

ENCLOSURE 1

Class 1 modifications for quarter ending September 30, 2008

Ms. Greta P. Davis, Ecology  
Consisting of 852 pages, including cover sheet

**RECEIVED**  
OCT 15 2008  
EDMC

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**Hanford Facility RCRA Permit Modification Notification Forms**

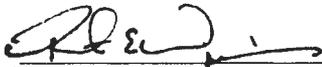
**Part III, Operating Unit 2  
PUREX Storage Tunnels**

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Index

- Page 2 of 5: Hanford Facility RCRA Permit III.2
- Page 3 of 5: Chapter 7.0, §7.2
- Page 4 of 5: Chapter 7.0, §7.3
- Page 5 of 5: Chapter 7.0, §7.4

Submitted by Co-Operator:

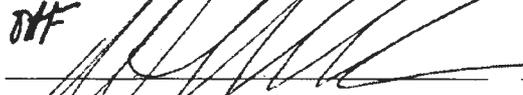


Robert E. Wilkinson

9/18/08

Date

Reviewed by RL Program Office:



Matthew S. McCormick

9/25/08

Date



**Hanford Facility RCRA Permit Modification Notification Form**

Unit: <b>PUREX STORAGE TUNNELS</b>	Permit Part <b>PART III, OPERATING UNIT 2</b>
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Description of Modification:

Chapter 7.0, §7.2:

**7.2 EMERGENCY COORDINATORS/BUILDING EMERGENCY DIRECTOR**

**Table 0.1. Emergency Coordinator/Building Emergency Director <sup>a</sup>**

Designation	Job title	Work location	Work phone
Primary	Facility Operations Manager	MO-294	373-36631355
Alternate	Field Work Supervisor	MO-294	373-5376

<sup>a</sup> The names and home phone numbers of all Emergency Coordinators/Building Emergency Director (EC/BED) are maintained at the single point-of-contact (the Hanford Patrol Operations Center) telephone number 373-3800 in accordance with the Hanford Facility RCRA Permit, ~~Dangerous Waste Portion, General Condition II.A.4.~~

Emergency response will be directed by the EC/BED until the Incident Commander arrives. The incident command structure and staff with supporting on-call personnel fulfill the responsibilities of the EC/BED as discussed in WAC 173-303-360.

During events, facility personnel perform response duties under the direction of the EC/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 Incident Commander (IC) and as such have the authority to request and obtain any resources necessary for protecting people and the environment. The EC/BED becomes a member of the ICP and functions under the direction of the IC. In this role, the EC/BED continues to manage and direct facility operations.

A listing of the primary and alternate EC/BEDs by title, work location and work telephone numbers is identified in the table above. The EC/BED is on the premises or is available through an "on-call" list 24 hours a day.

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.1. General Permit Provisions, Administrative and informational changes

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

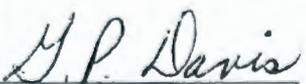
Reviewed by Ecology:

*G.P. Davis* 9-29-08

G. P Davis

Date

<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>PUREX STORAGE TUNNELS</b>	Permit Part <b>PART III, OPERATING UNIT 2</b>			
<p><u>Description of Modification:</u> Chapter 7.0, §7.3:</p> <p><b>7.3 IMPLEMENTATION OF THE PLAN</b></p> <p>In accordance with WAC 173-303-360(2)(b), 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.</p> <p>The BED shall use the following guidelines to determine if an event has met the requirements of WAC 173-303-360(2)(d):</p> <ol style="list-style-type: none"> <li>1. The event involved an unplanned spill, release, fire, or explosion, AND</li> <li>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</li> <li>2.b The unplanned fire or explosion occurred at the PUREX Storage Tunnels or transportation activity subject to RCRA contingency planning requirements, AND</li> <li>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.</li> </ol> <p>As soon as possible, after stabilizing event conditions, the BED shall determine, in consultation with the FH Site contractor environmental single-point-of-contact, if notification to the <u>Washington State Department of Ecology</u> 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 Attachment 4, <i>Hanford Emergency Management Plan</i> (DOE/RL-94-02), Section 4.2.</p> <p>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.</p> <p>The BED must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from HP, HFD, or ambulance units is required, the Hanford Emergency Response Number (911) must be used to contact the POC and request the desired assistance. To request other resources or assistance from outside the <u>Central Plateau Surveillance and Maintenance</u> ADP facilities, the POC business number is used (373-3800).</p>				
WAC 173-303-830 Modification Class Please mark the Modification Class:	Class 1 X	Class '1	Class 2	Class 3
<p>Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1.</p> <p>Enter wording of WAC 173-303-830, Appendix I Modification citation: A.1. General Permit Provisions, Administrative and informational changes</p>				
<p>Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)</p> <p>Reason for denial:</p>		<p>Reviewed by Ecology:</p> <p style="text-align: center;"><i>G.P. Davis</i>      9-29-08</p> <p style="text-align: center;">G. P Davis      Date</p>		

<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>PUREX STORAGE TUNNELS</b>	Permit Part <b>PART III, OPERATING UNIT 2</b>			
<p><u>Description of Modification:</u> Chapter 7.0, §7.4:</p> <p><b>7.4 UNIT/BUILDING EMERGENCY RESPONSE PROCEDURES</b></p> <p>The initial response to any emergency is to immediately protect the health and safety of persons in the area. Identification of released material is essential to determine appropriate protective actions. Containment, treatment, and disposal assessment are secondary responses.</p> <p>Emergency action levels associated with event classifications applicable to the PUREX Storage Tunnels include the following. A Site Area Emergency can be declared for a <del>mixed-waste</del> <u>hazardous material</u> release resulting from a <u>fire</u>, an explosion, natural hazards (i.e., seismic event and/or tornado/<u>high winds</u>), <del>and an</del> aircraft crash, <u>discovery or detonation of an explosive device, a hostage situation or armed intruders, or loss of containment</u>. An Alert Emergency can be declared for a fire, explosion, <u>natural hazards (i.e., seismic event and/or tornado/high winds)</u>, and <u>aircraft crash</u>. The preceding sections describe the process for implementing basic protective actions as well as descriptions of response actions for events.</p>				
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.1. General Permit Provisions, Administrative and informational changes				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)	Reviewed by Ecology:			
<u>Reason for denial:</u>				
	G. P Davis		Date	
			9-29-08	

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**Hanford Facility RCRA Permit Modification**

**Part III, Operating Unit 2  
PUREX Storage Tunnels**

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**Remove and Replace the Following Sections:**

- Part III, Operating Unit 2, Unit-Specific Conditions dated January 2007, replace with Unit-Specific Conditions dated September 30, 2008

1                                   **PART III, OPERATING UNIT 2 UNIT-SPECIFIC CONDITIONS**

2                                   **PUREX Storage Tunnels**

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3   The PUREX Storage Tunnels are mixed waste storage units consisting of two underground railroad  
4   tunnels: Tunnel Number 1, designated 218-E-14, and Tunnel Number 2, designated 218-E-15. This  
5   Chapter sets forth the operating Conditions for this TSD unit.

6   **III.2.A                   COMPLIANCE WITH PERMIT CONDITIONS**

7   The Permittees shall comply with all requirements set forth in the Hanford Facility RCRA Permit  
8   (Permit) as specified in Permit Attachment 3, Permit Applicability Matrix, including all approved  
9   modifications. All chapters, subsections, figures, tables, and appendices included in the following  
10   unit-specific Permit Conditions are enforceable in their entirety.

11   In the event that the Part III-Unit-Specific Conditions for Operating Unit 2, PUREX Storage Tunnels  
12   conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the  
13   unit-specific conditions for Operating Unit 2, PUREX Storage Tunnels prevail.

14   **OPERATING UNIT 2:**

- 15   Chapter 1.0       Part A Form, Revision 6, dated May 2005
- 16   Chapter 2.0, §2.1 Topographic Map (refer to Chapter 1.0)
- 17   Chapter 3.0       Waste Analysis Plan, dated October 2006
- 18   Chapter 4.0       Process Information, dated October 2006
- 19   Chapter 6.0       Procedures to Prevent Hazards, dated October 2006 (also refer to Permit  
20   Attachment 33, §6.1)
- 21   Chapter 7.0       Contingency Plan, dated September 30, 2008
- 22   Chapter 8.0       Personnel Training, dated October 2006
- 23   Chapter 11.0      Closure and Financial Assurance, dated October 2006
- 24   Chapter 12.0      Reporting and Recordkeeping (refer to Permit Attachment 33, Table 12.1)

25   **III.2.A                   UNIT-SPECIFIC CONDITIONS**

26   Portions of Permit Attachment 4, *Hanford Emergency Management Plan*, (DOE/RL-94-02) that are not  
27   made enforceable by inclusion in the applicability matrix for that document are not made enforceable by  
28   reference in this document.

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**Hanford Facility RCRA Permit Modification Notification Forms**

**Part III, Operating Unit 5  
325 Hazardous Waste Treatment Units**

Index

- Page 2 of 4: Hanford Facility RCRA Permit, III.5
- Page 3 of 4: Addendum A, Part A Form, Section XIV, Line 427:
- Page 4 of 4: Addendum J, Contingency Plan

Submitted by Co-Operator:

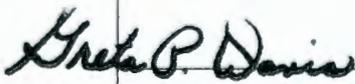
Reviewed by RL Program Office:

*Alice K. Ikenberry*  
Alice K. Ikenberry

25 Aug 08  
Date

*Joe R. Franco*  
Joe R. Franco

9/22/08  
Date

<b>Hanford Facility RCRA Permit Modification Notification Form</b>					
Unit: <b>325 Hazardous Waste Treatment Units</b>	Permit Part <b>Part III, Operating Unit 5</b>				
<p><u>Description of Modification:</u> Hanford Facility RCRA Permit III.5:</p> <p style="text-align: center;"><b>PART III, OPERATING UNIT 5 UNIT-SPECIFIC CONDITIONS</b></p> <p style="text-align: center;"><b>325 Hazardous Waste Treatment Units</b></p> <p>The 325 Hazardous Waste Treatment Units (325 HWTUs) consists of the Shielded Analytical Laboratory (SAL) that includes Rooms 32, 200, 201, 202, and 203; and the Hazardous Waste Treatment Unit (HWTU) that includes Rooms 520, 524, and 528 of the 325 Building located in the 300 Area.</p> <p>This document sets forth the operating conditions for the 325 HWTUs.</p> <p><b>III.5.A COMPLIANCE WITH PERMIT CONDITIONS</b></p> <p>The Permittees shall comply with all requirements set forth in the Hanford Facility RCRA Permit (Permit) as specified in Permit Attachment 3, 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.</p> <p>In the event that the Part III-Unit-Specific Conditions for Operating Unit 5, 325 HWTUs conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Operating Unit 5, 325 HWTUs prevail.</p> <p><b>OPERATING UNIT 5:</b></p> <p><u>Addendum A</u> <del>Chapter 1.0</del> Part A Form, Revision 5B, dated <del>September 30, 2008</del> <u>March 31, 2007</u></p> <p>Chapter 2.0, §2.1 Topographic Map (refer to Chapter 1.0)</p> <p>Chapter 3.0 Waste Analysis Plan, dated June 30, 2005</p> <p>Chapter 4.0 Process Information, dated June 30, 2005</p> <p>Chapter 6.0 Procedures to Prevent Hazards, dated December 31, 2007 (also refer to Permit Attachment 33, §6.1)</p> <p><u>Addendum J</u> <del>Chapter 7.0</del> Contingency Plan, dated <del>September 30, 2008</del> <u>September 30, 2006</u></p> <p>Chapter 8.0 Personnel Training, dated September 30, 2003</p> <p>Chapter 11.0 Closure and Postclosure Requirements, dated August 2004</p> <p>Chapter 12.0 Reporting and Recordkeeping (refer to Permit Attachment 33, Table 12.1, Reports and Records)</p> <p><b>III.5.B. UNIT-SPECIFIC CONDITIONS FOR 325 HWTUs</b></p> <p>Portions of Permit Attachment 4, <i>Hanford Emergency Management Plan</i>, (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.</p>					
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.1. General Permit Provisions, Administrative and informational changes					
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)			Reviewed by Ecology:		
Reason for denial:			 Date: <u>08-28-08</u>		
			G. P Davis		
			Date		

### Hanford Facility RCRA Permit Modification Notification Form

Unit: <b>325 Hazardous Waste Treatment Units</b>	Permit Part <b>Part III, Operating Unit 5</b>
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Description of Modification:  
Addendum A, Part A Form, Section XIV, Line 427:

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process	
				(1) Process Codes (enter)	(2) Process Description [If a code is not entered in D (1)]
4 2 7	F 0 3 9		K	S 0 1 T 0 4	Includes Debris

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.1. General Permit Provisions, Administrative and informational changes

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*Greta P. Davis* 8-28-08  
 G. P. Davis Date

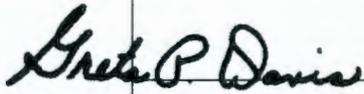
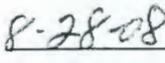
**Hanford Facility RCRA Permit Modification Notification Form**

Unit: <b>325 Hazardous Waste Treatment Units</b>	Permit Part <b>Part III, Operating Unit 5</b>
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Description of Modification:  
 Addendum J, Contingency Plan:  
 Replace Chapter 7.0, dated September 30, 2007, with Addendum J, dated September 30, 2008.

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.1. General Permit Provisions, Administrative and informational changes

Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) Reason for denial:	Reviewed by Ecology: <div style="text-align:center">                       G. P Davis                 </div> <div style="text-align:right">                       Date                 </div>
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**Hanford Facility RCRA Permit Modification**

**Part III, Operating Unit 5  
325 Hazardous Waste Treatment Units**

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**Remove and Replace the Following Sections:**

- Permit Conditions, dated December 31, 2007 with Permit Conditions dated September 30, 2008
- Chapter 1.0, dated March 31, 2007 with Addendum A, dated September 30, 2008

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**Hanford Facility RCRA Permit Modification**

**Part III, Operating Unit 5  
325 Hazardous Waste Treatment Units**

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**Remove and Replace the Following Sections:**

- Chapter 7.0, dated September 30, 2007, with Addendum J, dated September 30, 2008

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1                                   **PART III, OPERATING UNIT 5 UNIT-SPECIFIC CONDITIONS**

2                                   **325 Hazardous Waste Treatment Units**

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3   The 325 Hazardous Waste Treatment Units (325 HWTUs) consists of the Shielded Analytical Laboratory  
4   (SAL) that includes Rooms 32, 200, 201, 202, and 203; and the Hazardous Waste Treatment Unit  
5   (HWTU) that includes Rooms 520, 524, and 528 of the 325 Building located in the 300 Area.

6   This document sets forth the operating conditions for the 325 HWTUs.

7   **III.5.A                   COMPLIANCE WITH PERMIT CONDITIONS**

8   The Permittees shall comply with all requirements set forth in the Hanford Facility RCRA Permit  
9   (Permit) as specified in Permit Attachment 3, Permit Applicability Matrix, including all approved  
10  modifications. All chapters, subsections, figures, tables, and appendices included in the following  
11  unit-specific Permit Conditions are enforceable in their entirety.

12  In the event that the Part III-Unit-Specific Conditions for Operating Unit 5, 325 HWTUs conflict with the  
13  Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific  
14  conditions for Operating Unit 5, 325 HWTUs prevail.

15  **OPERATING UNIT 5:**

- 16  Addendum A           Part A Form, Revision 5B, dated September 30, 2008
- 17  Chapter 2.0, §2.1    Topographic Map (refer to Chapter 1.0)
- 18  Chapter 3.0           Waste Analysis Plan, dated June 30, 2005
- 19  Chapter 4.0           Process Information, dated June 30, 2005
- 20  Chapter 6.0           Procedures to Prevent Hazards, dated December 31, 2007 (also refer to Permit  
21  Attachment 33, §6.1)
- 22  Addendum J           Contingency Plan, dated September 30, 2008
- 23  Chapter 8.0           Personnel Training, dated September 30, 2003
- 24  Chapter 11.0          Closure and Postclosure Requirements, dated August 2004
- 25  Chapter 12.0          Reporting and Recordkeeping (refer to Permit Attachment 33, Table 12.1, Reports  
26  and Records)

27  **III.5.B                   UNIT-SPECIFIC CONDITIONS FOR 325 HWTUs**

28  III.5.B.1           Portions of Permit Attachment 4, *Hanford Emergency Management Plan*,  
29  (DOE/RL-94-02) that are not made enforceable by inclusion in the applicability matrix  
30  for that document are not made enforceable by reference in this document.

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1 **Addendum A**

**Part A Form**

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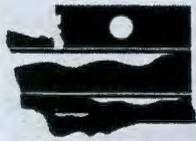
2 1.0 PART A FORM .....1.1

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WASHINGTON STATE  
DEPARTMENT OF  
E C O L O G Y

**Dangerous Waste Permit  
Application  
Part A Form**

Date Received			Reviewed by:				Date:							
Month	Day	Year	Approved by:				Date:							

**I. This form is submitted to: (place an "X" in the appropriate box)**

<input checked="" type="checkbox"/>	Request modification to a final status permit (commonly called a "Part B" permit)
<input type="checkbox"/>	Request a change under interim status
<input type="checkbox"/>	Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).
<input type="checkbox"/>	Establish interim status because of the wastes newly regulated on: _____ (Date)
List waste codes: _____	

**II. EPA/State ID Number**

W	A	7	8	9	0	0	0	8	9	6	7
---	---	---	---	---	---	---	---	---	---	---	---

**III. Name of Facility**

US Department of Energy - Hanford Facility

**IV. Facility Location (Physical address not P.O. Box or Route Number)**

**A. Street**

825 Jadwin

<b>City or Town</b>	<b>State</b>	<b>ZIP Code</b>
Richland	WA	99352

<b>County Code (if known)</b>	<b>County Name</b>
0 0 5	Benton

<b>B. Land Type</b>	<b>C. Geographic Location</b>	<b>D. Facility Existence Date</b>			
	Latitude (degrees, mins, secs)	Longitude (degrees, mins, secs)	Month	Day	Year
F	Refer to TOPO Map (Section XV.)		0 3	2 2	1 9 4 3

**V. Facility Mailing Address**

**Street or P.O. Box**

P.O. Box 550

<b>City or Town</b>	<b>State</b>	<b>ZIP Code</b>
Richland	WA	99352

<b>VI. Facility contact (Person to be contacted regarding waste activities at facility)</b>													
<b>Name (last)</b>						<b>(first)</b>							
Klein						Keith							
<b>Job Title</b>						<b>Phone Number (area code and number)</b>							
Manager						(509) 376-7395*							
<b>Contact Address</b>													
<b>Street or P.O. Box</b>													
P.O. Box 550													
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>					
Richland						WA		99352					
<b>VII. Facility Operator Information</b>													
<b>A. Name</b>						<b>Phone Number (area code and number)</b>							
Department of Energy Owner/Operator						(509) 376-7395							
Pacific Northwest National Laboratory Co-Operator for 325 HWTUs*						(509) 376-1187*							
<b>Street or P.O. Box</b>													
P.O. Box 550 P.O. Box 999*													
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>					
Richland						WA		99352					
<b>B. Operator Type</b>		F											
<b>C. Does the name in VII.A reflect a proposed change in operator?</b>						<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No					
If yes, provide the scheduled date for the change:						<b>Month</b>		<b>Day</b>			<b>Year</b>		
<b>D. Is the name listed in VII.A. also the owner? If yes, skip to Section VIII.C.</b>										<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No	
<b>VIII. Facility Owner Information</b>													
<b>A. Name</b>						<b>Phone Number (area code and number)</b>							
Keith A. Klein, Operator/Facility-Property Owner						(509) 376-7395							
<b>Street or P.O. Box</b>													
P.O. Box 550													
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>					
Richland						WA		99352					
<b>B. Owner Type</b>		F											
<b>C. Does the name in VIII.A reflect a proposed change in owner?</b>						<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No					
If yes, provide the scheduled date for the change:						<b>Month</b>		<b>Day</b>			<b>Year</b>		
<b>IX. NAICS Codes (5/6 digit codes)</b>													
<b>A. First</b>						<b>B. Second</b>							
5	4	1	7	1		Research & Development in the Physical, Engineering, & Life Sciences							
<b>C. Third</b>						<b>D. Fourth</b>							

X. Other Environmental Permits (see instructions)													
A. Permit Type		B. Permit Number										C. Description	
E		A	I	R	-	0	2	-	1	2	0	2	WAC 246-247, Non radioactive Air, 40 CFR 61, Subpart H, NESHAPS
E		D	E	9	8	N	W	P	-	0	0	3	WAC 173-400, General Regulations for Air Pollution Sources, WAC 173-460, Controls for New Sources of Toxic Air Pollutants

**XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)**

The 325 Hazardous Waste Treatment Units (325 HWTUs) consist of the Shielded Analytical Laboratory (SAL), which includes Rooms 32, 200, 201, 202, and 203 of the 325 Building; and the Hazardous Waste Treatment Unit (HWTU) encompassing Rooms 520, 524, and 528 of the 325 Building. The 325 HWTUs began waste management operations in 1991 (SAL) and 1995 (HWTU). Up to 12, 000 liters of dangerous and/or mixed waste may be stored in the 325 HWTUs (S01). A maximum of 1514 liters of dangerous and/or mixed waste may be treated per day in containers in the 325 HWTUs (T04).

A maximum of 1,218 liters of dangerous and/or mixed waste may be stored in tanks in the 325 HWTUs (S02). A maximum of 1,218 liters per day of dangerous and/or mixed waste may be treated in tanks in the 325 HWTUs (T01).

Dangerous and/or mixed waste treatments are generally conducted as small bench-scale operations except for in-tank treatments. Treatment processes utilized at the 325 HWTUs may include any of the types of treatment described in WAC 173-303-380(2)(d), Table 2, Section 2 except for the following: incineration technologies (T06-T10), large-scale biological treatment (T68, T72, and T73), boiler and industrial furnace-based treatment (T80-T93), and treatment in containment buildings (T94).

Routine dangerous and/or mixed waste treatment that will be conducted in the 325 HWTUs will include pH adjustment, ion exchange, carbon absorption, oxidation, reduction, waste concentration by evaporation, precipitation, filtration, solvent extraction, solids washing, phase separation, catalytic destruction, and solidification/stabilization. These waste treatments will be conducted on small quantities of diverse radioactive, dangerous, and/or mixed wastes generated from ongoing research and development and analytical chemistry activities. Waste to be handled in the 325 HWTUs will include listed waste, waste from non-specific sources, characteristic waste, and state-only criteria waste. Multi-source leachate (F039) is included as a waste derived from non-specific source waste F001 through F005.

**EXAMPLE FOR COMPLETING ITEMS XII and XIII (shown in lines numbered X-1, X-2, and X-3 below):** A facility has two storage tanks that hold 1200 gallons and 400 gallons respectively. There is also treatment in tanks at 20 gallons/hr. Finally, a one-quarter acre area that is two meters deep will undergo *in situ* vitrification.

Section XII. Process Codes and Design Capacities							Section XIII. Other Process Codes							
Line Number	A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	Line Number	A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	D. Process Description
				1. Amount	2. Unit of Measure (enter code)						1. Amount	2. Unit of Measure (enter code)		
X 1	S	0	2	1,600	G	002	X 1	T	0	4	700	C	001	In situ vitrification
X 2	T	0	3	20	E	001								
X 3	T	0	4	700	C	001								
1	S	0	1	12,000	L	001	1							
2	S	0	2	1218	L	001	2	T	0	4	1514	V	1	Treatment in containers
3	T	0	1	1218	V	001	3							
4							4							
5							5							
6							6							
7							7							
8							8							
9							9							
1 0							1 0							
1 1							1 1							
1 2							1 2							
1 3							1 3							
1 4							1 4							
1 5							1 5							
1 6							1 6							
1 7							1 7							
1 8							1 8							
1 9							1 9							
2 0							2 0							
2 1							2 1							
2 2							2 2							
2 3							2 3							
2 4							2 4							
2 5							2 5							

XIV. Description of Dangerous Wastes														
<p><b>Example for completing this section:</b> A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.</p>														
Line Number	A. Dangerous Waste No. (enter code)					B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Processes					(2) Process Description [If a code is not entered in D (1)]	
								(1) Process Codes (enter)						
X 1	D	0	0	2	400	P	S	0	1	T	0	1		
X 2	D	0	0	1	100	P	S	0	2	T	0	1		
X 3	D	0	0	2									Included with above	
	1	D	0	0	1	82,500 (60,000 (S01); 22,500 (T04))	K	S	0	1	T	0	4	Includes Debris
	2	D	0	0	2		K	S	0	1	T	0	4	Includes Debris
	3	D	0	0	3		K	S	0	1	T	0	4	Includes Debris
	4	D	0	0	4		K	S	0	1	T	0	4	Includes Debris
	5	D	0	0	5		K	S	0	1	T	0	4	Includes Debris
	6	D	0	0	6		K	S	0	1	T	0	4	Includes Debris
	7	D	0	0	7		K	S	0	1	T	0	4	Includes Debris
	8	D	0	0	8		K	S	0	1	T	0	4	Includes Debris
	9	D	0	0	9		K	S	0	1	T	0	4	Includes Debris
	0	D	0	1	0		K	S	0	1	T	0	4	Includes Debris
	1	D	0	1	1		K	S	0	1	T	0	4	Includes Debris
	2	D	0	1	2		K	S	0	1	T	0	4	Includes Debris
	3	D	0	1	3		K	S	0	1	T	0	4	Includes Debris
	4	D	0	1	4		K	S	0	1	T	0	4	Includes Debris
	5	D	0	1	5		K	S	0	1	T	0	4	Includes Debris
	6	D	0	1	6		K	S	0	1	T	0	4	Includes Debris
	7	D	0	1	7		K	S	0	1	T	0	4	Includes Debris
	8	D	0	1	8		K	S	0	1	T	0	4	Includes Debris
	9	D	0	1	9		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	0		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	1		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	2		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	3		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	4		K	S	0	1	T	0	4	Includes Debris
	2	D	0	2	5		K	S	0	1	T	0	4	Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)		B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
					(1) Process Codes (enter)				(2) Process Description [if a code is not entered in D (1)]				
2	6	D 0 2 6		K	S	0	1	T	0	4			Includes Debris
2	7	D 0 2 7		K	S	0	1	T	0	4			Includes Debris
2	8	D 0 2 8		K	S	0	1	T	0	4			Includes Debris
2	9	D 0 2 9		K	S	0	1	T	0	4			Includes Debris
3	0	D 0 3 0		K	S	0	1	T	0	4			Includes Debris
3	1	D 0 3 1		K	S	0	1	T	0	4			Includes Debris
3	2	D 0 3 2		K	S	0	1	T	0	4			Includes Debris
3	3	D 0 3 3		K	S	0	1	T	0	4			Includes Debris
3	4	D 0 3 4		K	S	0	1	T	0	4			Includes Debris
3	5	D 0 3 5		K	S	0	1	T	0	4			Includes Debris
3	6	D 0 3 6		K	S	0	1	T	0	4			Includes Debris
3	7	D 0 3 7		K	S	0	1	T	0	4			Includes Debris
3	8	D 0 3 8		K	S	0	1	T	0	4			Includes Debris
3	9	D 0 3 9		K	S	0	1	T	0	4			Includes Debris
4	0	D 0 4 0		K	S	0	1	T	0	4			Includes Debris
4	1	D 0 4 1		K	S	0	1	T	0	4			Includes Debris
4	2	D 0 4 2		K	S	0	1	T	0	4			Includes Debris
4	3	D 0 4 3		K	S	0	1	T	0	4			Includes Debris
4	4	F 0 0 1		K	S	0	1	T	0	4			Includes Debris
4	5	F 0 0 2		K	S	0	1	T	0	4			Includes Debris
4	6	F 0 0 3		K	S	0	1	T	0	4			Includes Debris
4	7	F 0 0 4		K	S	0	1	T	0	4			Includes Debris
4	8	F 0 0 5		K	S	0	1	T	0	4			Includes Debris
4	9	F 0 2 7		K	S	0	1	T	0	4			Includes Debris
5	0	P 0 0 1		K	S	0	1	T	0	4			Includes Debris
5	1	P 0 0 2		K	S	0	1	T	0	4			Includes Debris
5	2	P 0 0 3		K	S	0	1	T	0	4			Includes Debris
5	3	P 0 0 4		K	S	0	1	T	0	4			Includes Debris
5	4	P 0 0 5		K	S	0	1	T	0	4			Includes Debris
5	5	P 0 0 6		K	S	0	1	T	0	4			Includes Debris
5	6	P 0 0 7		K	S	0	1	T	0	4			Includes Debris
5	7	P 0 0 8		K	S	0	1	T	0	4			Includes Debris
5	8	P 0 0 9		K	S	0	1	T	0	4			Includes Debris
5	9	P 0 1 0		K	S	0	1	T	0	4			Includes Debris
6	0	P 0 1 1		K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
				(1) Process Codes (enter)				(2) Process Description [If a code is not entered in D (1)]					
6 1	P 0 1 2		K	S	0	1	T	0	4				Includes Debris
6 2	P 0 1 3		K	S	0	1	T	0	4				Includes Debris
6 3	P 0 1 4		K	S	0	1	T	0	4				Includes Debris
6 4	P 0 1 5		K	S	0	1	T	0	4				Includes Debris
6 5	P 0 1 6		K	S	0	1	T	0	4				Includes Debris
6 6	P 0 1 7		K	S	0	1	T	0	4				Includes Debris
6 7	P 0 1 8		K	S	0	1	T	0	4				Includes Debris
6 8	P 0 2 0		K	S	0	1	T	0	4				Includes Debris
6 9	P 0 2 1		K	S	0	1	T	0	4				Includes Debris
7 0	P 0 2 2		K	S	0	1	T	0	4				Includes Debris
7 1	P 0 2 3		K	S	0	1	T	0	4				Includes Debris
7 2	P 0 2 4		K	S	0	1	T	0	4				Includes Debris
7 3	P 0 2 6		K	S	0	1	T	0	4				Includes Debris
7 4	P 0 2 7		K	S	0	1	T	0	4				Includes Debris
7 5	P 0 2 8		K	S	0	1	T	0	4				Includes Debris
7 6	P 0 2 9		K	S	0	1	T	0	4				Includes Debris
7 7	P 0 3 0		K	S	0	1	T	0	4				Includes Debris
7 8	P 0 3 1		K	S	0	1	T	0	4				Includes Debris
7 9	P 0 3 3		K	S	0	1	T	0	4				Includes Debris
8 0	P 0 3 4		K	S	0	1	T	0	4				Includes Debris
8 1	P 0 3 6		K	S	0	1	T	0	4				Includes Debris
8 2	P 0 3 7		K	S	0	1	T	0	4				Includes Debris
8 3	P 0 3 8		K	S	0	1	T	0	4				Includes Debris
8 4	P 0 3 9		K	S	0	1	T	0	4				Includes Debris
8 5	P 0 4 0		K	S	0	1	T	0	4				Includes Debris
8 6	P 0 4 1		K	S	0	1	T	0	4				Includes Debris
8 7	P 0 4 2		K	S	0	1	T	0	4				Includes Debris
8 8	P 0 4 3		K	S	0	1	T	0	4				Includes Debris
8 9	P 0 4 4		K	S	0	1	T	0	4				Includes Debris
9 0	P 0 4 5		K	S	0	1	T	0	4				Includes Debris
9 1	P 0 4 6		K	S	0	1	T	0	4				Includes Debris
9 2	P 0 4 7		K	S	0	1	T	0	4				Includes Debris
9 3	P 0 4 8		K	S	0	1	T	0	4				Includes Debris
9 4	P 0 4 9		K	S	0	1	T	0	4				Includes Debris
9 5	P 0 5 0		K	S	0	1	T	0	4				Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
				(1) Process Codes (enter)				(2) Process Description [If a code is not entered in D (1)]					
9 6	P 0 5 1		K	S	0	1	T	0	4				Includes Debris
9 7	P 0 5 4		K	S	0	1	T	0	4				Includes Debris
9 8	P 0 5 6		K	S	0	1	T	0	4				Includes Debris
9 9	P 0 5 7		K	S	0	1	T	0	4				Includes Debris
1 0 0	P 0 5 8		K	S	0	1	T	0	4				Includes Debris
1 0 1	P 0 5 9		K	S	0	1	T	0	4				Includes Debris
1 0 2	P 0 6 0		K	S	0	1	T	0	4				Includes Debris
1 0 3	P 0 6 2		K	S	0	1	T	0	4				Includes Debris
1 0 4	P 0 6 3		K	S	0	1	T	0	4				Includes Debris
1 0 5	P 0 6 4		K	S	0	1	T	0	4				Includes Debris
1 0 6	P 0 6 5		K	S	0	1	T	0	4				Includes Debris
1 0 7	P 0 6 6		K	S	0	1	T	0	4				Includes Debris
1 0 8	P 0 6 7		K	S	0	1	T	0	4				Includes Debris
1 0 9	P 0 6 8		K	S	0	1	T	0	4				Includes Debris
1 1 0	P 0 6 9		K	S	0	1	T	0	4				Includes Debris
1 1 1	P 0 7 0		K	S	0	1	T	0	4				Includes Debris
1 1 2	P 0 7 1		K	S	0	1	T	0	4				Includes Debris
1 1 3	P 0 7 2		K	S	0	1	T	0	4				Includes Debris
1 1 4	P 0 7 3		K	S	0	1	T	0	4				Includes Debris
1 1 5	P 0 7 4		K	S	0	1	T	0	4				Includes Debris
1 1 6	P 0 7 5		K	S	0	1	T	0	4				Includes Debris
1 1 7	P 0 7 6		K	S	0	1	T	0	4				Includes Debris
1 1 8	P 0 7 7		K	S	0	1	T	0	4				Includes Debris
1 1 9	P 0 7 8		K	S	0	1	T	0	4				Includes Debris
1 2 0	P 0 8 1		K	S	0	1	T	0	4				Includes Debris
1 2 1	P 0 8 2		K	S	0	1	T	0	4				Includes Debris
1 2 2	P 0 8 4		K	S	0	1	T	0	4				Includes Debris
1 2 3	P 0 8 5		K	S	0	1	T	0	4				Includes Debris
1 2 4	P 0 8 7		K	S	0	1	T	0	4				Includes Debris
1 2 5	P 0 8 8		K	S	0	1	T	0	4				Includes Debris
1 2 6	P 0 8 9		K	S	0	1	T	0	4				Includes Debris
1 2 7	P 0 9 2		K	S	0	1	T	0	4				Includes Debris
1 2 8	P 0 9 3		K	S	0	1	T	0	4				Includes Debris
1 2 9	P 0 9 4		K	S	0	1	T	0	4				Includes Debris
1 3 0	P 0 9 5		K	S	0	1	T	0	4				Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
1 3 1	P 0 9 6		K	S	0	1	T	0	4			Includes Debris
1 3 2	P 0 9 7		K	S	0	1	T	0	4			Includes Debris
1 3 3	P 0 9 8		K	S	0	1	T	0	4			Includes Debris
1 3 4	P 0 9 9		K	S	0	1	T	0	4			Includes Debris
1 3 5	P 1 0 1		K	S	0	1	T	0	4			Includes Debris
1 3 6	P 1 0 2		K	S	0	1	T	0	4			Includes Debris
1 3 7	P 1 0 3		K	S	0	1	T	0	4			Includes Debris
1 3 8	P 1 0 4		K	S	0	1	T	0	4			Includes Debris
1 3 9	P 1 0 5		K	S	0	1	T	0	4			Includes Debris
1 4 0	P 1 0 6		K	S	0	1	T	0	4			Includes Debris
1 4 1	P 1 0 8		K	S	0	1	T	0	4			Includes Debris
1 4 2	P 1 0 9		K	S	0	1	T	0	4			Includes Debris
1 4 3	P 1 1 0		K	S	0	1	T	0	4			Includes Debris
1 4 4	P 1 1 1		K	S	0	1	T	0	4			Includes Debris
1 4 5	P 1 1 2		K	S	0	1	T	0	4			Includes Debris
1 4 6	P 1 1 3		K	S	0	1	T	0	4			Includes Debris
1 4 7	P 1 1 4		K	S	0	1	T	0	4			Includes Debris
1 4 8	P 1 1 5		K	S	0	1	T	0	4			Includes Debris
1 4 9	P 1 1 6		K	S	0	1	T	0	4			Includes Debris
1 5 0	P 1 1 8		K	S	0	1	T	0	4			Includes Debris
1 5 1	P 1 1 9		K	S	0	1	T	0	4			Includes Debris
1 5 2	P 1 2 0		K	S	0	1	T	0	4			Includes Debris
1 5 3	P 1 2 1		K	S	0	1	T	0	4			Includes Debris
1 5 4	P 1 2 2		K	S	0	1	T	0	4			Includes Debris
1 5 5	P 1 2 3		K	S	0	1	T	0	4			Includes Debris
1 5 6	P 1 2 7		K	S	0	1	T	0	4			Includes Debris
1 5 7	P 1 2 8		K	S	0	1	T	0	4			Includes Debris
1 5 8	P 1 8 5		K	S	0	1	T	0	4			Includes Debris
1 5 9	P 1 8 8		K	S	0	1	T	0	4			Includes Debris
1 6 0	P 1 8 9		K	S	0	1	T	0	4			Includes Debris
1 6 1	P 1 9 0		K	S	0	1	T	0	4			Includes Debris
1 6 2	P 1 9 1		K	S	0	1	T	0	4			Includes Debris
1 6 3	P 1 9 2		K	S	0	1	T	0	4			Includes Debris
1 6 4	P 1 9 4		K	S	0	1	T	0	4			Includes Debris
1 6 5	P 1 9 6		K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)			B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process							
						(1) Process Codes (enter)			(2) Process Description [If a code is not entered in D (1)]				
1 6 6	P	1	9	7		K	S	0	1	T	0	4	Includes Debris
1 6 7	P	1	9	8		K	S	0	1	T	0	4	Includes Debris
1 6 8	P	1	9	9		K	S	0	1	T	0	4	Includes Debris
1 6 9	P	2	0	1		K	S	0	1	T	0	4	Includes Debris
1 7 0	P	2	0	2		K	S	0	1	T	0	4	Includes Debris
1 7 1	P	2	0	3		K	S	0	1	T	0	4	Includes Debris
1 7 2	P	2	0	4		K	S	0	1	T	0	4	Includes Debris
1 7 3	P	2	0	5		K	S	0	1	T	0	4	Includes Debris
1 7 4	U	0	0	1		K	S	0	1	T	0	4	Includes Debris
1 7 5	U	0	0	2		K	S	0	1	T	0	4	Includes Debris
1 7 6	U	0	0	3		K	S	0	1	T	0	4	Includes Debris
1 7 7	U	0	0	4		K	S	0	1	T	0	4	Includes Debris
1 7 8	U	0	0	5		K	S	0	1	T	0	4	Includes Debris
1 7 9	U	0	0	6		K	S	0	1	T	0	4	Includes Debris
1 8 0	U	0	0	7		K	S	0	1	T	0	4	Includes Debris
1 8 1	U	0	0	8		K	S	0	1	T	0	4	Includes Debris
1 8 2	U	0	0	9		K	S	0	1	T	0	4	Includes Debris
1 8 3	U	0	1	0		K	S	0	1	T	0	4	Includes Debris
1 8 4	U	0	1	1		K	S	0	1	T	0	4	Includes Debris
1 8 5	U	0	1	2		K	S	0	1	T	0	4	Includes Debris
1 8 6	U	0	1	4		K	S	0	1	T	0	4	Includes Debris
1 8 7	U	0	1	5		K	S	0	1	T	0	4	Includes Debris
1 8 8	U	0	1	6		K	S	0	1	T	0	4	Includes Debris
1 8 9	U	0	1	7		K	S	0	1	T	0	4	Includes Debris
1 9 0	U	0	1	8		K	S	0	1	T	0	4	Includes Debris
1 9 1	U	0	1	9		K	S	0	1	T	0	4	Includes Debris
1 9 2	U	0	2	0		K	S	0	1	T	0	4	Includes Debris
1 9 3	U	0	2	1		K	S	0	1	T	0	4	Includes Debris
1 9 4	U	0	2	2		K	S	0	1	T	0	4	Includes Debris
1 9 5	U	0	2	3		K	S	0	1	T	0	4	Includes Debris
1 9 6	U	0	2	4		K	S	0	1	T	0	4	Includes Debris
1 9 7	U	0	2	5		K	S	0	1	T	0	4	Includes Debris
1 9 8	U	0	2	6		K	S	0	1	T	0	4	Includes Debris
1 9 9	U	0	2	7		K	S	0	1	T	0	4	Includes Debris
2 0 0	U	0	2	8		K	S	0	1	T	0	4	Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
				(1) Process Codes (enter)				(2) Process Description [If a code is not entered in D (1)]					
2 0 1	U 0 2 9		K	S	0	1	T	0	4				Includes Debris
2 0 2	U 0 3 0		K	S	0	1	T	0	4				Includes Debris
2 0 3	U 0 3 1		K	S	0	1	T	0	4				Includes Debris
2 0 4	U 0 3 2		K	S	0	1	T	0	4				Includes Debris
2 0 5	U 0 3 3		K	S	0	1	T	0	4				Includes Debris
2 0 6	U 0 3 4		K	S	0	1	T	0	4				Includes Debris
2 0 7	U 0 3 5		K	S	0	1	T	0	4				Includes Debris
2 0 8	U 0 3 6		K	S	0	1	T	0	4				Includes Debris
2 0 9	U 0 3 7		K	S	0	1	T	0	4				Includes Debris
2 1 0	U 0 3 8		K	S	0	1	T	0	4				Includes Debris
2 1 1	U 0 3 9		K	S	0	1	T	0	4				Includes Debris
2 1 2	U 0 4 1		K	S	0	1	T	0	4				Includes Debris
2 1 3	U 0 4 2		K	S	0	1	T	0	4				Includes Debris
2 1 4	U 0 4 3		K	S	0	1	T	0	4				Includes Debris
2 1 5	U 0 4 4		K	S	0	1	T	0	4				Includes Debris
2 1 6	U 0 4 5		K	S	0	1	T	0	4				Includes Debris
2 1 7	U 0 4 6		K	S	0	1	T	0	4				Includes Debris
2 1 8	U 0 4 7		K	S	0	1	T	0	4				Includes Debris
2 1 9	U 0 4 8		K	S	0	1	T	0	4				Includes Debris
2 2 0	U 0 4 9		K	S	0	1	T	0	4				Includes Debris
2 2 1	U 0 5 0		K	S	0	1	T	0	4				Includes Debris
2 2 2	U 0 5 1		K	S	0	1	T	0	4				Includes Debris
2 2 3	U 0 5 2		K	S	0	1	T	0	4				Includes Debris
2 2 4	U 0 5 3		K	S	0	1	T	0	4				Includes Debris
2 2 5	U 0 5 5		K	S	0	1	T	0	4				Includes Debris
2 2 6	U 0 5 6		K	S	0	1	T	0	4				Includes Debris
2 2 7	U 0 5 7		K	S	0	1	T	0	4				Includes Debris
2 2 8	U 0 5 8		K	S	0	1	T	0	4				Includes Debris
2 2 9	U 0 5 9		K	S	0	1	T	0	4				Includes Debris
2 3 0	U 0 6 0		K	S	0	1	T	0	4				Includes Debris
2 3 1	U 0 6 1		K	S	0	1	T	0	4				Includes Debris
2 3 2	U 0 6 2		K	S	0	1	T	0	4				Includes Debris
2 3 3	U 0 6 3		K	S	0	1	T	0	4				Includes Debris
2 3 4	U 0 6 4		K	S	0	1	T	0	4				Includes Debris
2 3 5	U 0 6 6		K	S	0	1	T	0	4				Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)						(2) Process Description [If a code is not entered in D (1)]		
2 3 6	U 0 6 7		K	S	0	1	T	0	4			Includes Debris
2 3 7	U 0 6 8		K	S	0	1	T	0	4			Includes Debris
2 3 8	U 0 6 9		K	S	0	1	T	0	4			Includes Debris
2 3 9	U 0 7 0		K	S	0	1	T	0	4			Includes Debris
2 4 0	U 0 7 1		K	S	0	1	T	0	4			Includes Debris
2 4 1	U 0 7 2		K	S	0	1	T	0	4			Includes Debris
2 4 2	U 0 7 3		K	S	0	1	T	0	4			Includes Debris
2 4 3	U 0 7 4		K	S	0	1	T	0	4			Includes Debris
2 4 4	U 0 7 6		K	S	0	1	T	0	4			Includes Debris
2 4 5	U 0 7 7		K	S	0	1	T	0	4			Includes Debris
2 4 6	U 0 7 8		K	S	0	1	T	0	4			Includes Debris
2 4 7	U 0 7 9		K	S	0	1	T	0	4			Includes Debris
2 4 8	U 0 8 0		K	S	0	1	T	0	4			Includes Debris
2 4 9	U 0 8 1		K	S	0	1	T	0	4			Includes Debris
2 5 0	U 0 8 2		K	S	0	1	T	0	4			Includes Debris
2 5 1	U 0 8 3		K	S	0	1	T	0	4			Includes Debris
2 5 2	U 0 8 4		K	S	0	1	T	0	4			Includes Debris
2 5 3	U 0 8 5		K	S	0	1	T	0	4			Includes Debris
2 5 4	U 0 8 6		K	S	0	1	T	0	4			Includes Debris
2 5 5	U 0 8 7		K	S	0	1	T	0	4			Includes Debris
2 5 6	U 0 8 8		K	S	0	1	T	0	4			Includes Debris
2 5 7	U 0 8 9		K	S	0	1	T	0	4			Includes Debris
2 5 8	U 0 9 0		K	S	0	1	T	0	4			Includes Debris
2 5 9	U 0 9 1		K	S	0	1	T	0	4			Includes Debris
2 6 0	U 0 9 2		K	S	0	1	T	0	4			Includes Debris
2 6 1	U 0 9 3		K	S	0	1	T	0	4			Includes Debris
2 6 2	U 0 9 4		K	S	0	1	T	0	4			Includes Debris
2 6 3	U 0 9 5		K	S	0	1	T	0	4			Includes Debris
2 6 4	U 0 9 6		K	S	0	1	T	0	4			Includes Debris
2 6 5	U 0 9 7		K	S	0	1	T	0	4			Includes Debris
2 6 6	U 0 9 8		K	S	0	1	T	0	4			Includes Debris
2 6 7	U 0 9 9		K	S	0	1	T	0	4			Includes Debris
2 6 8	U 1 0 1		K	S	0	1	T	0	4			Includes Debris
2 6 9	U 1 0 2		K	S	0	1	T	0	4			Includes Debris
2 7 0	U 1 0 3		K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)						(2) Process Description [If a code is not entered in D (1)]		
2 7 1	U 1 0 5		K	S	0	1	T	0	4			Includes Debris
2 7 2	U 1 0 6		K	S	0	1	T	0	4			Includes Debris
2 7 3	U 1 0 7		K	S	0	1	T	0	4			Includes Debris
2 7 4	U 1 0 8		K	S	0	1	T	0	4			Includes Debris
2 7 5	U 1 0 9		K	S	0	1	T	0	4			Includes Debris
2 7 6	U 1 1 0		K	S	0	1	T	0	4			Includes Debris
2 7 7	U 1 1 1		K	S	0	1	T	0	4			Includes Debris
2 7 8	U 1 1 2		K	S	0	1	T	0	4			Includes Debris
2 7 9	U 1 1 3		K	S	0	1	T	0	4			Includes Debris
2 8 0	U 1 1 4		K	S	0	1	T	0	4			Includes Debris
2 8 1	U 1 1 5		K	S	0	1	T	0	4			Includes Debris
2 8 2	U 1 1 6		K	S	0	1	T	0	4			Includes Debris
2 8 3	U 1 1 7		K	S	0	1	T	0	4			Includes Debris
2 8 4	U 1 1 8		K	S	0	1	T	0	4			Includes Debris
2 8 5	U 1 1 9		K	S	0	1	T	0	4			Includes Debris
2 8 6	U 1 2 0		K	S	0	1	T	0	4			Includes Debris
2 8 7	U 1 2 1		K	S	0	1	T	0	4			Includes Debris
2 8 8	U 1 2 2		K	S	0	1	T	0	4			Includes Debris
2 8 9	U 1 2 3		K	S	0	1	T	0	4			Includes Debris
2 9 0	U 1 2 4		K	S	0	1	T	0	4			Includes Debris
2 9 1	U 1 2 5		K	S	0	1	T	0	4			Includes Debris
2 9 2	U 1 2 6		K	S	0	1	T	0	4			Includes Debris
2 9 3	U 1 2 7		K	S	0	1	T	0	4			Includes Debris
2 9 4	U 1 2 8		K	S	0	1	T	0	4			Includes Debris
2 9 5	U 1 2 9		K	S	0	1	T	0	4			Includes Debris
2 9 6	U 1 3 0		K	S	0	1	T	0	4			Includes Debris
2 9 7	U 1 3 1		K	S	0	1	T	0	4			Includes Debris
2 9 8	U 1 3 2		K	S	0	1	T	0	4			Includes Debris
2 9 9	U 1 3 3		K	S	0	1	T	0	4			Includes Debris
3 0 0	U 1 3 4		K	S	0	1	T	0	4			Includes Debris
3 0 1	U 1 3 5		K	S	0	1	T	0	4			Includes Debris
3 0 2	U 1 3 6		K	S	0	1	T	0	4			Includes Debris
3 0 3	U 1 3 7		K	S	0	1	T	0	4			Includes Debris
3 0 4	U 1 3 8		K	S	0	1	T	0	4			Includes Debris
3 0 5	U 1 4 0		K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
				(1) Process Codes (enter)					(2) Process Description [if a code is not entered in D (1)]				
3 0 6	U 1 4 1		K	S	0	1	T	0	4				Includes Debris
3 0 7	U 1 4 2		K	S	0	1	T	0	4				Includes Debris
3 0 8	U 1 4 3		K	S	0	1	T	0	4				Includes Debris
3 0 9	U 1 4 4		K	S	0	1	T	0	4				Includes Debris
3 1 0	U 1 4 5		K	S	0	1	T	0	4				Includes Debris
3 1 1	U 1 4 6		K	S	0	1	T	0	4				Includes Debris
3 1 2	U 1 4 7		K	S	0	1	T	0	4				Includes Debris
3 1 3	U 1 4 8		K	S	0	1	T	0	4				Includes Debris
3 1 4	U 1 4 9		K	S	0	1	T	0	4				Includes Debris
3 1 5	U 1 5 0		K	S	0	1	T	0	4				Includes Debris
3 1 6	U 1 5 1		K	S	0	1	T	0	4				Includes Debris
3 1 7	U 1 5 2		K	S	0	1	T	0	4				Includes Debris
3 1 8	U 1 5 3		K	S	0	1	T	0	4				Includes Debris
3 1 9	U 1 5 4		K	S	0	1	T	0	4				Includes Debris
3 2 0	U 1 5 5		K	S	0	1	T	0	4				Includes Debris
3 2 1	U 1 5 6		K	S	0	1	T	0	4				Includes Debris
3 2 2	U 1 5 7		K	S	0	1	T	0	4				Includes Debris
3 2 3	U 1 5 8		K	S	0	1	T	0	4				Includes Debris
3 2 4	U 1 5 9		K	S	0	1	T	0	4				Includes Debris
3 2 5	U 1 6 0		K	S	0	1	T	0	4				Includes Debris
3 2 6	U 1 6 1		K	S	0	1	T	0	4				Includes Debris
3 2 7	U 1 6 2		K	S	0	1	T	0	4				Includes Debris
3 2 8	U 1 6 3		K	S	0	1	T	0	4				Includes Debris
3 2 9	U 1 6 4		K	S	0	1	T	0	4				Includes Debris
3 3 0	U 1 6 5		K	S	0	1	T	0	4				Includes Debris
3 3 1	U 1 6 6		K	S	0	1	T	0	4				Includes Debris
3 3 2	U 1 6 7		K	S	0	1	T	0	4				Includes Debris
3 3 3	U 1 6 8		K	S	0	1	T	0	4				Includes Debris
3 3 4	U 1 6 9		K	S	0	1	T	0	4				Includes Debris
3 3 5	U 1 7 0		K	S	0	1	T	0	4				Includes Debris
3 3 6	U 1 7 1		K	S	0	1	T	0	4				Includes Debris
3 3 7	U 1 7 2		K	S	0	1	T	0	4				Includes Debris
3 3 8	U 1 7 3		K	S	0	1	T	0	4				Includes Debris
3 3 9	U 1 7 4		K	S	0	1	T	0	4				Includes Debris
3 4 0	U 1 7 6		K	S	0	1	T	0	4				Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)						B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
									(1) Process Codes (enter)						(2) Process Description [If a code is not entered in D (1)]		
3 4 1	U	1	7	7				K	S	0	1	T	0	4			Includes Debris
3 4 2	U	1	7	8				K	S	0	1	T	0	4			Includes Debris
3 4 3	U	1	7	9				K	S	0	1	T	0	4			Includes Debris
3 4 4	U	1	8	0				K	S	0	1	T	0	4			Includes Debris
3 4 5	U	1	8	1				K	S	0	1	T	0	4			Includes Debris
3 4 6	U	1	8	2				K	S	0	1	T	0	4			Includes Debris
3 4 7	U	1	8	3				K	S	0	1	T	0	4			Includes Debris
3 4 8	U	1	8	4				K	S	0	1	T	0	4			Includes Debris
3 4 9	U	1	8	5				K	S	0	1	T	0	4			Includes Debris
3 5 0	U	1	8	6				K	S	0	1	T	0	4			Includes Debris
3 5 1	U	1	8	7				K	S	0	1	T	0	4			Includes Debris
3 5 2	U	1	8	8				K	S	0	1	T	0	4			Includes Debris
3 5 3	U	1	8	9				K	S	0	1	T	0	4			Includes Debris
3 5 4	U	1	9	0				K	S	0	1	T	0	4			Includes Debris
3 5 5	U	1	9	1				K	S	0	1	T	0	4			Includes Debris
3 5 6	U	1	9	2				K	S	0	1	T	0	4			Includes Debris
3 5 7	U	1	9	3				K	S	0	1	T	0	4			Includes Debris
3 5 8	U	1	9	4				K	S	0	1	T	0	4			Includes Debris
3 5 9	U	1	9	6				K	S	0	1	T	0	4			Includes Debris
3 6 0	U	1	9	7				K	S	0	1	T	0	4			Includes Debris
3 6 1	U	2	0	0				K	S	0	1	T	0	4			Includes Debris
3 6 2	U	2	0	1				K	S	0	1	T	0	4			Includes Debris
3 6 3	U	2	0	2				K	S	0	1	T	0	4			Includes Debris
3 6 4	U	2	0	3				K	S	0	1	T	0	4			Includes Debris
3 6 5	U	2	0	4				K	S	0	1	T	0	4			Includes Debris
3 6 6	U	2	0	5				K	S	0	1	T	0	4			Includes Debris
3 6 7	U	2	0	6				K	S	0	1	T	0	4			Includes Debris
3 6 8	U	2	0	7				K	S	0	1	T	0	4			Includes Debris
3 6 9	U	2	0	8				K	S	0	1	T	0	4			Includes Debris
3 7 0	U	2	0	9				K	S	0	1	T	0	4			Includes Debris
3 7 1	U	2	1	0				K	S	0	1	T	0	4			Includes Debris
3 7 2	U	2	1	1				K	S	0	1	T	0	4			Includes Debris
3 7 3	U	2	1	3				K	S	0	1	T	0	4			Includes Debris
3 7 4	U	2	1	4				K	S	0	1	T	0	4			Includes Debris
3 7 5	U	2	1	5				K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)						(2) Process Description [if a code is not entered in D (1)]		
3 7 6	U 2 1 6		K	S	0	1	T	0	4			Includes Debris
3 7 7	U 2 1 7		K	S	0	1	T	0	4			Includes Debris
3 7 8	U 2 1 8		K	S	0	1	T	0	4			Includes Debris
3 7 9	U 2 1 9		K	S	0	1	T	0	4			Includes Debris
3 8 0	U 2 2 0		K	S	0	1	T	0	4			Includes Debris
3 8 1	U 2 2 1		K	S	0	1	T	0	4			Includes Debris
3 8 2	U 2 2 2		K	S	0	1	T	0	4			Includes Debris
3 8 3	U 2 2 3		K	S	0	1	T	0	4			Includes Debris
3 8 4	U 2 2 5		K	S	0	1	T	0	4			Includes Debris
3 8 5	U 2 2 6		K	S	0	1	T	0	4			Includes Debris
3 8 6	U 2 2 7		K	S	0	1	T	0	4			Includes Debris
3 8 7	U 2 2 8		K	S	0	1	T	0	4			Includes Debris
3 8 8	U 2 3 4		K	S	0	1	T	0	4			Includes Debris
3 8 9	U 2 3 5		K	S	0	1	T	0	4			Includes Debris
3 9 0	U 2 3 6		K	S	0	1	T	0	4			Includes Debris
3 9 1	U 2 3 7		K	S	0	1	T	0	4			Includes Debris
3 9 2	U 2 3 8		K	S	0	1	T	0	4			Includes Debris
3 9 3	U 2 3 9		K	S	0	1	T	0	4			Includes Debris
3 9 4	U 2 4 0		K	S	0	1	T	0	4			Includes Debris
3 9 5	U 2 4 3		K	S	0	1	T	0	4			Includes Debris
3 9 6	U 2 4 4		K	S	0	1	T	0	4			Includes Debris
3 9 7	U 2 4 6		K	S	0	1	T	0	4			Includes Debris
3 9 8	U 2 4 7		K	S	0	1	T	0	4			Includes Debris
3 9 9	U 2 4 8		K	S	0	1	T	0	4			Includes Debris
4 0 0	U 2 4 9		K	S	0	1	T	0	4			Includes Debris
4 0 1	U 2 7 1		K	S	0	1	T	0	4			Includes Debris
4 0 2	U 2 7 8		K	S	0	1	T	0	4			Includes Debris
4 0 3	U 2 7 9		K	S	0	1	T	0	4			Includes Debris
4 0 4	U 2 8 0		K	S	0	1	T	0	4			Includes Debris
4 0 5	U 3 2 8		K	S	0	1	T	0	4			Includes Debris
4 0 6	U 3 5 3		K	S	0	1	T	0	4			Includes Debris
4 0 7	U 3 5 9		K	S	0	1	T	0	4			Includes Debris
4 0 8	U 3 6 4		K	S	0	1	T	0	4			Includes Debris
4 0 9	U 3 6 7		K	S	0	1	T	0	4			Includes Debris
4 1 0	U 3 7 2		K	S	0	1	T	0	4			Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)						B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process						
									(1) Process Codes (enter)			(2) Process Description [If a code is not entered in D (1)]			
4	1	1	U	3	7	3		K	S	0	1	T	0	4	Includes Debris
4	1	2	U	3	8	7		K	S	0	1	T	0	4	Includes Debris
4	1	3	U	3	8	9		K	S	0	1	T	0	4	Includes Debris
4	1	4	U	3	9	4		K	S	0	1	T	0	4	Includes Debris
4	1	5	U	3	9	5		K	S	0	1	T	0	4	Includes Debris
4	1	6	U	4	0	4		K	S	0	1	T	0	4	Includes Debris
4	1	7	U	4	0	9		K	S	0	1	T	0	4	Includes Debris
4	1	8	U	4	1	0		K	S	0	1	T	0	4	Includes Debris
4	1	9	U	4	1	1		K	S	0	1	T	0	4	Includes Debris
4	2	0	W	P	C	B		K	S	0	1	T	0	4	Includes Debris
4	2	1	W	P	0	1		K	S	0	1	T	0	4	Includes Debris
4	2	2	W	P	0	2		K	S	0	1	T	0	4	Includes Debris
4	2	3	W	P	0	3		K	S	0	1	T	0	4	Includes Debris
4	2	4	W	T	0	1		K	S	0	1	T	0	4	Includes Debris
4	2	5	W	T	0	2		K	S	0	1	T	0	4	Includes Debris
4	2	6	W	S	C	2		K	S	0	1	T	0	4	Includes Debris
4	2	7	F	0	3	9		K	S	0	1	T	0	4	Includes Debris
4	2	8	D	0	0	1	10,000	K	S	0	2	T	0	1	Includes Debris
4	2	9	D	0	0	2		K	S	0	2	T	0	1	Includes Debris
4	3	0	D	0	0	3		K	S	0	2	T	0	1	Includes Debris
4	3	1	D	0	0	4		K	S	0	2	T	0	1	Includes Debris
4	3	2	D	0	0	5		K	S	0	2	T	0	1	Includes Debris
4	3	3	D	0	0	6		K	S	0	2	T	0	1	Includes Debris
4	3	4	D	0	0	7		K	S	0	2	T	0	1	Includes Debris
4	3	5	D	0	0	8		K	S	0	2	T	0	1	Includes Debris
4	3	6	D	0	0	9		K	S	0	2	T	0	1	Includes Debris
4	3	7	D	0	1	0		K	S	0	2	T	0	1	Includes Debris
4	3	8	D	0	1	1		K	S	0	2	T	0	1	Includes Debris
4	3	9	D	0	1	8		K	S	0	2	T	0	1	Includes Debris
4	4	0	D	0	1	9		K	S	0	2	T	0	1	Includes Debris
4	4	1	D	0	2	2		K	S	0	2	T	0	1	Includes Debris
4	4	2	D	0	2	8		K	S	0	2	T	0	1	Includes Debris
4	4	3	D	0	2	9		K	S	0	2	T	0	1	Includes Debris
4	4	4	D	0	3	0		K	S	0	2	T	0	1	Includes Debris
4	4	5	D	0	3	3		K	S	0	2	T	0	1	Includes Debris



**XV. Map**

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

Topographic map is located in the Ecology Library

**XVI. Facility Drawing**

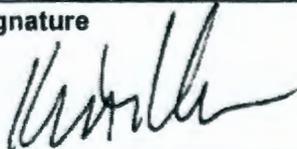
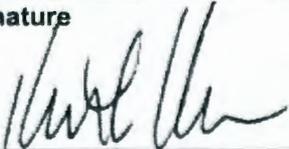
All existing facilities must include a scale drawing of the facility (refer to Instructions for more detail).

**XVII. Photographs**

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to Instructions for more detail).

**XVIII. Certifications**

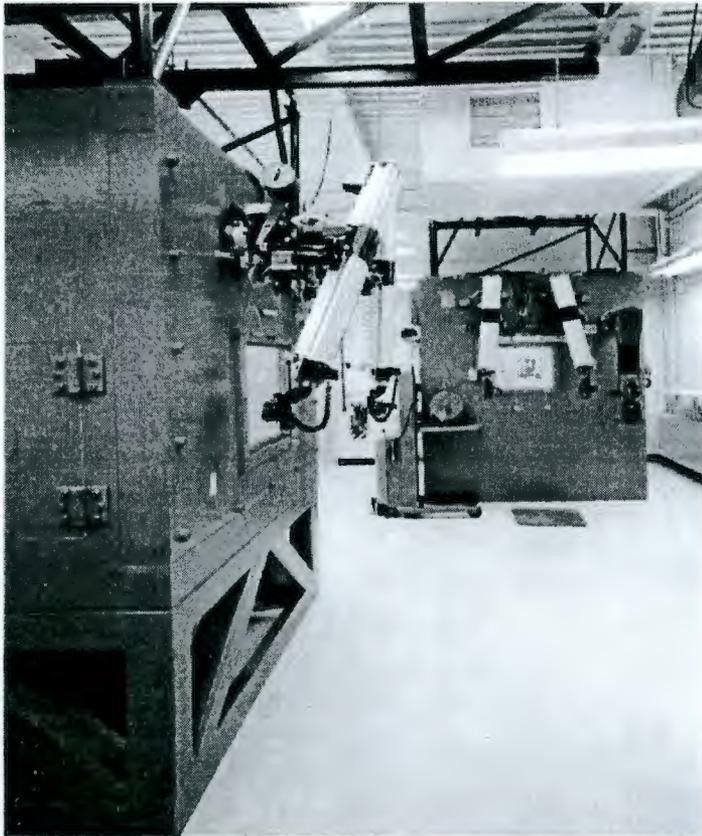
I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage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

<p><b>Operator</b> Name and Official Title (type or print) Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office</p>	<p>Signature </p>	<p>Date Signed 7/11/05</p>
<p><b>Co-Operator*</b> Name and Official Title (type or print) Roby D. Enge, Director Environment, Safety, Health and Quality Pacific Northwest National Laboratory</p>	<p>Signature </p>	<p>Date Signed 5/20/05</p>
<p><b>Co-Operator* – Address and Telephone Number</b> 3350 George Washington Way P.O. Box 999 Richland, WA 99352 (509) 376-1187</p>		
<p><b>Facility-Property Owner</b> Name and Official Title (type or print) Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office</p>	<p>Signature </p>	<p>Date Signed 7/11/05</p>

**Comments**

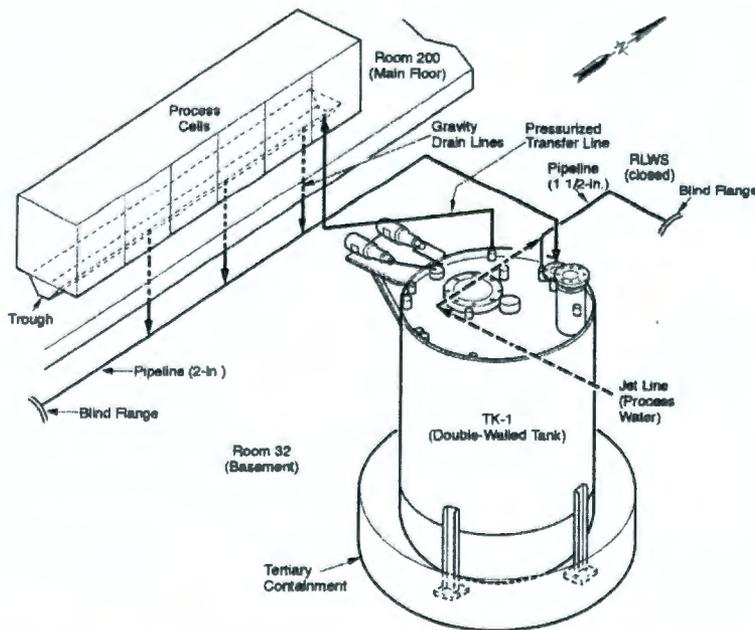
[Empty comment box]

325 Hazardous Waste Treatment Units



Shielded Analytical Laboratory  
Room 203

7908247-1CN  
(Photo Taken 1979)



M0505-1.1  
8-17-06

Shielded Analytical Laboratory Tank and Ancillary Piping

---

325 Hazardous Waste Treatment Units

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**Room 528**

96010398-20CN  
(Photo Taken 1996)



**Room 520**

96010398-17CN  
(Photo Taken 1996)

---

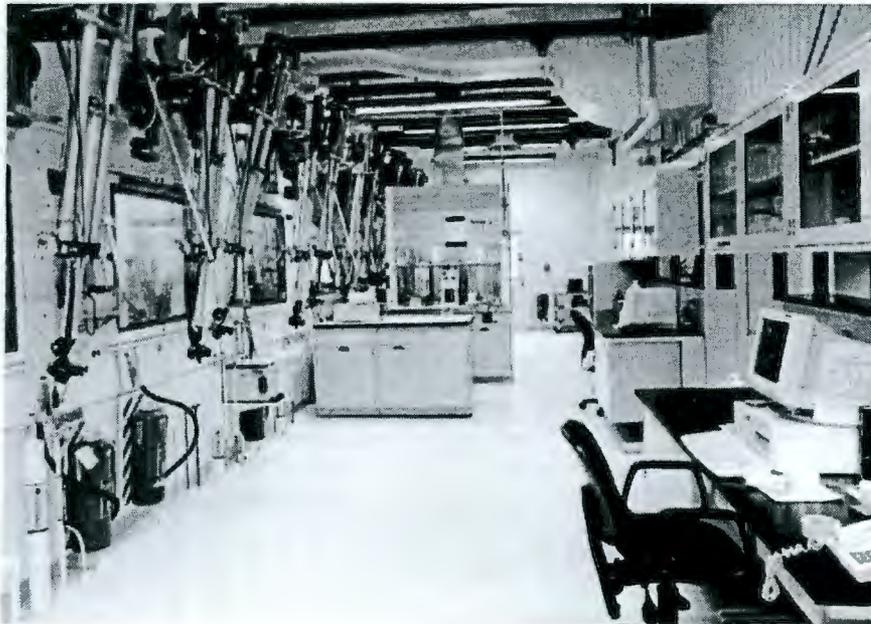
325 Hazardous Waste Treatment Units

---



**Room 201**

96010398-16CN  
(Photo Taken 1996)



**Room 201**

96010398-7CN  
(Photo Taken 1996)

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**Shielded Analytical Laboratory**

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**Room 200**

96010398-1CN  
(Photo Taken 1996)

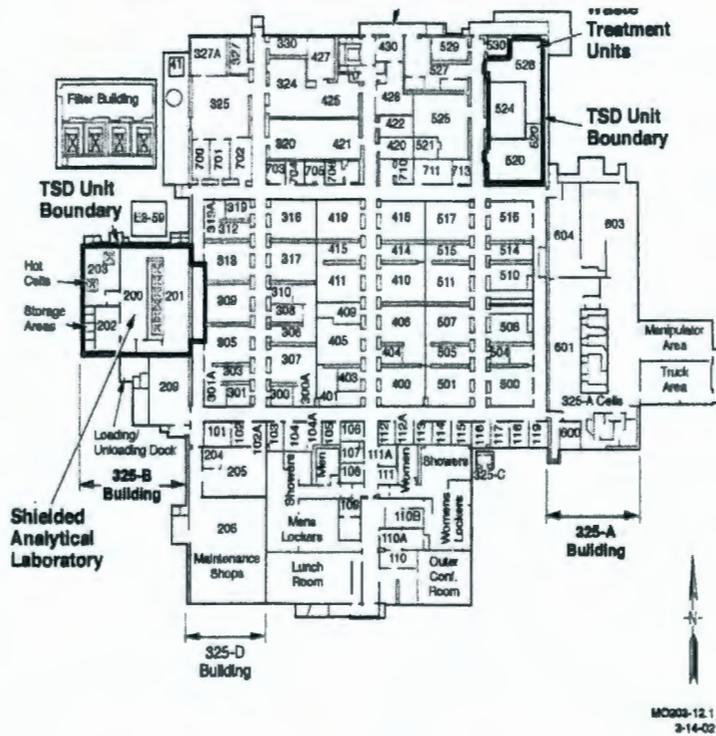


**SAL Tank (Room 32)**

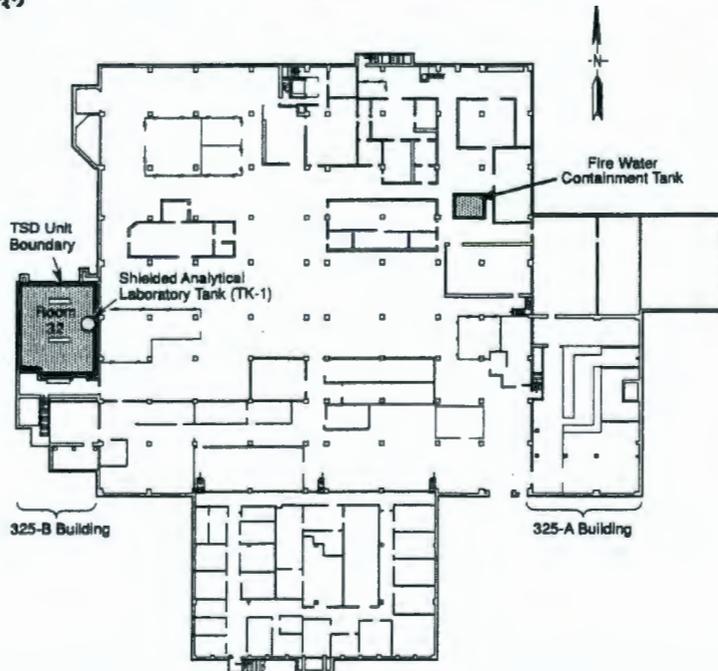
96010398-3CN  
(Photo Taken 1996)

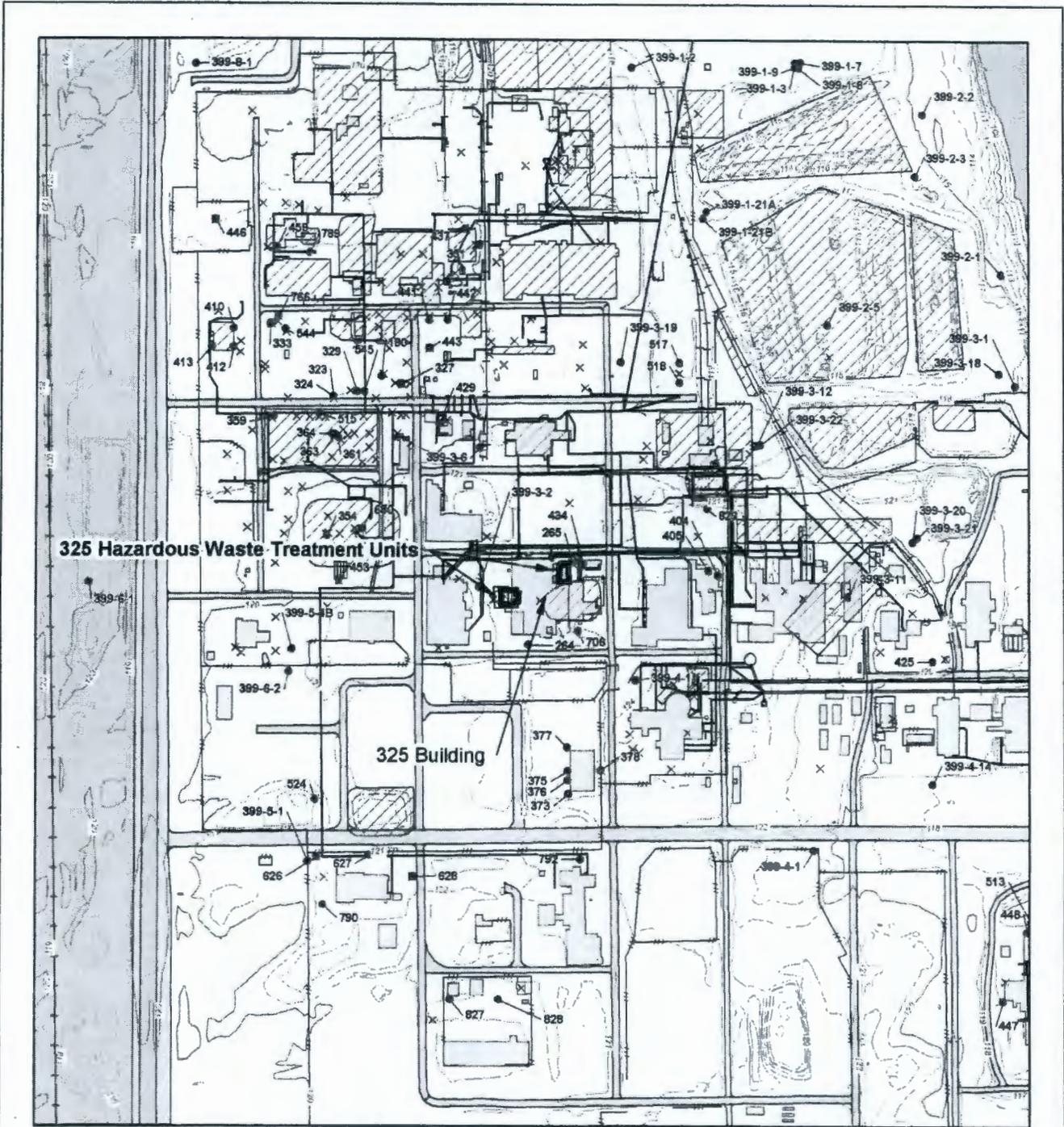
### 325 Hazardous Waste Treatment Units

#### Location of the Hazardous Waste Treatment Unit and Shielded Analytical Laboratory (main floor)



#### Location of Shielded Analytical Laboratory Tank in Room 32





## 325 Hazardous Waste Treatment Units

Hanford Site



Unit Location

- |  |                                 |  |               |
|--|---------------------------------|--|---------------|
|  | TSD Unit Boundary               |  | Buildings     |
|  | DOE Operating Areas             |  | Structures    |
|  | Hanford Facility                |  | Concrete      |
|  | Injection and Withdrawal Wells  |  | Major Roads   |
|  | Contours at 1 Meter Intervals   |  | Service Roads |
|  | Depression Contours             |  | Railroads     |
|  | SWMUs and Known Releases        |  | Fences        |
|  | Linear SWMUs and Known Releases |  |               |
|  | Spot SWMUs and Known Releases   |  |               |

Prepared for:  
US DEPARTMENT OF ENERGY  
RICHLAND OPERATIONS OFFICE  
Created and Published by:  
Central Mapping Services  
Fluor Hanford, Richland, WA  
(509) 373-9076  
Intended Use: REFERENCE ONLY  
Topographic Data:  
1996, Bechtel Hanford, Inc.



O:\Projects\2004\RCRA\_TSD\041102\_Top10\FacilityTops2005\_Bowman\Maps\050401\_325HWU\_LineDwg\_85x11\_Rev4.mxd - 8/25/2008 @ 1:28:19 PM

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**Hanford Facility RCRA Permit Modification Notification Forms**

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**Part III, Operating Unit 10  
Waste Treatment and Immobilization Plant (WTP)**

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Ecology approved PCNs for quarter ending September 30, 2008:

<b>PCN</b>	<b>Date on Modification Form</b>
24590-HLW-PCN-ENV-06-019	2008-9-19
24590-HLW-PCN-ENV-08-001	2008-8-20
24590-HLW-PCN-ENV-08-002	2008-7-24
24590-LAW-PCN-ENV-06-008	2008-7-28
24590-PTF-PCN-ENV-07-013	2008-8-14
24590-PTF-PCN-ENV-07-015	2008-9-09
24590-PTF-PCN-ENV-08-003	2008-8-12
24590-PTF-PCN-ENV-08-016	2008-9-09
24590-WTP-PCN-ENV-05-013	2008-9-11
24590-WTP-PCN-ENV-05-015	2008-8-14
24590-WTP-PCN-ENV-06-008	2008-8-26
24590-WTP-PCN-ENV-06-009	2008-8-20
24590-WTP-PCN-ENV-08-002	2008-8-20

Quarter Ending September 30,  
2008

24590-HLW-PCN-ENV-06-019

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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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&IDs) for the HLW Process Vessel  
Vent Exhaust System in Appendix 10.2 of the Dangerous Waste Permit.

Submitted by Co-Operator:



D. A. Klein

7/15/08  
Date

Reviewed by ORP Program Office:



S. J. Dinger

7/31/08  
Date

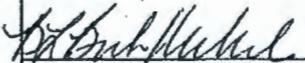
Quarter Ending September 30,  
2008

24590-HLW-PCN-ENV-06-019

<b>Hanford Facility RCRA Permit Modification Notification Form</b>			
Unit: <b>Waste Treatment and Immobilization Plant</b>		Permit Part & Chapter: <b>Part III, Operating Unit 10</b>	
<u>Description of Modification:</u>			
The purpose of this Class 1 modification is to update the Piping and Instrumentation Diagrams (P&IDs) for the HLW Process Vessel Vent Exhaust System. The following permit P&IDs are submitted to replace those currently in Appendix 10.2.			
<u>Appendix 10.2</u>			
Replace:	24590-HLW-M6-PVV-P0001, Rev. 0	With:	24590-HLW-M6-PVV-00001, Rev. 4
	24590-HLW-M6-PVV-P20001, Rev. 0		24590-HLW-M6-PVV-20001, Rev. 2
The referenced P&IDs 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 13 and 17 for 24590-HLW-M6-PVV-00001, Rev. 4, by notes 10 and 14 for 24590-HLW-M6-PVV-20001, Rev. 2, clouds, and revision triangles. Revisions are the result of ongoing design changes. The following identifies the significant types of changes on the attached drawings:			
<u>24590-HLW-M6-PVV-00001</u>			
<ul style="list-style-type: none"> <li>• Added wall modules and bulkheads</li> <li>• Changed pipe sizes</li> <li>• Revised seismic/quality category flags</li> <li>• Revised pipe slope</li> <li>• Added coaxial pipe for sections crossing the corridor</li> <li>• Changed fluid code and pipe specification on lines to pressure transmitters</li> <li>• Added pressure controls</li> <li>• Revised to incorporate pipe joggles</li> <li>• Added/deleted notes, holds and references</li> </ul>			
<u>24590-HLW-M6-PVV-20001</u>			
<ul style="list-style-type: none"> <li>• Added wall modules and bulkheads</li> <li>• Changed pipe sizes</li> <li>• Revised seismic/quality category flags</li> <li>• Revised pipe slope</li> <li>• Changed fluid code and pipe specification on lines to pressure transmitters</li> <li>• Added pressure controls</li> <li>• Revised to incorporate pipe joggles</li> <li>• Added/deleted notes, holds and references</li> </ul>			
The following is a list of outstanding change documents that have not been incorporated into this modification:			
<u>24590-HLW-M6-PVV-00001</u>			
<ul style="list-style-type: none"> <li>• 24590-HLW-M6N-PVV-00002</li> <li>• 24590-HLW-M6N-PVV-00012</li> <li>• 24590-HLW-M6PR-PVV-00001</li> </ul>			
<u>24590-HLW-M6-PVV-20001</u>			
<ul style="list-style-type: none"> <li>• 24590-HLW-M6N-PVV-00002</li> <li>• 24590-HLW-M6N-PVV-00013</li> </ul>			

Quarter Ending September 30,  
2008

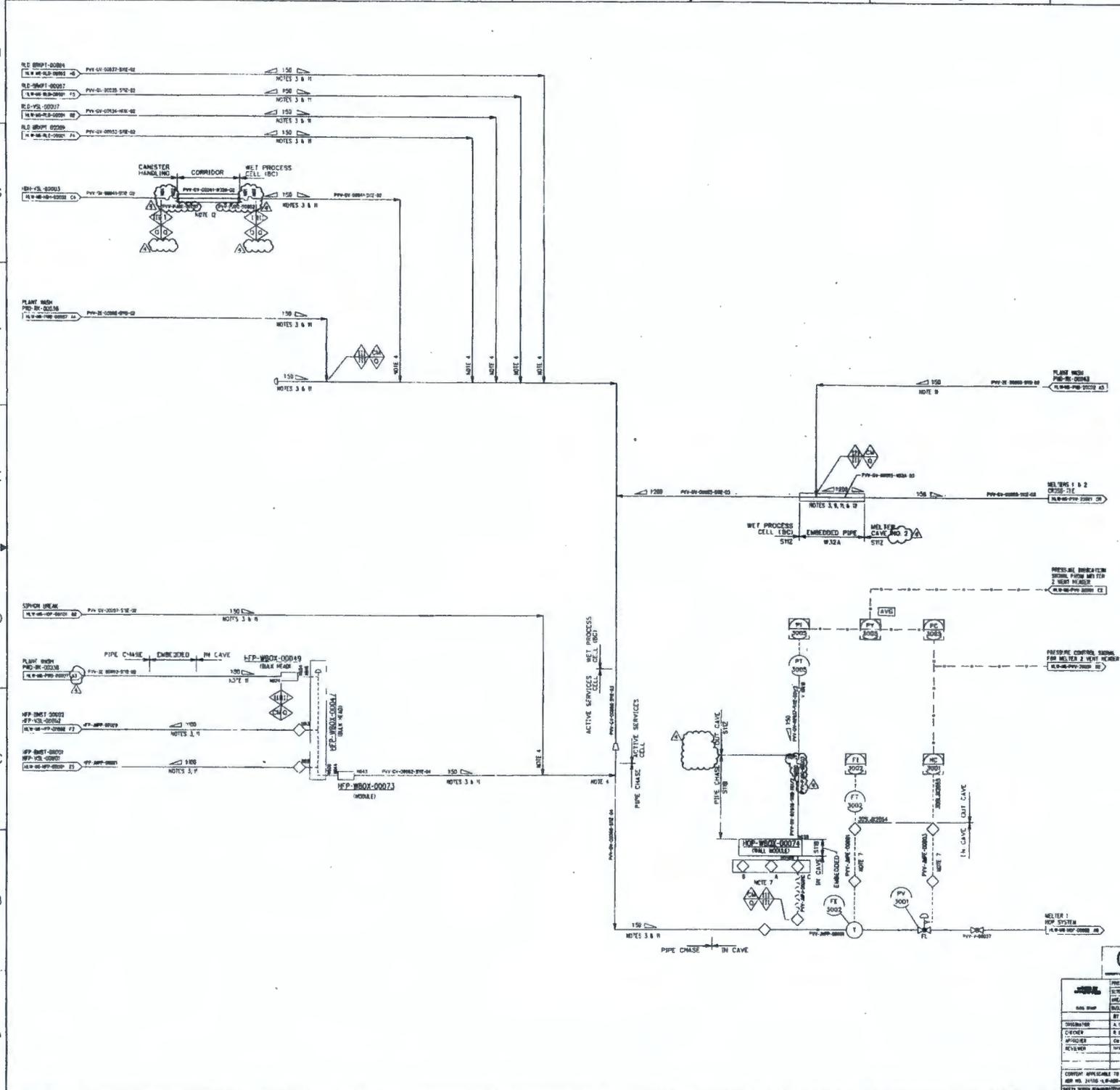
24590-HLW-PCN-ENV-06-019

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 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.3		
Enter wording of WAC 173-303-830, Appendix I Modification citation:				
A.1 - Administrative and informational changes. A.3 - Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls).				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
<u>Reason for denial:</u>		 9/19/08 B. Becker-Khaleel Date		

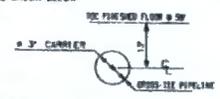
<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

H  
G  
F  
E  
D  
C  
B  
A



- NOTES:**
- SEE DRAWINGS 24590-WTP-M6-S0-00001 THROUGH 24590-WTP-M6-S0-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
  - DELETED
  - ALL PIPELINES ON THIS DRAWING ARE QUALITY LEVEL Q AND SEISMIC CATEGORY SC-III, UNLESS OTHERWISE NOTED.
  - A LATERAL FITTING SHALL BE USED TO CONNECT THE BRANCH LINE TO THE COLLECTION HEADER.
  - CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
  - DELETED
  - FOR ELECTRICAL AND INSTRUMENTATION JAMPERS REFER TO 24590-HLW-J1-PVV-00001 AND 24590-HLW-M6-ISA-00008 FOR SPECIFIC PENETRATIONS AND SUPPORT PNEUMATIC EQUIPMENT SEE 24590-HLW-M6-ISA-00008
  - DELETED
  - SHIELDING REQUIREMENTS FOR PIPELINE PIV-GV-00005-032A-03 ARE SHOWN BELOW:



- DELETED
- AS A MINIMUM, ALL PIPELINES ON THIS DRAWING SHALL BE FREE DRAINING WITH NO POCKETS. IN ADDITION, PIPELINES WITH CSWJ AREAS SHALL BE SLOPED AT 2% UNLESS CONSTRAINED BY LIMITED DIMENSIONS. IN A PORTION SECTION OF A PIPELINE'S SLOPE MUST BE LIMITED, THE SLOPE MAY BE REDUCED WITHIN THE AFFECTED SECTION AS NECESSARY, PROVIDED THAT THE MINIMUM SLOPE IS 0% OR GREATER.
- OUTER SHELL OF COAXIAL PIPE SHALL DRAIN TO A LINED CELL.
- REVISION 3 INCORPORATED 24590-HLW-M6-M01-00002, ADDED WALL JOISTES AND BRACKETS, DELETED NOTES 2, 5, AND 10. CHANGED PIPE LINE PIV-GV-00005-032A TO A BULK REVISY/ADDED QUALITY LEVEL/SEISMIC CATEGORY BRACKETS, DELETED LINE PIV-GV-00005-032A, REVISED SLOPE, ADDED COAXIAL PIPE TO ENCLOSED SECTION OF M6-VSL-00003 VENT LINE, CHANGED FLEED CODE AND PIPE SPEC ON LINES TO PRESSURE TRANSMITTER, ADDED PRESSURE CONTROLS, ADDED NOTES AND REFERENCES 2. SYSTEM DESIGN REVERIFICATION IS REQUIRED.
- DELETED
- INSTRUMENTS ARE QUALITY LEVEL CM AND SEISMIC CATEGORY SC-III UNLESS OTHERWISE NOTED.
- THE QUALITY LEVEL AND SEISMIC CATEGORY DESIGNATIONS OF ALL LEVEL Q FOR RADIATION PROTECTION, THE QUALITY LEVEL AND SEISMIC CATEGORY DESIGNATIONS OF PIPING WITH JOISTES ARE THE SAME AS CONNECTING PIPING.
- REVISED TO INCORPORATE 24590-HLW-M6-M01-00007 AND P-30005, DELETED THE QUALITY LEVEL/SEISMIC CATEGORY FLAG ON P1-3005 INSTRUMENT SERVING LINE, ADDED/DELETED NOTES, POLLS, AND REFERENCES.

**HOLD/OPEN ITEMS:**

- 1-3 DELETED

**REFERENCES:**

- 24590-HLW-3YD-HOP-ROOFS SYSTEMS DESCRIPTION FOR HLW MELTER OFFGAS TREATMENT PROCESS AND PROCESS VESSEL VENT EXHAUST (HOP AND PIPING SYSTEMS)
- THE REQUIRED BATCH REQUIREMENTS, INTERLOCKS, ALARMS AND OPERATOR INTERFACE POINTS ARE FULLY DESCRIBED IN THE SOFTWARE FUNCTIONAL SPECIFICATION FOR HLW MELTER OFFGAS TREATMENT PROCESS AND PROCESS VESSEL VENT EXHAUST (HOP AND PIPING SYSTEMS) 24590-HLW-3YD-HOP-TG001.

Please note that certain special notes and technical details are defined in the Electric Safety Plan (ESP) and are available at the HTR & Chemical Safety Plan (CSP) and are available at the HTR & Chemical Safety Plan (CSP) and are available at the HTR & Chemical Safety Plan (CSP). See the ESP and CSP for more information. See the ESP and CSP for more information. See the ESP and CSP for more information.

REVISION HISTORY		DATE	
1	REVISED FOR SHEET D	10/12/00	10/12/00
2	REVISED FOR SHEET E	10/12/00	10/12/00
3	REVISED FOR CONSTRUCTION	10/12/00	10/12/00

PROJECT NO.	24590	DATE	01-01-02
SITE	WTP-000	DESIGNED BY	09-02
AREA	WTP	CHECKED BY	10-02
NO. SHEET	18	DATE	01-01-02
DESIGNER	A. J. JONES	DATE	01-01-02
CHECKER	R. B. SMITH	DATE	01-01-02
APPROVER	DR. JONES	DATE	01-01-02
REVISOR	W. J. SMITH	DATE	01-01-02

CONTRACT NO.	24590-HLW-M6-PVV-00001	REV.	4
PROJECT NAME	HLW MELTER OFFGAS TREATMENT PROCESS AND PROCESS VESSEL VENT EXHAUST SYSTEM	DATE	01/01/02
PROJECT LOCATION	2433 STEVENS CENTER PLACE, ROCKLAND, VA 24156	DATE	01/01/02



Quarter Ending September 30,  
2008

24590-HLW-PCN-ENV-06-019

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**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&IDs) for the HLW Process Vessel  
Vent Exhaust System in Appendix 10.2 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

  
D. A. Klein

7/15/08  
Date

  
S. J. Dinger

7/31/08  
Date

Quarter Ending September 30,  
2008

24590-HLW-PCN-ENV-06-019

### Hanford Facility RCRA Permit Modification Notification Form

Unit:

**Waste Treatment and Immobilization Plant**

Permit Part & Chapter:

**Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 modification is to update the Piping and Instrumentation Diagrams (P&IDs) for the HLW Process Vessel Vent Exhaust System. The following permit P&IDs are submitted to replace those currently in Appendix 10.2.

Appendix 10.2

Replace:	24590-HLW-M6-PVV-P0001, Rev. 0	With:	24590-HLW-M6-PVV-00001, Rev. 4
	24590-HLW-M6-PVV-P20001, Rev. 0		24590-HLW-M6-PVV-20001, Rev. 2

The referenced P&IDs 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 13 and 17 for 24590-HLW-M6-PVV-00001, Rev. 4, by notes 10 and 14 for 24590-HLW-M6-PVV-20001, Rev. 2, clouds, and revision triangles. Revisions are the result of ongoing design changes. The following identifies the significant types of changes on the attached drawings:

24590-HLW-M6-PVV-00001

- Added wall modules and bulkheads
- Changed pipe sizes
- Revised seismic/quality category flags
- Revised pipe slope
- Added coaxial pipe for sections crossing the corridor
- Changed fluid code and pipe specification on lines to pressure transmitters
- Added pressure controls
- Revised to incorporate pipe joggles
- Added/deleted notes, holds and references

24590-HLW-M6-PVV-20001

- Added wall modules and bulkheads
- Changed pipe sizes
- Revised seismic/quality category flags
- Revised pipe slope
- Changed fluid code and pipe specification on lines to pressure transmitters
- Added pressure controls
- Revised to incorporate pipe joggles
- Added/deleted notes, holds and references

The following is a list of outstanding change documents that have not been incorporated into this modification:

24590-HLW-M6-PVV-00001

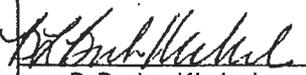
- 24590-HLW-M6N-PVV-00002
- 24590-HLW-M6N-PVV-00012
- 24590-HLW-M6PR-PVV-00001

24590-HLW-M6-PVV-20001

- 24590-HLW-M6N-PVV-00002
- 24590-HLW-M6N-PVV-00013

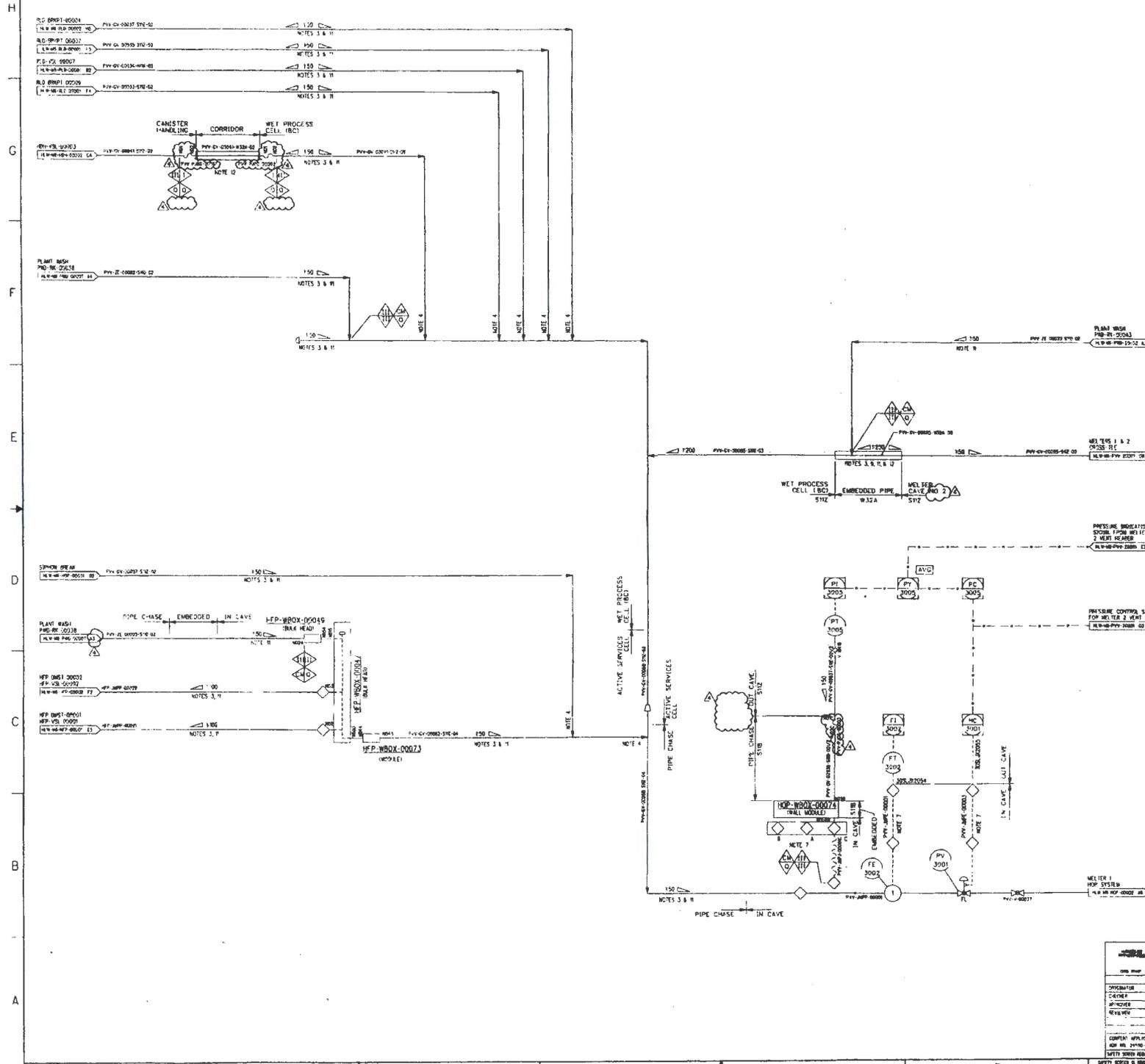
Quarter Ending September 30,  
2008

24590-HLW-PCN-ENV-06-019

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 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.3				
Enter wording of WAC 173-303-830, Appendix I Modification citation:				
A.1 - Administrative and informational changes.				
A.3 - Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls).				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)			Reviewed by Ecology:	
Reason for denial:			 9/19/08 B. Becker-Khaleel Date	

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.



**HOLD/OPEN ITEMS:**

- 1-3 DELETED

**REFERENCES:**

- 24590-HLW-310-HOP-00001, SYSTEMS DESCRIPTION FOR HLW MELTER EXHAUST TREATMENT PROCESS AND PROCESS VESSEL VENT EXTRACTION (HOP AND PVV SYSTEMS).
- THE REQUIRED BATCH SEQUENCES, PERMISSIVES, INTERLOCKS, ALARMS AND OPERATOR INTERFACES ARE FULLY DESCRIBED IN THE SOFTWARE FUNCTIONAL SPECIFICATION FOR HLW MELTER EXHAUST TREATMENT PROCESS AND PROCESS VESSEL VENT EXTRACTION (HOP AND PVV SYSTEMS) 24590-HLW-305-HOP-00001.

Please Note that sheets, special studies and technical notes, as well as the process description for all units (including the HLW Department of Energy (DOE) facilities) are maintained by the HLW Department of Energy (DOE) facilities. Facilities maintained by the HLW Department of Energy (DOE) facilities are maintained by the HLW Department of Energy (DOE) facilities. Facilities maintained by the HLW Department of Energy (DOE) facilities are maintained by the HLW Department of Energy (DOE) facilities.

REV	DESCRIPTION	DATE
1	REVISED PER M6-11	07/15/00
2	REVISED PER M6-11	08/14/00
3	REVISED PER M6-11	08/14/00
4	ISSUED FOR CONSTRUCTION	08/14/00

SYMBOL	DESCRIPTION
Q	REVISION HISTORY
Q	REVISION HISTORY

PROJECT No.	DATE	BY	DATE
24590	07/15/00	...	...
...	...	...	...
...	...	...	...
...	...	...	...

SCALE	NO.	DATE	REV.
AS SHOWN	24590-HLW-M6-PVV-00001	07/15/00	4

NOTES:

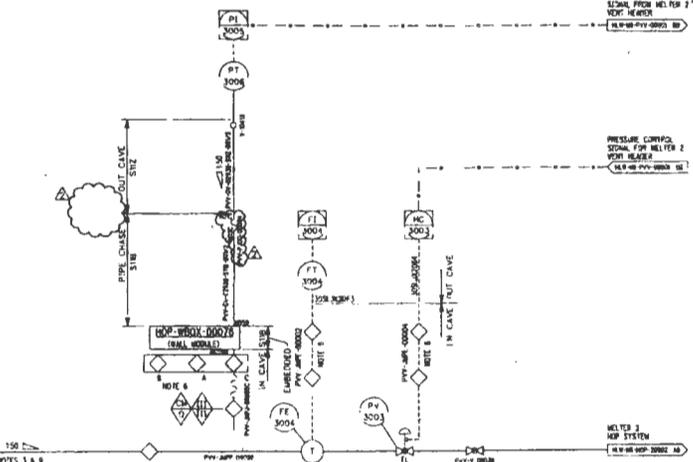
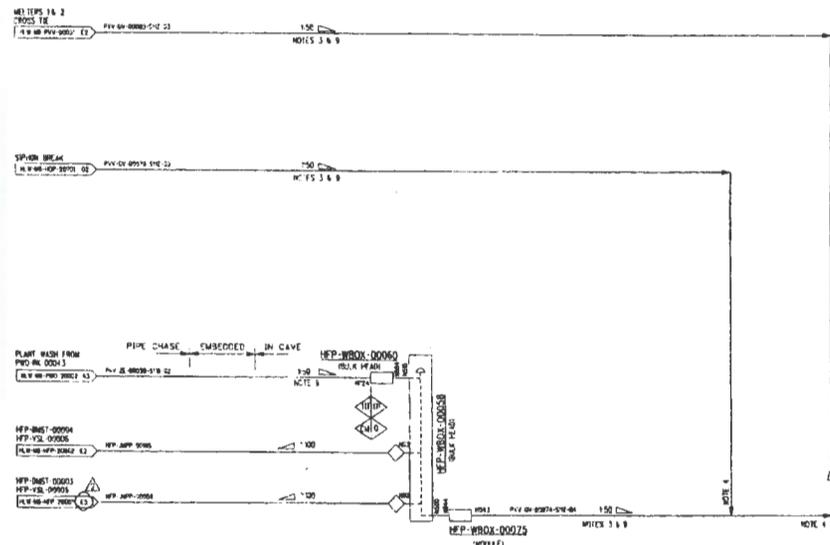
- SEE DRAWINGS 24590-MIP-ME-30-00001 THROUGH 24590-MIP-ME-30-00008 FOR GENERAL NOTES, SYMBOLS AND LEGEND AND GENERAL SLOPE REQUIREMENTS.
- DELETED
- ALL PIPELINES ON THIS DRAWING ARE QUALITY LEVEL 0 AND SEISMIC CATEGORY SC-III UNLESS OTHERWISE NOTED.
- A LATERAL FITTING SHALL BE USED TO CONNECT THE BRANCH LINE TO THE COLLECTION HEAD.
- CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
- FOR ELECTRICAL AND INSTRUMENTATION JAMPERS REFER TO 24590-M-JUV-PV-00001 THROUGH 24590-M-JUV-ISA-00008.
- DELETED
- DELETED
- DELETED
- AS A MINIMUM ALL PIPELINES ON THIS DRAWING SHALL BE FREE DRAINING WITH NO POCKETS. IN ADDITION PIPELINES WITH COVED AREAS SHALL BE SLOPED AT 2% UNLESS CONSTRAINED BY LAYOUT LIMITATIONS. IF A PORTION/SECTION OF A PIPELINE'S SLOPE MUST BE LIMITED THE SLOPE MAY BE REDUCED WITHIN THE AFFECTED SECTION AS NECESSARY PROVIDED THAT THE MINIMUM SLOPE IS 1% OR GREATER.
- REVISION 8 ADDED WELD SYMBOLS AND BULKHEADS. DELETED NOTE 1, 7 AND 8 ADDED NOTES. ADDED REFERENCES 2. CHANGED LINE SIZE OF P-V-00074 TO 4 INCH. DELETED LINE P-V-00070. REVISED/ADDED QUALITY LEVEL/SEISMIC CATEGORY BREAKS. REVISED SLOPES, CHANGED FLOW CODE AND FLOW DIRECTION ON LINES TO FANS/DRIVE TRANSMISSIONS ADDED PRESSURE CONTROLS SYSTEM DESIGN REINVESTIGATION REQUIRED.

HOLD/OPEN ITEMS:

- 1. DELETED

REFERENCES:

- 24590-HLW-JYO-HOP-00001 SYSTEMS DESCRIPTION FOR HLW MELTER OFFGAS TREATMENT PROCESS AND PROCESS VESSEL VENT EXHAUSTION (HOP AND P-V SYSTEMS)
- THE REQUIRED BATCH SEQUENCES, PERMISSIVES, INTERLOCKS, ALARMS AND OPERATOR INTERFACE POINTS ARE TO BE DETERMINED BY THE SOFTWARE FUNCTIONAL SPECIFICATION FOR HLW MELTER OFFGAS TREATMENT PROCESS AND PROCESS VESSEL VENT EXHAUSTION (HOP AND P-V SYSTEMS) 24590-HLW-JYO-HOP-00001



Please note that revised, special ordering, and technical methods are defined by the current drawing and all other drawings and references of the U.S. Department of Energy (DOE) facilities submitted by DOE to the U.S. Environmental Protection Agency (EPA) under the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) are hereby incorporated by reference into this drawing. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) are hereby incorporated by reference into this drawing. The U.S. Department of Energy (DOE) and the U.S. Environmental Protection Agency (EPA) are hereby incorporated by reference into this drawing.

REV	DESCRIPTION	DATE
1	ISSUED FOR CONSTRUCTION	07/23/04
2	REVISED PER NOTE 8	07/23/04
3	REVISED PER NOTE 9	07/23/04
4	ISSUED FOR CONSTRUCTION	07/23/04

PROJECT No: 24590  
SITE: WASTE TREATMENT PLANT  
AREA: 24590  
DRAWING No: 24590-HLW-M6-PVV-20001

DESIGNER: J. C. HENNING  
CHECKER: J. C. HENNING  
APPROVER: J. C. HENNING  
REVISIONS: J. C. HENNING

CONTRACT No: DC-MC37-00000001  
PROJECT: P&ID - HLW PROCESS VESSEL VENT EXHAUST SYSTEM  
SHEET 2 OF 2

DATE: 07/23/04  
SCALE: AS SHOWN  
PROJECT: SILVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2435 STEVENS CENTER PLACE  
RICHLAND, WA 99354

Quarter Ending Sept. 30, 2008

24590-HLW-PCN-ENV-08-001

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 2: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Replace Equipment Assembly Drawing for HLW Offgas Drains Collection Vessel (RLD-VSL-00002) in  
Appendix 10.6 of the Dangerous Waste Permit

Submitted by Co-Operator:

D. A. Klein

D. A. Klein

7/28/08

Date

Reviewed by ORP Program Office:

S. J. Dlinger

S. J. Dlinger

7/28/08

Date

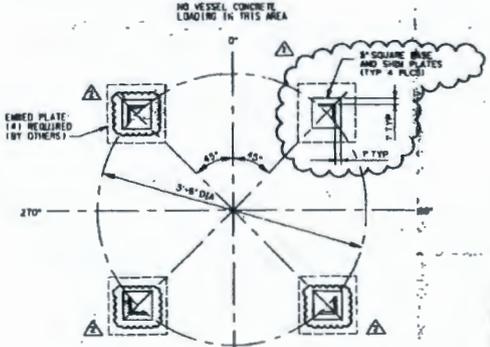
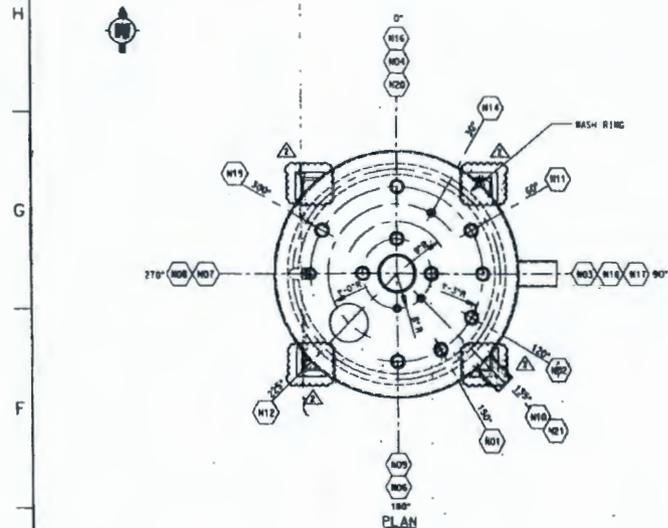
Quarter Ending Sept. 30, 2008

24590-HLW-PCN-ENV-08-001

<b>Hanford Facility RCRA Permit Modification Notification Form</b>														
Unit: <b>Waste Treatment and Immobilization Plant</b>	Permit Part & Chapter: <b>Part III, Operating Unit 10</b>													
<p><b>Description of Modification:</b>                      The purpose of this Class 1 modification is to update the Equipment Assembly Drawing for the HLW Offgas Drains Collection Vessel (RLD-VSL-00002). The following source drawing is submitted to replace the permitted drawing currently in Appendix 10.6.</p>														
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="5" style="padding: 2px;"><b>Appendix 10.6</b></td> </tr> <tr> <td style="width: 20%; padding: 2px;">Replace:</td> <td style="width: 30%; padding: 2px;">24590-HLW-MV-RLD-P0002, Rev. 0</td> <td style="width: 10%; padding: 2px;">With:</td> <td colspan="2" style="width: 39%; padding: 2px;">24590-HLW-MV-RLD-00002, Rev. 2</td> </tr> </table>					<b>Appendix 10.6</b>					Replace:	24590-HLW-MV-RLD-P0002, Rev. 0	With:	24590-HLW-MV-RLD-00002, Rev. 2	
<b>Appendix 10.6</b>														
Replace:	24590-HLW-MV-RLD-P0002, Rev. 0	With:	24590-HLW-MV-RLD-00002, Rev. 2											
<p>The drawing incorporates 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 source drawing. This modification requests Ecology approval and incorporation into the permit, the specific changes to the Equipment Assembly Drawing that are indicated by note 10, clouds, and revision triangles. Revisions are the result of ongoing design changes. Significant changes are summarized below:</p> <ul style="list-style-type: none"> <li>• Incorporated 24590-HLW-MVN-RLD-00010, 24590-HLW-MVN-RLD-00015, and 24590-HLW-MVN-RLD-00016</li> <li>• Updated nozzle table</li> <li>• Replaced vessel skirt with four vessel support legs</li> <li>• Revised shim plate detail</li> <li>• Deleted Detail 1</li> <li>• Added Notes 9 and 10</li> <li>• Deleted Hold 2</li> </ul>														
<p>The following is a list of outstanding change documents that have not been incorporated into this modification:                      24590-HLW-MVN-RLD-00019</p>														
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">WAC 173-303-830 Modification Class: <sup>1 2</sup></td> <td style="width: 12.5%; padding: 2px;">Class 1</td> <td style="width: 12.5%; padding: 2px;">Class <sup>1</sup>1</td> <td style="width: 12.5%; padding: 2px;">Class 2</td> <td style="width: 12.5%; padding: 2px;">Class 3</td> </tr> <tr> <td style="padding: 2px;">Please mark the Modification Class:</td> <td style="text-align: center; padding: 2px;">X</td> <td></td> <td></td> <td></td> </tr> </table>					WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3	Please mark the Modification Class:	X			
WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3										
Please mark the Modification Class:	X													
<p>Enter Relevant WAC 173-303-830, Appendix I Modification citation number:      A.1 and A.3                      Enter wording of WAC 173-303-830, Appendix I Modification citation:                      A. General Permit Provisions                      1. Administrative and informational changes                      3. Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls)</p>														
<p>Modification Approved:    <input checked="" type="checkbox"/> Yes    <input type="checkbox"/> No (state reason for denial)                      Reason for denial:</p>			<p style="text-align: center;">Reviewed by Ecology:</p> <div style="text-align: center;"> </div> <p style="text-align: center;">B. Becker-Khaleel      8/20/08                      Date</p>											

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

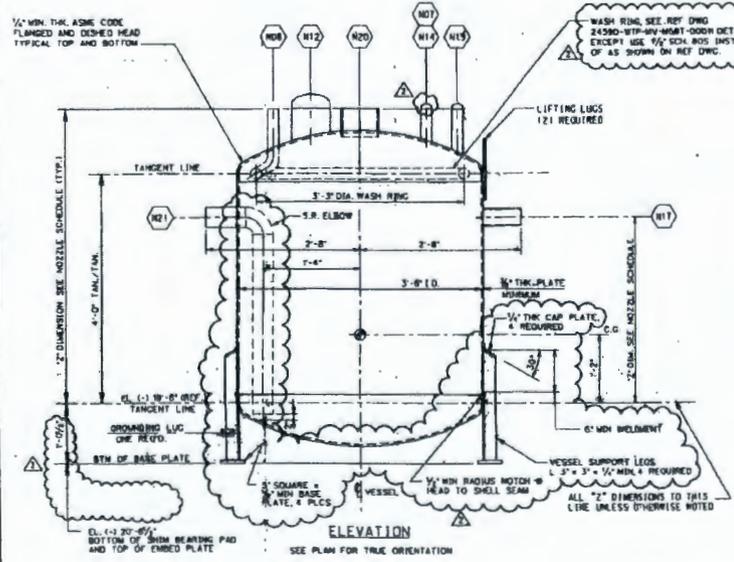
<sup>2</sup> If the proposed modification does not match any modification listed in WAC 173-303-830 Appendix I, then the proposed modification should automatically be given a Class 3 status. This status may be maintained by the Department of Ecology, or down graded to a Class '1, if applicable.



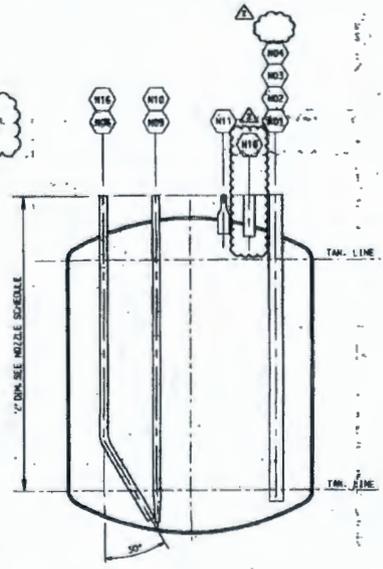
EMBED PLATE P.A.N. VIEW

NOZZLE	SIZE	SCHED/WALL	SERVICE/REMARKS	"2" DIM	REF DWG/DET	CONR PIPE SIZE/SCHED
N01	2"	1605	INLET - HOP-HEM-00001A	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	2" SCH. 40S
N02	2"	1605	INLET - HOP-HEM-00001B	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	2" SCH. 40S
N03	2"	1605	INLET - HOP-HEM-00002B	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	2" SCH. 40S
N04	2"	1605	INLET - HOP-HEM-00002A	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	2" SCH. 40S
N06	1 1/2"	1605	OUTLET TO RLD-ELECTR-00020A	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	1 1/2" SCH. 40S
N07	2"	805	SPARE	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 1	CAPPED
N08	1 1/2"	805	INLET TO WASH RING	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 1	1 1/2" SCH. 40S
N09	2" O.D.	1605	THERMOWELL	5'-1 1/2"	24990-WP-WV-M59T-00007 DETAIL 5	1" SCH. 105
N10	2" O.D.	1605	THERMOWELL	5'-1 1/2"	24990-WP-WV-M59T-00007 DETAIL 5	1" SCH. 105
N11	2" O.D.	SEE DETAIL	INSTRUMENT (PRESSURE)	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 5	1 1/2" SCH. 40S
N12	6"	405	INSPECTION/CLEANOUT POINT	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 1	CAPPED
N14	1 1/2"	405	SPARE	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 2	CAPPED
N16	1 1/2"	1605	OUTLET TO RLD-ELECTR-00020B	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 4	1 1/2" SCH. 40S
N17	4"	405	OVERFLOW	3'-6"	24990-WP-WV-M59T-00016001 DETAIL 1	4" SCH. 40S
N18	2"	1605	SPARE	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 1	CAPPED
N19	2"	805	SPARE	5'-1 1/2"	24990-WP-WV-M59T-00016001 DETAIL 2	CAPPED
N20	6"	405	INSTRUMENT (RADAR)	5'-9 1/2"	24990-WP-WV-M59T-00016003 DETAIL 24	N/A
N21	3"	805	P.V.J. DRAIN LINE	3'-4"	24990-WP-WV-M59T-00016001 DETAIL 1	3" SCH. 40S

- GENERAL NOTES:**
- FOR DEP LEG USE 3" CLEARANCE FROM BOTTOM UNLESS OTHERWISE NOTED.
  - "2" DIMENSION MEASURE FROM BOTTOM TANGENT LINE TO THE STUD END / CENTER LINE OF NOZZLE.
  - SELLER SHALL SIZE ANCHOR BOLTS AND CHAIRS PER REFERENCE DRAWING NO. 24990-WP-WV-M59T-00002. REFER SHIM, PLATING AND WELD ANCHOR BOLTS TO 2400 SHIM PLATES EMBEDDED IN CONCRETE FLOOR. SELLER SHALL SIZE ANCHOR BOLTS USING MATERIAL PROPERTIES OF THE EMBEDDED FLOOR.
  - LIFTING LUGS DESIGN BY VENDOR.
  - SELLER SHALL PROVIDE (41) SHIM PACK 5" SQUARE IN 304 SS. EACH COMPRISING OF:
    - (21) 1/2" THICK PLATE
    - (11) 3/4" THICK PLATE
    - (21) 3/8" THICK PLATE
  - VESSEL SHALL BE 100% RADIOGRAPHED.
  - ADD/REVISED/DELETED:
    - ADDED DETAIL 1 FOR NOZZLE N14.
    - ADDED NOZZLE N21
    - DELETED NOZZLE N13
    - REVISED-NEG. DETAILS FOR N09 & N10
  - THIS NOTE RELATES ONLY TO STEAM EJECTORS/NOZZLES N06 AND N07 OF THIS DRAWING. THIS DRAWING IS A LEAD DOCUMENT FOR DESIGN BASIS EVENT CALCULATIONS. DRAWING MODIFICATIONS THAT ALTER (FOR ADD TO) THE MAXIMUM SINGLE STEAM EJECTOR MASS FLOWRATE (SSS LBS/HR) FOR RLD-VBL-00002 OR ALTER THE MAXIMUM SINGLE STEAM EJECTOR MASS FLOWRATE (1199 LBS/HR) FOR RLD-VBL-00007 OR -00008 (REFERENCE 24990-HLW-RD-00014) REQUIRING A REVIEW BY THE EHS DISCIPLINE, CHANGES TO THE TEXT OF THIS NOTE REQUIRING A REVIEW BY THE EHS DISCIPLINE AS WELL AS THE CHANGES BEING MADE DO NOT ALTER (FOR ADD TO) THE FLOOR BASE OR THE STEAM EJECTORS, OR THE TEST OF THIS NOTE, OR REVISION 1; NOT RECEIVED.
  - COMMENTS OF THIS JUDGMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
  - REVISED TO INCORPORATE 24990-HLW-RD-00010, 24990-HLW-RD-00015 & 24990-HLW-RD-00016. UPDATED NOZZLE TABLE, REPLACED VESSEL SKIRT WITH FLOOR VESSEL SUPPORT LEGS, REVISED SHIM PLATE DETAIL, DELETED DETAIL 1, ADDED NOTES 9 & 10, DELETED HOLD 2.



ELEVATION

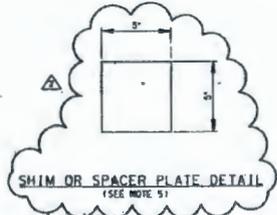


PARTIAL ELEVATION

**HOLDS:**  
 1. DELETED  
 2. DELETED

COMPONENTS	QUALITY LEVEL
MAIN VESSEL, SKIRT, ALL NOZZLES	CM
ALL INTERNAL SUPPORTS	CM
LEVEL INSTRUMENT / THERMOWELL	CM
WASH RING AND PIPING	CM

THIS DRAWING TO BE READ IN CONJUNCTION WITH THE MECHANICAL DATA SHEET NO 24990-HLW-RD-00008



SHIM OR SPACER PLATE DETAIL (SEE NOTE 5)

DWG NO	REV	TITLE
24990-HLW-RD-00001	1	MAIN HLW REACTIVE LIQUOR WASTE DISPOSAL SYSTEM
24990-WP-WV-M59T-00001	1	PRESSURE VESSEL RELIEF VALVE SYSTEM
24990-WP-WV-M59T-00002	1	CONCRETE FLOOR TREATMENT DETAILS
24990-WP-WV-M59T-00003	1	WELD CONNECTION STANDARD SHEET 1 OF 3
24990-WP-WV-M59T-00004	1	WELD CONNECTION STANDARD SHEET 2 OF 3
24990-WP-WV-M59T-00005	1	WELD CONNECTION STANDARD SHEET 3 OF 3
24990-HLW-RD-00002	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00003	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00004	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00005	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00006	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00007	1	REACTIVE LIQUOR TREATMENT VESSEL
24990-HLW-RD-00008	1	REACTIVE LIQUOR TREATMENT VESSEL

**REVISION HISTORY**

NO	DATE	DESCRIPTION	BY	CHKD	DATE
1	08/24/2001	REVISED PER NOTE 8	...	...	...
2	08/24/2001	REVISED PER NOTE 7, 8 REQUIRED FOR PURCHASE	...	...	...
3	08/24/2001	ORDER FOR PURCHASE	...	...	...

**EQUIPMENT ASSEMBLY**  
 HLW OFFGAS DRAINS COLLECTION  
 VESSEL RLD-VBL-00002

24990-HLW-WV-RD-00002

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Quarter Ending June 30, 2008

24590-HLW-PCN-ENV-08-002

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Page 2 of 2: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Update HLW Piping and Instrumentation Diagrams (P&ID) 24590-HLW-M6-HCP-P0001 and 24590-HLW-M6-  
HCP-P0002 for the Concentrate Receipt Process System (HCP) in Appendix 10.2 of the Dangerous Waste  
Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein                      6/16/08  
D. A. Klein                      Date

S. J. Olinger                      7/8/08  
S. J. Olinger                      Date

Quarter Ending June 30, 2008

24590-HLW-PCN-ENV-08-002

<b>Hanford Facility RCRA Permit Modification Notification Form</b>																
Unit: <b>Waste Treatment and Immobilization Plant</b>	Permit Part & Chapter: <b>Part III, Operating Unit 10</b>															
<p><u>Description of Modification:</u>                      The purpose of this Class 1 modification is to update the Piping and Instrumentation Diagrams (P&amp;IDs) for the HLW Concentrate Receipt Process System Transfer Piping. The following permit P&amp;IDs are submitted to replace those currently in Appendix 10.2. Note that Revision 2 of the P&amp;IDs was rejected by Ecology on 12/11/2006 (CCN 149511) and not incorporated in the permit.</p>																
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="4" style="text-align: left; padding: 2px;">Appendix 10.2</th> </tr> </thead> <tbody> <tr> <td style="width: 15%; padding: 2px;">Replace:</td> <td style="width: 35%; padding: 2px;">24590-HLW-M6-HCP-P0001, Rev. 1</td> <td style="width: 15%; padding: 2px;">With:</td> <td style="width: 35%; padding: 2px;">24590-HLW-M6-HCP-P0001, Rev. 3</td> </tr> <tr> <td></td> <td style="padding: 2px;">24590-HLW-M6-HCP-P0002, Rev. 1</td> <td></td> <td style="padding: 2px;">24590-HLW-M6-HCP-P0002, Rev. 3</td> </tr> </tbody> </table>					Appendix 10.2				Replace:	24590-HLW-M6-HCP-P0001, Rev. 1	With:	24590-HLW-M6-HCP-P0001, Rev. 3		24590-HLW-M6-HCP-P0002, Rev. 1		24590-HLW-M6-HCP-P0002, Rev. 3
Appendix 10.2																
Replace:	24590-HLW-M6-HCP-P0001, Rev. 1	With:	24590-HLW-M6-HCP-P0001, Rev. 3													
	24590-HLW-M6-HCP-P0002, Rev. 1		24590-HLW-M6-HCP-P0002, Rev. 3													
<p>The revisions to the P&amp;IDs are primarily editorial. 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&amp;IDs that are indicated. Revisions are the result of ongoing design changes. Significant changes are summarized below:</p> <ul style="list-style-type: none"> <li>• Changed the labels on the PTF side of the feed transfer line identifying the PTF vessels</li> <li>• Changed the labels on the HLW side of the feed transfer line regarding the return to PTF</li> <li>• Identified spare penetrations and boundary designations</li> <li>• Incorporated P-joggles</li> <li>• Modified quality/seismic flags</li> <li>• Revised pipe specification from S12A to S32A</li> <li>• Modified, deleted and renumbered notes.</li> </ul>																
<p>The following is a list of outstanding change documents that have not been incorporated into this modification: None</p>																
<table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 45%; padding: 2px;">WAC 173-303-830 Modification Class: <sup>1 2</sup></th> <th style="width: 10%; padding: 2px;">Class 1</th> <th style="width: 10%; padding: 2px;">Class <sup>1</sup>1</th> <th style="width: 10%; padding: 2px;">Class 2</th> <th style="width: 15%; padding: 2px;">Class 3</th> </tr> </thead> <tbody> <tr> <td style="padding: 2px;">Please mark the Modification Class:</td> <td style="text-align: center; padding: 2px;">X</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>					WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3	Please mark the Modification Class:	X					
WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3												
Please mark the Modification Class:	X															
<p>Enter Relevant WAC 173-303-830, Appendix I Modification citation number:     A.1 and A.3                      Enter wording of WAC 173-303-830, Appendix I Modification citation:                      A. General Permit Provisions                      1. Administrative and informational changes                      3. Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls)</p>																
<p>Modification Approved:   <input checked="" type="checkbox"/> Yes   <input type="checkbox"/> No (state reason for denial)                      Reason for denial:</p>			<p style="text-align: center;">Reviewed by Ecology:</p> <div style="text-align: center;">                           B. Becker-Khaleel     7/24/08                          Date                     </div>													

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

NOTES:

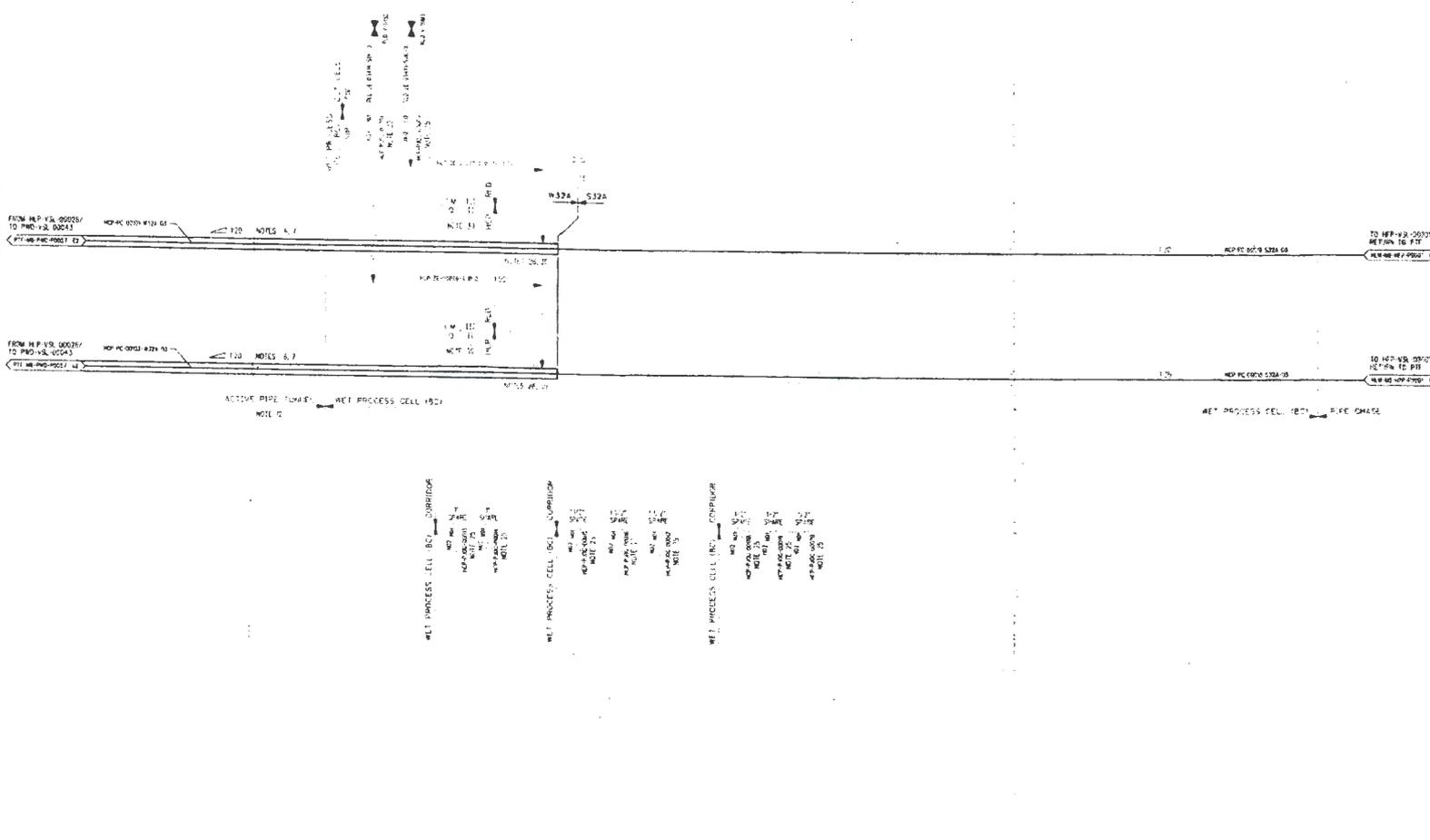
- 1. SEE DRAWINGS 24590-HLW-MB-HCP-P0001 THROUGH 24590-HLW-MB-HCP-P0003 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
- 2-5 DELETED
- 6. BATTERY LIMITS FOR PIPING IS INSIDE OF HLW FACILITY, BUT IS RESPONSIBLE FOR PIPING BETWEEN PRETREATMENT AND HLW (SEE DRAWING 24590-PIT-MB-PWD-P0007).
- 7. PIPING OUTSIDE OF BUILDING IS DIRECT-BURIED COAXIAL PIPE. PRETREATMENT IS RESPONSIBLE FOR COAXIAL PIPE LEAK DETECTION. SEE DRAWING 24590-PIT-MB-PWD-P0007.
- 8-11 DELETED
- 12. 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 PIPEWORK AFTER THE PLANT STARTUP PHASE IS COMPLETE.
- 13-20 DELETED
- 21. CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING.
- 22 DELETED
- 23 DELETED
- 24 DELETED
- 25. THE GEOMETRY OF JOGGED HOSE-END PENETRATIONS IS QUALITY LEVEL C FOR RADIATION PROTECTION. THE QUALITY LEVEL AND SEISMIC CATEGORY DESIGNATIONS OF PIPING WITHIN JOGGLES ARE THE SAME AS CORRESPONDING PIPING WITHIN SPANNS. JOGGLES IS QUALITY LEVEL D AND SEISMIC CATEGORY SC-II.
- 26. FLUSH LINE CONNECTION OF ENCASEMENT PIPE SHALL BE AT THE HIGHEST POINT ON TOP OF OUTER PIPE. THE SAFETY CLASS OF THE FLUSH LINE IS ADR-111E.
- 27 DELETED
- 28. REVISION 2 INCORPORATED EDITORIAL CHANGES TO OFFSET KEY CONNECTION TEXT, MODIFIED NON-NUMBERED NOTES, ADDED SPARE PENETRATIONS.
- 29 DELETED
- 30. THE PRESSURE BOUNDARY FOR THE INNER AND OUTER PIPE OF THE DOUBLE CONTAINMENT LINES ARE QUALITY LEVEL B. THE INNER PIPE IS SEISMIC CATEGORY SC-I. THE OUTER PIPE IS SEISMIC CATEGORY SC-II.
- 31 DELETED
- 32. THE COMPONENTS SHOWN ON THIS DRAWING IN PARTITION DO NOT REQUIRE INDEPENDENT QUALIFIED REGISTERED PROFESSIONAL ENGINEER ASSISTANCE OR DESIGN OR INSTALLATION INSPECTIONS BY A QUALIFIED INSTALLATION INSPECTOR IN ACCORDANCE WITH THE DWP AND/OR WASHINGTON ADMONSTRATIVE CODE WAC REGULATIONS.
- 33. REVISED PER 24590-HLW-MB-HCP-P0003, 24590-HLW-MB-HCP-P0004 AND TO INCORPORATE P-1 JOGGLES, ADDED/REVISED/DELETED NOTES, PIPE SPECIFICATIONS FROM WISA TO FSCA, QUALITY/SEISMIC FLAG AND MINOR EDITORIAL CHANGES.

HOLD/OPEN ITEMS

- 1-5 DELETED

REFERENCES

- 1. 24590-HLW-MB-HCP-P0003, PROCESS FLOW DIAGRAM HLW RECEIPT & FEED PREPARATION (SYSTEM HCP, OPR & HCP)
- 2. 24590-HLW-MB-HCP-P0004, SYSTEM DESCRIPTION FOR HLW CONCENTRATE RECEIPT AND MELTER FEED PROCESS SYSTEMS (OPR AND HCP)
- 3-8 DELETED



PLEASE NOTE THAT SAFETY SPECIAL MATERIAL AND APPROVED MATERIALS IS DEFINED IN THE PLANT ENERGY ACT OF 1968 AND AS REGULATED BY THE U.S. DEPARTMENT OF ENERGY (DOE). THESE MATERIALS ARE TO BE HANDLED BY PERSONNEL WHOSE EMPLOYERS ARE RESPONSIBLE AND AUTHORITY TO HANDLE, STORE, SPECIAL MATERIAL AND APPROVED MATERIALS IN THE SAME MANNER. THESE MATERIALS ARE TO BE HANDLED IN ACCORDANCE WITH THE REGULATIONS OF THE U.S. DEPARTMENT OF ENERGY (DOE) AND THE U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA).

REV	DESCRIPTION	DATE
1	ISSUED FOR PERMITTING USE AS NOTED BY	11/15/00
2	REVISED FOR NOTE BE ISSUED FOR PERMITTING USE	02/16/01
3	ISSUED FOR PERMITTING USE	06/15/01

PROJECT NO. 24590		REVISION HISTORY	
SITE: WASHINGTON		RIVER PROTECTION PROJECT	
AREA: 2706		WASTE TREATMENT PLANT	
EPA PROJECT NO. 24590		24590-HLW-MB-HCP-P0001	
BY: THOMAS GALICIO		DATE: 07/25/00	
CHECKED BY: S. J. CONNELL		DATE: 08/21/00	
APPROVED BY: T. J. KELLY		DATE: 09/28/00	
REVISION: 0001		DATE: 07/25/00	
CONTRACT NO. DE-AC07-SB-W-1438		SCALE: AS SHOWN	
CONTENT APPLICABLE TO ALL REV. NO. 0001		REV. NO. 0001	
SAFETY SPECIAL MATERIALS: YES		DATE: 02/16/01	
SAFETY SPECIAL MATERIALS: NO		DATE: 02/16/01	
SAFETY SPECIAL MATERIALS: YES		DATE: 02/16/01	
SAFETY SPECIAL MATERIALS: NO		DATE: 02/16/01	

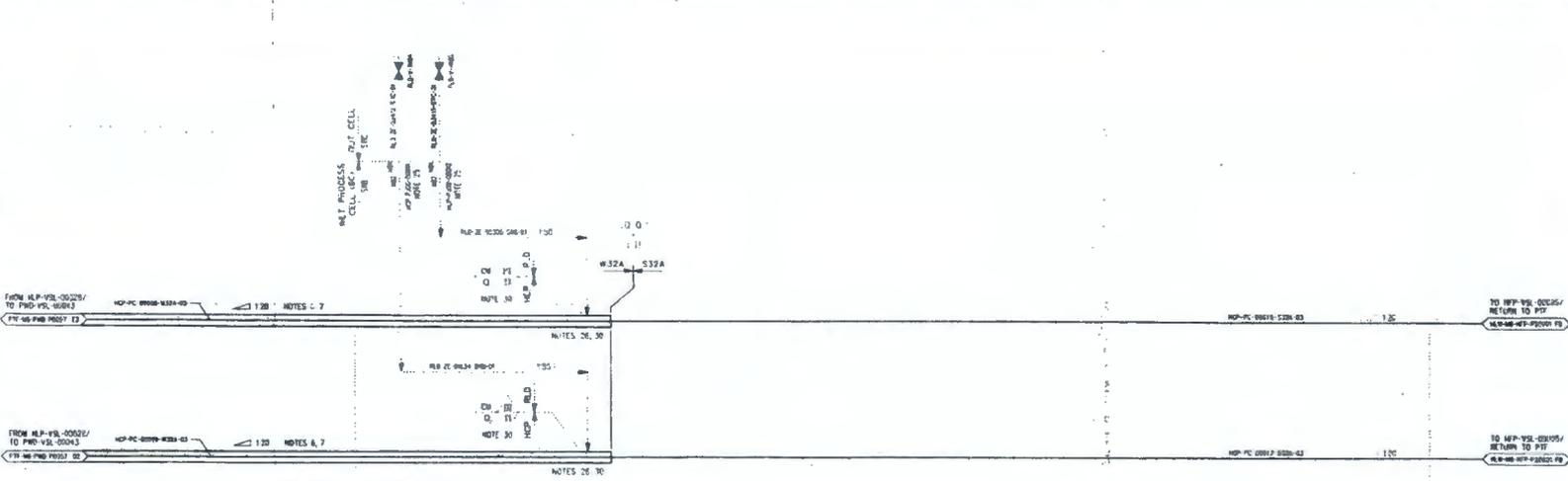
**P&ID - HLW  
CONCENTRATE RECEIPT  
PROCESS SYSTEM  
MELTER 1 TRANSFER PIPING**

24590-HLW-MB-HCP-P0001

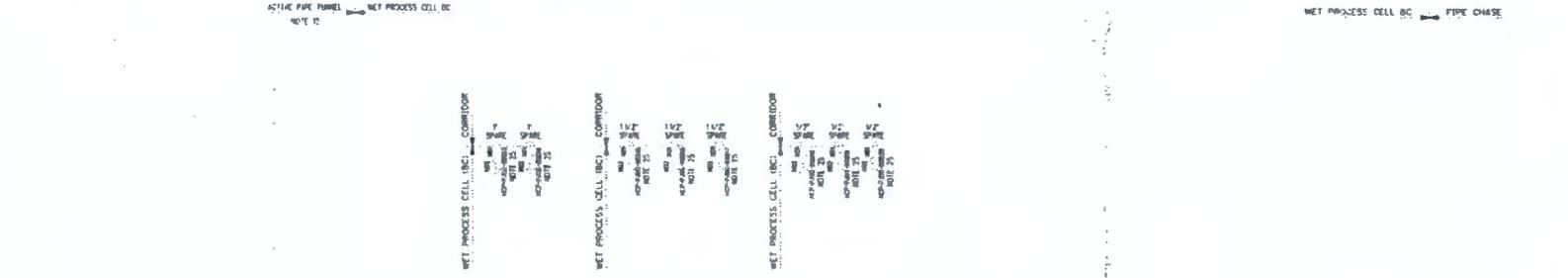
REV 3

H  
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H  
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A



- NOTES:**
- SEE DRAWINGS 24590-WTP-M6-SQ-P0001 THROUGH 24590-WTP-M6-SQ-P0008 FOR GENERAL NOTES, SYMBOLS AND LEGEND, AND GENERAL SLOPE REQUIREMENTS.
  - 5- DELETED
  - BATTERY LIMITS FOR PIPING IS INSIDE OF H.W. FACILITY. BDF IS RESPONSIBLE FOR PIPING BETWEEN PRETREATMENT AND H.W. SEE DRAWING 24590-PIT-M6-PWD-P0007.
  - PIPING OUTSIDE OF BUILDING IS DIRECT-BURIED COAXIAL PIPE. PRETREATMENT IS RESPONSIBLE FOR COAXIAL PIPE LEAK DETECTION. SEE DRAWING 24590-PIT-M6-PWD-P0007.
  - 9- DELETED
  - 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.
  - 22-DELETED
  - 23-CONTENTS OF THIS DOCUMENT ARE DANGEROUS WASTE PERMIT AFFECTING
  - 24- DELETED
  - 25 THE GEOMETRY OF JOGGED (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 JOGGLES IS QUALITY LEVEL Q AND SEISMIC CATEGORY SC-I.
  - 26 FLUSH LINE CONNECTIONS ON ENDANGERMENT PIPING SHALL BE AT THE HIGHEST POINT (ON TOP) OF OUTER PIPE. THE SAFETY CLASS OF THE FLUSH LINE IS NORS-ITS
  - 27 DELETED
  - 28 REVISION 7 INCORPORATED EDITORIAL CHANGES TO OFF-SHEET CONNECTION TITL, MODIFIED/REMOVED NOTES, ADDED SPARE PENETRATIONS
  - 29 DELETED
  - 30 THE PRESSURE BOUNDARY FOR THE INNER AND OUTER PIPE OF THE DOUBLE CONTAINMENT TRANSPORT LINES ARE QUALITY LEVEL Q. THE INNER PIPE IS SEISMIC CATEGORY SC-I. THE OUTER PIPE IS SEISMIC CATEGORY SC-II
  - 31 DELETED
  - 32 THE COMPONENTS SHOWN ON THIS DRAWING IN PHANTOM DO NOT REQUIRE INDEPENDENT QAM BY REGISTERED PROFESSIONAL ENGINEER ASSESSMENT OF DESIGN OR INSTALLATION INSPECTIONS BY A QUALIFIED INSTALLATION INSPECTOR IN ACCORDANCE WITH THE ONSI AND/OR WASHINGTON ADMINISTRATIVE CODE REQUIREMENTS
  - 33 REVISED PER 24590-HLW-M6-HCP-DIG-0001 24590-HLW-M6-M601-00004 AND TO INCORPORATE P-JOGGLES, ADDED/REVISED/DELETED NOTES, PIPE SPECIFICATION FROM S32A TO S32A, QUALITY/SEISMIC CLASS AND OTHER EDITORIAL CHANGES.



- HOLD/OPEN ITEMS**
- 1-5 DELETED
- REFERENCES**
- 24590-HLW-M6-V177-P0001 PROCESS FLOW DIAGRAM H.W. RECEIPT & FEED PREPARATION SYSTEM HCP, OPE & HFFT.
  - 24590-HLW-M6-HFP-0001 SYSTEM DESCRIPTION FOR H.W. CONCENTRATE RECEIPT AND MELTER FEED PROCESS SYSTEMS HCP AND HFFT.
- 3-B DELETED



PLEASE NOTE THAT SCHEMATIC, INSTRUMENT AND EQUIPMENT DRAWINGS ARE BEING IN THE STANCE UNDER THE USE OF A LICENSED REGISTERED PROFESSIONAL ENGINEER (RPE) FACILITIES EXCEPT BY THE LICENSEE PURSUANT TO ITS REGISTRATION AND AGREEMENT TO PROVIDE TO THE H.E.A. IT HAS SOLE AND EXCLUSIVE RESPONSIBILITY AND AUTHORITY TO RECALIBRATE SPECIAL MEASUREMENT AND PRODUCT MATERIAL AT THE OWNER'S FACILITIES. INFORMATION CONTAINED HEREIN OR INCORPORATED IS PROVIDED FOR PROCESS DESCRIPTION PURPOSES ONLY.

REV	DESCRIPTION	DATE
1	ISSUED FOR PERMITTING USE SEE NOTE 13	12/15/00
2	REVISED PER NOTE 28 REVISED FOR PERMITTING USE	01/18/01
3	ISSUED FOR PERMITTING USE	02/15/01

PROJECT No. 24590	REVISION HISTORY
DATE 04/08/00	REVISION PROTECTION PROJECT
AREA 2000	WASTE TREATMENT PLANT
BUILDING No. 30	2435 STEVENS CENTER PLACE
	REEDLAND, WA 98014
CONTRACTOR	CONTRACT No. 01-M62-000000
DESIGNER	P&ID - HLW
APPROVER	CONCENTRATE RECEIPT
REVIEWER	PROCESS SYSTEM
	MELTER 2 TRANSFER PIPING
COMPANY ADDRESS TO HARRY C. TRICE, INC.	24590-HLW-M6-HCP-P0002
DATE	04/08/2002
SCALE	AS SHOWN
DATE	04/08/2002

Quarter Ending June 30, 2008

24590-LAW-PCN-ENV-06-008

**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  
Update the Structural Integrity Assessment of Low-Activity Waste (LAW) Primary Offgas Process System (LOP) Plant Items (LOP-VSL-00001/2), (LOP-SCB-00001/2), and (LOP-WESP-00001/2) located in Appendix 9.11 of the WTP Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein

5/21/08

S. J. Olinger

6/18/08

D. A. Klein

Date

S. J. Olinger

Date

Quarter Ending June 30, 2008

24590-LAW-PCN-ENV-06-008

## Hanford Facility RCRA Permit Modification Notification Form

Unit:

Waste Treatment and Immobilization Plant

Permit Part &amp; Chapter:

Part III, Operating Unit 10

Description of Modification:

The purpose of this Class 1 prime modification is to update the Integrity Assessment Report for the LAW LOP vessels and miscellaneous treatment units (MTUs) located at Elevation 2'-0". The following document is submitted to replace and consolidate two documents currently in Appendix 9.11.

Appendix 9.11

Replace:	24590-CM-HC4-HXYG-00138-01-00019, and 24590-CM-HC4-HXYG-00138-02-00011	With	CCN 139510 / AREVA-IA-103
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This modification requests Washington State Department of Ecology (Ecology) approval and incorporation into the permit the above mentioned integrity assessment report. The report has been updated by the Independent Qualified Registered Professional Engineer (IQRPE). The report reflects the IQRPE's review of the following final design documents:

- Material Requisitions, Engineering Specifications, Facility and Vendor Fabrication Drawings, Mechanical Data Sheets, Material Selection Data Sheets, System Descriptions and Design Calculations produced in accordance with References
  - o ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers
  - o ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 2, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers
  - o UBC 1997, Uniform Building Code, International Conference of Building Officials
- 24590-WTP-DB-ENG-01-001, Rev. 1I, WTP Basis of Design
- 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Units
- 24590-WTP-PER-PR-03-002, Rev. 3, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Units
- 24590-QL-POB-MVA0-00002-03-01, Rev. 00E, Design Calculations for LOP-VSL-00001
- 24590-QL-POB-MVA0-00002-03-09, Rev. 00C, Design Calculations for LOP-VSL-00001
- 24590-QL-POB-MVA0-00002-03-11, Rev. 00C, Design Calculations for LOP-VSL-00001
- 24590-QL-POB-MVA0-00002-03-02, Rev. 00E, Design Calculations for LOP-VSL-00002
- 24590-QL-POB-MVA0-00002-03-10, Rev. 00C, Design Calculations for LOP-VSL-00002
- 24590-QL-POB-MVA0-00002-03-12, Rev. 00C, Design Calculations for LOP-VSL-00002
- 24590-QL-POA-MKAS-00001-01-03, Rev. 00C, Design Calculations for LOP-SCB-00001/2
- 24590-QL-POA-MKAS-00001-01-16, Rev. 00C, Design Calculations for LOP-SCB-00001/2
- 24590-QL-POA-MKAS-00001-01-17, Rev. 00C, Design Calculations for LOP-SCB-00001/2
- 24590-QL-POA-MKAS-00001-01-18, Rev. 00C, Design Calculations for LOP-SCB-00001/2
- 24590-QL-POA-MKE0-00001-07-01, Rev. 00D, Design Calculations for LOP-WESP-00002
- 24590-QL-POA-MKE0-00001-07-02, Rev. 00D, Design Calculations for LOP-WESP-00001
- 24590-QL-POA-MKE0-00001-07-03, Rev. 00H, Design Calculations for LOP-WESP-00001/2
- 24590-QL-POA-MKE0-00001-07-12, Rev. 00A, Design Calculations for LOP-WESP-00001/2

For each item of "Information Assessed" in the integrity assessment report, the items listed under the "Source of Information" column were reviewed and found to furnish adequate design controls and requirements to ensure the design fully satisfies the requirements of Washington Administrative Code WAC-173-303-640, *Dangerous Waste Regulations*.

Quarter Ending June 30, 2008

24590-LAW-PCN-ENV-06-008

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3
Please mark the Modification Class:		X		
Enter Relevant WAC 173-303-830, Appendix I Modification citation number:		N/A		
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 <sup>1</sup> 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 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: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
Reason for denial:		 B. Becker-Khaleel		
		7/28/08 Date		

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

CCN # 139510

File B.8



**AREVA**

AFS-08-0085

April 23, 2008

Ms. Jean Renner  
Subcontracts  
Bechtel National, Inc.  
2435 Stevens Center Place  
Richland, Washington 99354

**RPP-WTP  
RECEIVED**

**APR 30 2008**

**BY PDC**

Dear Ms. Renner:

**BECHTEL NATIONAL, INC. CONTRACT NO. 24590-CM-HC4-HXYG-00211 -  
STRUCTURAL INTEGRITY ASSESSMENT OF LOW-ACTIVITY WASTE (LAW)  
PRIMARY OFFGAS SYSTEM (LOP) PLANT ITEMS (LOP-VSL-00001/2), (LOP-SCB-  
00001/2), and (LOP-WESP-00001/2) (AREVA-IA-103, REV. 0)**

The integrity assessment of the subject Plant Items has been completed per the contract requirements and is enclosed for your use. The assessment found that the design is sufficient to ensure that each Plant Item is adequately designed and has sufficient structural strength, compatibility with the waste(s) to be processed/stored/treated, and corrosion protection to ensure that it will not collapse, rupture, or fail.

If you have any questions, please contact Tariok Hundal at (509) 373-4438, or via email at [tariok.hundal@areva.com](mailto:tariok.hundal@areva.com).

Sincerely,

A handwritten signature in black ink, appearing to read 'Mark D. Rickenbach'.

Mark D. Rickenbach  
Director, Technical Services  
AREVA Federal Services LLC  
Richland Office

Enclosure

cc: D. C. Pfluger, MS5-L w/enclosure (2)

**AREVA Federal Services LLC**

2425 Stevens Center Place, Richland, WA 99354 P.O. Box 840, Richland, WA 99352  
Tel: 509 372 8256 · Fax: 509 372 3169 · [www.aveva.com](http://www.aveva.com)

**STRUCTURAL INTEGRITY ASSESSMENT  
OF  
LOW-ACTIVITY WASTE (LAW) PRIMARY OFFGAS PROCESS SYSTEM (LOP)  
PLANT ITEMS  
(LOP-VSL-00001/2), (LOP-SCB-00001/2), and (LOP-WESP-00001/2)**

**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.**

**IQRPE REVIEW  
OF  
LOW-ACTIVITY WASTE (LAW) PRIMARY OFFGAS PROCESS SYSTEM (LOP)  
PLANT ITEMS  
(LOP-VSL-00001/2), (LOP-SCB-00001/2), and (LOP-WESP-00001/2)**

"I, Tarlok Hundal have reviewed, and certified a portion of the design of a new tank system or component located at the Hanford Waste Treatment Plant, owned/operated by Department of Energy, Office of River Protection, Richland, Washington. My duties were independent review of the current design for the Low-Activity Waste (LAW) Primary Offgas Process System (LOP) Plant Items (LOP-VSL-00001/2), (LOP-SCB-00001/2), and (LOP-WESP-00001/2) as required by the Washington Administrative Code, *Dangerous Waste Regulations*, Section WAC-173-303-640(3) (a) through (g) applicable components."

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

The documentation reviewed indicates that the design fully satisfies the requirements of the WAC.

The attached review is twenty-one (21) pages numbered one (1) through twenty-one (21).



EXPIRES: 02/15/10

T. Hundal

Signature

4/23/08

Date

**Low-Activity Waste (LAW) Primary Offgas Process System (LOP)  
 Melter 1 & Melter 2 SBS Condensate Vessels (LOP-VSL-00001/2),  
 Submerged Bed Scrubbers (LOP-SCB-00001/2), and  
 Wet Electrostatic Precipitators (LOP-WESP-00001/2)**

AREVA-IA-103, Rev. 0

Scope	Scope of this Integrity Assessment	<p>This Integrity Assessment includes the following LOP System plant items including their appurtenances are located at Elevation 2'-0" in cells L-0123 and L-0124 of the LAW Vitrification Building as shown on plant general arrangement Drawing 24590-LAW-PI-POIT-00002</p> <ol style="list-style-type: none"> <li>1. Two Melter Submerged Bed Scrubber Condensate Vessels (LOP-VSL-00001/2)- pages 4 thru 9.</li> <li>2. Two Submerged Bed Scrubbers (LOP-SCB-00001/2)--pages 10 thru 15.</li> <li>3. Two Wet Electrostatic Precipitators (LOP-WESP-00001/2) -pages 16 thru 21.</li> </ol>
References	Material Requisitions and Specifications	<p><b>Material Requisitions (MRs):</b></p> <p>24590-QL-MRD-MVAC 00002, Rev. 2 (including Supplement Nos S0014 and S0018 to Rev 2), Pressure Vessels, High Alloy, Shop Fabricated, Medium QL-1 (N:16) for Condensate Vessels          24590-QL-MRA-MKAS-00001, Rev. 6, Submerged Bed Scrubbers, Fine or Off-Gas LAW QL-1 (N081) (QQL1).          24590-QL-MRA-MKE0-00001, Rev. 6 (including Supplement No. S007 to Rev 6), Wet Electrostatic Precipitators (WESP) QL1/2 (QO: 5) (ML1001).</p> <p><b>Specifications:</b>          The following Specifications with their respective revision and Specification Change Notices (SCNs) are listed in the above listed Material Requisitions:</p> <p>24590-WTP-3PS-MV00-T0001, Engineering Specification for Pressure Vessel Design and Fabrication;          24590-WTP-3PS-MV00-T0002, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels;          24590-WTP-3PS-MV00-T0003, Engineering Specification for Pressure Vessel Fatigue Analysis,          24590-WTP-3PS-MVB2-T0001, Engineering Specification for Welding of Pressure Vessels, Heat Exchangers, and Boilers;          24590-WTP-3PS-M000-T0002, General Specification for Mechanical Handling, Equipment Design, and Manufacture;          24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements,          24590-WTP-3PS-G000-T0002, Engineering Specification for Positive Material Identification (PMI),          24590-WTP-3PS-G000-T0003, Engineering Specification for Packaging, Handling, and Storage Requirements;          24590-WTP-3PS-MKE0-T0001, Engineering Specification for Wet Electrostatic Precipitators (WESPs);          24590-WTP-3PS-FIB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks.</p>
Summary of Assessment	Summary of Assessment	<p>For each item of "Information Assessed" (i.e., Criteria) on the following pages, the items listed under "Source of Information" were reviewed and found to furnish adequate design controls and requirements to ensure that the design fully satisfies the requirements of Washington Administrative Code, WAC-173-303-640, <i>Dangerous Waste Regulations for Tank Systems</i></p>

Low-Activity Waste (LAW) Primary Offgas Process System (LOP)  
Melter 1 & Melter 2 SBS Condensate Vessels (LOP-VSL-00001/2),  
Submerged Bed Scrubbers (LOP-SCB-00001/2), and  
Wet Electrostatic Precipitators (LOP-WESP-00001/2)

AREVA-IA-103, Rev 0

Plant Drawings including Drawing Change Notices (DCNs) listed in the above listed Material Requisitions:

24590-LAW-P1-P01T-00002, Rev. 5, LAW Vitrification Building General Arrangement Plan at FI 3-0;  
24590-LAW-P1-P01T-00007, Rev. 8, LAW Vitrification Building General Arrangement Section A-A, B-B, C-C, and S-S,  
24590-LAW-P1-P01T-00012, Rev. 8, LAW Vitrification Building General Arrangement Section K-K, L-L, and M-M,  
24590-LAW-M6-LOP-00001, Rev. 4, P & ID-LAW Primary Offgas Process System Melter 1,  
24590-LAW-M6-LOP-00002, Rev. 4, P & ID-LAW Primary Offgas Process System Melter 2  
24590-LAW-MS-V17T-P0007, Rev. 0, Process Flow Diagram LAW Melter 1 Primary Offgas Treatment System (System LOP),  
24590-LAW-MS-V17T-P0008, Rev. 0, Process Flow Diagram LAW Melter 2 Primary Offgas Treatment System (System LOP).

Vendor Fabrication Drawings (\* Hechtel Code 1, 2, or 4 Drawings)

24590-QL-POB-MVA0-00002-01-01, Rev. 001, LAW Melter 1 SBS Condensate Vessel (LAW-LOP-VSL-00001),  
24590-QL-POB-MVA0-00002-01-02, Rev. 001, LAW Melter 1 SBS Condensate Vessel (LAW-LOP-VSL-00001),  
24590-QL-POB-MVA0-00002-01-03, Rev. 001, LAW Melter 2 SBS Condensate Vessel (LAW-LOP-VSL-00002);  
24590-QL-POB-MVA0-00002-01-04, Rev. 001, LAW Melter 2 SBS Condensate Vessel (LAW-LOP-VSL-00002),  
24590-QL-POA-MKAS-00001-01-01, Rev. 001, Submerged Bed Scrubber Assembly Drawing (LAW-LOP-SCB-00001/2),  
24590-QL-POA-MKAS-00001-01-10, Rev. 001, Submerged Bed Scrubber General Notes (LAW-LOP-SCB-00001/2),  
24590-QL-POA-MKE0-00001-06-01, Rev. 001, LAW-1 WESP Vessel Assembly, LOP-WESP-00001,  
24590-QL-POA-MKE0-00001-06-02, Rev. 001, LAW-1 WESP Vessel Assembly, LOP-WESP-00001,  
24590-QL-POA-MKE0-00001-06-03, Rev. 001, LAW-1 WESP Vessel Subassembly, LOP-WESP-00001,  
24590-QL-POA-MKE0-00001-06-04, Rev. 001, LAW-1 WESP Vessel Details, LOP-WESP-00001,  
24590-QL-POA-MKE0-00001-06-06, Rev. 001, LAW-1 WESP Vessel Details, LOP-WESP-00001 (including SO01),  
24590-QL-POA-MKE0-00001-06-13, Rev. 001, LAW-2 WESP Vessel Assembly, LOP-WESP-00002,  
24590-QL-POA-MKE0-00001-06-14, Rev. 001, LAW-2 WESP Vessel Assembly, LOP-WESP-00002,  
24590-QL-POA-MKE0-00001-06-15, Rev. 001, LAW-2 WESP Vessel Subassembly, LOP-WESP-00002 (including SO01),  
24590-QL-POA-MKE0-00001-06-16, Rev. 001, LAW-2 WESP Vessel Details, LOP-WESP-00002,  
24590-QL-POA-MKE0-00001-06-18, Rev. 001, LAW-2 WESP Vessel Details, LOP-WESP-00002,  
24590-QL-POA-MKE0-00001-06-33, Rev. 001, P & ID LAW-WESP, LOP-WESP-00001,  
24590-QL-POA-MKE0-00001-06-0049, Rev. 001, P & ID LAW-WESP, LOP-WESP-00002.

\* Hechtel Code 1 Drawing is an "as fabricated vendor drawing" approved/accepted by Hechtel.  
Hechtel Code 2 Drawing is an "as fabricated vendor drawing" approved (with comments)/accepted by Hechtel.  
Hechtel Code 4 Drawing is an "as fabricated vendor drawing" approved/accepted by Hechtel without review.

References (cont'd)

Drawings

Low-Activity Waste (LAW) Primary Offgas Process System (LOP)  
Melter 1 & Melter 2 SBS Condensate Vessels (LOP-VSL-00001/2),  
Submerged Bed Scrubbers (LOP-SCB-00001/2), and  
Wet Electrostatic Precipitators (LOP-WESP-00001/2)

AREVA-LA-103, Rev. 0

References (cont'd)

Mechanical Data  
Sheets and System  
Description

Mechanical Data Sheets

24590-LAW-MVD-LOP-00004, Rev. 5, LAW Melter 1 SBS Condensate Vessel (LOP-VSL-00001);  
24590-LAW-MVD-LOP-00005, Rev. 5, LAW Melter 2 SBS Condensate Vessel (LOP-VSL-00002);  
24590-LAW-MKJ-LOP-00008, Rev. 1, LAW Melter 1/2, Submerged Bed Scrubber (LOP-SCB-00001/2).

System Description

24590-LAW-1YD-LOP-00001, Rev. 1, System Description for LAW Primary Offgas Process (LOP) and LAW Secondary Offgas/Vessel Vent Process (LVP) Systems (including SDCN 00006 to Rev. 1)

Information Assessed	Source of Information	Assessment	
Design	<p>Vessel design standards are appropriate and adequate for the vessel's intended use.</p>	<p>Mechanical Data Sheets, Specifications, and Drawings, listed above under References;</p> <p>ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers</p>	<p>The Mechanical Data Sheets show that the LAW LOP system Melter 1 and Melter 2 SBS Condensate Vessels, LOP-VSL-00001/2 and their appurtenances are to be designed to the ASME Section VIII, Division 1 rules which are appropriate for pressure vessels operating with mixed waste solutions over the pressure and temperature ranges specified for these vessels. Supplementary requirements are specified in the Engineering Specification for Pressure Vessel Design and Fabrication. Supplementary requirements address pressure vessel, positive material identification, lifting attachment design, equipment drop evaluation, fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, and lifting, packaging, shipping, handling and storage requirements. These are adequate and acceptable design standards for the intended use of the vessels. The drawings show that the LOP-VSL-00001/2 are vertical with a 144 in. ID and a height of 98 in. from the bottom tangent line to the top tangent line. The vessels' top and bottom Flanged &amp; Disbol (F &amp; D) heads and shells are built with 5/8" thick plate. Each vessel is supported on a cylindrical skirt (1/2" thick plate by approx. 28" high) which in turn is supported on a base plate anchored to the concrete floor at Elev. 2'-0". Each vessel has internal equipment such as an eductor, spray nozzle, and piping that are supported from the vessel's top head. Material for the shell, top and bottom heads, and vessel's internal equipment is Hastelloy C-22 (SH-575 N06022) and is hereafter referred to as C-22. Each vessel's shell and bottom head has an external cooling coil jacket made of SA-312 304 stainless steel half-pipe section and the supporting skirt is specified as SA-240 304 stainless steel plate. Both of these aforementioned stainless steel components have a 0.030% maximum carbon content and this material is hereafter referred to as the 304 stainless steel. The operating volume of each vessel is about 7,400 gallons and the total internal volume is about 9,050 gallons.</p>

Information Assessed	Source of Information	Assessment
Design (cont'd)	<p>Mechanical Data Sheets, Material Requisition, and Drawings listed above under References;</p> <p>ASME Boiler &amp; Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers.</p> <p>24590-QL-POB-MVA0-00002-03-01, Rev. 00E, Design Calculations for LOP-VSL-00001;</p> <p>24590-QL-POB-MVA0-00002-03-09, Rev. 00C, Design Calculations for LOP-VSL-00001;</p> <p>24590-QL-POB-MVA0-00002-03-11, Rev. 00C, Design Calculations for LOP-VSL-00001;</p> <p>24590-QL-POB-MVA0-00002-03-02, Rev. 00E, Design Calculations for LOP-VSL-00002.</p> <p>24590-QL-POB-MVA0-00002-03-10, Rev. 00C, Design Calculations for LOP-VSL-00002.</p> <p>24590-QL-POB-MVA0-00002-03-17, Rev. 00C, Design Calculations for LOP-VSL-00002,</p>	<p>The LOP Melter 1 and Melter 2 SRS Condensate Vessels, LOP VSL-00001/2 are standard ASME Section VIII, Div. 1 vessels. The Mechanical Data Sheets require that the ASME Section VIII, Division 1 vessels be delivered after design, fabrication, inspection, and testing with an ASME code stamp and that the vessels be nationally registered. These are shop fabricated vessels that are delivered for service in the LAW Facility. Review of the Design Calculations Documents of these vessels show that the vessels have been designed as standard vessels per applicable requirements of ASME Section VIII, Division 1 Code and other documents listed in the Material Requisition for the vessels. The aforementioned statements and the vendor fabrication drawings reviewed demonstrate that sound engineering principles of construction and fabrication have been used for the vessels.</p>

If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction.

Information Assessed	Source of Information	Assessment
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Design (cont'd)</p> <p>Vessel has adequate strength after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads</p>	<p>Mechanical Data Sheets, Specifications, and Material Requisition, listed above under References,</p> <p>ASME Boiler &amp; Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers,</p> <p>IBC 1997, Uniform Building Code, International Conference of Building Officials,</p> <p>24590-QL-POB-MVA0-00002-03-01, Rev. 00E, Design Calculations for LOP-VSL-00001,</p> <p>24590-QL-POB-MVA0-00007-03-09, Rev. 00C, Design Calculations for LOP-VSL-00001,</p> <p>24590-QL-POB-MVA0-00007-03-11, Rev. 00C, Design Calculations for LOP-VSL-00001,</p> <p>24590-QL-POB-MVA0-00002-01-02, Rev. 00E, Design Calculations for LOP-VSL-00002;</p> <p>24590-QL-POB-MVA0-00002-03-10, Rev. 00C, Design Calculations for LOP-VSL-00002,</p> <p>24590-QL-POB-MVA0-00002-03-12, Rev. 00C, Design Calculations for LOP-VSL-00002</p>	<p>The Mechanical Data Sheets identify each vessel's operating pressure and temperature ranges, the materials selected for the vessel, the corrosion allowance, the vessel quality level, and its seismic category. The Mechanical Data Sheets also require that the vessels be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria and Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks to provide for the seismic design analysis. The Mechanical Data Sheets identify the vessels operating pressure and temperature ranges and the requirements for seismic qualification in the design. ASME Section VIII (Div. 1) requires that corrosion allowance thickness shall be excluded from nominal vessel thickness when evaluating the adequacy of vessel components for these loads at end of life. The Engineering Specification for Seismic Qualification Criteria for Pressure Vessels provides pertinent requirements for determination of seismic loads, analysis, and acceptance criteria for the vessels and their supports. The Mechanical Data Sheet identifies the vessels' Seismic Category as SC-III. For SC-III vessels, the detailed requirements for seismic load determination (per IBC 1997) are furnished in the Specification for Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks. Review of the Design Calculations documents of these vessels show that they have adequate strength after consideration of corrosion allowance to withstand the applicable operating pressure, temperature, and seismic loads for the specified design life of the vessels. Furthermore, approval and acceptance of the vendor fabrication drawings by Bechtel National Inc. (BNI) is an added assurance that all applicable requirements stated above and as described in documents (including daughter documents) listed in Material Requisition for the vessels have been met.</p>

Information Assessed	Source of Information	Assessment
Vessel foundation will maintain the load of a full vessel.	Specifications listed above under References;  ASME Boiler & Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; 24590-WTP-DB-ENG-01-001, Rev. 1K, Basis of Design; 24590-QL-POB-MVAO-00002-03-01, Rev. 00E, Design Calculations for LOP-VSL-00001; 24590-QL-POB-MVAO-00002-03-02, Rev. 00E, Design Calculations for LOP-VSL-00002	The Engineering Specification for Pressure Vessel Design and Fabrication requires the use of ASME Section VIII, Division 1 for the design of the vessel supports. This code ensures an adequate design for the vessel supports. Review of the Design Calculations documents of the vessels show that the vessels' support skirts have adequate strength to maintain the loads of full vessel. Furthermore, Chapter 14 of the Basis of Design document requires that the foundation underlying the vessel support must be adequate to support the loads from full vessel, which is out of scope of this assessment. The assessment of the adequacy of the underlying foundation is part of a separate integrity assessment report for the Secondary Containment of the vessels.
If in an area subject to flooding, the vessel is anchored	Specifications and Mechanical Data Sheets listed under References	Specification for Pressure Vessel Design requires designing the vessel supports and anchors to secure the buoyant vessel in case the vessel is empty and submerged to the level indicated in the Mechanical Data Sheet. The Mechanical Data Sheets for these vessels do not indicate any such conditions, therefore, the flooding consideration does not apply.
Vessel system will withstand the effects of frost heave	24590-WTP-DB-ENG-01-001, Rev. 1K, Basis of Design	The Basis of Design document requires that all structural foundations for outdoor equipment to extend a distance below grade that exceeds the 30" depth of the frost line. The vessels are located inside interior of the building at Elev. 2'-0" level, and the building's lower level floor is at Elev. (-) 21'-0", therefore, the vessels' foundations are not subject to frost heave.

Information Assessed	Source of Information	Assessment
<p>Characteristics of the waste to be stored or treated have been identified (dangerous waste characteristics, specific gravity, vapor pressure, flash point, storage temperature)</p>	<p>Mechanical Data Sheets listed above under References;</p> <p>Plant Item Material Selection Data Sheet, 24590-LAW-NID-LOP-P0002, Rev. 1, LOP-VSL-00001 &amp; LOP-VSL-00002 (LAW) Melter 1 &amp; Melter 2 SBS Condensate Vessel; 24590-WTP-PER-PR-03-002, Rev. 3, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems</p>	<p>The Mechanical Data Sheets present process conditions and design parameters of the vessels, such as the waste specific gravity, temperatures, and pressures, etc. The Plant Item Material Selection Data Sheet addresses the pH range and chemical composition of the waste and selects appropriate vessel materials and the corrosion allowance. Waste characteristics that are hazardous, such as ignitability, reactivity, and toxicity are appropriately addressed in the Toxic Vapors and Emissions document and Prevention of Hydrogen Accumulation document. These two documents do not specifically list these vessels to exhibit any hazardous waste characteristics.</p>
<p>Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents</p>	<p>System Description listed above under References.</p> <p>Plant Item Material Selection Data Sheet: 24590-LAW-NID-LOP-P0002, Rev. 1, LOP-VSL-00001 &amp; LOP-VSL-00002 (LAW) Melter 1 &amp; Melter 2 SBS Condensate Vessel.</p>	<p>The Plant Item Material Selection Data Sheet demonstrates that the vessels are designed to process the wastes discussed above. The System Description discusses normal and abnormal operations for the LOP vessels. The solids accumulated in the vessels are suspended by the Eductors (LOP-EDUC-00001/2) powered by a side stream from the recirculation line. The cooled condensate is recycled via purge pumps (LOP-PMP-00001/4) to the SBS column vessels.</p>
<p>The waste types are compatible with each other.</p>	<p>System Description listed above under References</p>	<p>The System Description for the LAW (LOP) does not describe any operations where incompatible wastes are mixed in these vessels for processing. These vessels are part of LAW LOP system's purpose of cooling the offgas and removing the aerosols generated by the LAW melters.</p>

Waste Characteristics

	Information Assessed	Source of Information	Assessment
Corrosion Protection	<p>Vessel material and protective coatings ensure the vessel structure is adequately protected from the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)</p>	<p>Mechanical Data Sheets and Drawings listed above under References;</p> <p>Plant Item Material Selection Data Sheet, 24590 LAW-NID-LOP-P0002, Rev. 1, LOP-VSL-00001 &amp; LOP-VSL-00002 (LAW) Melter 1 &amp; Melter 2 SBS Condensate Vessel.</p>	<p>The Plant Item Material Selection Data Sheet shows that the LAW Submerged Bed Scrubber condensate vessels, LOP-VSL-00001/2 normally operate at a pH range of 3 to 8, 2 psig pressure, and at a nominal temperature of 113°F. The vessels are designed for 15 psig pressure and a temperature of 227°F. Other pertinent vessel operation and design information is provided in the Mechanical Data Sheets. The material selected is C-22 and a corrosion allowance of 0.04 in. is recommended; however, Mechanical Data Sheets require conservative corrosion allowance values of 0.08 in. internal plus 0.01 in. external to be used in the design. The external corrosion allowance is used for shell surface under the jacket. The LOP vessels as shown on drawings are located in the LAW facility cells (L-01241, 0124) at Elevation 2'-0". Each vessel's support skirt material is 304 stainless steel. Each cell is equipped with a sump pump to remove any leakage. Therefore, the cells should remain dry during normal operations which will limit external corrosion of the vessel over the facility design life.</p>
Corrosion Allowance	<p>Corrosion allowance is adequate for the intended service life of the vessel.</p>	<p>Mechanical Data Sheets listed above under References.</p> <p>Plant Item Material Selection Data Sheet, 24590 LAW-NID-LOP-P0002, Rev. 1, LOP-VSL-00001 &amp; LOP-VSL-00002 (LAW) Melter 1 &amp; Melter 2 SBS Condensate Vessel.</p>	<p>The bases for the LOP vessel's material selection and corrosion allowance are furnished in the Plant Item Material Selection Data Sheet. Selection of C-22 material for the vessels with a corrosion allowance of 0.04 in. for a service life of 40 years is adequate and appropriate, however, conservatively, 0.08 in. internal plus 0.01 in. external corrosion allowance values have been used in the design calculations as required in the Mechanical Data Sheets.</p>
Pressure Relief	<p>Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.</p>	<p>Drawings and System Description listed above under References.</p>	<p>The LOP Melter 1 and Melter 2 SBS Condensate Vessels, LOP-VSL-00001/2 receive condensate overflow from SBS Column Vessels (LOP-SCV-00001/2) and then continuously pump out the further cooled off condensate back into the SBS, using purge pumps (LOP-PMP-00001/4). All these plant items are located at Elevation 2'-0", as shown on the drawings and described in the System Description document. The vessels are vented via the 2" diameter outlet lines to the SBS Column Vessels (LOP-SCV-00001/2) via the main offgas discharge pipe. These vents prevent the over-pressurization of the SBS Condensate Vessels.</p>

Information Assessed	Source of Information	Assessment
<p>Design</p> <p>Vessel design standards are appropriate and adequate for the vessel's intended use</p>	<p>Mechanical Data Sheet, Specifications, and Drawings, listed above under References:</p> <p>ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers</p> <p>ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 2, Alternate Rules, American Society of Mechanical Engineers</p>	<p>The Mechanical Data Sheets show that the LOP system Submerged Bed Scrubbers, LOP-SCB-00001/2 and their appurtenances are to be designed to the ASME Section VIII, Division 1 rules which are appropriate for pressure vessels operating with mixed waste solutions over the pressure and temperature ranges specified for these plant items. Supplementary requirements are specified in the Engineering Specification for Pressure Vessel Design and Fabrication. Supplementary requirements address pressure vessel, positive material identification, lifting attachment design, equipment drop evaluation, fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, and lifting, packaging, shipping, handling and storage requirements. The vessels are subjected to cyclic loading. The Specification for Fatigue Analysis requires the use of ASME Section VIII, Division 2 rules for vessel components with a high number of load cycles. These are adequate and acceptable design standards for the intended use of these SBSs. The drawings show that the LAW Submerged Bed Scrubbers, LOP-SCB-00001/2 are vertical with a 120 in. ID and a height of 78 in. from bottom tangent line to top tangent line. The top and bottom Flanged &amp; Dished (F &amp; D) heads and shell are built with 5/8" thick plate. Each SBS is supported on a cylindrical skirt (1/2" thick plate) by approx. 5'-7" high) which in turn is supported on a base plate anchored to the concrete floor at Elev. 2'-0". The SBSs have internal equipment such as coil and scrubber bed supported from the top head. Material for the shell, top and bottom heads, and internal equipment is Hastelloy C-22 (SB 575 N06022) and is hereafter referred to as C-22. The vessel's shell and bottom head has an external cooling coil jacket made of SA-312 304 stainless steel, 1/2" pipe section. The supporting skirt is specified as SA-240 304 stainless steel plate (0.020% maximum carbon content) and is hereafter referred to as 304 stainless steel. The operating volume of each vessel is about 1,690 gallons and the total internal volume of each is about 4,940 gallons.</p>

Information Assessed	Source of Information	Assessment
Design (cont'd)	<p>Specifications, Drawings, Mechanical Data Sheet, and Material Requisition listed above under References;</p> <p>ASME Boiler &amp; Pressure Vessel Code (BPVC) Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers.</p> <p>24590 QL POA-MKAS-00001-01-01, Rev. 00C, Design Calculations for (LOP-SCB-00001/2);</p> <p>24590 QL POA-MKAS-00001-01-16, Rev. 00C, Design Calculations for (LOP-SCB-00001/2);</p> <p>24590 QL POA-MKAS-00001-01-17, Rev. 00C, Design Calculations for (LOP-SCB-00001/2);</p> <p>24590 QL POA-MKAS-00001-01-18, Rev. 00C, Design Calculations for (LOP-SCB-00001/2);</p>	<p>The LOP Submerged Bed Scrubbers, LOP-SCB-00001/2 are standard ASME Section VIII vessels. The Mechanical Data Sheet requires that the ASME Section VIII, Division 1 plan items be delivered after design, fabrication, inspection, and testing with an ASME code stamp and are nationally registered. These are shop fabricated vessels that will be delivered for service in the LAW Facility. Review of the Design Calculations documents of these vessels show that they have been designed as standard vessels per applicable requirements of ASME Section VIII, Division 1 Code and other documents listed in the Material Requisition for the vessels. The aforementioned statements and the vendor fabrication drawings reviewed demonstrate that sound engineering principles of construction and fabrication have been used for the vessels.</p>

Information Assessed	Source of Information	Assessment
<p>Design (cont'd)</p> <p>Vessel has adequate strength after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads.</p>	<p>Specifications, Material Requisition, Drawings and Mechanical Data Sheet listed above under References.</p> <p>ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers.</p> <p>IBC, 1997 Uniform Building Code (International) Conference of Building Officials.</p> <p>24590 QL POA MKAS 00001-01-02, Rev 000, Design Calculations for (I.OP-SCB 00001/2).</p> <p>24590 QL POA-MKAS-00001-01-16, Rev 000, Design Calculations for (I.OP-SCB 00001/2).</p> <p>24590 QI POA MKAS 00001 01 17, Rev 000, Design Calculations for (I.OP-SCB 00001/2).</p> <p>24590 QI POA MKAS 00001 01 18, Rev 000, Design Calculations for (I.OP-SCB-00001/2)</p>	<p>The Mechanical Data Sheet identifies each vessel's operating pressure and temperature ranges, the materials selected for the vessel, the corrosion allowance, the vessel quality level, and its seismic category. The Mechanical Data Sheet also requires that the vessels be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressure, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria and Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks to provide for the seismic design analysis. The Mechanical Data Sheet identifies the vessels operating pressure and temperature ranges and the requirements for seismic qualification in the design. ASME Section VIII, Div. 1 requires that corrosion allowance thickness shall be excluded from nominal vessel thickness when evaluating the adequacy of vessel components for these loads at end of life. The Engineering Specification for Seismic Qualification Criteria for Pressure Vessels provides pertinent requirements for determination of seismic loads, analysis, and acceptance criteria for the vessels and their supports. The Mechanical Data Sheet identifies the vessels' seismic category as SC-III. For SC-III vessels, the detailed requirements for seismic load determination (per IBC 1997) are furnished in the Specification for Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks. Review of the Design Calculations documents of these vessels show that they have adequate strength after consideration of corrosion allowance to withstand the applicable operating pressure, temperature, and seismic loads for the specified design life of the vessels. Furthermore, approval and acceptance of the vendor fabrication drawings by Bechtel National Inc. (ONI) is an added assurance that all applicable requirements stated above and as described in the annexes (including daughter documents) listed in Material Requisition for the vessels have been met.</p>

	Information Assessed	Source of Information	Assessment
Foundation	Vessel foundation will maintain the load of a full vessel	Specifications listed above under References;  ASME Boiler & Pressure Vessel Code (BPV), Section VIII Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers, 24590-W7P-DR-ENG-01-001, Rev 1K, Basis of Design, 24590-QL-POA-MKAS-0001-01-16, Rev 00C, Design Calculations for (LOP-SCB-0001/2)	The Engineering Specification for Pressure Vessel Design and Fabrication requires the use of ASME Section VIII, Division 1 for the design of the vessel supports. This code ensures an adequate design for the vessel supports. Review of the Design Calculations document of the vessels show that the vessels' support skirts have adequate strength to maintain the loads of full vessel. Furthermore, Chapter 14 of the Basis of Design document requires that the foundation underlying the vessel support must be adequate to support the loads from full vessel, which is out of scope of this assessment. The assessment of the adequacy of the underlying foundation is part of a separate integrity assessment report for the Secondary Containment of the vessels.
	If in an area subject to flooding, the vessel is anchored	Specifications and Mechanical Data Sheet listed above under References	Buoyant forces of an empty vessel in a flooded room is identified in the Mechanical Data Sheet (MDS) as a mandatory standard design load case in the Specification for Pressure Vessel Design and Fabrication. There are no such requirements in the MDS and this requirement does not apply here. However, the buoyant forces have been considered in the calculations.
	Vessel system will withstand the effects of frost heave	Drawings listed above under References  24590-W7P-DR-ENG-01-001, Rev 1K, Basis of Design	The Basis of Design document requires that all structural foundations for outdoor equipment to extend a distance below grade that exceeds the 31" depth of the frost line. The drawings show that the SBSs are located inside interior of the building at Elev. 2'40" level, and the building's lower level floor is at Elev. (-21'6"); therefore, the foundations are not subject to frost heave.

	Information Assessed	Source of Information	Assessment
Waste Characteristics	Characteristics of the waste to be stored or treated have been identified (dangerous waste characteristics, specific gravity, vapor pressure, flash point, storage temperature)	Mechanical Data Sheet listed above under References;  Plant Item Material Selection Data Sheet, 24590-LAW-NID-LOP-P0001, Rev. 1, LOP-SCR-00001/2 (LAW) Melter 1 and Melter 2 Submerged Bed Scrubbers (SBS); 24590-WTP-PER-PR-03-002, Rev. 3, Toxic Vapors and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems; 24590-WTP-PER-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems	The Mechanical Data Sheet presents process conditions and design parameters of the vessels, such as the waste specific gravity, storage temperatures and pressures, etc. The Plant Item Material Selection Data Sheet addresses the pH range and chemical composition of the waste and selects appropriate vessel materials and the corrosion allowance. Waste characteristics that are hazardous, such as ignitability, reactivity, and toxicity are appropriately addressed in the Toxic Vapors and Emissions document and Prevention of Hydrogen Accumulation document. These two documents do not specifically list these vessels to exhibit any hazardous characteristics. As an added feature, these plant items are grounded to control ignition sources.
	Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents	System Description listed above under References;  Plant Item Material Selection Data Sheet, 24590-LAW-NID-LOP-P0001, Rev. 1, LOP-SCR-00001/2 (LAW) Melter 1 and Melter 2 Submerged Bed Scrubbers (SBS).	The Plant Item Material Selection Data Sheet demonstrates that the vessel is designed to process the wastes discussed above. The System Description discusses normal and abnormal operations for the SBSs. To help remove the solids the recirculated stream is pumped through 8 lances that agitate the bottom of the SBS column and consolidate the solids near the pump suction.
	The waste types are compatible with each other	System Description listed above under References	The System Description for the LAW (LOP) does not describe any operations where incompatible wastes are mixed in the SBSs for processing. These vessels are part of LAW LOP system's purpose of cooling the offgas and removing the aerosols generated by the LAW melters.

	Information Assessed	Source of Information	Assessment
Corrosion Protection	Vessel material and protective coatings ensure the vessel structure is adequately protected from the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	<p>Drawings and Mechanical Data Sheet listed above under References.</p> <p>Plant Item Material Selection Data Sheet, 24590-LAW-NID-LOP-P0001, Rev 1, LOP-SCB-00001/2 (LAW) Meher 1 and Meher 2 Submerged Bed Scrubbers (SBS)</p>	<p>Pertinent vessel operation and design information is listed in the Plant Item Material Selection Data Sheet and Mechanical Data Sheet documents. These documents show that the LAW Submerged Bed Scrubbers, LOP-SCB-00001/2 normally operate at a pH range of 1 to 8 and at a temperature of about 122°F and at (-) 2.7 to 0 psig and they are designed for full vacuum (1 1/2") and 15 psig pressure and a temperature of 237 °F. The material selected is C-22 and a corrosion allowance of 0.04 in. The SBSs are located in the LAW cells (L-0123/L-0124) at Elevation 2'-0". The vessel's support skirt material is 304 stainless steel. This cell is equipped with a sump to pump out any leaks. Therefore, the cell should remain dry during normal operations which will limit external corrosion of the vessel over the facility design life.</p>
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the vessel	<p>Mechanical Data Sheet listed above under References.</p> <p>Plant Item Material Selection Data Sheet, 24590-LAW-NID-LOP-P0001, Rev 1, LOP-SCB-00001/2 (LAW) Meher 1 and Meher 2 Submerged Bed Scrubbers (SBS).</p>	<p>The bases for the SBSs' material selection and corrosion allowance are furnished in the Plant Item Material Selection Data Sheet. Selection of C-22 and 304 stainless steel materials with a corrosion allowance of 0.04 in. for a service life of 40 years is adequate and appropriate. The material selections and corrosion allowances are carried forward to the Mechanical Data Sheet, consistently and correctly.</p>
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded	<p>Drawings and System Description listed above under References.</p>	<p>The LOP Submerged Bed Scrubbers, LOP-SCB-00001-2 are designed for unrestricted continuous liquid overflow through two 4" diameter lines to the SBS Condensate Vessels (LOP-VSC-00001/2) which are also located at Elevation 2'-0", as shown on the drawings and described in the System Description document. The offgas also flows unrestrictedly via the 10" diameter outlet lines to the LAW Wet Electrostatic Precipitators (LOP-WESP-00001/2). The unrestricted liquid overflow and offgas discharge prevent the over pressurization of the Scrubbers.</p>

Information Assessed	Source of Information	Assessment	
Design	<p>Vessel design standards are appropriate and adequate for the vessel's intended use</p>	<p>Specifications, Drawings, and System Description listed above under References.</p> <p>ASME Boiler and Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels American Society of Mechanical Engineers</p>	<p>The Engineering Specification for Wet Electrostatic Precipitators (WESPs) requires that the WESPs (LOP-WESP-00001/2) including appurtenances are to be designed to the ASME Section VIII, Division 1 rules which are appropriate for pressure vessels operating with mixed waste solutions over the pressure and temperature ranges specified for these plant items. Supplementary requirements are specified in the Engineering Specification for Pressure Vessel Design and Fabrication. Supplementary requirements address pressure vessel, positive material identification, lifting attachment design, equipment drop evaluation, fabrication tolerances, acceptable welding procedures for the vessel and appurtenances, welder qualifications and testing records, NDE inspections and records, and lifting, packaging, shipping, handling and storage requirements. These are adequate and acceptable design standards for the intended use of these plant items. The Specification for the LAW Wet Electrostatic Precipitators provides the overall dimensions of the vessels and the vendor fabrication drawings show that the LOP WESP-00001/2 are vertical with a 8'-0" OD and a height of 21'-6" from bottom of skirt base plate to the top. Each vessel's top and bottom Flanged and Dished (F &amp; D) heads are of ellipsoidal shape. The shells are made of 1/2" thick plate and top and bottom head plates are 3/8" thick. Each WESP is supported on a skirt (51" high x 3/8" thick plate) which in turn is supported on a base plate anchored to the concrete floor at Elev. 2'-0". Material specified for the vessels is 6% Molybdenum stainless steel alloy (ASME SB688, UNS N08367) and is hereafter referred to as 6% Mo. The material for supporting skirt plate is specified as SA 240 304 stainless steel (0.030% maximum carbon content) and is hereafter referred to as 304 stainless steel.</p>

	Information Assessed	Source of Information	Assessment
Design (cont'd)	If a non-standard vessel is to be used, the design calculations demonstrate sound engineering principles of construction	Specifications, Drawings, and Material Requisition listed above under References;  ASME Boiler & Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers; 24590-QL-POA-MKE0-00001-07-01, Rev. 00D Design Calculations for (LOP-WESP-00002), 24590-QL-POA-MKE0-00001-07-02, Rev. 00D, Design Calculations for (LOP-WESP-00001), 24590-QL-POA-MKE0-00001-07-03, Rev. 00H, Design Calculations for (LOP-WESP-00001/2), 24590-QL-POA-MKE0-00001-07-12, Rev. 00A, Design Calculations for (LOP-WESP-00001/2)	The LOP Wet Electrostatic Precipitators, LOP WESP 00001/2 are standard ASME Section VIII, Division 1 vessels. The Specification for the WESPs requires that the ASME Section VIII, Division 1 plant items be delivered after design, fabrication, inspection and testing with an ASME code stamp and be nationally registered. These are shop fabricated vessels that will be delivered for service in the LAW Facility. Review of the Design Calculations documents of these vessels show that the vessels have been designed as standard vessels per applicable requirements of ASME Section VIII, Division 1 Code and other documents listed in the Material Requisition for the vessels. The aforementioned statements and the vendor fabrication drawings reviewed demonstrate that sound engineering principles of construction and fabrication have been used for the vessels.

Information Assessed	Source of Information	Assessment
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Design (cont'd)</p> <p>Vessel has adequate strength, after consideration of the corrosion allowance, to withstand the operating pressure, operating temperature, and seismic loads</p>	<p>Specifications and Drawings listed above under References;</p> <p>ASME Boiler &amp; Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers;</p> <p>IBC 1997, Uniform Building Code, International Conference of Building Officials;</p> <p>24590-QI-POA-MKFO-00001-07-01, Rev. 00D, Design Calculations for (LOP-WESP-00002);</p> <p>24590-QL-POA-MKFO-00001-07-02, Rev. 00E, Design Calculations for (LOP-WESP-00001);</p> <p>24590-QL-PLA-MKFO-00001-07-03, Rev. 00H, Design Calculations for (LOP-WESP-00001/2);</p> <p>24590-QI-POA-MKFO-00001-07-12, Rev. 00A, Design Calculations for (LOP-WESP-00001/2)</p>	<p>The Specification for the WESPs identifies their operating pressure and temperature ranges, the materials selected for the vessel, the corrosion allowance, and the vessel quality level which determines the requirements for seismic design. The specification requires specific consideration of the operating pressures and temperatures and seismic loads in the design process. This specification further requires that vessels be designed to ASME Section VIII, Division 1 rules. This code requires specific consideration of the operating pressures, temperatures, seismic loads, and corrosion allowance in the design process. Supplementary design criteria are specified in the Engineering Specifications for Seismic Qualification Criteria and Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks to provide for the seismic design analysis. ASME Section VIII Div. 1 requires that corrosion allowance thickness shall be excluded from nominal vessel thickness when evaluating the adequacy of vessel components for these loads at end of life. The Engineering Specification for Seismic Qualification Criteria for Pressure Vessels provides pertinent requirements for determination of seismic loads, analysis, and acceptance criteria for the vessels and their supports. The Specification for the WESPs design identifies the vessels' Seismic Category as SC-III. For SC-III vessels, the detailed requirements for seismic load determination (per IBC 1997) are furnished in the Specification for Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks. Review of the Design Calculations documents of these vessels show that they have adequate strength after consideration of corrosion allowance to withstand the applicable operating pressure, temperature, and seismic loads for the specified design life of the vessels. Furthermore, approval and acceptance of the vendor fabrication drawings by Bechtel National Inc. (BNI) is an added assurance that all applicable requirements stated above and as described in documents (including daughter documents) listed in Material Requisition for the vessels have been met.</p>

Information Assessed	Source of Information	Assessment
Vessel foundation will maintain the load of a full vessel	<p>Specifications listed above under References.</p> <p>ASME Boiler &amp; Pressure Vessel Code (BPV), Section VIII, Division 1, Rules for Construction of Pressure Vessels, American Society of Mechanical Engineers, 24590-WTP-DB-ENG-01-001, Rev. 1K, Basis of Design;</p> <p>24590-Q1-POA-MKE0-00001-07-03, Rev. 0011, Design Calculations for (LOP-WESP-00001/2)</p>	<p>The Engineering Specification for Pressure Vessel Design and Fabrication requires the use of ASME BPV Code, Section VIII, Division 1, for the design of the WESP supports. This code ensures an adequate design for the WESP supports. Review of the Design Calculations document of the vessels show that their support skirts have adequate strength to maintain the loads of full vessel. Furthermore, Chapter 14 of the Basis of Design document requires that the foundation underlying the vessel support must be adequate to support the loads from full vessel, which is out of scope of this assessment. The assessment of the adequacy of the underlying foundation is part of a separate integrity assessment report for the Secondary Containment of the vessels.</p>
Foundation	<p>Specifications listed above under References.</p> <p>24590-LAW-PER-M-02-002, Rev. 6, Flooding Volume for LAW Facility;</p> <p>24590-Q1-POA-MKE0-00001-07-03, Rev. 00H, Design Calculations for (LOP-WESP-00001/2)</p>	<p>Buoyant forces consideration on an empty vessel in a flooded room identified in the design media, is a mandatory standard design load case requirement in the Specification for Pressure Vessel Design and Fabrication. No design document identifies these vessels to be fully submerged under water. The Flooding Volume document for LAW facility shows that the process cells (Rooms L-0123 and L-0124) are constructed with steel liner plate up to 2'-0" height which is anticipated as the maximum design flood height. However, the Design Calculations document shows that the buoyant forces on anchors were conservatively computed by considering a case of fully submerged empty vessels.</p>
	<p>Drawings listed above under References.</p> <p>24590-WTP-DB-ENG-01-001, Rev. 1K, Basis of Design.</p>	<p>The Basis of Design document requires that all structural foundations for outdoor equipment to extend a distance below grade that exceeds the 30" depth of the frost line. The drawings show that the WESPs are located inside interior of the building at Elev. 2'-0" level, and the building's lower level floor is at elev. 1'-21" 0", therefore, the foundations are not subject to frost heave.</p>
Vessel system will withstand the effects of frost heave		

Information Assessed	Source of Information	Assessment
<p>Waste Characteristics</p> <p>Characteristics of the waste to be stored or treated have been identified (dangerous waste characteristics, specific gravity, vapor pressure, flash point, storage temperature)</p>	<p>Specification listed above under References:</p> <p>24590-LAW-NID-LOP-00001, Rev. 1, Corrosion Evaluation, LOP WESP 00001 &amp; LOP WESP 00002 (LAW) Melter 1 and Melter 2 Wet Electrostatic (WESP),</p> <p>24590-WTP-PER-PR-03-002, Rev. 3, Toxic Vapor and Emissions from WTP Tank Systems and Miscellaneous Treatment Unit Systems,</p> <p>24590-WTP-PLR-PR-03-001, Rev. 1, Prevention of Hydrogen Accumulation in WTP Tank Systems and Miscellaneous Treatment Unit Systems</p>	<p>The Specification for WESPs and their Corrosion Evaluation document present the temperatures, pressures, and chemical composition, select appropriate materials, and specify the corrosion allowance. Waste characteristics that are hazardous, such as ignitability, reactivity, and toxicity are appropriately addressed in the Toxic Vapors and Emissions document and Prevention of Hydrogen Accumulation document. These two documents do not specifically list these vessels to exhibit any hazardous characteristics. As an added feature, these plant items are grounded to control ignition sources.</p>
<p>Vessel is designed to store or treat the wastes with the characteristics defined above and any treatment reagents</p>	<p>System Description listed above under References:</p> <p>24590-LAW-NID-LOP-00001, Rev. 1, Corrosion Evaluation, LOP WESP 00001 &amp; LOP WESP 00002 (LAW) Melter 1 and Melter 2 Wet Electrostatic (WESP)</p>	<p>The Corrosion Evaluation document demonstrates that the vessel is designed to process the wastes discussed above. The System Description discusses normal and abnormal operations for the WESPs. Demineralized water will be used for flushing/rinsing or wash-downs of the vessels.</p>
<p>The waste types are compatible with each other.</p>	<p>System Description listed above under References</p>	<p>The System Description for the LAW (LOP) does not describe any operations where incompatible wastes are mixed in the WESPs for processing. These vessels are part of LAW LOP system's purpose of cooling the offgas and removing the aerosols generated by the LAW melter.</p>

	Information Assessed	Source of Information	Assessment
Corrosion Protection	Vessel material and protective coatings ensure the vessel structure is adequately protected from the corrosive effects of the waste stream and external environments (expected to not leak or fail for the design life of the system)	Drawings and Specifications listed above under References,  24590 LAW-N111-LOP-00001, Rev. 3, Corrosion Evaluation, LOP-WESP-00001 & LOP-WESP-00002 (LAW), Melter 1 and Melter 2 Wet Electrostatic (WESP)	The Engineering Specification for WESPs and Corrosion Evaluation document show that the WESPs (LOP-WESP-00001/2) normally operate at a pH range of 0.71 to 1.57 and at a temperature of 121°F (50-157°F). They are designed for a range of (-1) atmospheric to (-1) atmospheric pressure and for 170°F temperature. The material selected is 6% Ni alloy and a corrosion allowance of 0.04 in. The WESPs are located in the LAW cells (I-G1237-9124) at Elevation 2'-0". The WESPs' support skirt material is 304 stainless steel. Each cell is equipped with a sump to pump out any leaks. Therefore, the cell should remain dry during normal operations which will limit external corrosion of the vessel over the facility design life.
Corrosion Allowance	Corrosion allowance is adequate for the intended service life of the vessel.	Specification listed above under References,  24590 LAW-N111-LOP-00001, Rev. 3, Corrosion Evaluation, LOP-WESP-00001 & LOP-WESP-00002 (LAW), Melter 1 and Melter 2 Wet Electrostatic (WESP)	The material selection and corrosion allowance are furnished in the Corrosion Evaluation documents and Specification for WESPs. Selection of 6% Ni alloy with a corrosion allowance of 0.04 in. for a service life of 40 years, appear to be adequate and appropriate.
Pressure Relief	Pressure controls (vents and relief valves) are adequately designed to ensure pressure relief if normal operating pressures in the vessel are exceeded.	Drawings and System Description listed above under References.	The LOP Wet Electrostatic Precipitators, LOP-WESP-00001/2 are inline vessels designed for unrestricted upward continuous flow of offgas to the HEPA pre-heaters for further processing and for the unrestricted condensate gravity flow down into the COCS draughtsump collection vessel (RII-VSI-4K034), as shown on the drawings and described in the System Description document.

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Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-07-013

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Replace Mechanical Systems Data Sheet 24590-PTF-MVD-TLP-00004, Treated LAW Evaporator  
Condensate Vessel TLP-VSL-00002 in Appendix 8.6 of the Dangerous Waste Permit.

Submitted by Co-Operator:

D. A. Klein

D. A. Klein

7/21/08

Date

Reviewed by ORP Program Office:

S. J. Oinger

S. J. Oinger

7/30/08

Date

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-07-013

**Hanford Facility RCRA Permit Modification Notification Form**

Unit:

**Waste Treatment and Immobilization Plant**

Permit Part & Chapter:

**Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 modification is to update 24590-PTF-MVD-TLP-00004, mechanical systems data sheet for Pretreatment facility vessel "Treated LAW Evaporator Condensate Vessel TLP-VSL-00002".

The following mechanical systems data sheet is being submitted to replace the data sheet currently in Appendix 8.6.

Appendix 8.6

Replace:	24590-PTF-MVD-TLP-P0004, Rev. 0	With:	24590-PTF-MVD-TLP-00004, Rev. 1
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This modification requests Ecology approve and incorporate into the permit changes to the referenced mechanical systems data sheet as highlighted below. Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design) and incorporates general criteria from a design verification review.

**Informational Changes:**

- Updated vessel drawing and seismic references
- Verified and finalized Seller data for vessel capacity and specifications
- Updated data sheet notes for forgings and bar stock

**Vessel Material Composition Changes:**

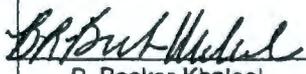
- Top head changed from SA-240 TP 304L with 1/4" thickness, maximum carbon content of 0.030% for welded components to SA-240 340 with 5/8" thickness, maximum carbon content of 0.030% for welded components
- Shell changed from SA-240 TP 304L with 1/4" thickness, maximum carbon content of 0.030% for welded components to SA-240 TP 304 5/8" (upper), 3/8" (lower) thickness, maximum carbon content of 0.030% for welded components
- Bottom head changed from SA-240 TP 304L with 1/4" thickness, maximum carbon content of 0.030% for welded components to SA-240 TP 304 with 1/2" thickness, maximum carbon content of 0.030%
- Vessel support changed from stainless steel to SA-240 304
- Pipe changed from SA-312 TP 316 to SA-312 TP 304
- Gaskets changed from flex spiral wound / flexitallic spiral wound to N/A / N/A
- Bolting changed from A193 or B7 with 2 hex nuts to N/A / N/A
- Wash ring consisting of SA-312 TP 304 with a maximum carbon content of 0.030% added
- Support type changed from support legs to stainless steel legs 304 SS with a maximum carbon content of 0.030%

The following is a list of outstanding change documents that have not been incorporated into this modification:

- None.

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-07-013

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 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.3 Enter wording of WAC 173-303-830, Appendix I Modification citation: A. General Permit Provisions 1. Administrative and informational changes 3. Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls.)				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) Reason for denial:		Reviewed by Ecology:  B. Becker-Khaleel		
		8/14/08 Date		

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.



Mechanical Data Sheet: Vessel

Plant Item No. 24590-PTF-MV-TLP-VSL-00002 Date Sheet No. 24590-PTF-MVD-TLP-00004

R10315852

Table with Project, P&IDs, Process Calculations, Vessel Drawings, and Description. Includes a stamp: ISSUED BY RFB-WTP-PDC DATE

Table with Charge Vessels, Pulse Jet Mixers / Agitators, RFDs/Pumps, and Service Data.

Table with Quality Level, Seismic Category, Service/Contents, Design Specific Gravity, Max Operating Volume, Total Volume, Postweld Heat Treat, and Seismic Base Moment.

Table with Inside Diameter, Length/Height (TL-TL), Internal Pressure, External Pressure, Temperature, and Min Design Metal Temp.

Table with Component, Material, Containment, and Notes for various parts like Top Head, Shell, Bottom Head, Vessel Support, Jacket/Cols/Half-Pipe Jacket, Internals, Pipe, Forgings/ Bar stock, Gaskets, Bolting, and Wash Ring.

Table with Orientation, Support Type, Insulation Function, Insulation Thickness, Insulation Material, External Finish, and Internal Finish.

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.

Notes: (1) Nozzles located below the top of the overflow nozzle are primary containment. See 24590-WTP-3PS-MVD-T0001 for NDE requirements. (2) Nozzle tolerance +/- 1/4" (3) 40 years design life (4) NDE for this vessel must meet requirements per para. 6.1, 6.4, and 7.2 of specification 24590-WTP-3PS-MVD-T0001

Revision History table with columns for Rev, Description, By, Checked, Reviewed, Approved, and Date.

Quarter Ending March 31, 2008

24590-PTF-PCN-ENV-07-015

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Page 2 of 2: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Update PTF Plant Item Corrosion Evaluation for the Pretreatment Spent Resin Dewatering Moisture  
Separation Vessel (RDP-VSL-00004) in Appendix 8.9 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein

12/27/07

D. A. Klein

Date

S. J. Olinger

2/6/08

S. J. Olinger

Date

Quarter Ending March 31, 2008

24590-PTF-PCN-ENV-07-015

Hanford Facility RCRA Permit Modification Notification Form					
Unit: <b>Waste Treatment and Immobilization Plant</b>		Permit Part & Chapter: <b>Part III, Operating Unit 10</b>			
<u>Description of Modification:</u>					
The purpose of this Class 1 modification is to update PTF Plant Item Corrosion Evaluation for the Pretreatment Facility Spent Resin Dewatering Moisture Separation Vessel (RDP-VSL-00004) in Appendix 8.9 of the Dangerous Waste Permit. The following data sheet is submitted to replace the permitted data sheet currently in Appendix 8.9.					
Appendix 8.9					
Replace:	24590-PTF-N1D-RDP-P0002, Rev. 0	With:	24590-PTF-N1D-RDP-00002, Rev. 3		
This modification requests Ecology approval and incorporation into the permit the specific changes to this data sheet that have occurred since issuance of the permitted version. Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design). The following identifies the significant changes that have been revised on the attached data sheet.					
<ul style="list-style-type: none"> <li>• Design Pressure specified as internal/external (formerly min/max)</li> <li>• Locations specified as Room P-0119 (formerly outcell)</li> <li>• Specified corrosion allowance (0.024 inch) (total corrosion allowance is unchanged)</li> <li>• Specified erosion allowance (0.004 inch) (total corrosion allowance is unchanged)</li> <li>• Specified additional references used as basis for conclusions (Sheets 4 and 5)</li> <li>• Indicated document number CCN 163061 for the source of value (6.00E+00 g/L) shown in Contract Max Leach/No Leach specification (Sheet 5 of 6).</li> <li>• Increased Process Corrosion Data Sheet Contract Max Leach/No Leach specification from 4.65E-04 to 6.00E+00 (Sheet 5 of 6).</li> <li>• Indicated document number 24590-PTF-3YD-RDP-00001 for the source of excerpt 4.10.2 Spent Resin Dewatering Moisture Separation Vessel (RDP-VSL-00004) (Sheet 6 of 6)</li> </ul>					
The following is a list of outstanding change documents that have not been incorporated into this modification: None					
WAC 173-303-830 Modification Class: <sup>1 2</sup>		Class 1	Class <sup>1</sup> 1	Class 2	Class 3
Please mark the Modification Class:		X			
Enter Relevant WAC 173-303-830, Appendix I Modification citation number: A.3					
Enter wording of WAC 173-303-830, Appendix I Modification citation: Equipment replacement or upgrading with functionally equivalent components (e.g., pipes, valves, pumps, conveyors, controls)					
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) <u>Reason for denial:</u>		Reviewed by Ecology:  B. Becker-Khaleel 9/9/08 B. Becker-Khaleel Date			

<sup>1</sup> Class 1 modifications requiring prior Agency approval.<sup>2</sup> 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 applicable.

CORROSION EVALUATION



RDP-VSL-00004 (PTF)

Spent Resin Dewatering Moisture Separation Vessel

- Design Temperature (°F)(max/min): 300/-10
- Design Pressure (psig) (internal/external): 15/FV
- Location: Room P-0119

Contents of this document are Dangerous Waste Permit affecting  
Operating conditions are as stated on attached Process Corrosion Data Sheet

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X	
316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1	X	

Recommended Material: 304 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch general erosion allowance)

Process & Operations Limitations:

- None

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.

Concurrence NA  
C&T

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
3	12/19/07	To correct Rev. C issued with incorrect page 5 of 6	DLAdler	RBDavis	NA	SWVail
2	11/1/07	Incorporate revised PCDS	DLAdler	RBDavis	NA	SWVail
1	3/8/06	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	HMKrafft	NA	SWVail
0	7/14/04	Initial Issue	DLAdler	JRDivine	APR	APRangus

## CORROSION EVALUATION

### Corrosion Considerations:

Warm air is circulated by a blower to pick up moisture from the spent resin and is cooled and condensed in RDP-VSL-00004.

#### a General Corrosion

Hamner (1981) lists a corrosion rate for 304 (and 304L) in 2 M HNO<sub>3</sub> of less than 2 mpy. Davis (1994) states the corrosion rate for 304L in 12% HNO<sub>3</sub> will be less than about 1 mpy up to about 212°F.

In this system, the conditions are such that 304L stainless steel will be acceptable.

#### Conclusion:

Under normal conditions either 304L or 316L will be satisfactory.

#### b Pitting Corrosion

While chloride is known to cause pitting in acid and neutral solutions, with no chloride present in reportable concentrations, both 304L and 316L stainless steel are acceptable.

#### Conclusion:

The use of 304L or 316L is acceptable.

#### c End Grain Corrosion

End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

#### Conclusion:

Not expected in this system.

#### d Stress Corrosion Cracking

The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as a few ppm can lead to cracking under some conditions. Generally, as seen in Sedrils (1996) and Davis (1987), chloride stress corrosion cracking does not usually occur below about 140°F. During the normal operations, either 304L or 316L is expected to be satisfactory.

#### Conclusion:

At the normal operating environment, either 304L or 316L is acceptable.

#### e Crevice Corrosion

Comments under Pitting are generally applicable here.

#### Conclusion:

See Pitting.

#### f Corrosion at Welds

Corrosion at welds is not considered a problem in the proposed environment.

#### Conclusion:

Weld corrosion is not considered a problem for this system.

#### g Microbiologically Induced Corrosion (MIC)

MIC is not considered a problem in this system.

#### Conclusion:

Not a concern.

#### h Fatigue/Corrosion Fatigue

Corrosion fatigue is not expected to be a concern. The pressures encountered are so low and the strength of the material is so comparatively high that corrosion fatigue is not a problem.

#### Conclusions

Not a concern.

#### i Vapor Phase Corrosion

Not expected in this system.

#### Conclusion:

Not considered to be a concern.

**CORROSION EVALUATION****j Erosion**

Velocities in the vessel are expected to be low. Erosion allowance of 0.004 inch for components with low solids content (<2 wt%) at low velocities is based on 24590-WTP-RPT-M-04-000E.

**Conclusion:**

Erosion is not expected to be a concern.

**k Galling of Moving Surfaces**

Not applicable.

**Conclusion:**

Not applicable.

**l Fretting/Wear**

No contacting surfaces expected.

**Conclusion:**

Not applicable.

**m Galvanic Corrosion**

No dissimilar metals are present.

**Conclusion:**

Not applicable.

**n Cavitation**

None expected.

**Conclusion:**

Not believed to be of concern.

**o Creep**

The temperatures are too low to be a concern.

**Conclusion:**

Not applicable.

**p Inadvertent Nitric Acid Addition**

Vessel normally operates at low pH.

**Conclusion:**

Not applicable.

## CORROSION EVALUATION

## References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. C, *WTP Process Corrosion Data*
3. CCN 130177, Zapp, PE, 2000, *Material Corrosion and Plate-Out Test of Types 304L and 316L Stainless Steel*, WSRC-TR-2000-00434, Savannah River Site, Aiken, SC
4. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
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**CORROSION EVALUATION**

Attachment to CCN 163061  
 Replaces Page A-45 of  
 24590-WP-RPT-PR-04-0001, Rev C  
 WTP Process Corrosion Data

**PROCESS CORROSION DATA SHEET**

Component(s) (Name/ID #) Spent resin slurry vessel (RDP-VSL-00002 A/B/C)  
Spent resin dewatering moisture separation vessel (RDP-VSL-00004)

Facility PTF

In Black Cell? Yes (RDP-VSL-00002A/B/C only)

Chemicals	Unit <sup>1</sup>	Contract Max <sup>2</sup>		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	µ/L					
Chloride	µ/L					
Fluoride	µ/L					
Iron	µ/L					
Nitrate	µ/L	6.0E+00	6.0E+00			
Nitrite	µ/L					
Phosphate	µ/L					
Sulfate	µ/L					
Mercury	µ/L					
Carbonate	µ/L					
Undissolved solids	wt%					
Other (NaMnO <sub>4</sub> , Pb,....)	µ/L					
Other	µ/L					
pH	N/A					Note 4
Temperature	°F					Note 3, Assumption 1

List of Organic Species:

References

System Description: 24590-PTF-SYD-RDP-00001

Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A

Normal Inlet Stream #: CXP19, CXP18, RDP01

Off Normal Inlet Stream # (e.g., overflow from other vessels): N/A

SPID: N/A

PFID: 24590-PTF-M5A-V11T-00020

Technical Reports:

Notes:

1 Concentrations less than 1x 10<sup>-1</sup> µ/L do not need to be reported, list concentration values to three significant digits max.

2 Data developed from a mass balance model which has constituents in the plant feed which are important to corrosion, adjusted to contract maximum values.

3 For RDP-VSL-00002ABC: 50 °F to 123 °F (24590-WTP-RPT-ENG-07-007, Rev 0)

4 Minimum pH approximately 1

Assumptions:

1 For RDP-VSL-00004 123 °F maximum operating temperature based on maximum temperature in RDP-VSL-00002ABC, and given that there is no heating in the dewatering unit.

## CORROSION EVALUATION

24590-WTP-RPT-PR-04-0001, Rev. C

WTP Process Corrosion Data

### 4.10.2 Spent Resin Dewatering Moisture Separation Vessel (RDP-VSL-00004)

#### Routine Operations

The spent resin dewatering moisture separation vessel serves to collect liquid from spent resin dewatering operations performed by the vendor dewatering package (page 9, 24590-PTF-3YD-RDP-00001, Rev 0).

#### Non-Routine Operations that Could Affect Corrosion or Erosion

None identified.

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-003

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Replace Permit Specification 24590-PTF-3PS-MEVV-TP001 (Engineering Specification for Forced Circulation Vacuum Evaporator System) in Appendix 8.7 of the Dangerous Waste Permit.

Submitted by Co-Operator:

D. A. Klein  
D. A. Klein

7/10/08  
Date

Reviewed by ORP Program Office:

S. J. Olinger  
S. J. Olinger

7/23/08  
Date

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-003

### Hanford Facility RCRA Permit Modification Notification Form

Unit:

**Waste Treatment and Immobilization Plant**

Permit Part & Chapter:

**Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 prime modification is to update 24590-PTF-3PS-MEVV-TP001 (*Engineering Specification for Forced Circulation Vacuum Evaporator System*).

The following specification is being submitted to replace the specification currently in Appendix 8.7.

Appendix 8.7

Replace:	24590-PTF-3PS-MEVV-TP001, Rev. 2	With:	24590-PTF-3PS-MEVV-T0001, Rev. 2
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This modification requests that Ecology approve and incorporate into the permit the changes to this specification that have been issued since the last revision of the specification. Changes are identified by revision bars. Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design) and design verification. Significant changes are summarized below:

- Revised sections 1.2.6, 3.4.3.2, and 3.9.13 to remove low-pressure steam information
- Revised section 1.2.12 to indicate that seismic information is provided in Appendix V
- Revised section 1.2.14 to correct steam supply information
- Added section 1.2.31 to address coupled seismic response spectra dynamic analysis requirements
- Added section 1.2.32 to address uncoupled seismic response spectra dynamic analysis of all SC-I/SC-II evaporator components
- Revised section 1.4.9 to delete outdated acceleration values
- Section 2.2 was revised to add the following references: Section 2.2.29, ASCE 4-98, Seismic Analysis of Safety-Related Nuclear Structures and Commentary; Section 2.2.30, ASTM A 193, Editions 1991 through 2005, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service; Section 2.2.31, ASTM A 194, Editions 1991 through 2005a, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service; Section 2.2.32, Any Year, Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled and Cold-Finished; Section 2.2.33, ASTM A564, Editions 1988b, 1989, 1991, 1992, 1992a, 1994, 1995, 1997, 1999, 2001, 2002, 2002a, 2004, Standard Specification for Hot Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes; Section 2.2.34, SSPC-SP10, Near White Metal Blast Cleaning; Section 2.2.35, SSPC-SP11, Power Tool Cleaning to Bare Metal; and Section 2.2.36 API 610-1995, Centrifugal Pumps for General Refinery Service
- Added section 3.14.20 to incorporate 2" drain nozzle inlet to reboiler steam condensate vessel from desuperheater
- Revised section 3.16.3 to refer Appendix V for seismic analysis requirements
- Revised sections 3.1.9, 3.9.2, 3.10.2, 3.11.4, and 3.12.3 to clarify nozzle loading requirements
- Revised section 4.2.8 to clarify that no threaded flanges or fittings shall be used in the black cells
- Revised section 6.6.3 to clarify weld acceptance criteria
- Revised section 7.1.4 to indicate that the functional test of the antifoam tank/agitator assembly as a unit is not required if the antifoam agitator is tested by the fabricator prior to shipment to the vessel shop
- Revised section 7.2 to clarify the stimulant test using nonradioactive cesium is not required
- Revised section 11.2 to clarify design stress/seismic report submittal requirements
- Revised Appendix D correct steam supply conditions
- Revised Appendix E to add a note for clarification regarding QL-1 and QL-2 used by the Seller
- Revised Appendix L to provide location of 2" inlet drain nozzle
- Deleted Appendix M, Minimum Nozzle Design Loads, per SCN 24590-PTF-3PN-MEVV-00014
- Deleted Appendix R, ISRS Figures for Reboilers at the Steel Frame Supports, due to outdated In-Structure Response Spectra curves
- Added and subsequently deleted Appendix U, Parametric Study, per SCNs 24590-PTF-3PN-MEVV-00012 and 24590-PTF-3PN-MEVV-00014, respectively (information moved to Appendix V)
- Added and revised Appendix V, FEP/TLP Evaporator System Composite Analyses, per SCNs 24590-PTF-3PN-

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-003

MEVV-00014 and 24590-PTF-3PN-MEVV-00019, respectively

The following is a list of outstanding change documents that have not been incorporated into this modification:

- 24590-PTF-3PN-MEVV-00022
- 24590-PTF-3PN-MEVV-00023
- 24590-WTP-SDDR-M-06-00395
- 24590-WTP-SDDR-MS-07-00030

<b>WAC 173-303-830 Modification Class:</b> <sup>1 2</sup>	<b>Class 1</b>	<b>Class <sup>1</sup>1</b>	<b>Class 2</b>	<b>Class 3</b>
Please mark the Modification Class:		X		
Enter Relevant WAC 173-303-830, Appendix I Modification citation number: N/A				
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 <sup>1</sup> 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: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
Reason for denial:			8/12/08	
		B. Becker-Khaleel	Date	

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.



R10757015

ISSUED BY  
RPP-WTP PDC

# RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

## ENGINEERING SPECIFICATION

FOR

### Forced Circulation Vacuum Evaporator System

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.

Content applicable to ALARA?  Yes  No

ADR No.  
24590-PTF-ADR-M-03-003

Rev  
0

Quality Level

Q

DOE Contract No.  
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPEM
2	2/21/07	E. Le	J. Donovan	B. Malacia J. Julyk	N/A	Ehlinger	R. Voke
1	03/24/05	E. Le	S. Crow	J. Julyk	N/A	G. Warner	R. Smith
0	04/24/03	E. Le	G. Butt	J. Julyk	N/A	G. Warner	S. Grabowski

SPECIFICATION No.  
24590-PTF-3PS-MEVV-T0001

Rev  
2

### Best Available Copy

**Revision History**

Revision	Reason for Revision
0	Issued for Procurement
1	<p>Incorporated Design Changes:</p> <p>24590-PTF-3PN-MEVV-00001</p> <p>24590-PTF-3PN-MEVV-00004 (which incorporated 24590-WTP-SDDR-PROC-04-00104)</p> <p>24590-PTF-3PN-MEVV-00005</p> <p>24590-PTF-3PN-MEVV-00006 with the following revisions:</p> <ol style="list-style-type: none"> <li>1. Revised section 1.2.1 to delete duplicate information regarding internal deentrainment separation system for FEP &amp; TLP separator vessels.</li> <li>2. Revised section 1.2.1 to group support structure with their associated separator vessels.</li> <li>3. Revised section 1.2.1 to provide more descriptive steam conditioning assembly of FEP &amp; TLP evaporators for clarification.</li> <li>4. Revised section 1.2.1 to add reboiler steam condensate transfer stations for FEP &amp; TLP evaporators for Seller's additional scope of supply.</li> <li>5. Revised section 1.2.1 to change "mechanical seal" to "pump seal"</li> <li>6. Revised section 3.19.5 to delete "following by vertical up-ending" at the end of the 1<sup>st</sup> sentence</li> <li>7. Revised section 3.20.3.5 to delete "assemblies" in the 1<sup>st</sup> sentence</li> </ol> <p>24590-PTF-3PN-MEVV-00007</p> <p>24590-PTF-3PN-MEVV-00009</p> <ol style="list-style-type: none"> <li>1. Incorporated 24590-WTP-SDDR-PROC-04-00994, 24590-WTP-SDDR-PROC-04-00995, 24590-WTP-SDDR-PROC-04-01193, 24590-WTP-SDDR-PROC-04-01194, 24590-WTP-SDDR-PROC-04-01270, 24590-WTP-SDDR-PROC-04-01271, 24590-WTP-SDDR-PROC-04-01272, 24590-WTP-SDDR-PROC-04-01278 and 24590-WTP-SDDR-PROC-05-00181</li> <li>2. Revised section 2.1.2 for clarifications</li> <li>3. Revised wording in section 4.2.12 for clarification</li> <li>4. Revised section 8.18 to delete "for off-gas piping pieces" from the 1<sup>st</sup> sentence</li> </ol> <p>24590-WTP-SDDR-PROC-05-00208.</p> <p>Revised Appendix E to include reboiler steam condensate transfer stations.</p> <p>Revised Appendix P to add drawings for reboiler nozzle locations.</p> <p>Added Appendix T to provide design evaluation inputs</p>
2	<p>Incorporated Design Changes:</p> <p>24590-PTF-3PN-MEVV-00012 with revision of section 3.4.3.3 for clarification</p> <p>24590-PTF-3PN-MEVV-00014 with the following revisions</p> <ol style="list-style-type: none"> <li>1. Revised section V8b of appendix V to remove digitized data verification requirement that is no longer applicable</li> <li>2. Revised section V5.2 of appendix V to add "or greater" at the end of the sentence for clarification.</li> </ol> <p>24590-PTF-3PN-MEVV-00019</p>

Revision	Reason for Revision
	<p>24590-WTP-SDDR-M-05-00438                      24590-WTP-SDDR-MS-07-00029</p> <p>Deleted Appendix R – outdated In-Structure Response Spectra (ISRS) curves</p> <p>Revised section 3.19.15 to add “following by vertical up-ending” from 24590-PTF-3PN-MEVV-00006 which was erroneously deleted in revision 1 of this specification</p> <p>Revised section 3.20.3.5 to add “assemblies” to the 1<sup>st</sup> sentence from 24590-PTF-3PN-MEVV-00006 which was erroneously deleted in revision 1 of this specification</p> <p>Revised section 4.2.12 to correct typos</p> <p>Revised section 8.1.8 to add “off-gas piping pieces” from 4590-PTF-3PN-MEVV-00009 which was erroneously deleted in revision 1 of this specification</p> <p>Revised sections 1.2.6, 3.4.3.2, and 3.9.13 to remove low-pressure steam information which is no longer applicable</p> <p>Revised section 1.2.12 to indicate that seismic information is provided in Appendix V.</p> <p>Revised section 1.2.14 to correct steam supply information</p> <p>Deleted section 1.3.29 to correct Buyer’s scope of work</p> <p>Revised section 1.4.9 to delete outdated acceleration values</p> <p>Revised sections 1.4.11, 1.4.13, 1.4.15, 1.4.16, 1.4.18, 1.4.25, 1.4.26, 1.4.29, 1.4.30, and 1.4.32 to correct definitions</p> <p>Revised sections 2.2.6, 2.2.15, and 2.2.16 to be consistent with SRD</p> <p>Add sections 2.2.34, 2.2.35, and 2.2.36 for references.</p> <p>Revised section 3.1.17 to add “gpm” at the end of 2<sup>nd</sup> bullet.</p> <p>Added section 3.14.20 to incorporate 2” drain nozzle inlet to reboiler steam condensate vessel from desuperheater.</p> <p>Revised Appendix L to provide the location of 2” inlet drain nozzle.</p> <p>Revised section 3.16.3 to provide seismic analysis requirements in the Appendix V.</p> <p>Revised section 4.2.8 to clarify that threaded flanges and fittings are not allowed only in the balck cells.</p> <p>Revised section 6.6.3 to clarify the weld acceptance criteria</p> <p>Revised section 7.2 to clarify the stimulant test using non-radioactive cesium is not required.</p> <p>Revised section 11.2 to clarify design stress/seismic report submittal requirements.</p> <p>Revised sections 3.1.9, 3.9.2, 3.10.2, 3.11.4, 3.12.3 to clarify nozzle loading requirements</p> <p>Revised sections 2.4.60 and 2.4.61 to correct typos</p> <p>Revised Appendices A, B, and C to remove outdated references.</p> <p>Revised Appendix D to correct steam supply conditions.</p> <p>Revised Appendix E to add a note for clarification regarding QL-1 and QL-2 used by Seller.</p>

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# 1 Scope

## 1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (DOE) Hanford Site tank waste will be pretreated and immobilized into stable glass form via vitrification. The WTP Contractor will design, build, and startup the WTP pretreatment and vitrification facilities for the DOE 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 Richland, WA in the U.S.A. The WTP Facility will be constructed at the east end of the 200 East Area of the Hanford Site. The counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

This specification provides the requirements for the design, analysis, fabrication, quality assurance, inspection, testing, qualification, and labeling of three (3) forced circulation vacuum evaporator systems for use in the WTP Pretreatment Facility. This specification also provides the requirements for the supply of services, manuals, instructions, procedures, and other associated documentation.

The scope of work for the Seller includes all work defined in this specification and its addenda and attachments. Work shall include, but is not limited to, the following:

- 1.2.1 Provide fully detailed designs, drawings, diagrams, supporting calculations, supporting analyses, procedures, installation instructions, and all labor, materials, equipment, and services necessary to manufacture, test, inspect, label and package for shipment three (3) sets of the forced circulation vacuum evaporator system hardware, including handling and servicing equipment, all fabricated to appropriate NQA-1 requirements in accordance with all specification requirements, with the deliverables being reports, calculations, procedures, data sheets, drawings and diagrams as outlined in this specification and the Material Requisition (MR). Refer to tables below for what shall be included as part of evaporator systems to be provided.

Waste Feed Evaporator (FEP) Systems

Equipment	Tag
Two (2) FEP Separator Vessels. Each vessel with support structure, three layers of de-entrainment trays, two layers of mesh pads and sprays.	FEP-SEP-00001A FEP-SEP-00001B
Two (2) FEP Reboilers with Graylocs and PUREX nozzles installed in accordance with this specification and stainless steel structural support frames.	FEP-RBLR-00001A FEP-RBLR-00001B
Two (2) FEP Recirculation Pumps. Each pump includes motor, pump seals, and adjustable speed drive. The pump inlet and outlet pipe ends prepared for butt welding.	FEP-PMP-00009A FEP-PMP-00009B
Two (2) FEP Condenser skid. Each skid consisting of Primary Condenser, 1st stage steam ejector, Intercondenser, 2nd stage steam ejector, Aftercondenser and interconnecting piping.	FEP-COND-00001A FEP-COND-00002A FEP-COND-00003A FEP-EJCTR-00040 FEP-EJCTR-00041  FEP-COND-00001B FEP-COND-00002B FEP-COND-00003B FEP-EJCTR-00042 FEP-EJCTR-00043
One (1) FEP Condensate Vessel for both FEP systems. Vessel includes skirt and support ring.	FEP-VSL-00005
Two (2) FEP Condensate Pumps include base plate, motor, variable speed drive, and mechanical seal mounted on common skid.	FEP-PMP-00006A FEP-PMP-00006B
One (1) Antifoam Vessel serves the FEP and TLP separators. Vessel includes skirt.	AFR-TK-00001
Three (3) Antifoam Pumps (common for FEP and TLP systems) with base plate and motor mounted on common skid.	AFR-PMP-00006 AFR-PMP-00007 AFR-PMP-00008
Two (2) sets of FEP offgas piping 30" diameter from separator to Primary condenser. Piping includes pipe hangers.	"Note 1"
Two (2) FEP Steam Conditioning Assembly consisting of a steam supply flow control valve, desuperheater and flow element.	FEP-SKID-00006A FEP-SKID-00006B
Four (4) lifting yokes. One lifting yoke for three (3) separator vessels, two lifting yokes for three (3) reboiler and support frame assemblies, and one lifting yoke for three (3) recirculation pumps	"Note 1"
Two (2) FEP Reboiler Steam Condensate Transfer Stations including level tank, transfer pump and condensate recycle pump.	FEP-VSL-00021 FEP-PMP-00010A FEP-PMP-00010B  FEP-VSL-00022 FEP-PMP-00011A FEP-PMP-00011B

Note 1: Stainless steel or plastic tags (foil strip is not acceptable) shall be firmly attached by stainless steel wire or stainless steel screws to each separate item. Each tag shall be stamped with, as a minimum: (1) Purchase Order Number, (2) Purchase Order item number, and (3) Equipment/Instrument Tag number.

Treated LAW Evaporator (TLP) System

Equipment	Tag
One (1) TLP Separator Vessel with support structure, three layers of de-entrainment trays, two layers of mesh pads and sprays.	TLP-SEP-00001
One (1) TLP Reboiler with Graylocs and PUREX nozzles installed in accordance with this specification and stainless steel structural support frame.	TLP-RBLR-00001
One (1) TLP Recirculation Pump including motor, pump seals, and adjustable speed drive. The pump inlet and outlet pipe ends prepared for butt welding.	TLP-PMP-00001
Two (2) LAW SBS Feed Pumps with base plate, motor, pump seals, and adjustable speed drive.	TLP-PMP-00005A TLP-PMP-00005B
Two (2) TLP Concentrate Pumps with base plate, motor, pump seals, and adjustable speed drive.	TLP-PMP-00011A TLP-PMP-00011B
One (1) TLP Condenser skid consisting of Primary Condenser, 1st stage steam ejector, Intercondenser, 2nd stage steam ejector, Aftercondenser and interconnecting piping.	TLP-COND-00001 TLP-COND-00002 TLP-COND-00003 TLP-EJCTR-00064 TLP-EJCTR-00067
One (1) TLP Condensate Vessel with support.	TLP-VSL-00002
Two (2) Condensate Pumps include base plate, motor, variable speed drive, and mechanical seal mounted on common skid.	TLP-PMP-00002A TLP-PMP-00002B
One (1) set of offgas piping 30" diameter from Separator to Primary Condenser with pipe hangers.	"Note 1"
One (1) TLP steam conditioning Assembly consisting of a steam supply flow control valve, a desuperheater and flow element.	TLP-SKID-00008
One (1) TLP Reboiler Steam Condensate Transfer Station including level tank, transfer pump and condensate recycle pump.	TLP-VSL-00047 TLP-PMP-00012A TLP-PMP-00012B

Note 1: Stainless steel or plastic tags (foil strip is not acceptable) shall be firmly attached by stainless steel wire or stainless steel screws to each separate item. Each tag shall be stamped with, as a minimum: (1) Purchase Order Number, (2) Purchase Order item number, and (3) Equipment/Instrument Tag number.

- 1.2.2 Provide a guarantee that all equipment listed in section 1.2.1 will perform in accordance with the requirements of this specification and all referenced codes, standards, and documentation in section 2 of this specification. Process warranty shall include demonstration of compliance of the Seller's provided evaporator system during testing per section 7.2 of this specification with the boil-off and decontamination factor requirements. The process warranty is provided with the following conditions: (1) the evaporator systems are operated per Seller's instructions within mutually agreed parameters and chemical analytes that are representative of waste and process conditions, and (2) mutual agreement that foaming within the Separator Vessel is adequately controlled by the Buyer-supplied antifoaming reagent.
- 1.2.3 Perform sizing calculations and process performance modeling to ensure that each component of the evaporator systems is properly specified to ensure desired performance.

- 1.2.4 Provide the following nonreplaceable components/equipment which shall attain a 40-year life:
- Separator vessels and all their internal parts (exception made for demister pad life).
  - Section of separator offgas pipework located inside the R5/C5 black cells.
- 1.2.5 Deleted.
- 1.2.6 Provide three (3) steam conditioning equipment necessary to reduce plant pressure steam to Seller's provided optimal saturated steam condition for reboiler operation. Provide specifications (i.e pipe diameter, associated equipment and layout) for reboiler shell vacuum/vent line.
- 1.2.7 Provide specifications and data sheets during contract performance for Buyer to procure the following equipment/components.
- FEP feed pumps (FEP-PMP-00007A/B)
  - FEP concentrate pumps (FEP-PMP-00008A/B)
- 1.2.8 Provide evaporator skids, equipment, components, and structural supports with the materials of construction as specified per this specification and on the attached data sheets in section 2 of the MR. The structural supports for evaporator equipment shall match with Buyer's provided embed layout.
- 1.2.9 Provide evaporator systems that accommodate the wall penetrations, piping layout, equipment dimension envelopes, and equipment locations as specified in Appendices H, I, and J.
- 1.2.10 Provide stainless steel skid framing to match Buyer embed plates for all three separator vessels. The vessel skid shall conform to the proposed skid layout dimensions shown in the Appendix F.
- 1.2.11 Provide below-the-hook lifting devices for installation, commissioning, and operation/maintenance of the demister pads assembly, reboiler, and recirculation pump. These will include lifting yokes, beams, fixtures, etc., according to Buyer design constraints for remote handling, which will be provided in 30 % design review stage. Seller is also to provide all special lifting equipment required for installation and maintenance of the evaporator systems.
- 1.2.12 Provide seismic analysis for evaporator structures, systems, and components. Seismic analysis shall also be performed for reboiler and support frame assemblies. Seismic model shall include: (1) vessel/equipment, (2) skid frames, and (3) supporting posts. For post/embeds locations and details, see drawings 24590-PTF-DD-S13T-00023 thru -0030, 24590-PTF-DD-S13T-00049, 24590-PTF-SS-S15T-00311 thru -00318, 24590-PTF-SS-S15T-00352, and 24590-PTF-SS-S15T-00354. The seismic response spectra and damping values for the performance of the seismic analysis are provided in the Appendix V.
- 1.2.13 Provide the thermal and static stress analyses for the evaporator structures, systems, and components. Seller shall also provide fatigue analysis to support a

40 year design life for the evaporator system. The fatigue analysis shall include all calculations and all supporting data. Buyer will provide the necessary cyclic data for Seller to perform an assessment regarding the fatigue life of the equipment. However, Seller will be responsible for confirmation that the cyclic data has been accurately interpreted before proceeding with the component fatigue analysis.

- 1.2.14 Identify all interfaces and requirements for external connections with equipment and services supplied by the Buyer. The interface system data parameters for use in each of the evaporator systems shall include, as a minimum, the following:

Inlet Conditions:

- Feed (flow rate @ 77 °F)
- High pressure steam (see section 3.4.3.3)
- Service Water (flow rate)
- Antifoam (flow rate)
- Instrument air (flow rate @ pressure)
- Cooling water (flow rate @ 75 °F)
- Operating electrical (kW)
- Installed electrical (kW)

Outlet Conditions:

- Steam Condensate (volumetric flow rate & temperature)
- Process Condensate (volumetric flow rate & temperature)
- Vent System (mass flow rate & temperature)
- Concentrate waste (volumetric flow rate & temperature)

- 1.2.15 Provide completed Instrument and Mechanical data sheets for all instruments and equipment in the 60 % design review package, utilizing Buyer's supplied instrument data sheet samples attached in the section 2 of the MR as templates. Buyer will procure the required instruments as detailed by the Seller's control philosophy documents (data sheets) for installation by others. Instrumentation shall conform to 24590-WTP-3PS-JQ07-T0001.

- 1.2.16 Provide the following for instrumentation and controls of Seller's supplied evaporator systems, equipment, and components to support Seller's software development. Any effect that the evaporator control strategy has on equipment operating parameters (i.e., pump flow rates, line flushes, feed and concentrate takeoff strategies, temperature, or pressure) will be mutually agreed upon prior to being implemented into the design.

- P&IDs
- Instrument data sheets
- Instrument loop diagrams
- Instrument location diagrams
- Control philosophies
- Functional descriptions
- Installation details
- Instrument index which includes functional test and operational set points
- Control and sequencing requirements

- Instrumentation and controls for the FEP evaporator feed and concentrate systems.

1.2.17 Provide a reliability analysis and documentation for each of the three (3) evaporator systems in accordance with the following:

1.2.17.1 A complete Failure Modes and Effects Analysis (FMEA) shall be performed on all the equipment that falls within Seller's scope of supply. This shall include associated components such as vessels, remote handling equipment, pumps have associated valves, (for isolation, for maintenance, for cross-ties, etc.) that have electronic control system which are used for process variability (e.g., flow rate). All support systems (e.g., power, air, water, steam, etc.) will be assumed to be 100 % reliable and will not be considered in the FMEA. Structural failure modes will be limited to seismic events, based on whatever seismic analyses have been performed to support the design. The FMEA shall follow in MIL-STD-1629A as close as possible. The equivalent standard actually used to perform the FMEA shall be provided as a reference (including version and year) at the 60 % design review. Also, an explanation shall be included to demonstrate how the standard has been applied. Failure modes for a reboiler are at least as follows: (1) pin hole, (2) crack, and (3) tube rupture. In addition, Seller shall indicate the possibility of the reboiler tube rupture without precursor of pin hole or crack. Determination of the possibility of reboiler tube rupture without a precursor of a pin hole or crack can be made with a qualitative argument based on fracture mechanics. No stress analysis or fracture mechanics calculations will be required to support the qualitative assessment. Failure modes for the remaining components covered by the FMEA shall be as determined by the Seller, however, the basis for the failure mode shall be specified.

1.2.17.2 Failure rate data for the purposes of an availability assessment (performed by Seller) will be derived using the following hierarchy:

- Supplier In-Service Data
- In-Service Data of similar equipment, preferably in similar applications
- Generic Documented Failure Rate Data – data taken from recognized data sources, e.g., Dexter & Perkins, NPRD 1995, etc.

The specific data source shall be provided at the 60 % design review

1.2.17.3 A maintainability analysis will be undertaken in concert with the Buyer. The analysis will address preventative and corrective maintenance activities and estimate the required maintenance for the reboiler and appurtenances.

1.2.17.4 A recommended spare parts list, operations manuals, and maintenance manuals shall be provided.

1.2.17.5 Assume operations are 8,760 operating hours per year.

- 1.2.18 Provide an analysis of operating life for separator vessel, including its internal demister pads, separation trays, and feed distribution, reboiler, and recirculation pump. Justify all assumptions and references.
- 1.2.19 Provide structural support requirements and recommended support locations for recirculation pumps (i.e., load points, weight distribution, and maximum weight, geometry of equipment, and location of center gravity). In addition, identify areas that cannot be used as load points. Equipment support locations shall be mutually agreed with the Buyer due to remote handling requirements in the hot cell.
- 1.2.20 Provide design and fabrication of three support frames for reboilers. The support frame shall be welded to the reboiler and designed to force the thermal expansion of all nozzles (PUREX and remote clamp connectors) upward. Upper support points can be maintained for a lateral guide support. The structural supports for reboiler shall meet BNI remoteability requirements such as weight, remotely removable, airlock sizing, crane and impact wrench specified in this document.
- 1.2.21 Nozzles shall be located to  $\pm 1/4$  inch diametric tolerance by the hole in support frame as relative to the master dowel of the reboiler and support frame assembly. Nozzles shall be perpendicular / parallel within 0.5 degree or 1/4 inch whichever is smaller relative to the datum formed by the lower base plate of the reboiler and support frame assembly.
- 1.2.22 For reboiler nozzle locations, see Appendix P. Nozzles shall be located in accordance with 1.2.21.
- 1.2.23 Provide demonstration and recorded VHS format video tape for demister pad removal and replacement in Seller shop test. Buyer shall be notified prior to demonstration.
- 1.2.24 Provide radiographic film with technique and reader sheets. Exposed film must be sent, along with a copy of the technique and reader sheets in accordance with section 3 of the MR. Film must be suitably packaged to preclude moisture and handling damage.
- 1.2.25 Provide any necessary special remote repair tools for the reboiler and support frame assemblies and recirculation pumps. Special tools shall not include tools readily available in the commercial market. Also, provide a list of commercially available tools needed.
- 1.2.26 Provide final inspection of completed vessels. Buyer will not be designating a representative to carry out final inspections of the vessels as described per Buyer specification 24590-WTP-3PS-MV00-T0001, *Pressure Vessel Design and Fabrication*.
- 1.2.27 Provide personnel to perform dimensional measurements for reboiler and support frame assembly, and recirculation pumps at the Seller's shop.
- 1.2.28 Provide certified reports for all components subject to any heat treatment during manufacture.

- 1.2.29 Provide procedures suggesting how the integrated testing of evaporator system functionality be conducted by Buyer at the Hanford jobsite per section 7.2 of this specification. Technical support for installation, testing and commissioning will be under a separate contract.
- 1.2.30 Provide design documents in progressively complete package form. Design reviews at 30 %, 60 %, 90 % and Final Design to resolve all outstanding issues are planned to include face-to-face discussions between Buyer's personnel and Seller's personnel at Buyer's location. Future meetings will be arranged after Design Review Package Materials have been reviewed and meeting agenda have been established. The discussions are intended to help establish/clarify interface points in system requirements, review design/design progress, design documents, exchange ideas/information, provide design direction. See G-321-E Form for document submittal requirements.
- 1.2.31 Perform a coupled seismic response spectra dynamic analysis that will qualify the recirculation piping, offgas piping, and provide vessel nozzle loads & nozzle loads at the Grayloc connection on each jumper. See Appendix V for requirement details on coupled dynamic analysis.
- 1.2.32 Perform detailed FEA uncoupled seismic response spectra dynamic analysis of all SC-I/SC-II evaporator components (including the individual components' internals and frames). See Appendix V for requirement details on FEA uncoupled analysis. Equipment static method is not permitted.

### 1.3 Work by Others

Any item not specifically listed as being supplied by the Buyer shall be provided by the Seller.

- 1.3.1 Provide installation labor.
- 1.3.2 Provide equipment shipment, unloading and storage at Buyer's site.
- 1.3.3 Provide Instrumentation and controls (including installation). Provide Buyer internal standards for digital control system equipment and will specify and procure the control system equipment based on the necessary I/O requirements detailed by Seller.
- 1.3.4 Instrument location information for instrument location drawings.
- 1.3.5 Generate control logic in Buyer standard format using the final control loop definitions, system interlocks and alarms, system control philosophies, and control and sequencing requirements provided by Seller.
- 1.3.6 Procure the digital control system components. Buyer will provide the "Device" and "I/O" address of the serial communications link for each instrument for inclusion in the Instrument Index.
- 1.3.7 Perform the inspection of dimensional measurement activities for separator vessels, reboilers, and recirculation pumps.

- 1.3.8 Perform remote handling verification test for reboilers and support frame assemblies, recirculation pumps, and recirculation pipework jumper functionality at Buyer site. Lift tests shall be performed per section 3.19.8 by Seller prior to shipment.
- 1.3.9 Provide the appropriate seismic response spectra and damping values for Seller to perform the evaporator equipment skid (including reboiler and support frame assemblies) seismic analyses.
- 1.3.10 Provide video/camera systems for the Seller's provided demister pad removal systems.
- 1.3.11 Provide heat tracing, seismic review, and any necessary uninterruptible power supplies.
- 1.3.12 Provide all the piping, instrumentation and controls for the antifoam systems per Seller design and specification.
- 1.3.13 Provide all valves (including control valves) located in the jumpers for remote maintenance in the R5/C5 hot cell.
- 1.3.14 Provide design and fabrication for all piping, jumpers, and connectors for the recirculation pipework. This includes the piping connecting the separator vessel to the recirculation pump, the recirculation pump to the reboiler nozzle, and the reboiler nozzle to the separator vessel for two FEP evaporator systems and the TLP evaporator system.
- 1.3.15 Provide structural supports per Seller's structural support requirements for three recirculation pumps (FEP-PMP-00009A/B and TLP-PMP-00001) and recirculation piping/jumpers.
- 1.3.16 Provide hot cell process equipment platform (PEP) for all reboiler and support frame assemblies and recirculation pumps.
- 1.3.17 Provide the necessary cyclic data for Seller to perform an assessment regarding the fatigue life of the equipment. However, Seller will be responsible for confirmation that the cyclic data has been accurately interpreted before proceeding with the component fatigue analysis.
- 1.3.18 Provide remote handling verification test for reboiler and support frame assemblies, recirculation pumps, and recirculation pipework jumper functionality.
- 1.3.19 Provide all jumpers, jumper mounted equipment, and pipework connections to the separator vessel (excluding the separator offgas pipework) within the black cell.
- 1.3.20 Provide all pipework between Seller's provided skids (excluding the evaporator separator offgas pipework and piping connecting condenser skids and steam ejectors).

- 1.3.21 Provide specification of process and utility piping jumper interfaces and their locations.
- 1.3.22 Provide Jumper stack-up tolerance study.
- 1.3.23 Provide shielding for penetrations through the walls and floors.
- 1.3.24 Provide hot cell remote handling equipment (including impact wrenches and standard lifting equipment).
- 1.3.25 Provide specification for antifoam reagents.
- 1.3.26 Provide feed vessels (FEP-VSL-00017A/B and TLP-VSL-00009A/B).
- 1.3.27 Provide concentrate receipt vessels (UFP-VSL-00001A/B and TCP-VSL-00001).
- 1.3.28 Provide Vessel Vent system.
- 1.3.29 **Deleted**
- 1.3.30 Provide FEP feed pumps (FEP-PMP-00007A/B) and concentrate pumps (FEP-PMP-00008A/B) (refer to 1.2.7).
- 1.3.31 Provide utility (i.e., air, steam, cooling water) supply systems. However, Seller is responsible to provide steam condition skids for reboiler operation.
- 1.3.32 Interface drawings for evaporator equipment skids.

#### 1.4 Definitions

- 1.4.1 *Skid*: A skid is a group of components that can be manufactured and installed as a unit. These skid units are structurally self-supporting, allowing the skid to be handled by crane. Whenever practical, skids will contain all the equipment associated with the process, including vessels, piping, and supports.
- 1.4.2 *ALARA*: As Low As Reasonably Achievable (ALARA) documentation requirements apply to systems, structures, and components (SSCs) that have the potential to affect radiation doses, contamination levels, or releases to the environment.
- 1.4.3 *Buyer's Representative(s)*: The Buyer's designee(s), who shall witness onsite operations at the Seller and sub-seller sites and perform onsite inspections and surveillances.
- 1.4.4 *Black Cell (R5/C5)*: is a sealed concrete structure containing very high radiation and contamination where human access is prohibited during the normal operating lifetime of the cell and maintenance is not performed in the cell.
- 1.4.5 *C1*: Uncontrolled Area.
- 1.4.6 *C2*: Controlled area. Personnel must be verified free of contamination prior to exit.

- 1.4.7 *C3*: Contamination classification for plant areas that are ordinarily free of contamination, but have the potential of being contaminated.
- 1.4.8 *C5*: Contamination classification for plant areas that are considered high contamination areas. Access to C5 areas is not permitted.
- 1.4.9 *Design Basis Earthquake (DBE)*: A specification of the ground motion at the site.
- 1.4.10 *Hot Cell (R5/C5)*: A room that is restricted from personnel due to high radiation. A hot cell is constructed with thick concrete walls usually lined internally with stainless steel sheet. Process equipment located in the hot cell is connected to wall nozzles using jumpers. Process equipment in the hot cell is skid mounted and designed for either remote maintenance using crane-mounted services or, preferably, no maintenance over the 40 year design life of the WTP.
- 1.4.11 *Important to Safety (ITS)*: SSCs that serve to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the workers and the public. ITS encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (i.e., normal operation as well as accident mitigation). ITS includes SSCs designated as Safety Class (SC), Safety Significant (SS), and **additional protection class (APC)**
- 1.4.12 *Jumper*: A remotely removable section of pipework usually incorporating connector heads and some items of process equipment (i.e., valves, instruments, etc.).
- 1.4.13 *Commercial Material (CM)*: SC items and associated services (those that are not designated as SC or SS) that are manufactured using standard commercial practices.
- 1.4.14 *Paragraph*: When a paragraph of this specification, referenced documents, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced and all subparagraphs and sub-subparagraphs of the paragraph referenced shall be considered inclusive.
- 1.4.15 *Quality (Q)*: SC and SS items. NQA-1 (1989) compliance is required. **QL-1 and QL-2 designations are used by the Seller to comply with other referenced specification requirements (i.e. weld, design). These designations meet NQA-1 (Q) requirements and are not necessarily reflected in their associated Buyer's P&IDs.**
- 1.4.16 *Deleted*
- 1.4.17 *Rad*: A unit of energy absorbed from ionizing radiation, equal to 100 ergs per gram or 0.01 joules per kilogram of irradiated material.
- 1.4.18 *Additional Protection Class*: APC are ITS SSCs that are neither SC nor SS.

- 1.4.19 *R1*: Unrestricted area.
- 1.4.20 *R2*: Radiation controlled area.
- 1.4.21 *R3*: Radiation classification for plant areas considered average. Contamination area requiring anti-contamination clothing for entry. At early design stages, when insufficient information is available regarding worker occupancy, an initial target radiation level of 2.5 mRad/hr is to be used for the R3 classification.
- 1.4.22 *R4*: Radiation area (maximum).
- 1.4.23 *R5*: Radiation classification for areas considered to be high or very high radiation areas.
- 1.4.24 Reboiler and support frame assembly: Reboiler and pipe work up to and including PUREX nozzles, remote clamp connector hubs, and all permanently attached frame work.
- 1.4.25 *Safety Class (SC)*: SSCs that, by performing their specified safety function, prevent workers or the maximally exposed member of the public from receiving a radiological exposure that exceeds the accident exposure standards defined in the Safety Requirements Document (SRD). SC also applies to those features that, by functioning, prevent the worker or maximally exposed member of the public from receiving a chemical exposure that exceeds the ERPG-2 (AIHA 1988) chemical release standard. Those features credited for the prevention of a criticality event are also designated as SC.
- 1.4.26 *Safety Significant (SS)*: SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SCs that can, if they fail or malfunction, place frequent demands on or adversely affect the function of SC SSCs.
- 1.4.27 *Seismic Category I (SC-I)*: Equipment/tanks important to safety, which have a seismic safety function. For the design of Seismic Category I equipment/tanks, no credit for inelastic energy absorption is allowed. Seismic Category I equipment/tanks shall be functional during and after a Design Basis Earthquake (DBE).
- 1.4.28 *Seismic Category II (SC-II)*: Equipment/tanks important to safety whose failure during a seismic event could prevent a Seismic Category I structure, system, or component (SSC) from performing its seismic safety function. For the design of Seismic Category II equipment/tanks, credit for inelastic energy absorption is allowed. Seismic Category II equipment/tanks shall maintain control and confinement of hazardous materials during and after a Design Basis Earthquake (DBE), but do not need to be functional.
- 1.4.29 *Seismic Category III Equipment (SC-III)*: (a) SC and SS SSCs that do not have a natural phenomena hazard (NPH) safety function. (b) SCs that have a seismic safety function solely because they protect workers and members of the public from exposure to chemical hazards. (c) APC SSCs that provide primary

confinement of significant inventories of radioactive materials, but in amounts less than quantities that require an SC or SS designation.

1.4.30 *Seismic Category IV (SC-IV):* APC SSCs that have been designated as APC do not provide primary confinement of significant inventories of radioactive materials.

1.4.31 *Special Tools:* Any tooling which is not commercially available required to perform maintenance on the evaporator system.

1.4.32 *Acronyms*

- ALARA As Low As Reasonably Achievable
- AISC American Institute of Steel Construction
- ANSI American National Standards Institute
- APC **Additional Protection Class**
- ASD Adjustable Speed Drive
- ASD Manual of Steel Construction (Allowable Stress Design)
- ASME American Society of Mechanical Engineers
- ASNT American Society of Nondestructive Testing
- ASTM American Society for Testing and Materials
- AWS American Welding Society
- CFR Code of Federal Regulations
- CM Commercial grade
- DBE Design Basis Earthquake
- DOE US Department of Energy
- DOT Department of Transportation
- FEA **Finite Element Analysis**
- FEP Waste Feed Evaporator Process System
- GPM Gallons per minute
- ITS Important to Safety
- LAW Low-Activity Waste
- M Molarity
- MDS Material Data Sheet
- MR Material Requisition
- MSDS Material Safety Data Sheet
- NDE Nondestructive Evaluation/Examination
- NPS Nominal Pipe Size
- NQA Nuclear Quality Assurance
- OBE Operating Basis Earthquake
- ORP DOE Office of River Protection
- PEP Process Equipment Platform
- PMI Positive Material Identification
- P&ID Piping and Instrumentation Diagram
- PTF Pretreatment Facility
- QA Quality Assurance
- QAP Quality Assurance Program
- QAM Quality Assurance Manual
- QL Quality Level

- SBS Submerged Bed Scrubber
- SC Safety Class
- SS Safety Significant
- SC Seismic Category
- SSCs Structures, Systems, and Components
- SSPC The Society for Protective Coating
- RPP-WTP River Protection Project-Waste Treatment Plant
- TID Total Integrated Dose
- TLP Treated LAW Evaporator Process System
- SC Seismic Categor
- SDDR Supplier Deviation Disposition Request
- SG Specific Gravity
- UBC Uniform Building Code
- WT % Weight percent
- WTP Hanford Tank Waste Treatment and Immobilization Plant

## 1.5 Mechanical Data Sheets

Specific design parameters and requirements for evaporator components will be shown on the individual Mechanical Data Sheet (MDS) in section 2 of the MR. The data shall be considered as preliminary. Seller shall verify thermal, hydraulic, mechanical and process designs. Where necessary, the Seller shall change the data in order to furnish complete thermal, hydraulic, mechanical, and process guarantees. Any difference between Seller's final design and Buyer's preliminary data shall be brought to Buyer's attention for resolution and approval. Seller shall supply evaporator components that meet specified materials of construction, quality level, and seismic category as described on the MDS. The nominal feed chemistries used for the design should be based on Appendix A and B of this specification. Process design of the evaporator system is given in Appendix D of this specification.

## 1.6 Safety/Quality/Seismic Classifications

- 1.6.1 The quality level (QL) and seismic category (SC) of the major components of the evaporator system are specified on the data sheets in section 2 of the MR and Appendix E of this specification.
- 1.6.2 Seismic category (SC) classification requirements are specified in 24590-WTP-3PS-SS90-T0001, Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks and 24590-WTP-3PS-FB01-T0001, Specification for Seismic Qualification for Seismic Category III/IV Equipment and Tanks.

# 2 Applicable Documents

## 2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.

2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of award shall apply. Pre-approved acceptable alternate editions are listed in section 4.2.12. For codes and standards listed below, the specific revision or effective date of codes and standards that they incorporate by reference (daughter codes and standards), shall be followed. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing. For commercial grade quality items, Seller may use any year of the ASME or ASTM standards for materials.

## 2.2 Codes and Industry Standards

- 2.2.1 ASME B31.3-1996, Process Piping
- 2.2.2 ASME B16.5-1988, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Addend A
- 2.2.3 ASME B16.47-1990, Large Diameter Steel Flanges NPS 26 through NPS 60 Addenda A
- 2.2.4 ASME B18.15-1985, Forged Eye Bolts
- 2.2.5 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessel
- 2.2.6 ASME Boiler and Pressure Vessel Code, Section IX-1995 or later, Welding and Brazing Qualifications
- 2.2.7 ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facility Applications
- 2.2.8 ASME Y14.100, Engineering Drawing Practices
- 2.2.9 AISC ASD, 9th Edition, Manual of Steel Construction, Allowable Stress Design
- 2.2.10 AISC N690-1994, Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities
- 2.2.11 ANSI N14.6, For Radioactive Materials-Special Lifting Devices for Shipping Containers Weighing 10,000 Pounds (4500 kg) or More
- 2.2.12 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- 2.2.13 ASTM F594, Standard Specification for Stainless Steel Nuts
- 2.2.14 AWS D1.6, Structural Welding Code-Stainless Steel
- 2.2.15 AWS D9.1-1984 or later, Sheet Metal Welding Code

- 2.2.16 IEEE Std 1023-1988, IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations
- 2.2.17 MIL-STD-1629A, Military Standard, Procedures for Performing A Failure Mode, Effects and Criticality Analysis
- 2.2.18 UBC-1997, Uniform Building Code
- 2.2.19 10 CFR 835, Occupational Radiation Protection
- 2.2.20 49 CFR 173, General Requirements for Shipments and Packaging. Code of Federal Regulations. U.S. Department of Transportation, Washington, D.C.
- 2.2.21 29 CFR 1910, Occupational Safety and Health Standards
- 2.2.22 NFPA 101, Code for Safety to Life from Fire in Buildings and Structures
- 2.2.23 NFPA 70 -1999, National Electric Code
- 2.2.24 SSPC-SP10, Near White Metal Blast Cleaning
- 2.2.25 SSPC-SP11, Power Tool Cleaning to Bare Metal
- 2.2.26 WAC 296-24, General Safety and Health Standards
- 2.2.27 595, Colors Used in Government Procurement
- 2.2.28 E 709, Standard Test Method for Magnetic Particle Examination
- 2.2.29 ASCE 4-98, Seismic Analysis of Safety-Related Nuclear Structures and Commentary.
- 2.2.30 ASTM A193 Editions 1991 through 2005 Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
- 2.2.31 ASTM A194 Edition 1991 through 2005a, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service
- 2.2.32 ASTM A582, Any Year, Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled and Cold Finished.
- 2.2.33 ASTM A564 Editions 1988b, 1989, 1991, 1992, 1992a, 1994, 1995, 1997, 1999, 2001, 2002, 2002a, 2004, Standard Specification for Hot Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
- 2.2.34 SSPC-SP10, Near White Metal Blast Cleaning
- 2.2.35 SSPC-SP11, Power Tool Cleaning to Bare Metal
- 2.2.36 API 610-1995 Centrifugal Pumps for General Refinery Service

## 2.3 Reference Documents

### 2.3.1 Interfacing References

- 2.3.1.1 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements
- 2.3.1.2 24590-WTP-3PS-G000-T0002, Specification for Positive Material Identification (PMI)
- 2.3.1.3 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping, Handling, and Storage Requirements
- 2.3.1.4 24590-WTP-3PS-NWPO-T0001, Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping
- 2.3.1.5 24590-WTP-3PS-P000-T0001, Engineering Specification for Piping Material Classes General Description and Summary
- 2.3.1.6 24590-WTP-3PS-SS00-T0002, Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel
- 2.3.1.7 24590-WTP-3PS-SS90-T0001, Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks
- 2.3.1.8 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks
- 2.3.1.9 24590-WTP-3PS-EVV1-T0001, Specification for Low Voltage Adjustable Speed Drives
- 2.3.1.10 24590-WTP-3PS-MUMI-T0002, Specification for Low Voltage Induction Motors
- 2.3.1.11 24590-WTP-3PS-MPC0-T0002, Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components
- 2.3.1.12 24590-WTP-3PS-M000-T0002, General Specification for Mechanical Handling Equipment Design and Manufacture
- 2.3.1.13 24590-WTP-3PS-MJJ0-T0001, Engineering Specification for Lifting Beams for Mechanical Handling Equipment Important to Safety Quality Level II
- 2.3.1.14 24590-WTP-3PS-MV00-T0001, Engineering Specification for Pressure Vessel Design and Fabrication

- 2.3.1.15 24590-WTP-3PS-MV00-T0002, Engineering Specification for Seismic Qualification Criteria for Pressure Vessels
- 2.3.1.16 24590-WTP-3PS-MES0-T0001, Engineering Specification for Shell and Tube Heat Exchangers
- 2.3.1.17 24590-WTP-3PS-MVB2-T0001, Engineering Specification for Welding of Pressure Vessels, Heat Exchangers, and Boilers
- 2.3.1.18 24590-WTP-3PS-JQ07-T0001, Engineering Specification for Instrumentation for Package Systems
- 2.3.1.19 24590-WTP-3PS-PS02-T0001, Engineering Specification for Shop Fabrication of Piping
- 2.3.1.20 24590-WTP-3PS-SS00-T0001, Engineering Specification for Welding of Carbon Structural Steel.
- 2.3.1.21 24590-WTP-3PS-EKP0-T0001, Engineering Specification for Electrical Requirements for Packaged Equipment
- 2.3.1.22 24590-WTP-3PS-PP00-T0002, Engineering Specification for Dimensional Record Program.

#### 2.3.2 Developmental References

- 2.3.2.1 24590-PTF-3YD-FEP-00001, System Description for Waste Feed Evaporation Process (FEP)
- 2.3.2.2 24590-PTF-3YD-TLP-00001, System Description for Treated LAW Evaporation Process (TLP)
- 2.3.2.3 24590-WTP-3PS-MV00-T0003, Engineering Specification for Pressure Vessel Fatigue Analysis

#### 2.4 Reference Drawings / Data Sheets

- 2.4.1 24590-WTP-MV-M59T-00001, Pressure Vessel Tolerances Standard Details
- 2.4.2 24590-WTP-MV-M59T-00007, Thermowell Connection Standard Details
- 2.4.3 24590-WTP-MV-M59T-00009, Lifting Lugs Standard Details
- 2.4.4 24590-WTP-MV-M59T-00010, Tailing Lug Standard Details
- 2.4.5 24590-WTP-MV-M59T-00011, Wash Rings Standard Details
- 2.4.6 24590-WTP-MV-M59T-00012, Grounding Lug Standard Details
- 2.4.7 24590-WTP-MV-M59T-00016001, Vessel Connections Standard Details Sheet 1 of 3

- 2.4.8 24590-WTP-MV-M59T-00016002, Vessel Connections Standard Details Sheet 2 of 3
- 2.4.9 24590-WTP-MV-M59T-00016003, Vessel Connections Standard Details Sheet 3 of 3
- 2.4.10 24590-WTP-MV-M59T-00017, Vessel Inspection Manway Standard Details
- 2.4.11 24590-WTP-MV-M59T-00018, Vessel Name Plate Standard Details
- 2.4.12 24590-WTP-MV-M59T-00026, Anchor Bolt Chair Details for Vertical Vessels
- 2.4.13 24590-WTP-M0-M10T-00004, HLW & PTF Vitrification Systems HSH, RWH, PFH, PIH Design Proposal Drawing 3 Ton Capacity Lifting Hook
- 2.4.14 24590-WTP-M6-50-00001, P&ID Symbol and Legend Sheet 1 of 6
- 2.4.15 24590-WTP -M6-50-00002, P&ID Symbol and Legend Sheet 2 of 6
- 2.4.16 24590-WTP -M6-50-00003, P&ID Symbol and Legend Sheet 3 of 6
- 2.4.17 24590-WTP -M6-50-00004, P&ID Symbol and Legend Sheet 4 of 6
- 2.4.18 24590-WTP -M6-50-00005, P&ID Symbol and Legend Sheet 5 of 6
- 2.4.19 24590-WTP -M6-50-00006, P&ID Symbol and Legend Sheet 6 of 6
- 2.4.20 24590-PTF-P1-P01T-00001, Pretreatment Building General Arrangement Plan at El. 0'-0"
- 2.4.21 24590-PTF-P1-P01T-00002, Pretreatment Building General Arrangement Plan at El. 28'-0"
- 2.4.22 24590-PTF-P1-P01T-00007, Pretreatment Building General Arrangement Section A-A
- 2.4.23 24590-PTF-P1-P01T-00008, Pretreatment Building General Arrangement Section B-B
- 2.4.24 24590-PTF-P1-P01T-00009, Pretreatment Building General Arrangement Section C-C
- 2.4.25 24590-PTF-P1-P01T-00010, Pretreatment Building General Arrangement Section D-D
- 2.4.26 24590-PTF-P1-P01T-00011, Pretreatment Building General Arrangement Section E-E
- 2.4.27 24590-PTF-P1-P01T-00012, Pretreatment Building General Arrangement Sect. F-F and Sect. G-G

- 2.4.28 24590-PTF-P1-P01T-00013, Pretreatment Building General Arrangement Sect. H-H and Sect. J-J
- 2.4.29 24590-PTF-P1-P01T-00014, Pretreatment Building General Arrangement Sect. K-K and Sect. L-L
- 2.4.30 24590-PTF-P1-P01T-00015, Pretreatment Building General Arrangement Sect. M-M and Sect. N-N
- 2.4.31 24590-PTF-P1-P01T-00016, Pretreatment Building General Arrangement Sect. P-P and Sect. Q-Q
- 2.4.32 24590-PTF-P1-P01T-00017, Pretreatment Building General Arrangement Sect. R-R
- 2.4.33 24590-PTF-DD-S13T-00022, Pretreatment Facility Structural Concrete Embedments Key Plan Elevation 0 ft – 0 in
- 2.4.34 24590-PTF-DD-S13T-00023, Pretreatment Facility Structural Concrete Embedments Key Plan Elevation 0 ft – 0 in Sh 1
- 2.4.35 24590-PTF-DD-S13T-00025, Pretreatment Facility Structural Concrete Embedments Plan El 0 ft – 0 in Sh 3
- 2.4.36 24590-PTF-DD-S13T-00026, Pretreatment Facility Structural Concrete Embedments Plan El 0 ft – 0 in Sh 4
- 2.4.37 24590-PTF-DD-S13T-00027, Pretreatment Facility Structural Concrete Embedments Plan Elevation 0 ft – 0 in Sh 5
- 2.4.38 24590-PTF-DD-S13T-00028, Pretreatment Facility Structural Concrete Embedments Plan Elevation 0 ft – 0 in Sh 6
- 2.4.39 224590-PTF-DD-S13T-00029, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 7
- 2.4.40 24590-PTF-DD-S13T-00030, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 8
- 2.4.41 24590-PTF-DD-S13T-00031, Pretreatment Facility Structural Concrete Embedments Plan El. 0'-0" Sh 9
- 2.4.42 24590-PTF-DD-S13T-00036, Pretreatment Facility Structural Concrete Embedments EL 0 ft – 0 in Vessels Sh 1
- 2.4.43 24590-PTF-DD-S13T-00039, Pretreatment Facility Structural Concrete Embedments EL 0 ft – 0 in Vessels Sh 2
- 2.4.44 24590-PTF-DD-S13T-00042, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 1

- 2.4.45 24590-PTF-DD-S13T-00043, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 2
- 2.4.46 24590-PTF-DD-S13T-00044, Pretreatment Facility Structural Concrete Embedment Details EL 0 ft – 0 in Vessels Sh 3
- 2.4.47 24590-PTF-DD-S13T-00047, Pretreatment Facility Structural Concrete Embedment EL 0 ft – 0 in Misc Sh1
- 2.4.48 24590-PTF-DD-S13T-00049, Pretreatment Facility Structural Concrete Embedment EL 0 ft – 0 in Misc Sh 3
- 2.4.49 24590-PTF-MJD-PIH-00001, Mechanical Handling Data Sheet for Overhead Mast Power Manipulator
- 2.4.50 24590-PTF-M0-PIH-00008, Pretreatment System PIH Design Proposal Drawing 30 Ton Capacity Lifting Hook
- 2.4.51 24590-WTP-M61-P23T-00056, WTP Details Lower Holder Bottom Outlet Electrical Connector 2"
- 2.4.52 24590-PTF-SS-S15T-00311, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 1
- 2.4.53 24590-PTF-SS-S15T-00312, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 2
- 2.4.54 24590-PTF-SS-S15T-00313, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 3
- 2.4.55 24590-PTF-SS-S15T-00314, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 4
- 2.4.56 24590-PTF-SS-S15T-00315, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 5
- 2.4.57 24590-PTF-SS-S15T-00316, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 6
- 2.4.58 24590-PTF-SS-S15T-00317, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 7
- 2.4.59 24590-PTF-SS-S15T-00318, Pretreatment Facility Structural Misc Support Steel El. 0'-0" Plan Sh 8
- 2.4.60 24590-PTF-SS-S15T-00352, Pretreatment Facility Structural Misc Support Steel Details Sh 3
- 2.4.61 24590-PTF-SS-S15T-00354, Pretreatment Facility Structural Misc Support Steel Details Sh 5

- 2.4.62 24590-WTP-M61-P23T-00056, WTP Details Lower Holder Bottom Outlet Electrical Connector 2".
- 2.4.63 24590-WTP-M61-P23T-00057, WTP Assembly Lower Holder Electrical Connector 2 Inch.
- 2.4.64 24590-WTP-M61-P23T-00005, WTP Details - Nozzles PUREX Male Connector 1", 2", 3", 4"
- 2.4.65 24590-WTP-M61N-P23T-00006, Nozzles PUREX Connector 1", 2", 3", 4"
- 2.4.66 24590-WTP-M61-P23T-00040, WTP Details - Kickoff Plates PUREX Connector 1", 2", 3", 4"
- 2.4.67 24590-WTP-M61-P23T-00057, WTP Assembly Lower Holder Electrical Connector 2 Inch.
- 2.4.68 24590-WTP-P61-P27T-00001, WTP Standard Jumper Details
- 2.4.69 24590-PTF-M6-FEP-00001, P&ID - PTF Waste Feed Evaporation Process System Evaporator Feed Vessels FEP-VSL-00017A/B.
- 2.4.70 24590-PTF-M6-FEP-00002, P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001A.
- 2.4.71 24590-PTF-M6-FEP-00003, P&ID - PTF Waste Feed Evaporation Process System Condensers & Condensate Collection FEP-VSL-00005.
- 2.4.72 24590-PTF-M6-FEP-00004, P&ID - PTF Waste Feed Evaporation Process System Separator FEP-SEP-00001B.
- 2.4.73 24590-PTF-M6-FEP-00005, P&ID - PTF Waste Feed Evaporation Process System Condensers.
- 2.4.74 24590-PTF-M6-TLP-00001, P&ID - PTF Treated LAW Evaporation Process System LAW SBS Condensate Receipt TLP-VSL-00009A & 9B.
- 2.4.75 24590-PTF-M6-TLP-00002, P&ID - PTF Treated LAW Evaporation Process System Condensate Collection TLP-VSL-00002.
- 2.4.76 24590-PTF-M6-TLP-00003, P&ID - PTF Treated LAW Evaporation Process System Separator TLP-SEP-00001.
- 2.4.77 24590-PTF-M6-STR-00001, P&ID - PTF Strontium Nitrate, Sodium Permanganate, and Anti-foam Reagent Distribution (CM).

### 3 Design Requirements

#### 3.1 General

- 3.1.1 As Low As Reasonably Achievable (ALARA) principles shall be factored into the design and maintenance of the evaporator systems per 10 CFR 835, *Occupational Radiation Protection*.
- 3.1.2 Unless otherwise specified, the evaporator systems shall be designed and fabricated per applicable documents listed in section 2.0 of this specification, and the data sheets in section 2 of the MR. No changes, substitutions, or deviations shall be made without Buyer's concurrence.
- 3.1.3 The evaporator system design shall comply with the requirements stipulated in this specification. Seller shall conform with Buyer's requirements for hot cell wall penetrations, recirculation piping/jumper configuration, layout, dimension, location as shown in the Appendices I, J, and K. Seller shall confirm locations for all evaporator equipment are adequate for system functionality. Seller shall submit any variances to these requirements during design review stage for concurrence.
- 3.1.4 The evaporator piping and instrumentation sketches provided in the Appendix L of this specification illustrate the conceptual piping and instrument control of the evaporator systems. All evaporator systems or components shall have adequate control features to bring evaporator operations to a safe and stable 'shutdown' condition during an abnormal event. Seller's control design philosophy can differ from Buyer's conceptual control; however, the Seller's control system design shall conform to Buyer's specification 24590-WTP-3PS-JQ07-T0001.
- 3.1.5 General Arrangement drawings should be used to convey approximate equipment locations for skids. Equipment locations shown in the Appendices I, J, and K shall be maintained unless the design dictates an alternate location.
- 3.1.6 The Seller shall be responsible for the evaporator system design including component specification such as design parameters, sizing, pipe support loads, pipe hangers, anchors, pipe slopes and environmental protection (temperature, humidity, etc.) as required.
- 3.1.7 A means shall be provided to avoid accumulation of settled solids (e.g., sparging or removal of separator contents) in event of recirculation pump failure.
- 3.1.8 All heat exchangers including reboilers and condensers shall comply with ASME section VIII and TEMA standard, Class B. "Code Stamp" shall be provided for all Seller's provided heat exchangers.
- 3.1.9 Seller shall comply with nozzle loading requirements specified in Appendix V for SC-I and SC-II vessels/equipment.
- 3.1.10 Gusset plates cannot be utilized to accommodate the required nozzle loading on safety class vessels and heat exchangers.

- 3.1.11 The equipment shall be designed such that personnel sound level exposure outside of R5/C5 area shall not exceed 85 dBA. Seller shall clearly state how the specified sound level limit will be met.
- 3.1.12 All calculations, modeling, analyses, drawings, and documentation shall utilize U.S. customary units.
- 3.1.13 Design of the evaporator systems shall incorporate the latest and best proven technology, components, and materials for the required service conditions and performance.
- 3.1.14 The evaporator system model analysis, thermal analysis, design analysis, and seismic analysis shall be verified such that the final system, equipment and component design meet the requirements of this specification as well as its addenda and attachments.
- 3.1.15 Evaporator system equipment shall be furnished as discrete skid mounted units that are ready to integrate with the Buyer's structures, systems, and components.
- 3.1.16 The evaporator systems shall be identical in component count, capacity, and mode of operation and shall utilize common component types and equipment manufacturers.
- 3.1.17 The FEP and TLP Evaporator systems shall be designed in accordance with following feed conditions:
- Design FEP feed flow of 50 gpm
  - Design TLP feed flow of 38 gpm
  - Design feed temperature of 77 °F
  - Waste feed pH of 11 – 14
  - LAW SBS pH of 6.8
- 3.1.18 Normal design cooling water temperature of 75 °F with a peak summer maximum of 83 °F shall be used for designing/sizing all condensers. The cooling water temperature of 75 °F is valid for 85 % of the time through a year. During 15 % of the time when cooling water temperature is above 75 °F, the TLP evaporator system can be operated at a higher temperatures (i.e., 1.2 psia, 127 °F – 131 °F). This operating strategy is for short term operation and is to minimize cooling water flow.
- 3.1.19 Evaporator systems and components should be designed to prevent the migration of contamination into the utility / reagent systems.
- 3.1.20 Human factors and ergonomics shall be designed into all evaporator equipment requiring manual operations per IEEE Std 1023, *IEEE Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations*.
- 3.1.21 Quality level, seismic category, materials of construction, design pressure, and design temperature shall be in accordance with the data sheets in section 2 of the MR and Appendix E of this specification. If a change to the requirements for

materials and/or the equipment types to be used during the execution of the contract is dictated because of design analyses, then the Seller is required to provide Buyer its recommendation for review and concurrence prior to incorporation into the design of the evaporator systems.

- 3.1.22 All equipment in evaporator systems requiring maintenance or removal shall have flushing and draining capability to facilitate decontamination. Design features shall minimize the need for decontamination by including sloping features, replacing sharp bends with gradual bends, etc. where practical, consistent with ALARA practices.
- 3.1.23 Provision for temperature instrumentation shall be jumper nozzles incorporating the required thermowell details.
- 3.1.24 Nozzle and flange alignment shall be within  $\pm 0.5$  degrees of design specifications.
- 3.1.25 Jumper nozzle connections shall be included in the evaporator systems to interface with the Buyer supplied jumpers. Location and details of the connections shall be per Appendix P.
- 3.1.26 The reboiler support frame detail sketches provided in the Appendix P of this specification illustrate the conceptual design to support remotability.
- 3.1.27 Seller's reboiler frame design shall not protrude into the crane path as specified in Appendix P.
- 3.1.28 The hub type (remote clamp) connectors and PUREX nozzles are the only government-furnished equipment, which will be sent to Seller for installation. Buyer will provide Seller hydro test blanks for the remote clamp connectors (Grayloc) and the remote PUREX and other connectors for installation on the axial flow pumps and reboilers.
- 3.1.29 Nozzles for reboiler and support frame assemblies are to be designed to maintain positional tolerance during operational loading conditions and maintain structural integrity during and after a DBE. Preliminary loading information for the nozzle loads at Grayloc connections on the reboilers are provided in Appendix P.
- 3.1.30 All adjustable speed drives for pumps can be designed for non-radiation environment.
- 3.1.31 Seller's fabrication drawings shall be used as the document of record for fabrication of the components. Seller's specification drawings are not required to be revised and maintained in total agreement with approved fabrication drawings.
- 3.1.32 Regarding Buyer's specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packing, Handling, and Storage requirements*, the center of gravity and sling points are not needed for off-gas piping pieces and separator vessel support towers because they are awkward hollow parts that do not allow a meaningful center of gravity to be determined or designed. Multiple sling

configurations are possible to affect a successful lift and should be at the discretion of site construction supervisor.

3.1.33 Seller shall provide evaporator systems in the skids for ease of transportation, installation, and replacement. Seller is responsible for equipment skid sizing and layout to fit Buyer's facility. For the baseline design, each evaporator system will comprise the following skids:

- Separator vessel skids
- Reboiler and support frame assemblies.
- TLP feed pumps skid
- TLP concentrate pumps skid
- Primary condenser skids
- Secondary condenser skids which includes inter-condenser, after-condenser, and steam ejector
- Process condensate skids which includes vessel and pump
- Steam conditioning system which includes a pressure reducing valve and control and a desuperheater
- Antifoam skids which include vessel and pumps

### 3.2 Basic Function

The evaporator systems employ forced circulation and vacuum evaporation. The Waste Feed Process (FEP) evaporator system consists of two (2) identical evaporators which will be installed at the west end of the pretreatment facility (PTF). The Treated Low Activity Waste Process (TLP) evaporator system will be installed at the east end of the PTF.

Each evaporator will be designed to process 100 % of the design feed flow (50 gpm for each FEP system and 39 gpm for TLP system) with an evaporation feed rate of 30 gpm and to operate independent of each other. Normal operation of the FEP evaporator system consists of one evaporator operating at a time but simultaneous operation is possible. The FEP evaporators partially evaporate Waste Feed from the Department of Energy (DOE) and various recycle streams from within the pretreatment process. The Waste Feed is evaporated in order to optimize the operation of downstream unit operations. The Waste Feed flow is varied in order to control the level in the FEP separator. The FEP evaporator shall be designed to achieve a sodium concentration of 5 to 6M.

The LAW Submerged Bed Scrubber (SBS) condensate and treated LAW are fed to the TLP evaporator simultaneously. The treated LAW feed is fed continuously and at a constant rate while the flow of SBS condensate is varied in order to control the level in the TLP separator vessel. The TLP evaporator shall be designed to achieve a sodium concentration of 8 to 10M.

The feed stream is introduced into the recirculation loop on the suction side of the recirculation pump. The recirculation pump circulates the liquor at a rate of approximately 11,000 gpm. The pump discharges liquor through evaporator reboiler, which raises the temperature of the liquor by approximately 2 to 4 °F using 2.5 psig steam throttled from 40 psig low pressure steam supply to the building. This small temperature rise is necessary to prevent the liquor from boiling (fouling) in the tubes before it reaches the separator vessel. Sufficient hydrostatic head is maintained to suppress boiling inside the reboiler. When the

recirculating liquor reaches the separator vessel, flash evaporation occurs due to the reduced pressure in the vessel. The vapor flows through a series of separation trays and a removable demister pad section which are internal parts of the separator vessel. The vapor then flows to the primary condenser where the majority of the vapor is condensed. The noncondensables and a small amount of moisture are vented to the ejector/condenser vacuum system. The secondary condenser system consists of primary ejector, secondary ejector, inter-condenser, and after-condenser. The humid noncondensables from the primary condenser flow to the suction side of the primary ejector which discharges to the inter-condenser. The vent from the inter-condenser flows to the suction side of the secondary ejector which discharges into the after-condenser. The vent from the after-condenser flows to the facility vessel vent system. The secondary condenser system is designed to achieve a pressure of 1.0 to 1.3 psia in the separator vessel during normal operating conditions. The operating pressure is automatically controlled by an air in-bleed into the suction line of the primary ejector. This operating pressure lowers the boiling point of the liquor to approximately 122 °F which reduces potential corrosion of the evaporator by chlorides. Condensate from the condensers flows by gravity to the condensate vessel. Some of the condensate is drawn off and used to wash the demister pads in the separator vessel. Because of the foaming tendencies of evaporator feed chemistry, when foaming is anticipated in the separator vessel, antifoam will be continuously added.

### 3.3 Performance

- 3.3.1 All three (3) evaporator systems shall be capable of continuous operation while achieving a feed evaporation rate ranging from 10 to 30 gpm. The design feed evaporator rate shall exclude all water/fluid addition to demister pads spray, separation trays, and antifoam injection.
- 3.3.2 Each evaporator system shall operate independently.
- 3.3.3 Each evaporator system shall have the ability to be placed on "total reflux" mode.
- 3.3.4 A minimum decontamination factor of  $8.0E+06$  shall be achieved as defined in section 7.2.1, function test requirements, with consideration to achieving the evaporator stream operating conditions described in subsection 3.4 and the ALARA general design condition in subsection 3.1.
- 3.3.5 Evaporator system operating parameters shall minimize reboiler fouling by using low differential temperature and high tube velocity to the extent practical in the design.
- 3.3.6 The FEP evaporator systems shall produce waste concentration of 5 to 6M sodium (1.23 to 1.50 SG).
- 3.3.7 The TLP evaporator system shall produce waste concentration of 8 to 10M sodium (1.33 to 1.57 SG).
- 3.3.8 All evaporator system components within the R5/C5 black cell (except the demister pads) shall be nonreplaceable components with a design life of 40 years. Reboilers and recirculation pumps in the R5/C5 hot cell shall be remotely replaceable.

### 3.4 Design Conditions

#### 3.4.1 General

- 3.4.1.1 For nominal conditions refer to Appendix A and Appendix B for the FEP evaporator and TLP evaporator stream data, respectively. The data defines the system performance operating conditions and requirements. For predicted maximum radionuclides, refer to Appendix C.
- 3.4.1.2 All equipment skids shall meet applicable Department of Transportation (DOT) requirements for road transportation per 49 CFR 173.

#### 3.4.2 Physical Constraints/Interfaces

- 3.4.2.1 The FEP evaporator separator vessels (FEP-SEP-00001A/B) with demister pads shall be located in the R5/C5 black cell, room P-0106 on the 0-ft floor elevation. The TLP evaporator separator vessel (TLP-SEP-00001) shall be located in the R5/C5 black cell, room P-0117 on the 0-ft floor elevation. Demister pad assemblies shall be accessed through a sealed, shielded aperture in the 56 ft floor (10-ft diameter maximum). Refer to Appendices I and J for their locations and layout.
- 3.4.2.2 All Reboiler and support frame assemblies and recirculation pumps shall be located in the R5/C5 hot cell, room P-0123 on the 0-ft floor elevation. Each reboiler and support frame assemblies shall not weigh more than 27.5 tons including all lifting fixtures and lifting beams. The available space for each reboiler (excluding nozzles) has dimensions of 6 ft diameter by 15 ft high. All equipment assembly must fit through a 13 ft by 13 ft air lock door and shall not exceed 21 ft length. Assume air lock transportation cart is 3 ft high. The space envelope limitation of 6 feet diameter shall be used for mounting of remote connectors and seal flush reservoir on the recirculation pump assembly. Refer to Appendix P for location of reboiler and recirculation pump.
- 3.4.2.3 FEP evaporator primary condensers (FEP-COND-00001A/B) and secondary condenser system (FEP-COND-00002A/B, -00003A/B, and FEP-EJCTR-00040, -00041, -00042, -00043) shall be designed to fit in room P-0304 on the 56-ft floor elevation. TLP evaporator primary condenser (TLP-COND-00001) and secondary condenser system (TLP-COND-00002, -00003, and TLP-EJCTR-00064, -00067) shall be designed to fit in room P-0311 on the 56-ft floor elevation. Refer to Appendices I and J for locations and layout.
- 3.4.2.4 FEP evaporator condensate vessel and pump system (FEP-VSL-00005 and FEP-PMP-00006A/B) shall be designed to fit in room P-0105B (R2/C3) on the 0-ft floor elevation. TLP evaporator

condensate vessel and pump system (TLP-VSL-00002 and TLP-PMP-00002A/B) shall be designed to fit in room P-0118 (R2/C3) on the 0-ft floor elevation. Refer to Appendices I and J for locations and layout.

3.4.2.5 Antifoam vessel and pump system (AFR-TK-00001 and AFR-PMP-00006, -00007, -00008) shall be designed to fit in room P-0429 on the 77-ft floor elevation (R2/C2). Refer to Appendix K for locations and layout.

### 3.4.3 Buyer Supplied Utilities

Values for all utility supply pressures and temperatures are nominal values.

3.4.3.1 Plant service air and instrument air will be supplied at approximately 100 psig and 65 °F.

3.4.3.2 Deleted

3.4.3.3 High pressure steam supply conditions:

3.4.3.3.1 Minimum operating condition: 110 psig @ 344°F

3.4.3.3.2 Normal operating condition: 118 psig @ 349°F

3.4.3.3.3 Maximum operating condition: 135 psig @ 358°F

3.4.3.3.4 Design condition: 163 psig @ 372°F

3.4.3.4 Cooling water will be supplied at approximately 45 psig and 75 °F with a peak summer maximum of 83 °F. The cooling water temperature of 75 °F is valid for 85 % of the time through a year.

3.4.3.5 Demineralized water will be supplied at approximately 72.5 psig and 75 °F for demister pad and separation tray spray in the event that sufficient process condensate is unavailable.

3.4.3.6 Water, 5 M nitric acid at approximately 75 psig and 77 °F, or 50 % wt caustic at approximately 75 psig and 77 °F can be supplied for the Seller's flushing system.

### 3.5 Environmental Conditions

Environmental qualification is not applicable per Buyer's equipment qualification design guide.

#### 3.5.1 Storage

Prior to installation, the evaporator systems may be stored outdoors at ambient temperature extremes ranging from -30 °F dry-bulb to 117 °F dry-bulb and with a relative humidity of 0-100 %.

### 3.5.2 Evaporator Separator Vessels

The separator vessels (FEP-SEP-00001A/B and TLP-SEP-00001) will be installed indoors in an R5/C5 black cell maintained between 59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure for the FEP separator vessels (FEP-SEP-00001A/B) will be 1,000 – 1,800 Rad/hr. Radiation exposure for the TLP separator vessel (TLP-SEP-00001) will be 0.5 Rad/hr.

### 3.5.3 Reboilers and Recirculation Pumps

The reboilers (FEP-RBLR-00001A/B and TLP-RBLR-00001) and recirculation pumps (FEP-PMP-00009A/B and TLP-PMP-00001) will be installed indoors in an R5/C5 hot cell maintained between 59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure will be 1,000 Rad/hr.

### 3.5.4 Primary and secondary condensers

The FEP primary condensers (FEP-COND-00001A/B) and FEP secondary condensers (FEP-COND-00002A/B, -00003A/B, and FEP-EJCTR-00040, -00041, -00042, -00043) will be installed indoors in an R5/R3/C3 area maintained between 59 to 113 °F dry-bulb temperature during normal operation. The TLP primary condenser (TLP-COND-00001) and TLP secondary condensers (TLP-COND-00002, -00003, and TLP-EJCTR-00064, -00067) will be installed indoors in an R3/C3 area maintained between 59 to 113 °F dry-bulb temperature. Radiation exposure will be 10 mRad/hr during normal operation.

### 3.5.5 Condensate Vessels, Antifoam Vessel, Condensate Pumps, Antifoam Pumps, FEP Feed Pumps, FEP Concentrate pumps, and FEP/TLP Reboiler Steam Condensate Transfer Stations

The condensate vessels (FEP-VSL-00005 and TLP-VSL-00002), condensate pumps (FEP-PMP-00006A/B and TLP-PMP-00002A/B), and FEP/TLP reboiler steam condensate transfer stations (FEP-VSL-00021, FEP-PMP-00010A/B, FEP-VSL-00022, FEP-PMP-00011A/B, TLP-VSL-00047, TLP-PMP-00012A/B) will be installed indoors in an R2/C3 area. The antifoam vessel (AFR-TK-00001) and antifoam pumps (AFR-PMP-00006, -00007, and -00008) will be installed indoors in an R2/C2 area. The R2/C3 and R2/C2 areas are maintained between 59 to 113 °F dry-bulb temperature during normal operation. Radiation exposure will be 0.5 mRad/hr.

## 3.6 Feed Pumps

- 3.6.1 For feed pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.6.2 Two TLP feed pumps (TLP-PMP-00005A/B) shall be supplied by the Seller in accordance with Buyer's specification 24590-WTP-3PS-MPC0-T0002, *Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components.*

- 3.6.3 The TLP feed pumps shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility. Seal flush plan to API 7353.
- 3.6.4 Each TLP feed pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification 24590-WTP-3PS-EVVI-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*.
- 3.6.5 LAW SBS Condensate feed pumps (TLP-PMP-00005A/B) for the TLP evaporator system shall be supplied by the Seller. These pumps shall be designed for contact maintenance and designed for the following operating conditions. All fluid properties are referenced at 77 °F.
- 10 to 38 gpm
  - 1.0 to 16.3 cP
  - 1.0 to 1.41 SG
  - 68 to 167 °F
  - less than 3 wt % feed solids.
- 3.6.6 For FEP feed pumps (FEP-PMP-00007A/B), the sections for liquid property and operating conditions on the Mechanical Data Sheets (section 2 of the MR) shall be specified by the Seller. The Buyer will procure pumps which meet these criteria unless otherwise directed by the Seller as described in section 1.2.16. The following operating conditions shall apply. All fluid properties are referenced at 77 °F.
- 20 to 50 gpm
  - 4.2 to 12 cP
  - 1.0 to 1.29 SG
  - 59 to 122 °F
  - 0 to 10 wt % suspended solids
- 3.6.7 Treated LAW Collection vessel feed pump (CXP-PMP-00002A/B) for the Treated LAW evaporator system will be specified and provided by the Buyer for the following operating conditions. All fluid properties are referenced at 77 °F.
- 22 to 34 gpm
  - 0.6 to 5.0 cP
  - 1.0 to 1.26 SG
  - 59 to 113 °F
  - 0 wt % suspended solids
- 3.6.8 The feed pump flow rate shall be controlled by the separator vessel liquid level.
- 3.6.9 All waste feeds shall be transferred by the feed pump into the recirculation line on the suction side of the recirculation pump.

3.6.10 Deleted

### 3.7 Recirculation Pumps

- 3.7.1 For recirculation pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.7.2 The recirculation pumps shall be axial-flow type mounted vertically in an elbow of the recirculation loop. Structural support requirements for the recirculation pump shall be provided by the Seller with provision to transfer loads from the pump to the structural base rather than the pump nozzles or pump shaft/impeller.
- 3.7.3 Each recirculation pump shall be provided with a pump motor and an adjustable speed drive (ASD). Motors shall be provided with radiation resistant insulation, rated for  $10^9$  TID rad (gamma). The ASD shall be compliant with specification 24590-WTP-3PS-EVVI-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*.
- 3.7.4 The recirculating pumps shall have dual mechanical seals that will be lubricated/flushed with water. Flush piping will be based on API Plan 53. Seller shall coordinate with Buyer for details.
- 3.7.5 Inlet and outlet pipe ends of the recirculation pumps shall be prepared for butt welding.
- 3.7.6 Seller shall comply with API 610 nozzle loading requirements .
- 3.7.7 The recirculation pump nozzle locations shall be within ( $\pm$ ) 1/4 inch tolerance. However, the tolerance measurement device shall have a minimum of 1/1000 inch accuracy.
- 3.7.8 The recirculation pump remote flange mating surface shall be approximately at 12 ft-11 inches plant elevation. The pump and motor withdrawal length shall not be greater than 6 ft-1 inch. The dowel pins shall be 2 in diameter with the master being 1 ft-3 3/4 inches and the secondary being 1 ft-3/4 inch. The bolts shall be 1-1/4 inch ACME studs with 2 inches nuts.
- 3.7.9 The recirculation pumps shall be designed with the following features to ensure ease of process operating with a long expected mechanical lifetime:
- Low operating speed, high flow, and low head process conditions.
  - Low casing fluid velocity to minimize wear on the casing.
  - Top mounted motor and vertical removal design for easy crane access.
  - The recirculation pump motor, impeller, shafting, and seals shall be remotely removable as one unit by using a single crane hook and crane mounted impact wrench with CCTV cameras.

- 3.7.10 FEP recirculation pumps (FEP-PMP-00009A/B) shall be designed for the following operating conditions. All fluid properties are referenced at 77 °F.
- 11,000 gpm
  - 5.5 to 12 cP
  - 1.23 to 1.50 SG
  - 59 to 140 °F
  - 1 to 20 wt % suspended solids
- 3.7.11 TLP recirculation pump (TLP-PMP-00001) shall be designed for the following operating conditions. All fluid properties are referenced at 77 °F.
- 11,000 gpm
  - 0.68 to 30 cP
  - 1.33 to 1.57 SG
  - 77 to 145 °F
  - less than 4 wt % suspended solids

### 3.8 Concentrate Pumps

- 3.8.1 For concentrate pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.8.2 Two TLP concentrate pumps (TLP-PMP-00011A/B) shall be supplied by the Seller in accordance with Buyer's specification *24590-WTP-3PS-MPC0-T0002, Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components.*
- 3.8.3 Deleted
- 3.8.4 The TLP concentrate pumps shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility. Seal flush plan to API 7353.
- 3.8.5 Each TLP concentrate pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification *24590-WTP-3PS-EVV1-T0001, Engineering Specification for LAW Voltage Adjustable Speed Drives* and specification *24590-WTP-3PS-MUMI-T0002, Engineering Specification for Low Voltage Induction Motors.*
- 3.8.6 The concentrate pump flow rate shall be controlled by the specific gravity of the waste concentrate in the evaporator separator vessel.
- 3.8.7 For FEP concentrate pumps (FEP-PMP-00008A/B), the sections for liquid property and operating conditions on the Mechanical Data Sheets (section 2 of the MR) shall be specified by the Seller. The Buyer will procure pumps which meet these criteria unless otherwise directed by the Seller as described in section

1.2.16. The following operating conditions shall apply. All fluid properties are referenced at 77 °F.

- 3 to 34 gpm
- 5.5 to 12 cP
- 1.23 to 1.50 SG
- 59 to 140 °F
- 1 to 20 wt % suspended solids

3.8.8 The TLP concentrate pumps (TLP-PMP-00011A/B) shall be supplied by the Seller. The pumps shall be designed for contact maintenance and designed for the following operating conditions. All fluid properties are referenced at 77 °F.

- 5 to 14 gpm
- 0.68 to 30 cP
- 1.4 to 1.57 SG
- 68 to 145 °F
- less than 4 wt % suspended solids

### 3.9 Reboilers

- 3.9.1 For reboiler requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.9.2 The reboilers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-T0001, *Specification for Shell and Tube Heat Exchangers*. **Seller shall comply with nozzle loading requirements specified in Appendix V of this specification.**
- 3.9.3 The reboilers (FEP-RBLR-00001A/B and TLP-RBLR-00001) shall be of all welded construction on both tube and shell sides.
- 3.9.4 Reboiler tubes shall be seamless and welded to the tubesheet(s) with full strength welds. The tubes shall include a corrosion allowance of 0.04 inch for the process side.
- 3.9.5 The reboilers shall be capable of sustaining a water evaporation rate of 10 to 30 gpm based on a final SG of 1.50 for the FEP evaporator systems and 1.57 for the TLP evaporator system.
- 3.9.6 Reboiler process fluid velocity shall be greater than 4.0 ft/sec for solid suspension and not exceed 10 ft/sec velocities for minimal erosion effects.
- 3.9.7 The reboiler and support frame assemblies shall be designed for remote installation and replacement as one unit.
- 3.9.8 The reboiler and support frame assemblies shall be designed for horizontal transportation as one unit within the hot cell but for vertical installation with integral tailing features.

- 3.9.9 The maximum dimensions for a reboiler shall be 6 ft diameter and 15 ft height. The reboiler design shall be either multi-pass or U-tube heat exchanger with side bottom process fluid inlet and outlet.
- 3.9.10 The reboiler process fluid inlet and outlet nozzles shall be sized not greater than 24 inch diameter. Inlet and outlet pipe ends of the reboiler shall be prepared for butt welding.
- 3.9.11 Seller shall supply as-built dimensions for the nozzle locations upon completion of fabrication. Measurements shall be taken to the nearest 0.001 inch measuring equipment accuracy shall be within  $\pm 0.006$  inch.
- 3.9.12 Deleted
- 3.9.13 Pressure steam will be provided by Buyer. The Seller is responsible for providing steam conditioning skids. Each skid will include a pressure reducing valve and control and a desuperheater to produce Seller's specified saturated pressure steam for reboiler operation.
- 3.9.14 Seller shall provide specifications for steam condensate removal system. The steam condensate will travel from the reboiler through approximately 100 lateral feet and 2 vertical feet of pipe to the steam condensate vessel.
- 3.9.15 The reboiler shall be designed such that the static pressure of the process fluid above the reboiler is sufficient to suppress the boiling in the reboiler tubes. Boiling shall occur only near or at the liquid surface in the evaporator separator vessel.
- 3.9.16 The temperature rise of the process fluid as it passes through the reboiler shall be approximately 2 – 4 °F design basis to minimize the potential for tube fouling.
- 3.9.17 Reboiler will be installed without insulation. Reboiler duty and steam demand calculations shall include heat loss from all reboiler surfaces without insulation.

### 3.10 Evaporator Separator Vessels

- 3.10.1 For separator vessel requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.10.2 The separator vessels shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*. Seller shall comply with nozzle loading requirements specified in Appendix V of this specification.
- 3.10.3 The separator vessels shall be designed to maximize liquid – vapor separation and to achieve a 30 gpm feed evaporation rate.
- 3.10.4 The separator vessels shall incorporate nozzle connections for temperature (including thermowells), pressure, level, and density instrumentation as required. The Seller shall propose reliable measurement instrumentation for Buyer to review.

- 3.10.5 Deleted.
- 3.10.6 The top section of the separator vessel shall incorporate lateral guides to the 56 ft floor to minimize horizontal forces and base overturning moments during a seismic event.
- 3.10.7 The centerline elevation of the separator vessel offgas nozzles shall be no higher than 47 ft-0 inch plant elevation.
- 3.10.8 The separator vessel heads shall be removable for access to the demister pads section, which contains two layers of 12 inch thick Inconel 625 fine mesh.
- 3.10.9 The separator vessel shall incorporate a 2 inch inlet nozzle to supply sufficient dilution air to negate hydrogen buildup.
- 3.10.10 The separator vessel shall incorporate a series of three internal separation trays and an internal two-layer demister pads section to deentrain the steam droplets and remove solids from the vapor.
- 3.10.11 Spray nozzles shall be provided to allow nitric acid cleaning of the demister mesh and separation trays. The placement of spray nozzles shall accommodate demister section removal and not hinder maintenance operations.
- 3.10.12 A spray pipe with nozzles located below the lower demister pad shall be provided to spray demin water or recycled condensate into the steam flow to assist in mesh performance.
- 3.10.13 To improve demister efficiency and facilitate decontamination, the demister pads shall be sprayed from above and below with recycled condensate or 5 M nitric acid from a spray control system located at the 56 ft elevation. Sections of the demister pads shall be able to be sprayed either individually or collectively.
- 3.10.14 Differential pressure across a series of separation trays and the demisters pad section shall not significantly elevate boiling point.
- 3.10.15 All nozzle connection points shall be provided clear and below any surrounding floor structural steel at 56 ft plant elevation.
- 3.10.16 The antifoam nozzles of the evaporator separator vessel shall be located above the uppermost liquid level.

### 3.11 Primary Condensers

- 3.11.1 For primary condenser requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification
- 3.11.2 Primary condensers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-T0001, *Specification for Shell and Tube Heat Exchangers*.

- 3.11.3 The primary condensers (FEP-COND-00001A/B and TLP-COND-00001) shall be of all welded construction on the process fluid side. Tubes shall be welded to the tubesheets(s) with full strength welds.
- 3.11.4 Seller shall comply with nozzle loading requirements specified in **Appendix V of this specification.**
- 3.11.5 Condensers shall be designed with hinged bonnets to allow isolation of leaking tubes utilizing contact maintenance techniques.
- 3.11.6 Condensers shall be designed for retubing as part of the maintenance strategy.
- 3.11.7 Condensers shall be designed to maximize vapor condensation from the offgas streams at a nominal rate of 30 gpm.
- 3.11.8 Average cooling water temperature rise of 18 °F shall be used for condenser design.
- 3.11.9 Cooling water (tube side) pressure must exceed the process vapor (shell side) pressure.
- 3.11.10 The primary condensers shall be compatible with process condensate that has a pH of 7 to 10, a temperature of 122 °F, and a 0 to 300 ppm ammonium ion concentration. They shall also be compatible with 5M nitric acid used for separator vessel decontamination.
- 3.11.11 Primary condenser will be installed without insulation. Primary condenser duty and cooling water demand calculations shall include heat loss from all primary condenser surfaces without insulation.

### 3.12 Secondary Condenser System

- 3.12.1 The secondary condenser system shall consist of inter-condenser, after-condenser, and two steam ejectors. For secondary condenser system requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification.
- 3.12.2 Inter-condensers and after-condensers shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MES0-T0001, *Specification for Shell and Tube Heat Exchangers.*
- 3.12.3 Seller shall comply with nozzle loading requirements specified in **Appendix V of this specification.**
- 3.12.4 Inter-condensers and after-condensers shall be of all welded construction on the process fluid side. Tubes shall be welded to the tubesheets(s) with full strength welds.
- 3.12.5 The boiling point elevation range of the evaporator concentrate for the FEP evaporator system is approximately 11 to 18 °F and for TLP evaporator system is approximately 17 to 24 °F.

- 3.12.6 The evaporator separator vessel pressure shall be maintained by a two-stage vacuum ejector system. The first stage shall maintain a vacuum on the primary condenser and consists of a steam ejector, air in-bleed control valve, and an inter-condenser. The vapor discharged from the inter-condenser enters the second stage of the vacuum system. The second stage shall consist of a second steam ejector and an after-condenser.
- 3.12.7 The secondary condenser systems shall provide capability for operating at a vacuum as low as practicably achievable.
- 3.12.8 The two-stage vacuum ejector system shall be designed to control the separator vessel pressures at between 1.0 and 1.3 psia.
- 3.12.9 The desired vacuum within the separator vessel shall be obtained by automatically controlling the air in-bleed into the suction side of the first-stage vacuum ejectors.
- 3.12.10 Process condensate from each condenser shall be individually routed to the process condensate vessel.
- 3.12.11 All components of secondary condenser skid will be installed without insulation. The duty, cooling water demand, and steam demand calculations shall include heat loss from all surfaces without insulation.
- 3.12.12 Cooling water pressure must exceed the process vapor pressure.

### 3.13 Evaporator Process Condensate Vessels & Pumps

- 3.13.1 For process condensate vessel and pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendices I and J of this specification
- 3.13.2 The evaporator process condensate vessels shall be designed in accordance with Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 3.13.3 Seller shall comply with nozzle loading requirements for vessels specified in Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 3.13.4 The FEP evaporator process condensate vessel (FEP-VSL-00005) shall be designed for an operating volume of 4144 gallons (911-gallon batch).
- 3.13.5 The support frame shall be made such that the overflow nozzle centerline for the FEP evaporator process condensate vessel shall be at or above 15 ft-5 3/8 inches plant elevation.
- 3.13.6 The TLP evaporator process condensate vessel (TLP-VSL-00002) shall be designed for an operating volume of 2304 gallons (375-gallon batch).

- 3.13.7 The support frame shall be made such that the overflow nozzle centerline for the TLP evaporator process condensate vessel shall be at or above 17 ft-5 7/8 inches in plant elevation.
- 3.13.8 The evaporator process condensate vessels shall be equipped with interior wash rings to facilitate decontamination per standard drawing 24590-WTP-MV-M59T-00011.
- 3.13.9 Evaporator process condensate vessels and pumps shall be designed for contact maintenance.
- 3.13.10 Process condensate pumps shall be in accordance with Buyer's specification 24590-WTP-3PS-MPC0-T0002, *Engineering Specification for General Centrifugal Pumps to Meet Requirements of ASME B73.1M-1991 and ASME B73.2M-1991 for Commercial (CM) Components*.
- 3.13.11 Each process condensate pump shall be provided with an adjustable speed drive (ASD). The ASD shall be compliant with specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives* and specification 24590-WTP-3PS-MUM1-T0002, *Engineering Specification for Low Voltage Induction Motors*.
- 3.13.12 The process condensate pumps (FEP-PMP-00006A/B and TLP-MPM-00002A/B) shall be centrifugal type. Each pump shall be provided with a pump motor mounted on a common base plate for contact maintenance. The pumps are plumbed together for operational flexibility.
- 3.13.13 The FEP evaporator process condensate pumps (FEP-PMP-00006A/B) shall be designed for the maximum feed evaporation rate of 60 gpm (30 gpm per FEP evaporator) and maximum steam ejector demands. The TLP Evaporator condensate pumps (TLP-PMP-00002A/B) shall be designed for the maximum feed evaporation rate of 30 gpm and maximum steam ejector demands.
- 3.13.14 The process condensate vessels and pumps shall be compatible with process condensate that has a pH of 7 to 10, a temperature of 68 to 145 °F, and a 0 to 300 ppm ammonium ion concentration. They shall also be compatible with 5M nitric acid used for separator vessel decontamination.
- 3.13.15 The process condensate pumps shall have the ability to supply adequate condensate to the separation trays and demister pad sprays in the separator vessels.
- 3.13.16 Single mechanical seals shall be incorporated in each process condensate pump in accordance with American Petroleum Institute (API) Plan 11.
- 3.13.17 The process condensate pumps shall be designed to comply with pump nozzle loading requirements specified in API 610.

### 3.14 Antifoam Skid and FEP/TLP Reboiler Condensate Transfer Stations

- 3.14.1 For antifoam vessel and pump requirements, refer to individual MDS in section 2 of the MR and equipment sketches in Appendix K of this specification.
- 3.14.2 The antifoam vessel and reboiler condensate vessels shall be designed in accordance with Specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 3.14.3 Seller shall comply with nozzle loading requirements specified Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 3.14.4 One (1) antifoam system composed of a vessel (AFR-TK-00001) with three metering pumps (AFR-PMP-00006, -00007, -00008) shall supply antifoam reagent to both FEP and TLP evaporator systems.
- 3.14.5 The antifoam vessel (AFR-TK-00001) shall be designed for a maximum operating volume of 1500 gallons.
- 3.14.6 Deleted.
- 3.14.7 Each antifoam vessel shall be equipped with the following:
- Reagent inlet nozzle
  - Demineralized water inlet nozzle
  - Level instrumentation nozzle
  - Agitator to provide homogeneous antifoam solutions
- 3.14.8 The antifoam pumps shall be positive displacement metering types. The metering pump design shall include an internal relief valve or an internal bypass valve that automatically stops the pumping action when the line pressure gets above a setpoint.
- 3.14.9 Antifoam vessels and pumps shall be designed for contact maintenance.
- 3.14.10 Seller shall supply three (3) identical transfer stations, which collect steam condensate drained from the reboilers.
- 3.14.11 The transfer stations shall be designed to support continuous steady state operation in maintaining nominal operating level while receiving and supplying steam condensate to steam conditioning desuperheater and to a general condensate receiver.
- 3.14.12 The condensate transfer vessel design and configuration shall support installation of pressure-differential level instrumentation and associated flanged "direct connect diaphragm seal pressure transmitters.
- 3.14.13 The condensate transfer vessel shall be a vertical oriented vessel constructed of 304L stainless steel with a capacity of 225 gallons.

- 3.14.14 Each condensate transfer vessel shall be designed to be attached to a mounting ring which will be installed using anchor bolts.
- 3.14.15 The condensate transfer vessel shall be designed to support a minimum operating volume of 80 gallons.
- 3.14.16 The condensate transfer pumps shall be vertical turbine pumps with a by-pass valve to limit the pump discharge pressure preventing the motor to become overloaded. The pumps along with their motors shall be mounted on the transfer stations.
- 3.14.17 Single mechanical seals shall be incorporated in each condensate transfer pump in accordance with American Petroleum Institute (API) Plan 11.
- 3.14.18 The condensate transfer pumps shall be designed to comply with pump nozzle loading requirements specified in API 610.
- 3.14.19 The condensate transfer pumps and accessories shall be made of 300 series stainless steel. The pump materials of construction for wetted parts shall be cast high alloy steel 316 SS.
- 3.14.20 **A 2-inch nozzle on the side of each reboiler steam condensate vessel shall be provided for an additional condensate drain from the reboiler steam conditioning system desuperheater to function. Location of the 2-inch inlet drain nozzle is provided in Appendix L.**

### 3.15 Mechanical Handling Requirements

- 3.15.1 Equipment located in the R5/C5 hot cell shall be designed in accordance with Buyer's specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*.
- 3.15.2 Seller designed equipment shall incorporate jumper connector nozzles to facilitate process, utility, instrument, and power connections to the Buyer supplied jumpers and systems.
- 3.15.3 Equipment skids shall incorporate jumper nozzles for process pipework (e.g., pump suction and discharge connections, utilities, instrumentation, and power, as required).
- 3.15.4 Seller shall identify all interface points for systems requiring connection to the Buyer's process piping, jumpers, and utility systems.
- 3.15.5 The nozzle tolerance requirements for reboiler and recirculation pumps in the R5/C5 hot cell shall be  $\pm 1/4$  inch. The nozzle tolerance measurement device shall have a minimum of  $\pm 1/1000$  inch accuracy. Jumpers shall be built to as-built dimensions and replaced with equipment as necessary.
- 3.15.6 Deleted
- 3.15.7 Deleted

### 3.16 Loadings

- 3.16.1 The evaporator equipment assemblies shall be self-supporting, capable of carrying the static loads of components, and capable of handling stresses imposed during shipment, installation, operation and an earthquake.
- 3.16.2 Loads to be considered for the structural design of evaporator vessel, equipment, and components shall be in accordance with applicable codes, standards, and reference documents listed in section 2 of this specification.
- 3.16.3 All vessels or equipment with SC-I and SC-II designation shall be seismically analyzed and qualified in accordance with AISC N690 and requirements specified in the Appendix V.
- 3.16.4 All vessels or equipment with SC-III and SC-IV designation shall be seismically analyzed and qualified in accordance with the AISC ASD and UBC zone 2B.
- 3.16.5 Seller shall complete a seismic analysis of the evaporator package designs, including skids, and skid anchorage, equipment and pressure vessel anchorage, piping anchorage. Loadings shall be calculated in accordance with the appropriate requirements of Buyer's specifications 24590-WTP-3PS-SS90-T0001, Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks, and 24590-WTP-3PS-FB01-T0001, Structural Design Loads for Seismic Category III & IV Equipment and Tanks. Analysis shall show that the evaporator system and components are capable of withstanding seismic loadings.
- 3.16.6 All vessels, heat exchangers, and any other pressure containing vessels or equipment shall be seismically analyzed and qualified by the Seller per Buyer's specification 24590-WTP-3PS-MV00-T0002, *Engineering Specification for Seismic Qualification Criteria for Pressure Vessels*, Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 3.16.7 The Seller shall perform thermal and static stress analyses for all evaporator structures, systems, and components.
- 3.16.8 Except for reboiler and recirculation pump skids, all equipment skids shall be designed for a maximum floor loading of 160 lbs/ft<sup>2</sup>. Refer to drawings 24590-PTF-DD-S13T-00022, 24590-PTF-DD-S13T-00025, 24590-PTF-DD-S13T-00028, 24590-PTF-DD-S13T-00027, 24590-PTF-DD-S13T-00036, 24590-PTF-DD-S13T-00042, 24590-PTF-DD-S13T-00043, and 24590-PTF-DD-S13T-00044 for structural concrete embed details.
- 3.16.9 The embed location for reboilers are detailed on drawings 24590-PTF-DD-S13T-00025, 24590-PTF-DD-S13T-00027, 24590-PTF-DD-S13T-00028, AND 24590-PTF-DD-S13T-00049. Each embed has a support post which connects to the PEP. To avoid displacement in skid under the heavy reboiler weight, reboiler frame shall rest upon support posts with the embeds underneath. These embeds are type "D" which have been designed for ultimate compressive strength of 100 kips.

The flow meter unit of the steam conditioning skids for the FEP and TLP evaporator systems are SC-III items and may not be qualified at the accelerations defined in the Buyer's specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks, and 24590-WTP-3PS-FB01-T0001. Equivalent test can be performed and considered successful if there is no physical damage to the instrument. For the equivalent test, the flow meter units will undergo a frequency sweep (0 to 500 Hz) to determine their resonant frequency. Once the resonant frequency is determined, the units are tested at 1 g vertical and then 1 g horizontal for a period of twenty minutes each, all while being excited at the resonant frequency.

### 3.17 Electrical Requirements

- 3.17.1 The electric motor drive shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives*.
- 3.17.2 The pump motor and all other motors in this evaporator package shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*.
- 3.17.3 Seller shall comply with the requirements set forth in Buyer's specification 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*.

### 3.18 Instrumentation and Control Requirements

#### 3.18.1 General

- 3.18.1.1 All controls, control systems, control panels, alarm systems, analyzers, instrumentation, and their installation into the evaporator system shall conform to the requirements set forth in Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.
- 3.18.1.2 The Seller shall provide instrument data sheets and installation details. The Buyer will use this information for procurement and installation of required instrumentation.
- 3.18.1.3 The Seller shall provide functional test set points and recommended operating set points with the packaged systems.
- 3.18.1.4 The Seller shall supply the control requirements, which shall consist of the control loop definitions, system interlocks, alarms, and control philosophy.
- 3.18.1.5 The Buyer will use the Seller's control requirements to provide the software requirement specification for logic programming and DCS hardware, which will integrate the Seller's control requirements into the Buyer's overall control system.

3.18.1.6 Seller shall comply with NQA-1 1989, 11S-2, for computer program testing.

3.18.1.7 The following table describes the work processes and the division of the responsibilities:

	Buyer's Responsibility	Seller's Responsibility
Blank Instrument Data Sheet	•	
Complete Instrument Data Sheet		•
Instrument Installation Details		•
Instrumentation Procurement	•	
Instrumentation Installation	•	
Functional Test Set Points		•
Operating Set Points		•
Control Requirements		•
Software Requirements Specification	•	
Logic Programming	•	
DCS Hardware	•	

**3.18.2 Other**

The Seller shall select level, specific gravity, temperature, and pressure instrumentation that shall provide accuracy of the measured range as specified in Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.

**3.19 Lifting Requirements**

3.19.1 Seller shall identify the weight and center of gravity of each equipment skid.

3.19.2 Seller shall provide yokes for separator vessels, reboiler and support assemblies, and recirculation pumps for installation and remote maintenance. Each part will be made of 304SS. The yokes shall be designed for balanced lifting and handling by a single hook crane. The yokes shall be designed in accordance with ANSI N14.6 and Buyer's specification 24590-WTP-3PS-MJJ0-T0001, *Specification for Lifting Beams for Mechanical Handling Equipment*.

3.19.3 All evaporator equipment and skids shall have lift points and attachment mechanism. Lifting bail design shall comply with proposal hook design shown in Appendix G.

3.19.4 All lifting attachments shall have either a safety factor of three (3), based on the material yield strength, or five (5), based on the material ultimate strength, whichever is more conservative. The lifting points shall have a label clearly identifying its safe working load. If forged bolts are used, they shall be used in accordance with ASME B18.15.

3.19.5 The reboiler and support assemblies shall be designed for horizontal transportation in the hot cell following by vertical up-ending. The reboiler and

support assemblies shall have tailing lug and tilt-up features for vertical installation with a 2-ton hoist for tailing operation.

- 3.19.6 The lifting lugs shall be designed to permit lifting the equipment skid without distortion or damage to the components of the equipment skid.
- 3.19.7 All lifting points shall be proof tested in situ. Test and examination certificates shall be provided to the Buyer review.
- 3.19.8 Each reboiler and support frame assembly shall be lift tested by the Seller to demonstrate proper vertical orientation using the Seller-supplied lifting fixture. This testing includes verification of all tilt up features. Each reboiler shall be balanced after fabrication. Actual vertical lift (with vessel empty) shall not more than 1/4 inch from true verticality. Permanent deflection or a change in the assembly alignment is unacceptable. The Seller shall notify the Buyer a minimum of 15 working days in advance of reboiler and support frame assembly lift test. The Buyer may send representatives to witness the inspections or perform an independent inspection.

### **3.20 Accessibility and Maintenance**

#### **3.20.1 General Maintenance Requirements**

Accessibility and maintenance requirements shall be per this specification and its addenda and attachments.

#### **3.20.2 R5/C5 Black Cell Equipment Maintenance Requirements**

- 3.20.2.1 No equipment requiring maintenance, with the exception of demister pads, shall be located inside the R5/C5 black cells (rooms P-0106 and P-0117). The nonreplaceable 40-year life components shall include offgas piping, separator vessels and all its internal parts (except demister pads) and their supporting structures/anchorage.
- 3.20.2.2 Demister pad assembly shall be remotely removable and replaceable through a 10-foot diameter opening from the 56-foot elevation floor, rooms P-0304 and P-0311, which are directly above the black cells P-0106 and P-0117. If the water connections for the spray connections for the spray down mechanism are incorporated into the pad assembly, the connections shall utilize a quick disconnect type connection for the water source. Due to potential radiation and contamination concerns, viewing and removal of the of the demister pad will be accomplished with the top demister pads submerged approximately 6-inch below the water during the maintenance duration. Seller shall demonstrate and record on VHS format video tape demister pad removal and replacement in their shop test.

**3.20.3 R5/C5 Hot Cell Equipment Maintenance Requirements**

- 3.20.3.1 Reboiler and support frame assemblies and recirculation pumps in the R5/C5 hot cell shall be designed to be remotely removable and replaceable in accordance with specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design and Manufacture*. No components shall require special tools.
- 3.20.3.2 Reboiler and support frame assemblies and recirculation pumps in R5/C5 hot cell shall be designed in accordance with the requirements stated within this specification.
- 3.20.3.3 Each reboiler and support frame assembly shall not weigh more than 27.5 tons, including all required lifting fixtures.
- 3.20.3.4 All fittings, pipe connections, electrical power, and control connections for equipment in R5/C5 hot cell shall be engineered on jumpers suitable for remote operation using a crane hook and crane mounted impact wrench with CCTV cameras.
- 3.20.3.5 Reboiler and support frame assemblies and recirculation pumps shall be made suitable for remote operation utilizing features such as trunnions, guide pins, location dowels, captive bolts, and lead-ins on bolts, and be able to be removed using a crane hook and crane mounted impact wrench with CCTV cameras. Refer to Appendix G for remote impact wrench and drawings nos. 24590-WTP-M0-M10T-00004 and 24590-PTF-M0-PIH-00008 for crane details.
- 3.20.3.6 The use of shims to position reboiler and support frame assemblies or recirculation pumps in the R5/C5 hot cell is not allowed. All surfaces shall be machined to locate equipment and support remote handling and replaceability.
- 3.20.3.7 Due to the requirement of a 12-foot reserved path for equipment removal in the hot cell, Seller shall comply with the location requirements for reboiler and support frame assemblies and recirculation pumps as shown in sketches in Appendices I and Q.
- 3.20.3.8 All services to or from the recirculation pumps shall be provided using jumper connections.
- 3.20.3.9 The maximum height of any 2-inch hex nut (jumper connector), oriented vertically, is 24 ft-6 inches in plant elevation.
- 3.20.3.10 The maximum height of any 2-inch hex nut (jumper connector), oriented horizontally, is 25 ft-6 inches in plant elevation.
- 3.20.3.11 The maximum height of the 2 ton slewing hoist is 28 ft-6 inches.

3.20.3.12 The maximum height and hook approach of the 30 ton hook is distinctly different than the 2 ton hoist. Refer to the crane data sheet, 24590-PTF-MJD-PIH-00001 for details.

3.20.4 Deleted.

## 4 Materials

### 4.1 Positive Material Identification

Refer to Buyer's specification 24590-WTP-3PS-G000-T0002, *Specification for Positive Material Identification (PMI)* for PMI requirements. Seller shall submit documentation of all PMI test results which show chemical properties and material classification.

### 4.2 Construction

- 4.2.1 Seller shall specify surface finish for all materials and submit to Buyer for review.
- 4.2.2 Seller shall maintain a record of ASTM numbers, material test reports, and manufacturer material certifications for all materials used for construction of evaporator equipment/skids. Seller shall provide copies to the Buyer.
- 4.2.3 All stainless steel bolts and studs shall conform to ASTM F593.
- 4.2.4 All stainless steel nuts shall conform to ASTM F594.
- 4.2.5 Seller shall provide Material Safety Data Sheets (MSDSs) for all materials installed or used.
- 4.2.6 Process fluids may contain caustic solutions (50 wt % caustic), however 5 M nitric acid solutions may also be used for decontamination of the pipework, pumps, valves, and instruments/instrument tubing both inside and outside of the pipework assembly.
- 4.2.7 All flanges and pipe fittings shall conform to ASME B31.3 1996 and be weld-neck and long radius type, respectively, unless otherwise specified. Flanges shall also be in accordance with ASME B16.5, and B16.47 Series A, as applicable.
- 4.2.8 No threaded flanges or fittings shall be used in the black cells.
- 4.2.9 Certified material test reports shall be supplied for all stainless steel pipe, plate, sheet, and sections.
- 4.2.10 Selection of materials for threaded components shall minimize galling. Where the Seller determines that potential for galling is present assuming proper removal and reinstallation, designs shall be considered that favor components that are difficult to replace remotely. The Seller shall also consider different material selection, sleeving, etc. where practical.

4.2.11 All materials used in the construction of the evaporator equipment shall be new and unused. Where specific criteria are not provided, material section shall be determined by the Seller and have properties and composition suitable for the specific service conditions and consistent with this specification and its addenda and attachments.

4.2.12 The alternate ASTM and alternate ASME standard editions listed below can be used in lieu of the specified editions in effect.

Alternate Materials	Specified Materials
ASTM A182-98, A182-01	ASTM A182/A182M-99
ASTM A312-04	ASTM A312/A312M-00c
ASTM A403-95	ASTM A403/A403M-99
ASTM A403-99	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-403 / ASTM A403-95
ASTM A182-98	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-182 / ASTM A182-99
ASME 2001 Edition SA-312, 2003 Addenda SA-312  ASME 1995 Edition SA-312, 1995 Addenda SA-312	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-312 / ASTM A312-00c
ASME 1998 Edition SA-240, 2003 Addenda SA-240  ASME 1997 Addenda SA-240	ASME Section II Part A, 2001 Edition 2002 Addenda, SA-240 / ASTM A240-97a
ASTM A240-00, -02, -03, -03c, -04a	ASTM A240/A240M-03b
ASME SFA 5.22 Part C - 1995 Edition 1996 Addenda	ASME SFA 5.22, Section II, Part C 2001 Edition 2002 Addenda
ASTM A480-03c	ATM A480-03b
ASTM 554-98, -03	ASTM 554-98eJ
ASME SFA-5.9, SFA5.22 Sec III, Subsec NB, 1995 Edition, 1996 Addenda	ASME Code, Section II, 2001 Edition with 2002 Addenda (weld wire)
ASME A240-00, -03 /A240-01	ASME A240/A240M-03b

### 4.3 Vessels

Vessel materials shall conform to individual MDS in section 2 of the MR.

#### 4.4 Pipework

Pipework material shall meet the piping material requirements in Buyer's specification 24590-WTP-3PS-P000-T0001, *Specification for Piping Material Classes*.

#### 4.5 Prohibited Materials

- 4.5.1 Mercury and other low melting point metals, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of any components of the evaporator systems.
- 4.5.2 Molybdenum and halides shall not be used in direct contact with stainless steel.
- 4.5.3 Asbestos shall not be included in any component of the evaporator systems.
- 4.5.4 Halide containing materials shall not be used in any component of the evaporator systems.
- 4.5.5 "Teflon" or compounds thereof must be qualified for use with the radiation levels specified in this specification.

#### 4.6 Storage of Special Materials (e.g., stainless steel) prior to work

- 4.6.1 The Seller shall meet the storage requirements in Buyer's specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Shipping, Handling, and Storage Requirements*.
- 4.6.2 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.

## 5 Fabrication

The Seller shall obtain written Final Design Review from the Buyer prior to the start of fabrication activities.

### 5.1 General

- 5.1.1 Fabrication of vessels shall be performed in accordance with Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 5.1.2 Fabrication of pipework shall be performed in accordance with Buyer's specification 24590WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*.
- 5.1.3 Fabrication of mechanical handling equipment shall be performed in accordance with Buyer's specification 24590WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design and Manufacture*.

- 5.1.4 All fabrication shall be performed by personnel qualified in accordance with this specification and applicable documents in section 2 of this specification.

## 5.2 Welding

- 5.2.1 Seller shall develop detailed welding, weld inspection, NDE, and weld repair procedures for fabrication of the evaporator vessel, equipment, and structural supports. Seller shall submit them to the Buyer for review prior to fabrication. Procedures shall include acceptance criteria. The procedures shall conform to the following, as applicable:
- Buyer's Specification 24590-WTP-3PS-SS00-T0002
  - Buyer's Specification 24590-WTP-3PS-NWP0-T0001
  - Buyer's Specification 24590-WTP-3PS-MVB2-T0001
  - ASME Boiler and Press Vessel Code, section VIII, Div. 1
  - ASME B31.3-1996
  - AWS D1.6
  - AWS D9.1
- 5.2.2 Welding, weld inspection, NDE, and weld repair shall be carried out in accordance with the applicable procedures developed per section 5.2.1 above.
- 5.2.3 Each procedure shall be prepared and qualified in accordance with the requirements of the listed specification and standards in 5.2.1 above or ASME section IX, whichever is more stringent.
- 5.2.4 Welder qualifications shall be performed in accordance with ASME section IX or AWS as required.
- 5.2.5 Personnel performing weld inspection shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, section VIII, Div. 1 and Buyer's specification 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*.
- 5.2.6 Repairs required as a result of weld rejection by either the Buyer's or Seller's final inspection shall be fully documented in accordance with Seller's Quality Assurance Program (QAP). Weld repairs shall be performed in accordance with ASME Boiler and Pressure Vessel Code, section VIII. Weld repair records shall be included with Seller's quality verification document package to be submitted to Buyer.

## 6 Inspections and Examinations

### 6.1 Nondestructive Examinations

- 6.1.1 Unless otherwise specified, all vessel welds shall be inspected in accordance with the requirements outlined in the Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.

- 6.1.2 Unless otherwise specified all pipework welds shall be inspected in accordance with the requirements outlined in Buyer's specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*. For nondestructive examination (NDE) of fabricated pipe welds. Appendix O of this evaporator specification, 24590-PTF-3PS-MEVV-T0001, shall be used in replacement of Appendix A of specification for Shop Fabrication of Piping, 24590-WTP-3PS-PS02-T0001.

## 6.2 Dimensional Inspections

- 6.2.1 Refer to Buyer's specification 24590-WTP-3PS-PP00-T0002, *Specification for Dimensional Record Program*, for final dimensional measurement requirements. Third party validation of special dimensional inspection is not required.
- 6.2.2 Buyer's specification 24590-WTP-3PS-PP00-T0002, *Specification for Dimensional Record Program*, is applicable only to recirculation pumps and reboiler and support frame assemblies and does not apply to any other components.
- 6.2.3 For recirculation pumps, a dimensional record is required for removable pump features that are not part of the process jumper. The process portion of the recirculation pump will be installed in a jumper, and the jumper dimensional record will be performed by the Buyer.
- 6.2.4 For reboilers, all remote connector nozzles shall be measured to precise as-built dimensions.
- 6.2.5 Seller shall furnish personnel to perform measurement activities.

## 6.3 Visual Weld Inspections

- 6.3.1 The Seller shall develop and implement a procedure to perform visual weld inspections (visual tests, VT) to inspect each weld. The inspection procedure shall be developed in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and ASME B31.3 1996, and shall include inspection materials and acceptance criteria.
- 6.3.2 Acceptance criteria for visual weld inspections for vessels shall be in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and for pipework shall be in accordance with ASME B31.3 1996.
- 6.3.3 The Seller shall prepare a visual weld inspection report for each fabricated item.
- 6.3.4 Deleted.
- 6.3.5 Deleted.
- 6.3.6 The Seller shall notify the Buyer in advance of inspections. The Buyer may send representatives to witness inspections or perform independent inspections.

#### 6.4 Liquid Penetrant Test

- 6.4.1 The Seller shall develop and implement a procedure to perform a liquid penetrant test (PT) to inspect each weld. The procedure shall be developed in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and ASME B31.3 1996, and shall include inspection materials, dwell time for dye and developer, and acceptance criteria.
- 6.4.2 Acceptance criteria for PT inspection shall be in accordance with Buyer's specification 24590-WTP-3PS-MVB2-T0001, *Specification for Welding Pressure Vessels, Heat Exchangers and Boilers* and for pipework shall be in accordance with ASME B31.3 1996.
- 6.4.3 The Seller shall prepare a liquid penetrant test report for each weld connection on each fabricated item.
- 6.4.4 Deleted.
- 6.4.5 Deleted.
- 6.4.6 The Seller shall notify the Buyer in advance of testing. The Buyer may send representatives to witness testing or perform independent tests.

#### 6.5 Radiography

- 6.5.1 Radiographic examinations shall be carried out on all primary containment pipework butt-welds using 100 % radiography for QL components. For all other quality levels, refer to Appendix O of this specification for radiographic examination requirements.
- 6.5.2 The Seller shall develop and implement a procedure to perform radiographic weld examinations of piping butt-welds. The procedure shall be developed in accordance with ASME B31.3 1996, and shall include examination materials and acceptance criteria.
- 6.5.3 Deleted.
- 6.5.4 Deleted.
- 6.5.5 The Seller shall provide radiographic film with technique and reader sheets. Exposed film must be sent, along with a copy of the technique and reader sheets in accordance with section 3 of the MR. Film must be suitably packaged to preclude moisture and handling damage.
- 6.5.6 The Seller shall notify the Buyer in advance of examinations. The Buyer may send representatives to witness or perform independent examinations.

## 6.6 Magnetic Particle Examination

- 6.6.1 The Seller shall develop and implement a procedure to perform magnetic particle examination. The procedure shall be submitted to the Buyer for review prior to fabrication.
- 6.6.2 Magnetic particle examination (MT) shall be in accordance with ASTM Specification E709.
- 6.6.3 Welds specified under AWS D1.1 will be evaluated and accepted under criteria of AWS D1.1 Table 6.1.

## 6.7 Final Inspection

- 6.7.1 The Seller shall develop and implement a procedure for final inspection of each fabricated item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging. The inspections shall include inspection of all surfaces for contamination. Visible evidence of contamination is not acceptable.
- 6.7.2 The Seller shall prepare a final inspection report for each item, which documents the results of the final inspection. The Seller shall include the final inspection report in the documentation package for each piece.

## 6.8 Inspection and Test Status

The Seller shall maintain a positive system for identifying inspection and testing status of items and systems.

## 6.9 Control of Nonconforming Items

The Seller shall use the Supplier Deviation Disposition Request per MR section 2 to notify the Buyer of fabricated items and fabrication activities not conforming to the requirements. Any nonconforming work shall be redone by the Seller at Seller's cost.

# 7 Testing

## 7.1 Shop Tests

- 7.1.1 The Buyer reserves the right to witness all shop tests and shall be given a minimum of 10 working days written notice prior to each test date.
- 7.1.2 All pipework shall be hydrostatically tested in accordance with ASME B31.3 1996. Test water used for hydrostatic testing shall be tested for chlorides. The chloride content of the test water shall not exceed 50 ppm and the water temperature shall not exceed 120 °F. Buyer shall review all test pressures prior to commencement of any testing. The testing results shall be documented and provided to Buyer.

- 7.1.3 Testing of vessels shall be performed in accordance with Buyer's specification 24590-WTP-3PS-MV00-T0001, *Specification for Pressure Vessel Design and Fabrication*.
- 7.1.4 Functional tests of evaporator equipment/skids shall be performed by the Seller. **If the antifoam agitator is tested by the fabricator prior to shipment to the vessel shop, then functional test of the antifoam tank/agitator assembly as a unit is not required.**
- 7.1.5 Seller shall demonstrate and record on VHS format video tape demister pad removal. Test shall be done with equipment representative of what will actually be installed and utilized in the Buyer's facility.
- 7.1.6 Seller will furnish lifting yokes details for separator vessels, reboiler and support frame assemblies, and recirculation pumps. All Seller supplied lifting yokes shall be load tested to 1.5 times the design load.
- 7.1.7 Each evaporator equipment skid shall be lift tested by the Seller to demonstrate proper vertical orientation using the Seller-supplied tooling and fixtures. This testing includes verification of all tilt up features. During the lift test the deflection at the midpoint of each skid shall be monitored and recorded to ensure that proper alignment is maintained. The centerline of the evaporator skid shall be within  $\pm 1$  inch of true vertical when measured from the lift point. Permanent deflection or a change in the evaporator skid alignment is unacceptable.
- 7.1.8 Seller shall furnish blind flanges or other acceptable closures for the nozzles, as required for hydrotesting. Closures shall be removed after testing, unless they are required for shipment.
- 7.1.9 Deleted.
- 7.1.10 All test results shall be documented, certified, and submitted to the Buyer for review.

## 7.2 Integrated Acceptance Tests

**An Integrated Acceptance Test (stimulant test) using stable (non-radioactive) cesium is not required. The specified requirements provided in this section shall be used only for determining minimum separator decontamination factor.**

### 7.2.1 Performance

- 7.2.1.1 Limiting the entrainment of radionuclides from the evaporator to the primary condenser is an important safety function. During cold commissioning, the performance of the evaporator system will be measured using surrogate chemicals to determine the degree of entrainment from the evaporator to the primary condenser. Stable (nonradioactive) cesium will be the surrogate of choice for simulating radionuclide carryover to the condensing system.

- 7.2.1.2 Steady state operation is defined as:
- Liquid density of the concentrate ranges from 1.22 to 1.25 g/ml at operating temperature.
  - Sodium cation and nitrate, hydroxide, chloride anions are the predominate soluble chemical analytes in the concentrate.
  - The soluble concentration of stable (nonradioactive) cesium in the evaporator bottoms (concentrate) is no greater than 41.5 milligrams per liter.
- 7.2.1.3 The following criteria must be met prior to final acceptance of the evaporator system design:
- At steady state operation, the time-average mass rate of stable (nonradioactive) cesium carry-over from the evaporator to the condensing system shall not exceed 1.0 E-04 gram during any 24 hour period.
  - At steady state operation, the instantaneous mass rate of stable (nonradioactive) cesium carry-over from the evaporator to the condensing system shall not exceed 1.0 E-03 gram in any one (1) hour period.
- 7.2.1.4 The performance testing and acceptance criteria shall apply over a boil-off range from 10 gpm to 30 gpm of total condensate, as measured in the condensate receiver vessel.
- 7.2.1.5 Performance testing shall be corrected for uncertainty in instrument and analytical measurements.
- 7.2.1.6 Relative performance indicators include:
- The estimated mass distribution ratio (mass rate of cesium removed with the overhead/mass rate of cesium in the feed) at steady state is approximately 1.0E-07.
  - The estimated decontamination factor (concentration of cesium in the feed / concentration of cesium in the overheads) at steady state is approximately 8.0E+06.
  - The estimated concentration of cesium in the condensate from the condensing system ranges from 6.0E-04 to 1.8E-03 microgram per liter.

7.2.2 A full simulation of abnormal shutdown conditions.

## 8 Preparation for Shipment

### 8.1 General Requirements

- 8.1.1 The evaporator equipment/skids shall be packaged/prepared for shipment, handled, and stored in accordance with the following requirements in

- Section 7 of the MR.
  - Buyer's Specification 24590-WTP-3PS-G000-T0003, *General Specification for Packaging, Shipping, Handling, and Storage Requirements*.
  - Buyer's Specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*.
  - Buyer's Specification 24590-WTP-MV00-T0001, *Pressure Vessel Design and Fabrication*.
- 8.1.2 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person(s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.
- 8.1.3 Seller shall ensure that appropriate documentation is prepared for the evaporator equipment/skids. At a minimum, documentation shall include the following information, as applicable:
- Manufacturer name, model number, and serial number.
  - Skid number.
  - Plant item number.
- 8.1.4 Solvents and cleaning solutions used on stainless steel shall have a halogen content of less than 200 ppm.
- 8.1.5 Recirculation pumps will be shipped only in temporary shipping skids not meant for installation. The reboiler and support frame assemblies shall be transported from the Seller site to the Buyer site in the horizontal orientation due to air lock size limits.
- 8.1.6 Separator vessels will be shipped on temporary shipping skids. The installation skids are shipped separately, each in two pieces because of their height.
- 8.1.7 Lifting weight shall be clearly marked on both the equipment skid and its shipping documentation.
- 8.1.8 Regarding Buyer's Specification 24590-WTP-3PS-PS02-T0001, *Specification for Shop Fabrication of Piping*, polyethylene wrap can be used for off-gas piping pieces and subsequent blocking using Styrofoam cushioning and equivalent backed by plywood/wood to provide protection against damage or access by elements. Special end caps are not required.

## 8.2 Painting

- 8.2.1 Stainless steel shall not have coating applied.
- 8.2.2 Seller shall submit the information requested on Form H (see appendix S) along with technical data sheet and MSDS. Supplier shall provide Certificate of Conformance verifying application of coating in compliance with coating manufacturer's Technical Product Data Sheet.
- 8.2.3 All painting and coating shall be applied in accordance with the manufacturer's directions for application.

- 8.2.4 Exposed carbon steel surface shall be primed and painted with enamel base coating in accordance with the coating manufactures surface and application requirements. All visible oil, grease, dust, dirt, mill scale, rust, coating, oxides, corrosion products and other foreign matter shall be removed prior to application of primer. See section 8.2.14 and 8.2.15 for custom fabricated equipment.
- 8.2.5 In the absence of standard manufacturer's colors, the finish coat of all carbon steel items and equipment shall be ANSI 70 Gray. Contrasting colors shall be used for fasteners and bails.
- 8.2.6 Repainting by the Seller, or custom finishing by the manufacturer shall not be required when commercially available components and equipment which are normally mass produced, inventoried, supplied from stock, and have been coated with the manufacturer's standard coating system.
- 8.2.7 Surfaces exposed to the environment, but inaccessible after assembly, shall be coated prior to assembly.
- 8.2.8 Painting of interior and enclosed surfaces of the equipment, such as inside a welded box section, is not required.
- 8.2.9 Machined carbon steel mating surfaces and other surfaces not protected by coating system (such as seal surfaces, threaded surfaces, lifting hooks, hook nuts, wheel treads, gears, shafts, pinions, and couplings), shall be protected with a solvent cutback asphalt temporary preservative (Dauber Chemical Tectyl 891, EF Houghton Chemical Rust Veto 342 or Buyer's accepted equivalent) for shipment and storage. The Seller shall specify which preservatives must be removed and how the preservatives are removed by the Buyer before operation of the equipment.
- 8.2.10 Welds shall be coated only after completion of the required tests. Required tests include leak tightness, hydrostatic testing or other NDE of the welds.
- 8.2.11 Filler, sealant, and caulking compounds shall be compatible with the coating system.
- 8.2.12 The lifting fixtures for separator vessel shall be safety yellow # 13655 in accordance with FEP-STD 595B, *Colors Used in Government Procurement*. The lifting fixtures can be coated with the manufacturer's standard coating systems.
- 8.2.13 Items covered by 8.2.14 and 8.2.15, shall be surface prepared in accordance with SSPC SP10. For repair, the surfaces shall be prepared in accordance with SPPC SP11.
- 8.2.14 For support frames for steam conditioning skids and reboiler transporter, Seller shall use two coats (P04) of Epoxy with 4-6 mils per coat. Acceptable coating products for P04 are as follows:
- 8.2.14.1 Amercoat 385 from Ameron
- 8.2.14.2 Carboguard 890 from Carbonline

- 8.2.14.3 224HS from Devoe
  - 8.2.14.4 Protecto-Coat 330 or 300 from Dudick
  - 8.2.14.5 Intergard 475HS from International
  - 8.2.14.6 Macropoxy 646 from Sherwin Williams
- 8.2.15 For reboiler and recirculation pump lifting beams, Seller shall use three coats with 1st coat (P02) of Epoxy Primer with 3-5 mils and (P06) Epoxy Novolac with 5 - 10 mils for 2nd and 3rd coats. Acceptable coating products for P02 are as follows:
- 8.2.15.1 Amercoat 68HS from Ameron
  - 8.2.15.2 Carbozinc 859 from Carbonline
  - 8.2.15.3 313 from Devoe
  - 8.2.15.4 Interzinc 52 from International
  - 8.2.15.5 Zinc Clad IV from Sherwin Williams
- Acceptable coating products for P06 are as follows:
- 8.2.15.6 Amercoat 91 from Ameron
  - 8.2.15.7 Phenoline 1205 FR from Carbonline
  - 8.2.15.8 253 from Devoe
  - 8.2.15.9 Protecto-Coat 100XT or EN from Dudick
  - 8.2.15.10 Intertherm 875 HS from International
  - 8.2.15.11 Macropoxy 646 from Sherwin Williams

### 8.3 Tagging

- 8.3.1 Tagging of the evaporator component, equipment, and skids shall be per this specification and the applicable documents listed in section 2 of this specification. Plant item numbers for evaporator component/equipment shall be per the data sheets that are in section 2 of the MR.
- 8.3.2 Instruments shall have nameplates installed per section 8 of Buyer's specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.
- 8.3.3 Motors shall have nameplates per section 3 of Buyer's specification 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*.

- 8.3.4 Packages shall be suitably marked on the outside to facilitate identification of the purchase order, the procurement specification, the package contents, and any special handling instructions.
- 8.3.5 Slinging points and orientation for storage shall be clearly marked.
- 8.3.6 Temporary material such as bolting and shipping material shall have clear identification per sections 3.13 and 3.13.12 of Buyer's specification 24590-WTP-GPP-GCB-00100, *Field Materials Management*.
- 8.3.7 A stainless steel nameplate shall be rigidly attached to the evaporator equipment skid packages in a prominent position for ease of visibility, and shall include the following:
- Manufacturer's name.
  - Shop location.
  - Date of manufacture.
  - Serial number.
  - Skid number.
  - Weight of assembly.
  - Purchase order number.

## 9 Quality Assurance

### 9.1 General Commercial Designation (CM) Requirements

- 9.1.1 The Seller's Quality Assurance Program (QAP) Requirements are included in 24590-WTP-3PS-G000-T0001, *Supplier Quality Assurance Program*.
- 9.1.2 Seller's QAP Manual shall be submitted to buyer for review in accordance with 24590-WTP-3PS-G000-T0001, *Supplier Quality Assurance Program*.
- 9.1.3 Seller's QAP, as a minimum, shall contain the requirements of DOE Order 414.1A as detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in section 2 of the MR. The very same requirements shall be passed down to any lower tier subcontractor.

### 9.2 Quality Level (QL) Requirements

- 9.2.1 Seller shall have in place a QA program meeting the requirements marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Buyer's specification 24590-WTP-3PS-G000-T0001.
- 9.2.2 Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Supplier shall allow the Buyer, its agent, and DOE access to their facilities and records pertaining to this purchase order for the purpose of QA Audits and Surveillance at mutually agreed times.

- 9.2.3 All items shall be manufactured in accordance with the Supplier's Quality Assurance Program that has been previously evaluated and accepted by the RPP-WTP Quality Organization. The very same requirements shall be passed down to any lower tier subcontractor.
- 9.2.4 Seller shall submit their QA program and work plan to Buyer for review prior to commencement of work. The 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.

## 10 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item Numbers shown in the attached data sheets in section 2 of the MR. Each item shall be identified in accordance with section 8.3 of this specification.

## 11 Documentation and Submittals

### 11.1 General

- 11.1.1 Seller shall submit to Buyer all detailed designs, drawings, documentation, procedures, instructions, calculations, analyses, manufacturer documentation, manufacturer data, inspection reports, test reports, certifications, certificates, manuals, MSDSs, video tapes, and drawings required per this specification, the applicable codes, standards, and reference documents in section 2 of this specification, and the MR.
- 11.1.2 All detailed designs, drawings, assembly drawings, shop drawings, final P&IDs, MDSs, supporting calculation, supporting analyses, and all other requirements in the 60 % design stage shall be issued to the Buyer for review prior to fabrication of evaporator vessels and equipment.
- 11.1.3 Seller 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 MR, section 3.
- 11.1.4 Seller shall submit a report identifying any deviations and/or conflicts per section 2 of the MR to the Buyer for review.
- 11.1.5 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages each.
- 11.1.6 All documents submitted for review (e.g., General Arrangement, Shop Details, Calculations must contain their own unique NAME AND IDENTIFICATION NUMBER) Example:

Calculations for Item:  
Document No: Calc TLP-PMP-00001-0001

- 11.1.7 Data sheets in section 2 of the MR shall be marked up by the Seller and submitted to the Buyer for review with the detailed design. Seller shall fill in all information that is marked as asterisk or TBD and markup actual overall dimensions for each evaporator component, equipment, and skid based on the detailed design.
- 11.1.8 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, Engineering Drawing Practices.

## 11.2 Calculations

All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- A concise statement of the purpose of the calculation.
- Input data, applicable criteria, and stated assumptions.
- A list of references used, including drawings, codes, standards, and computer programs (indicate the version or issue date).
- A discussion of rationale used for design assumption basis.
- Equations used for all computations.
- Numerical calculation including identification of units used.
- A concise statement addressing the calculation results and/or recommendations.
- A table of contents for complex calculations.

**Design Stress/Seismic Reports shall provided, as a minimum, the following information**

### 11.2.1 ANSI/AISC N690 Steel Frame / Support Designs

**For Finite Element Analysis (FEA) by Computer Program, submit the bases or reference to the bases that supports applicability of the computer program to the specific physical problem being solved. (i.e; application /validation to steel code formulas and allowable stresses)**

### 11.2.2 ASME VIII, Div 2, Appendix 4, Vessel including internal supports/components

**For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. (i.e; application/validation to the ASME VIII, Div 2, Appendix 4, Maximum Shear Stress Theory.)**

### 11.2.3 ASME B31.3 Piping Design

**For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. [i.e; application/validity to the ASME B31.3 design requirements in accordance with B31.3-96, section 300(c)(3)]**

### 11.3 As-Built Drawings

#### 11.3.1 Progress As-Builts

During construction, the Seller shall keep an updated marked-up set of progress as-built drawings on the jobsite as an accurate record of all deviations between the work, as shown on the Buyer reviewed drawings, and work as fabricated. These drawings shall be available to the Buyer for inspection at any time during regular business hours.

#### 11.3.2 Final As-Builts

Seller shall furnish to Buyer final as-built drawings with AS-BUILT clearly printed on each sheet for all final work left in place. Seller shall accurately and neatly transfer all deviations from progress as-builts to final as-builts.

### 11.4 Dimensional Record Drawings

See 24590-WTP-3PS-PP00-T0002 for final dimensional measurement requirements. Third party validation of special dimensional inspection is not required. Seller shall furnish to Buyer dimensional record drawings for reboiler and support frame assemblies, and recirculation pumps with all their associated lifting yokes and/or lifting lugs.

### 11.5 Project Start

Seller shall submit drawing index and detailed schedule of engineering document submittals, material purchases, fabrication, shop test, and ready for shipment. Include bar charts or critical path method diagrams, which detail the chronological sequence of activities.

### 11.6 30 % Design Review

11.6.1 Provide drawings with outline dimensions, services, foundations, and mounting details of all three (3) evaporator systems. Drawings shall show external envelope, including lugs, centerline(s), location and size for electrical cable, conduit, fluid, other service connections, isometrics, and details related to foundations and mountings.

11.6.2 Provide preliminary dimension, location, and layout for all evaporator component, equipment, and skids.

11.6.3 Provide preliminary design of the demister pads replacement methodology.

11.6.4 Provide preliminary system description. Describe general system functions and basis of design. It shall include a systematic process flow diagram for system operation.

11.6.5 Provide preliminary Piping and Instrumentation Diagrams (P&IDs).

- 11.6.6 Provide preliminary instrument control requirements. Include system interlocks and control philosophy. Provide flow charts, schematics, logic diagrams, or function diagrams showing the equipment functional controls.
- 11.6.7 Provide document that describes the proposed equipment skids, including sketches of typical skids indicating skid-to-skid and skid-to-building interfaces, as well as the components included.
- 11.6.8 Identify all large and heavy items of equipment to ensure lifting capability during construction, maintenance, and decommissioning.
- 11.6.9 Provide preliminary electrical drawings, schematics, wiring drawings, and motor data sheets per Buyer's specifications 24590-WTP-3PS-MUMI-T0002 and 24590-WTP-3PS-EKP0-T0001.

### 11.7 60 % Design Review

- 11.7.1 Provide final P&IDs.
- 11.7.2 Provide final skid constructability study.
- 11.7.3 Provide final evaporator component, equipment, skid size, and layout.
- 11.7.4 Provide assembly drawings.
- 11.7.5 Provide shop detail drawings with sufficient detail to facilitate fabrication, manufacture, or installation. This includes a complete Bill of Materials (BOM), pipe spool drawings, internal piping and wiring details, cross-section details, and structural details.
- 11.7.6 Provide wiring diagrams including schematic diagrams, equipment internal wiring diagrams, and interconnection wiring diagrams for electrical items.
- 11.7.7 Submit completed Instrument and Mechanical data sheets for all instruments and equipment, utilizing Buyer's supplied instrument data sheet samples attached in section 2 of the MR as templates.
- 11.7.8 Provide functional test setpoints and recommended operating set points for the instrumentation and control packaged systems.
- 11.7.9 Provide final instrument control requirements including control loop definitions, system interlocks, alarms, and control philosophies. Control and sequencing requirements of the system and its components shall be detailed as described in section 3.5 of 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.
- 11.7.10 Submit all final detailed drawings, calculations, analyses, and information necessary for evaporator vessels and equipment fabrication.
- 11.7.11 Submit all FMEA documentation.

- 11.7.12 Provide final electrical drawings, schematics, wiring drawings, motor data sheets, nameplates per Buyer's specifications 24590-WTP-3PS-MUMI-T0002 and 24590-WTP-3PS-EKP0-T0001.

## 11.8 90 % Design Review

- 11.8.1 Provide detailed written procedures, instructions, and drawings (including all lifting requirements) for evaporator system erection/installation.
- 11.8.2 Provide complete remote installation instructions for the utilization of the hot cell existing cranes for the needed reorientation, installation, and extraction of the reboiler.
- 11.8.3 Provide instrument installation details.
- 11.8.4 Provide list of required spares.
- 11.8.5 Provide startup and commissioning spares list, including all components or equipment that may be needed during startup and commissioning.
- 11.8.6 Provide operation manuals with detailed written instructions describing how the evaporator systems and components should be operated. Manuals shall include specific instructions, procedures, and illustrations for the following:
  - 11.8.6.1 Safety Precautions – List personnel hazards and equipment or product safety precautions for all operating conditions.
  - 11.8.6.2 Operator Prestart – Include requirements to set up and prepare each system for use.
  - 11.8.6.3 Start-up, Shutdown, and Post-shutdown Procedures – Include a control sequence for each of these operations.
  - 11.8.6.4 Normal Operations – Include control diagrams with data to explain operation and control of systems and specific equipment.
  - 11.8.6.5 Emergency Operations – Include emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, over-pressure, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.
  - 11.8.6.6 Operator Service Requirements – Include instructions for services to be performed by the operator, such as lubrication, adjustments, and inspections.
  - 11.8.6.7 Environmental Conditions – Include a list of environmental conditions (temperature, humidity, and other relevant data) which

are best suited for each product or piece of equipment and describe conditions under which equipment should not be allowed to run.

- 11.8.6.8 Lay-up Instructions – Include step-by-step instructions for lay-up.
- 11.8.7 Provide maintenance manuals with detailed written instructions to disassemble, reassemble, and maintain systems or components in an operating condition. Manuals shall include specific instructions, procedures, and illustrations for the following phases of maintenance:
  - 11.8.7.1 Preventive Maintenance - Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair:
    - 11.8.7.1.1 Lubrication Data – Include lubrication data, other than instructions for lubrication, in accordance with operator service requirements to be included in operation manuals.
    - 11.8.7.1.2 Preventive Maintenance Plan and Schedule – Include manufacturer’s schedule for routine preventive maintenance, inspections, testing, and adjustments required to ensure proper and economical operation and to minimize corrective maintenance and repair. Provide manufacturer’s projection of preventive maintenance frequency of work, and hours to complete the task. Provide surveillance and in-service inspection recommendations.
  - 11.8.7.2 Corrective Maintenance – Include manufacturer’s schedule for procedures and instructions for correcting problems and making repairs. Include the following information for performing corrective maintenance:
    - 11.8.7.2.1 Troubleshooting Guide and Diagnostic Techniques – Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.
    - 11.8.7.2.2 Wiring Diagrams and Control Diagrams – Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factor-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing, as well as the terminals for each type, identical to actual installation numbering.

- 11.8.7.2.3 Maintenance and Repair Procedures – Include instructions and list tools required to restore product or equipment to proper condition or operating standards.
- 11.8.7.2.4 Removal and Replacement Instructions – Include step-by-step procedures and list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide all tolerances, dimensions, settings, and adjustments required. Instructions shall include a combination of text and illustrations.
- 11.8.7.2.5 Recommended Spare Parts and Supply Lists – Include list of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Include the cost of each item.
- 11.8.7.2.6 MSDSs – Include MSDSs for all chemicals and hazardous materials supplied as part of the product, system, or equipment. In addition, include MSDSs for all chemicals and hazardous materials required to be added (lubricants, antifreeze, etc.).
- 11.8.7.2.7 Parts Identification – Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustration and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.
- 11.8.7.2.8 Other than Seller's Commercial Practice – End item manufacturer may add a cross-reference to implement component assemblies and parts requirements when implementation in manual form varies significantly from the style, format, and method of Seller's standard commercial practice.

- 11.8.7.2.9 Warranty Information – List and explain the various warranties and include the servicing and technical precautions prescribed by the Seller or contract documents to keep warranties in force.
- 11.8.7.2.10 Personnel Training Requirements – Provide information available from the Seller to use for training designated personnel to operate and maintain the equipment and systems properly.
- 11.8.7.3 Calibration Testing Equipment and Special Tool Information – Include information on test equipment required to perform specific tests and on special tools needed for the operation, maintenance, and repair of components.
- 11.8.8 Provide system, component, and instrumentation descriptions as identified below:
  - 11.8.8.1 System Descriptions - Include comprehensive system description describing, in detail, how the overall system functions, and the basic design basis. Include component interfaces and interactions. Provide a systematic process flow diagram for system operation.
  - 11.8.8.2 Component Descriptions – Include comprehensive component descriptions describing, in detail, how each individual process component functions and the basic design basis. Include other component interfaces and interactions. Provide a systematic process flow diagram for component operation.
  - 11.8.8.3 Instrument Descriptions – Include a list or table describing instrument ID number, ID name, location, and basic operating function. Include separately, in systematic descriptive detail, instrument controls and logic that correspond to instrumentation and logic diagrams.
- 11.8.9 Provide design and operational requirements per the following:
  - 11.8.9.1 Design requirements – Include a list or table describing the maximum design limits and conditions required to safely operate the equipment (i.e., temperatures, pressures, etc.).
  - 11.8.9.2 Operational requirements – Include a list or table describing the normal operating ranges for equipment (i.e., temperatures, pressures, etc.).
- 11.8.10 Provide analysis and design reports, including analytical data (stress, electrical loading, fluid dynamics, etc.) which demonstrates that an item satisfies all specified requirements.

- 11.8.11 Provide seismic analysis or test data reports providing data and demonstrating suitability of materials, components, or systems in relation to the conditions imposed by the stated seismic criteria.
- 11.8.12 Provide thermal stress analysis or test data reports providing data and demonstrating suitability of materials, components, or systems in relation to the conditions imposed by thermal stresses.
- 11.8.13 Provide site storage and handling manuals including the requirements and time period for lubrication, rotation, heating, lifting, or other handling requirements to prevent damage or deterioration during storage and handling at job site. Include return shipping instructions.
- 11.8.14 Provide inspection and test plan including detailed descriptions of the inspections and tests planned during the receipt, manufacturing, and conformance verification activities. Include identification of witness and hold points.
- 11.8.15 Provide welding procedures, specifications, and supporting qualification records required for welding, hard facing, overlaying, brazing, and soldering.
- 11.8.16 Provide material control procedures including controlling issuance, handling, storage, and traceability of materials such as weld rod.
- 11.8.17 Provide PMI procedures for performing PMI testing of materials.
- 11.8.18 Provide repair procedures including controlling material removal and replacement by welding, brazing, etc., subsequent thermal treatments, and final acceptance inspection.
- 11.8.19 Provide pressure testing procedures including hydro, air, leak, separation, or vacuum test procedures for performing hydrostatic or pneumatic structural integrity and leakage tests.
- 11.8.20 Provide inspection procedures for the purpose of determining that specified requirements (i.e., dimensions, properties, performance results, etc.) are met.
- 11.8.21 Provide radiographic testing procedures for identifying the presence and certain characteristics of discontinuities and inclusions in materials by x-ray or gamma ray exposure of photographic film.
- 11.8.22 Provide liquid penetrant testing procedures for detection of surface discontinuities in materials by application of a penetrating liquid in conjunction with suitable developing techniques.
- 11.8.23 Provide functional shop test procedures to demonstrate that design function and operational parameters are met (e.g., pump performance data, valve stroking, load, temperature rise, calibration, environment, etc.).
- 11.8.24 Provide integrated acceptance test requirements document per engineering specifications to demonstrate design function and operational parameters for the complete assembled evaporator systems.

11.8.25 Provide electrical test procedures to demonstrate that design function and operational parameters are met (e.g., impulse, overload, continuity, voltage, temperature rise, calibration, saturation loss, etc.).

11.8.26 Provide shipping preparation procedures for cleaning, packaging, and handling.

## 11.9 Final Design Review

Provide final design report including all design documents, manuals, and drawings that are specified in this specification. All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to evaporator components, equipment, and skid shipment.

**APPENDIX A**  
**WASTE FEED EVAPORATOR**  
**STREAM DATA**

24590-PTF-3PS-MEVV-T0001, Rev 2  
 Forced Circulation Vacuum Evaporator System

Stream Description	Evaporator Feed	Evaporator Concentrate	Process Condensate
Specific Gravity	1.050882E+00	1.197295E+00	1.000072E+00
pH	1.227066E+01	1.305375E+01	9.325531E+00
Total Volume (gpm)	1.962454E+01	3.234591E+00	1.710009E+01
Total Mass (lb/hr)	1.030370E+04	1.934908E+03	8.544156E+03
Na Molarity	8.231085E-01	5.000000E+00	3.116202E-05
Activity (Ci/gallon)			
129-I	1.070549E-07	6.456333E-07	7.335298E-10
134-Cs	6.794152E-06	4.120906E-05	2.202542E-09
137-Cs	1.531654E-01	9.292679E-01	1.866905E-09
14-C	4.343208E-06	2.632459E-05	4.923495E-09
126-Sn	3.687065E-07	2.235285E-06	3.195409E-10
233-U	7.147865E-07	4.333113E-06	6.729994E-10
235-U	5.308471E-09	3.218466E-08	4.216552E-12
152-Eu	1.787821E-06	1.083834E-05	1.612622E-09
154-Eu	1.047067E-04	6.347777E-04	9.210747E-08
155-Eu	2.783818E-05	1.688275E-04	1.307200E-08
237-Np	1.743947E-07	1.057294E-06	1.462592E-10
238-Pu	1.558783E-06	9.457271E-06	1.600678E-13
239-Pu	2.427044E-05	1.472509E-04	1.683651E-12
240-Pu	6.791157E-06	4.120253E-05	7.334047E-13
241-Am	1.539731E-04	9.341677E-04	4.075735E-11
243-Am	5.791005E-05	3.513452E-04	7.425120E-12
242-Cm	2.927004E-07	1.774511E-06	2.511805E-10
241-Pu	5.791005E-05	3.513452E-04	7.425120E-12
243-Cm	4.125221E-08	2.501032E-07	3.356803E-11
244-Cm	8.401929E-07	5.093914E-06	6.825013E-10
3-H	1.025165E-05	2.637668E-05	6.775766E-06
60-Co	1.897588E-06	1.150925E-05	6.773841E-10
90-Sr	2.251101E-02	1.365762E-01	1.437153E-09
99-Tc	5.315124E-04	3.223320E-03	2.669563E-07
125-Sb	6.485595E-05	3.931850E-04	1.619373E-07
Specific Mass (wt%)			
Ag+	0.0000851	0.0004528	0.0000000
Al+3	0.1407107	0.7486167	0.0001564
B+3	0.0002618	0.0013935	0.0000002
Ba+2	0.0001225	0.0006518	0.0000001
Bi+3	0.0001670	0.0008883	0.0000002
Ca+2	0.0023604	0.0125596	0.0000022
Cd+2	0.0006340	0.0033758	0.0000000
Cl-	0.0256441	0.1362996	0.0000587
CO3-2	0.3966942	2.1103727	0.0004730
Cr(TOTAL)	0.0140436	0.0747823	0.0000005
Cs+	0.0001128	0.0006007	0.0000000

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F-	0.0209444	0.1115277	0.0000010
Fe+3	0.0111118	0.0591522	0.0000045
Hg+2	0.0001399	0.0007446	0.0000001
K+	0.0677068	0.3604479	0.0000230
La+3	0.0004065	0.0021647	0.0000000
Li+	0.0002899	0.0015438	0.0000000
Mg+2	0.0002586	0.0013766	0.0000001
Mn+4	0.0012678	0.0067511	0.0000001
Mo+6	0.0002105	0.0011200	0.0000002
Na+	1.8061286	9.6176128	0.0000717
NH3	0.0163755	0.0051900	0.0185725
Ni+2	0.0023278	0.0023372	0.0022779
NO2-	0.4747226	2.5269331	0.0002360
NO3-	3.5169979	18.6961248	0.0073514
OH(BOUND)	0.1876967	0.9986652	0.0001926
OH-	0.0301822	0.1605662	0.0000360
Pb+2	0.0007719	0.0040181	0.0000209
Phosphor containing components	0.0646907	0.3441493	0.0000768
Se+6	0.0010836	0.0057700	0.0000001
Si+4	0.0121852	0.0648277	0.0000137
SO4-2	0.0669264	0.3561423	0.0000570
Sr+2	0.0000854	0.0004544	0.0000001
Ti+4	0.0000312	0.0001660	0.0000000
TOC	0.0494322	0.2459911	0.0039049
U(TOTAL)	0.0002514	0.0013377	0.0000003
Zn+2	0.0001314	0.0006996	0.0000000
Zr+4	0.0115379	0.0613963	0.0000102
H2O	92.3882691	63.2687429	99.9664571
H+	0.0000000	0.0000000	0.0000000
CO2	0.0000000	0.0000000	0.0000000
Total Dissolved Solids (Na Excluded) (wt%)	5.0601243	26.7981844	0.0334712
Total Suspended Solids (wt%)	0.7454780	0.3154599	0.0000000

**APPENDIX B**  
**TREATED LAW EVAPORATOR**  
**STREAM DATA**

**24590-PTF-3PS-MEVV-T0001, Rev 2**  
**Forced Circulation Vacuum Evaporator System**

Stream Description	Feed Treated LAW	Feed Neutralized Effluent	Concentrated LAW	Condensate from LAW Evap
Specific Gravity	1.201279E+00	9.960371E-01	1.354830E+00	1.000211E+00
pH	1.400000E+01	1.199980E+01	1.400000E+01	1.108047E+01
Total Volume (gpm)	1.398842E+01	9.800359E+00	8.316158E+00	1.574299E+01
Total Mass (lb/hr)	8.395616E+03	4.877051E+03	5.629209E+03	7.867172E+03
Na Molarity	4.654928E+00	9.564147E-02	8.001080E+00	1.384081E-04
Activity (Cl/gallon)				
129-I	4.749081E-07	0.000000E+00	7.940393E-07	2.531875E-09
134-Cs	1.575297E-08	4.663790E-10	2.703969E-08	4.038980E-12
137-Cs	3.359384E-04	9.978015E-06	5.768332E-04	3.256697E-12
14-C	3.582432E-05	0.000000E+00	6.019971E-05	3.147259E-08
126-Sn	1.430030E-06	0.000000E+00	2.403044E-06	1.256318E-09
233-U	8.109593E-07	0.000000E+00	1.362748E-06	7.124486E-10
235-U	7.044819E-09	0.000000E+00	1.183822E-08	6.189054E-12
152-Eu	1.012468E-05	0.000000E+00	1.701366E-05	8.894794E-09
154-Eu	1.453164E-04	0.000000E+00	2.441918E-04	1.276642E-07
155-Eu	3.750157E-05	0.000000E+00	6.301818E-05	3.294609E-08
237-Np	6.467932E-07	0.000000E+00	1.086881E-06	5.682244E-10
238-Pu	1.128371E-06	0.000000E+00	1.898007E-06	2.681847E-13
239-Pu	2.250086E-05	0.000000E+00	3.784818E-05	5.347876E-12
240-Pu	6.141525E-06	0.000000E+00	1.033052E-05	1.459683E-12
241-Am	1.046161E-04	0.000000E+00	1.759723E-04	6.571346E-11
243-Am	4.604254E-05	0.000000E+00	7.744709E-05	1.094313E-11
242-Cm	3.178432E-07	0.000000E+00	5.341082E-07	2.792334E-10
241-Pu	4.604254E-05	0.000000E+00	7.744709E-05	1.094313E-11
243-Cm	4.969903E-08	0.000000E+00	8.351496E-08	4.366187E-11
244-Cm	9.701220E-07	0.000000E+00	1.630207E-06	8.522771E-10
3-H	4.475971E-05	0.000000E+00	3.012124E-05	2.385981E-05
60-Co	5.350007E-06	0.000000E+00	8.990228E-06	4.700118E-09
90-Sr	1.768254E-02	0.000000E+00	2.974328E-02	6.760816E-08
99-Tc	1.119640E-04	0.000000E+00	1.881459E-04	9.836324E-08
125-Sb	2.554858E-04	0.000000E+00	4.293221E-04	2.244509E-07
Specific Mass (wt%)				
Ag+	0.0001789	0.0000000	0.0002666	0.0000002
Al+3	0.8781368	0.0000000	1.3083917	0.0009266
B+3	0.0011040	0.0000000	0.0016449	0.0000012
Ba+2	0.0003972	0.0000000	0.0005919	0.0000004
Bi+3	0.0009166	0.0000000	0.0013656	0.0000010
Ca+2	0.0036401	0.0000000	0.0054235	0.0000039
Cd+2	0.0001758	0.0000000	0.0002620	0.0000002
Cl-	0.1927241	0.3081970	0.5533995	0.0007536
CO3-2	1.8709695	0.0000000	2.7876764	0.0019741
Cr(TOTAL)	0.0436851	0.0000000	0.0651518	0.0000013

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Forced Circulation Vacuum Evaporator System**

Cs+	0.0000002	0.0000000	0.0000003	0.0000000
F-	0.1369480	0.0311205	0.2312023	0.0000068
Fe+3	0.0051922	0.0000000	0.0077362	0.0000055
Hg+2	0.0002119	0.0017125	0.0002775	0.0000002
K+	0.4371071	0.0000000	0.6517338	0.0001319
La+3	0.0000717	0.0000000	0.0001068	0.0000001
Li+	0.0001031	0.0000000	0.0001537	0.0000001
Mg+2	0.0007039	0.0000000	0.0010487	0.0000007
Mn+4	0.0003630	0.0000000	0.0005408	0.0000004
Mo+6	0.0014914	0.0000000	0.0022221	0.0000016
Na+	8.9124915	0.2205096	13.4830308	0.0003183
NH3	0.0556091	0.0000000	0.0046946	0.0559853
Ni+2	0.0010718	0.0000000	0.0000905	0.0010791
NO2-	3.6214624	0.0000000	5.3989608	0.0015931
NO3-	8.2610982	0.1691503	12.4458561	0.0154626
OH(BOUND)	1.2709676	0.0000000	1.8936954	0.0013410
OH-	1.9297357	0.0170413	2.8899856	0.0020466
Pb+2	0.0022422	0.0000000	0.0032374	0.0000764
Phosphor containing components	0.2305136	0.0000000	0.3434569	0.0002432
Se+6	0.0007265	0.0000000	0.0010825	0.0000008
Si+4	0.0190601	0.0000000	0.0283989	0.0000201
SO4-2	0.4242482	0.0000000	0.6322928	0.0003199
Sr+2	0.0002059	0.0000000	0.0003067	0.0000002
Ti+4	0.0000875	0.0000000	0.0001303	0.0000001
TOC	0.1782369	0.0000016	0.2481087	0.0126807
U(TOTAL)	0.0014123	0.0000000	0.0021042	0.0000015
Zn+2	0.0001606	0.0000000	0.0002393	0.0000002
Zr+4	0.0092074	0.0000000	0.0137187	0.0000097
H2O	71.5070307	98.7871894	55.3633120	99.9050111
H+	0.0000000	0.0000000	0.0000000	0.0000000
CO2	0.0000000	0.0000000	0.0000000	0.0000000
Total Dissolved Solids (Na Excluded) (wt%)	19.5804777	0.5272233	29.5260185	0.0946707
Total Suspended Solids (wt%)	0.0000000	0.4650777	1.6276387	0.0000000

## APPENDIX C

### Predicted Maximum Radionuclide

**24590-PTF-3PS-MEVV-T0001, Rev 2**  
**Forced Circulation Vacuum Evaporator System**

Stream Number	Waste Feed Evaporators			Treated LAW Evaporator		
	FEP Feed	FEP Concentrate	FEP Overhead	TLP Feed	TLP Concentrate	TLP overhead
Specific Gravity	1.108297E+00	1.291591E+00	1.000111E+00	1.105304E+00	1.278000E+00	1.000163E+00
pH	1.312459E+01	1.389913E+01	1.017151E+01	1.321351E+01	1.386570E+01	1.029492E+01
Total Volume (gpm)	1.921589E+01	3.462492E+00	2.248903E+00	1.074593E+01	2.391253E+00	1.179073E+00
Total Mass (lb/hr)	1.066579E+04	2.239702E+03	8.426084E+03	5.948428E+03	1.530498E+03	4.417929E+03
Na Molarity	1.678973E+00	1.000000E+01	6.235205E-05	2.217504E+00	9.964802E+00	8.915611E-05
<b>Activity (Cl/gallon)</b>						
129-I	1.118972E-06	5.133318E-06	1.657679E-06	6.388461E-07	2.124451E-06	1.513816E-06
134-Cs	1.129467E-04	6.250516E-04	2.728177E-06	2.084563E-08	9.341234E-08	5.370692E-10
137-Cs	4.359059E+00	2.419159E+01	2.232506E-06	4.525083E-04	2.033504E-03	4.407797E-10
14-C	1.530790E-05	8.491637E-05	5.895986E-08	8.056168E-06	3.616737E-05	7.268873E-08
126-Sn	1.923017E-04	1.067222E-03	1.486077E-10	2.043400E-08	9.173655E-08	1.841322E-10
233-U	1.150416E-06	6.384484E-06	1.248818E-11	1.717230E-09	7.709344E-09	1.547408E-11
235-U	6.946466E-07	3.853045E-06	3.162332E-09	4.348219E-07	1.952093E-06	3.918211E-09
152-Eu	6.188336E-04	3.434357E-03	6.581440E-10	9.049626E-08	4.062746E-07	8.154683E-10
154-Eu	6.562753E-02	3.642143E-01	8.345943E-07	1.147543E-04	5.151790E-04	1.034060E-06
155-Eu	3.737761E-02	2.074354E-01	2.034016E-07	2.796783E-05	1.255590E-04	2.520201E-07
237-Np	9.537993E-05	5.293324E-04	2.536272E-10	3.487470E-08	1.565667E-07	3.142584E-10
238-Pu	4.520421E-04	2.508710E-03	2.573295E-11	1.309172E-06	5.883206E-06	3.191544E-11
239-Pu	3.985830E-03	2.212027E-02	5.228669E-11	2.660106E-06	1.195409E-05	6.484898E-11
240-Pu	2.153818E-04	1.195310E-03	4.564062E-11	2.321981E-06	1.043461E-05	5.660605E-11
241-Am	4.833846E-02	2.682652E-01	3.172753E-09	6.111128E-05	2.746230E-04	3.937305E-09
241-Pu	2.838034E-02	1.575032E-01	8.472452E-10	4.310391E-05	1.937020E-04	1.050802E-09
242-Cm	4.706917E-15	2.611634E-14	8.863463E-18	1.212658E-15	5.444115E-15	1.092735E-17
243-Am	1.646951E-06	9.139638E-06	7.551321E-10	1.033137E-07	4.638171E-07	9.309668E-10
243-Cm	1.726031E-04	9.578996E-04	7.809701E-10	1.073837E-07	4.820890E-07	9.676419E-10
244-Cm	3.700041E-03	2.053421E-02	1.637305E-08	2.251301E-06	1.010701E-05	2.028663E-08
3-H	2.663313E-04	8.683912E-04	9.386773E-04	1.255884E-04	2.257503E-04	6.867589E-04
60-Co	1.287961E-02	7.147826E-02	6.882351E-08	9.462625E-06	4.248158E-05	8.526838E-08
90-Sr	1.320134E+01	7.326381E+01	2.292527E-06	7.286412E-03	3.274264E-02	2.857525E-06
99-Tc	3.006068E-02	1.668241E-01	6.876193E-06	2.174950E-04	9.764235E-04	1.959863E-06
125-Sb	4.141097E-02	2.298192E-01	6.367954E-09	8.755757E-07	3.930816E-06	7.889875E-09
<b>Specific Mass (wt%)</b>						
Ag+	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Al+3	0.635506	3.025530	0.000224	0.266638	1.035288	0.000355
B+3	0.000135	0.000642	0.000000	0.080263	0.311642	0.000107
Ba+2	0.000074	0.000352	0.000000	0.000044	0.000172	0.000000
Bi+3	0.000068	0.000325	0.000000	0.000001	0.000004	0.000000
Ca+2	0.024647	0.117371	0.000000	0.050340	0.195456	0.000068
Cd+2	0.000067	0.000320	0.000000	0.000159	0.000619	0.000000
Cl-	0.003163	0.015034	0.000008	0.005424	0.021042	0.000014

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Forced Circulation Vacuum Evaporator System**

CO3-2	1.242770	5.913663	0.001220	1.128055	4.379954	0.001504
Cr(TOTAL)	0.035967	0.171277	0.000001	0.030544	0.118710	0.000001
Cs+	0.001630	0.007759	0.000001	0.000000	0.000001	0.000000
F-	0.044968	0.214134	0.000002	0.067028	0.260499	0.000004
Fe+3	0.482484	2.297630	0.000007	0.019977	0.077566	0.000027
Hg+2	0.000456	0.002170	0.000000	0.000000	0.000000	0.000000
K+	1.096415	5.218836	0.000385	1.327461	5.157862	0.000500
La+3	0.010410	0.049572	0.000000	0.000119	0.000464	0.000000
Li+	0.000448	0.002130	0.000001	0.018270	0.070937	0.000024
Mg+2	0.000003	0.000016	0.000000	0.009913	0.038490	0.000013
Mn+4	0.047130	0.224438	0.000000	0.000360	0.001397	0.000000
Mo+6	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Na+	3.931713	18.722852	0.000143	4.614350	17.933525	0.000205
NH3	0.011529	0.032152	0.006048	0.000354	0.000000	0.000448
Ni+2	0.021794	0.101921	0.000495	0.000086	0.000020	0.000108
NO2-	1.354414	6.447289	0.000698	1.559829	6.059939	0.000861
NO3-	4.344527	20.654158	0.009333	6.329382	24.557934	0.014488
OH(BOUND)	1.748240	8.324258	0.000297	0.274711	1.066633	0.000366
OH-	0.201424	0.958261	0.000252	0.251582	0.976831	0.000335
Pb+2	0.011534	0.054916	0.000003	0.000091	0.000342	0.000004
Phosphor components	0.040853	0.194443	0.000028	0.026038	0.101099	0.000035
Se+6	0.001869	0.008898	0.000001	0.001729	0.006714	0.000002
Si+4	0.074861	0.356440	0.000016	0.083117	0.322721	0.000111
SO4-2	0.494661	2.353991	0.000441	0.869199	3.375827	0.000831
Sr+2	0.001500	0.007143	0.000000	0.000039	0.000151	0.000000
Ti+4	0.000406	0.001934	0.000000	0.000638	0.002479	0.000001
TOC	2.874880	13.677296	0.003535	3.269664	12.695283	0.004358
U(TOTAL)	0.121728	0.579682	0.000001	0.000868	0.003370	0.000001
Zn+2	0.000235	0.001118	0.000000	0.030679	0.119120	0.000041
Zr+4	0.266983	1.271405	0.000001	0.008245	0.032015	0.000011
H2O	80.763931	8.482255	99.976817	79.669593	21.055761	99.975139
H+	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
CO2	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Total Dissolved Solids (Na Excluded) (wt%)	11.304045	53.744832	0.023039	15.716052	61.010697	0.024656
Total Suspended Solids (wt%)	4.000310	19.050061	0.000000	0.000004	0.000016	0.000000

**APPENDIX D**  
**EVAPORATOR PROCESS DATA**

		PROCESS DATA SHEET: Mechanical Pump				PLANT ITEM No. 24590-PTF-FEP-PMP-00007A	
Project:	RPP-WTP	System:		FEP			
Project No:	24590	Description:		Waste Feed Evaporator Feed Pump			
Site:	Hanford	Supporting Calcs No.:		24590-PTF-MEC-FEP-00001, Rev. A			
Building No.:	10	Associated Drawings:		24590-PTF-M5-V17T-00004001, Rev. B			
<b>PROCESS DATA</b>	<b>Units</b>	<b>Mode 1 (Note 1)</b>	<b>Mode 2 (Note 2)</b>	<b>Mode 3 (Note 3)</b>	<b>Mode 4</b>	<b>ETC.</b>	
Capacity Normal (Note 4)	gpm	50	39	36			
Capacity Rated	gpm	60	N/A	N/A			
Minimum Pumping Temperature	°F	59	59	59			
Normal Pumping Temperature	°F	77	77	77			
Maximum Pumping Temperature	°F	122	122	122			
Density at Normal Pumping Temperature (Note 7)	lb/ft <sup>3</sup>	75.9	87.8	88.9			
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.08	1.10			
Viscosity at Normal Pumping Temperature	cP	11.8	11.8	11.8			
Vapor Press at Normal Pumping Temp	psia	0.43	0.44	0.44			
Origin Pressure	psia	14.61	14.61	14.61			
Delivery Pressure	psia	(Note 5)	(Note 5)	(Note 5)			
<b>FLUID COMPOSITION</b>							
Content Code (e.g., Type/Name of Liquid)							
Solids Content	% w/wt	4	7	2			
Solids Size Range	microns	(Note 6)	(Note 6)	(Note 6)			
Solids Characteristics		(Note 6)	(Note 6)	(Note 6)			
Notes: 1. Mode 1 represents Envelope A waste feed and recycles required to meet production rate of 60 M/d LAW glass. 2. Mode 1 represents Envelope B waste feed and recycles required to meet production rate of 60 M/d LAW glass. 3. Mode 1 represents Envelope C waste feed and recycles required to meet production rate of 30 M/d LAW glass. 4. Minimum flowrate is 20 gpm for Envelope A, 25 gpm for Envelope B, and 23 gpm for Envelope C. 5. Delivery pressure to be determined by waste feed evaporator vendor. 6. Solids size range and characteristics to be determined by R&T. 7. Density and Specific Gravity based on pretreated AW-101 of same molarity. Does not include weight percent solids.							



**PROCESS DATA SHEET: Mechanical Pump**

**PLANT ITEM No.**  
 24590-PTF-FEP-PMP-00007B

Project:	RPP-WTP	System:	FEP			
Project No:	24590	Description:	Waste Feed Evaporator Feed Pump			
Site:	Harford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. A			
Building No.:	10	Associated Drawings:	24590-PTF-M5-V17T-00004001, Rev. B			
<b>PROCESS DATA</b>	<b>Units</b>	<b>Mode 1 (Note 1)</b>	<b>Mode 2 (Note 2)</b>	<b>Mode 3 (Note 3)</b>	<b>Mode 4</b>	<b>ETC.</b>
Capacity Normal (Note 4)	gpm	50	39	36		
Capacity Rated	gpm	60	N/A	N/A		
Minimum Pumping Temperature	°F	59	59	59		
Normal Pumping Temperature	°F	77	77	77		
Maximum Pumping Temperature	°F	122	122	122		
Density at Normal Pumping Temperature (Note 7)	lb/ft <sup>3</sup>	75.9	67.6	68.9		
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.06	1.10		
Viscosity at Normal Pumping Temperature	cP	11.8	11.8	11.8		
Vapor Press at Normal Pumping Temp	psia	0.43	0.44	0.44		
Origin Pressure	psia	14.61	14.61	14.61		
Delivery Pressure	psia	(Note 5)	(Note 5)	(Note 5)		
<b>FLUID COMPOSITION</b>						
Content Code (e.g., Type/Name of Liquid)						
Solids Content	% w/wt	4	7	2		
Solids Size Range	microns	(Note 6)	(Note 6)	(Note 6)		
Solids Characteristics		(Note 6)	(Note 6)	(Note 6)		

**Notes:**

1. Mode 1 represents Envelope A waste feed and recycles required to meet production rate of 60 M/d LAW glass.
2. Mode 1 represents Envelope B waste feed and recycles required to meet production rate of 60 M/d LAW glass.
3. Mode 1 represents Envelope C waste feed and recycles required to meet production rate of 30 M/d LAW glass.
4. Minimum flowrate is 20 gpm for Envelope A, 25 gpm for Envelope B, and 23 gpm for Envelope C.
5. Delivery pressure to be determined by waste feed evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity pretreated AW-101 of same molarity. Does not include weight percent solids.



**PROCESS DATA SHEET: Mechanical Pump**

**PLANT ITEM No.**  
 24590-PTF-FEP-PMP-00008A

Project:	RPP-WTP	System:	FEP			
Project No:	24590	Description:	Waste Feed Evaporator Concentrate Pump			
Site:	DOE Hanford	Supporting Calcs No.	24590-PTF-MEC-FEP-00001, Rev. A			
Building No.:	10	Associated Drawings:	24590-PTF-M5-V17T-00004002, Rev. B			
<b>PROCESS DATA</b>	Units	Mode 1 (Note 1)	Mode 2 (Note 2)	Mode 3 (Note 3)	Mode 4	ETC.
Capacity Normal (Note 4)	gpm	28	14	14		
Capacity Rated	gpm	34	N/A	N/A		
Minimum Pumping Temperature	°F	59	59	59		
Normal Pumping Temperature	°F	122	122	122		
Maximum Pumping Temperature	°F	122	122	122		
Density at Normal Pumping Temperature (Note 7)	lb/ft <sup>3</sup>	75.9	75.9	78.6		
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.23	1.25		
Viscosity at Normal Pumping Temperature	cP	5.5	5.5	5.5		
Vapor Press at Normal Pumping Temp	psia	1.3	1.3	1.2		
Origin Pressure	psia	Note 5	Note 5	Note 5		
Delivery Pressure	psia	14.6	14.6	14.6		
<b>FLUID COMPOSITION</b>						
Content Code (e.g., Type/Name of Liquid)						
Solids Content	% wt/wt	5	15	3		
Solids Size Range	microns	Note 6	Note 6	Note 6		
Solids Characteristics		Note 6	Note 6	Note 6		

**Notes:**

1. Mode 1 represents Envelope A concentrate required to meet production rate of 60 Mt/d LAW glass.
2. Mode 2 represents Envelope B concentrate required to meet production rate of 60 Mt/d LAW glass.
3. Mode 3 represents Envelope C concentrate required to meet production rate of 30 Mt/d LAW glass.
4. Minimum flowrate is 12 gpm for Envelope A, 4 gpm for Envelope B, and 3 gpm for Envelope C.
5. Origin pressure to be determined by treated LAW evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity based on pretreated AW-101 solutions of same molarity. Does not include weight percent solids.



PROCESS DATA SHEET: Mechanical Pump

PLANT ITEM No.  
 24590-PTF-FEP-PMP-000088

Project:	RPP-WTP		System:		FEP	
Project No:	24590		Description:		Waste Feed Evaporator Concentrate Pump	
Site:	Hanford		Supporting Calcs No.		24590-PTF-MEC-FEP-00001, Rev. A	
Building No.:	10		Associated Drawings:		24590-PTF-M5-V17T-00004002, Rev. B	
<b>PROCESS DATA</b>	Units	Mode 1 (Note 1)	Mode 2 (Note 2)	Mode 3 (Note 3)	Mode 4	ETC.
Capacity Normal (Note 4)	gpm	28	14	14		
Capacity Rated	gpm	34	N/A	N/A		
Minimum Pumping Temperature	°F	59	59	59		
Normal Pumping Temperature	°F	122	122	122		
Maximum Pumping Temperature	°F	122	122	122		
Density at Normal Pumping Temperature (Note 7)	lb/ft <sup>3</sup>	75.9	75.9	76.6		
Sp Gravity at Normal Pumping Temperature (Note 7)		1.23	1.23	1.25		
Viscosity at Normal Pumping Temperature	cP	5.5	5.5	5.5		
Vapor Press at Normal Pumping Temp	psia	1.3	1.3	1.2		
Origin Pressure	psia	Note 5	Note 5	Note 5		
Delivery Pressure	psia	14.6	14.6	14.6		
<b>FLUID COMPOSITION</b>						
Content Code (e.g. Type/Name of Liquid)						
Solids Content	% w/wt	5	15	3		
Solids Size Range	microns	Note 6	Note 6	Note 6		
Solids Characteristics		Note 6	Note 6	Note 6		

Notes:

1. Mode 1 represents Envelope A concentrate required to meet production rate of 60 M/d LAW glass.
2. Mode 2 represents Envelope B concentrate required to meet production rate of 60 M/d LAW glass.
3. Mode 3 represents Envelope C concentrate required to meet production rate of 30 M/d LAW glass.
4. Minimum flowrate is 12 gpm for Envelope A, 4 gpm for Envelope B, and 3 gpm for Envelope C.
5. Origin pressure to be determined by treated LAW evaporator vendor.
6. Solids size range and characteristics to be determined by R&T.
7. Density and Specific Gravity based on pretreated AW-101 solutions of same molarity. Does not include weight percent solids.

<b>PROCESS DATA SHEET: Evaporator</b>				<b>PLANT ITEM No.</b> 24590-PTF-FEP-EVAP-00001A	
<b>Project:</b>	RFP-WTP	<b>System:</b>	FEP		
<b>Project No.:</b>	24590	<b>Description:</b>	Waste Feed Evaporator		
<b>Site:</b>	Hanford	<b>Supporting Code No.:</b>	24590-PTF-MEC-FEP-00001, Rev. B		
<b>Building No.:</b>	10	<b>Associated Drawings:</b>	24590-PTF-MS-V17T-0000002, Rev. 0		

UTILITIES DATA	Units	Cooling Water	High Pressure Steam	Instrument Air
		Note 1		
Temperature	°F	83		80
Pressure	psig	85		100

PROCESS DATA	Units	Envelope A				Evaporator Bypass (Envelope A)			
		Feed		Concentrate	Overheads	Condensate	Feed (Recycle)		Concentrate (Note 14)
		Minimum No	Maximum No				Minimum No (Note 14)	Maximum No (Note 14)	
Liquid Flow (Note 4)	lb <sub>m</sub> /hr	11,000	27,000	7,000 (Note 7)	N/A	14,900 (Note 8)	14,200	18,200 (Note 13)	14,200
Vapor Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	14,900	N/A	N/A	N/A	N/A
Noncondensables Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	42.7	N/A	N/A	N/A	N/A
Temperature (Note 8)	°F	77	77	122	111	111	77	77	122
Na Molarity	lb <sub>m</sub> /ft <sup>3</sup>	1.4	4	5	N/A	0	0.2	1	5
Density	lb <sub>m</sub> /ft <sup>3</sup>	87.8	78.0	74.0	0.0039	81.9	83.4	88.8	78.0
Specific Gravity		1.09	1.22	1.23	N/A	1	1.02	1.07	1.23
Viscosity	cP	11.8	11.8	5.5	0.01	0.7	11.8	11.8	5.5
Specific Heat	BTU/lb <sub>m</sub> ·°F	0.93	0.98	0.98	0.45	1	0.98	0.94	0.90
Thermal Conductivity	BTU/hr ft °F	0.36	0.39	0.39	0.01	0.37	0.353	0.369	0.38

	Units	Envelope B			Envelope C		
		Feed		Concentrate	Feed		Concentrate
		Minimum No	Maximum No		Minimum No	Maximum No	
Liquid Flow (Note 4)	lb <sub>m</sub> /hr	13,000	21,100	8,480 (Note 10)	11,900	19,500	8780 (Note 11)
Vapor Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	N/A	N/A	N/A
Non-Condensables Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	N/A	N/A	N/A
Temperature (Note 8)	°F	77	77	122	77	77	122
Na Molarity	lb <sub>m</sub> /ft <sup>3</sup>	0.78	1.81	8	0.77	2.30	6
Density (Note 12)	lb <sub>m</sub> /ft <sup>3</sup>	84.9	87.6	74.0	84.9	88.9	78.8
Specific Gravity (Note 12)		1.04	1.06	1.21	1.04	1.10	1.25
Viscosity	cP	11.8	11.8	5.5	11.8	11.8	5.5
Specific Heat	BTU/lb <sub>m</sub> ·°F	0.94	0.91	0.96	0.94	0.91	0.98
Thermal Conductivity	BTU/hr ft °F	0.377	0.385	0.39	0.377	0.385	0.39

**Notes:**

1. Maximum temperature and pressure of cooling water supply.
2. Temperature and pressure of steam supply.
3. Delete.
4. Evaporator to require 80% shutdown capability.
5. Evaporator overheads prior to condensate removal.
6. Vacuum system to enable concentration of feed at reduced temperature
7. Maximum transfer rate. Minimum Transfer rate is 7,300 lb/hr
8. Maximum evaporator overhead condensate production capacity. Envelope A average conditions require 11,900 lb/hr.
9. Maximum overhead vapor and noncondensable flow. Average vapor flow is 11,900 lb/hr. Noncondensable flow also applies to average conditions.
10. Maximum transfer rate. Minimum transfer rate is 2430 lb/hr
11. Maximum transfer rate. Minimum transfer rate is 1880 lb/hr.
12. Density and Specific Gravity based on sodium hydroxide solutions of same molarity. Does not include weight percent solids.
13. Maximum transfer rate. Minimum transfer rate is 7,200 lb/hr.
14. Based on evaporator semibatch operation.

*15. See section 3.A.3.3 for high pressure steam supply conditions.*

 <b>PROCESS DATA SHEET: Evaporator</b>				<b>PLANT ITEM No.</b> 24590-PTF-FEP-EVAP-00001B																																																																																																																											
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		Minimum No	Maximum No		Minimum No	Maximum No																																																																																																																									
Liquid Flow (Note 4)	lb <sub>m</sub> /hr	13,000	21,100	8,490 (Note 10)	17,900	18,900	8780 (Note 11)																																																																																																																								
Vapor Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	N/A	N/A	N/A																																																																																																																								
Non-Condensables Flow	lb <sub>m</sub> /hr	N/A	N/A	N/A	N/A	N/A	N/A																																																																																																																								
Temperature (Note 8)	°F	77	77	122	77	77	122																																																																																																																								
No Molarity		0.78	1.81	5	0.77	2.30	6																																																																																																																								
Density (Note 12)	lb <sub>m</sub> /ft <sup>3</sup>	64.9	67.6	74.0	64.9	66.8	76.6																																																																																																																								
Specific Gravity (Note 12)		1.04	1.08	1.21	1.04	1.10	1.23																																																																																																																								
Viscosity	cP	11.8	11.8	5.5	11.8	11.8	5.5																																																																																																																								
Specific Heat	BTU/lb <sub>m</sub> °F	0.94	0.91	0.88	0.94	0.91	0.68																																																																																																																								
Thermal Conductivity	BTU/hr ft °F	0.377	0.386	0.38	0.377	0.385	0.38																																																																																																																								
<p>Notes:</p> <ol style="list-style-type: none"> <li>Maximum temperature and pressure of cooling water supply.</li> <li>Temperature and pressure of steam supply.</li> <li>Delete.</li> <li>Evaporator to require 60% turndown capability.</li> <li>Evaporator overheads prior to condensate removal.</li> <li>Vacuum system to enable concentration of feed at reduced temperature.</li> <li>Maximum transfer rate. Minimum Transfer rate is 7,300 lb/hr.</li> <li>Maximum evaporator overhead condensate production capacity. Envelope A average conditions require 11,800 lb/hr.</li> <li>Maximum overhead vapor and noncondensable flow. Average vapor flow is 11,800 lb/hr. Noncondensable flow also applies to average conditions.</li> <li>Maximum transfer rate. Minimum transfer rate is 2430 lb/hr.</li> <li>Maximum transfer rate. Minimum transfer rate is 1880 lb/hr.</li> <li>Density and Specific Gravity based on sodium hydroxide solutions of same molarity. Does not include weight percent solids.</li> <li>Maximum transfer rate. Minimum transfer rate is 7,300 lb/hr.</li> <li>Based on evaporator semibatch operation.</li> </ol> <p style="text-align: center;"><i>15. See section 3.4.3.3 for high pressure steam supply conditions.</i></p>																																																																																																																															

<b>PROCESS DATA SHEET: VESSEL &amp; PUMPS</b>		<b>Plant Item No.</b>		
		24590-PTF-MV-TLP-VSL-00009A 24590-PTF-MV-TLP-VSL-00009B 24590-PTF-MV-TLP-PMP-00005A 24590-PTF-MV-TLP-PMP-00005B		
Project: RPP-WTP				
Project No: 24590		Description: Treated LAW SBS Condensate Receipt Vessels and Pumps		
Site: Hanford				
Building No.: 10		Associated Drawing: 24590-PTF-M5-V17T-00005		
<b>SUMMARY DATA</b>	<b>Units</b>	<b>Minimum</b>	<b>Nominal</b>	<b>Maximum</b>
Batch Volume	Gal	N/A	80,000	N/A
Transfer Rate	gpm	10	13	38
Receipt Rate	gpm	N/A	175	N/A
Fluid Temperature	°F	68	113	167
Specific Gravity	N/A	1.02	1.02	1.02
Viscosity	cP	1	1	1
Internal Pressure	psig	-0.22	-0.14	0
Solids Content	wt %	0.30	0.34	0.41

<b>PROCESS DATA SHEET: SYSTEM TLP</b>				
Project: RPP-WTP				
Project No: 24590		Description: Treated LAW Evaporation - System TLP		
Site: Hanford				
Building No.: 10		Associated Drawing: 24590-PTF-M5-V17T-00005		
<b>SUMMARY DATA</b>	<b>Units</b>	<b>Minimum</b>	<b>Nominal</b>	<b>Maximum</b>
<b>Treated LAW (TXP14)</b>				
Transfer Rate	gpm	11.4	14.3	17.9
Fluid Temperature	°F	59	77	113
Specific Gravity	N/A	1.15	1.20	1.22
Viscosity	cP	2.0	3.3	4.0
<b>LAW SBS Condensate (RLD21)</b>				
Batch Volume	Gal	N/A	80,000	N/A
Transfer Rate	gpm	10	13	38
Receipt Rate	gpm	N/A	175	N/A
Fluid Temperature	°F	68	113	167
Specific Gravity	N/A	1.02	1.02	1.02
Viscosity	cP	1	1	1
Thermal Conductivity	BTU/(hr*ft-°F)	N/A	0.372	N/A
<b>Treated LAW Concentrate (TLP02)</b>				
Transfer Rate	gpm	5.6	9.2	13.7
Fluid Temperature	°F	77	122	150
Specific Gravity	N/A	1.33	1.40	1.57
Viscosity	cP	12.8	12.8	30.0
Vapor Pressure	torr	55	67	77
Thermal Conductivity	BTU/(hr*ft-°F)	N/A	0.397	0.399

**APPENDIX E**

**Quality Level and Seismic Category for  
Evaporator Equipment**

FEP Separator Vessels	FEP-SEP-00001A/B	QL-1	SC-I
• Demister Pads	Pad Materials	CM	SC-II
• Upper Demister Pad Supports	Structural supports	CM	SC-II
• Lower Demister Pad Supports	Structural supports	QL-2	SC-II
• Internal Piping/Misc.	Bubble trays, spray rings, dip legs, etc.	QL-2	SC-II
TLP Separator Vessel	TLP-SEP-00001	QL-1*	SC-I*
• Demister Pads	Pad Materials	CM	SC-II
• Upper Demister Pad Supports	Structural supports	CM	SC-II
• Lower Demister Pad Supports	Structural supports	QL-2	SC-II
• Internal Piping/Misc.	Bubble trays, spray rings, dip legs, etc.	QL-2	SC-II
Reboilers	FEP-RBLR-00001A/B	QL-1	SC-I
	TLP-RBLR-00001	QL-1*	SC-I*
Recirculation Pumps, Motors, Speed Adjustable Drives, and Seal Barrier Systems	FEP-PMP-00009A/B, FEP-MTR-00009A/B	QL-1	SC-I
	TLP-PMP-00001, TLP-MTR-00001	QL-1*	SC-I*
	FEP-ASD-00009A/B, TLP-ASD-00001, and Pump Seal Barrier Systems	CM	SC-III
Feed Pumps, Motors, and Speed Adjustable Drives	TLP-PMP-00005A/B, TLP-MTR-00005A/B, TLP-ASD-00005A/B	CM	SC-III
Concentrate Pumps, Motors, and Speed Adjustable Drives	TLP-PMP-00011A/B, TLP-MTR-00011A/B, TLP-ASD-00011A/B	CM	SC-III
Black Cell Separator Vessel Offgas Pipework	Piping from the top section of the FEP Evaporator separator vessels to the 56' Elev. floor (ceiling of black cell).	QL-1	SC-I*
	Piping from the top section of the TLP Evaporator separator vessel to the 56' Elev. floor (ceiling of black cell).	QL-1*	SC-I*
Out-Cell Separator Vessel Offgas Pipework	Piping from 56' Elev. floor to the FEP Evaporator primary condenser in C3 room.	QL-1	SC-I*
	Piping from 56' Elev. floor to the TLP Evaporator primary condenser in C3 room.	QL-1*	SC-I*
	FEP-COND-00001A/B FEP-COND-00002A/B FEP-COND-00003A/B FEP-EJCTR-00040, -00041, -00042, and -00043	QL-1	SC-I*
	TLP-COND-00001 TLP-COND-00002 TLP-COND-00003 TLP-EJCTR-000064 and -00067	QL-1*	SC-I*
Condensate Collection Vessels	FEP-VSL-00005	CM	SC-III
	TLP-VSL-00002	CM	SC-III
Condensate Pumps, Motors, and Speed Adjustable Drives	FEP-PMP-00006A/B, FEP-MTR-00006A/B, FEP-ASD-00006A/B	CM	SC-III
	TLP-PMP-00002A/B, TLP-MTR-00002A/B, FEP-ASD-00002A/B	CM	SC-III
Antifoam Vessel	AFR-TK-00001	CM	SC-IV
Antifoam Pumps	AFR-PMP-00006, -00007, and -00008	CM	SC-IV

Steam Conditioning Skids	FEP Steam Conditioning Skids	CM	SC-III
	TLP Steam Conditioning Skid	CM	SC-III
Reboiler Steam Condensate Transfer Stations	FEP-VSL-00021, FEP-PMP-00010A/B	CM	SC-III
	FEP-VSL-00022, FEP-PMP-00011A/B	CM	SC-III
	TLP-VSL-00047, TLP-PMP-00012A/B	CM	SC-III

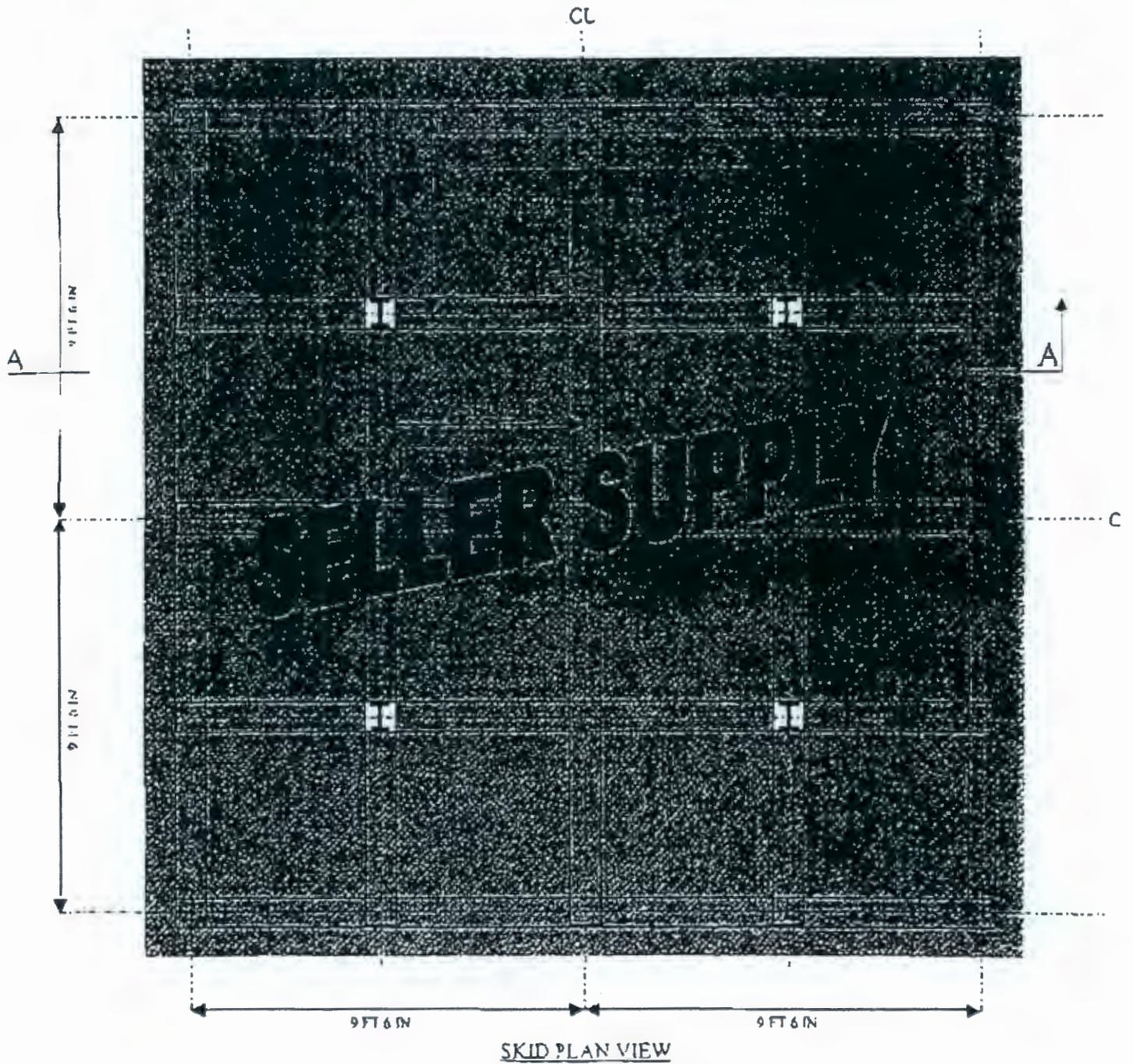
\*These quality level and seismic category designations are higher than those required for safety as deemed necessary for commercial reasons. They are consistent with the Buyer's Authorization Basis document because they meet and exceed the minimum safety requirements. These designations are not necessarily reflected in their associated Buyer's P&IDs.

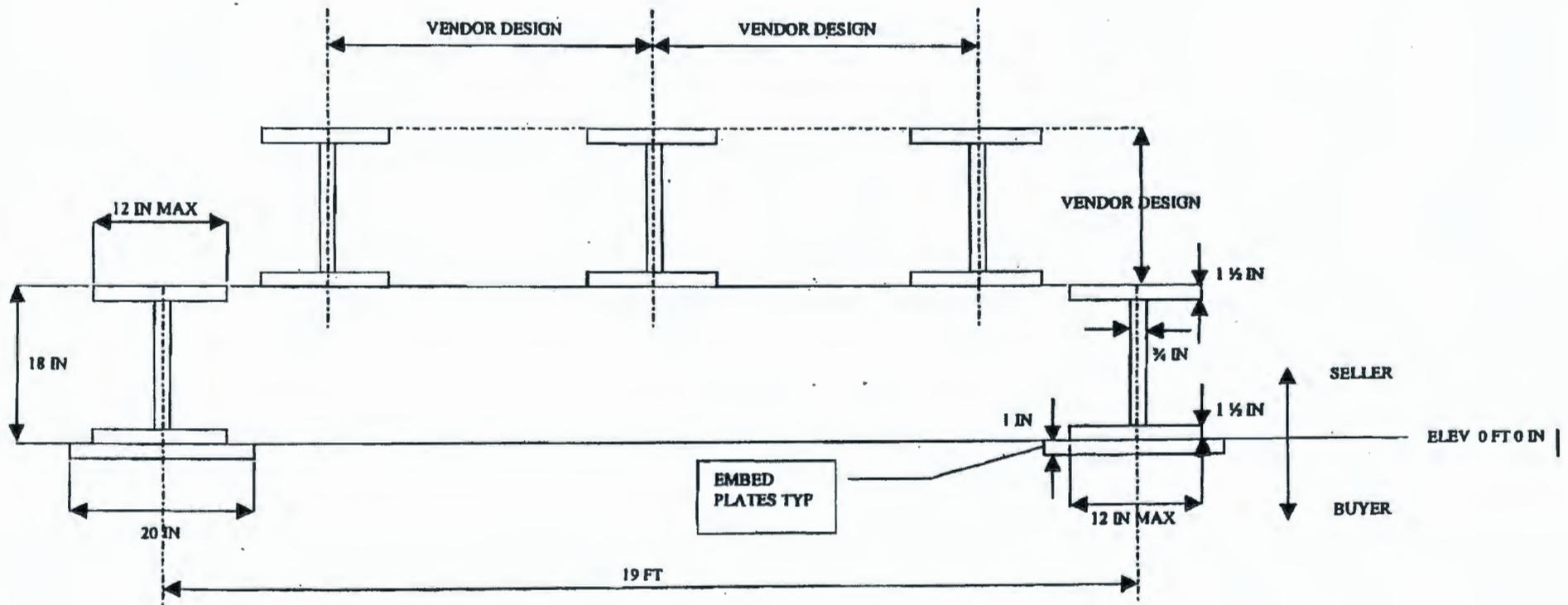
For CM material to the ASME or ASTM standards, any year of the standard is acceptable.

Note: QL-1 and QL-2 designations are used by the Seller to comply with other referenced specification requirements (i.e. weld, design). These designations meet NQA-1 (QL) requirements and are not necessarily reflected in their associated Buyer's P&IDs.

**APPENDIX F**  
**SEPARATOR VESSEL SKID SUPPORT LAYOUT**

# SEPARATOR VESSEL, EMBEDDED PLATES & SKID





**SECTION A**

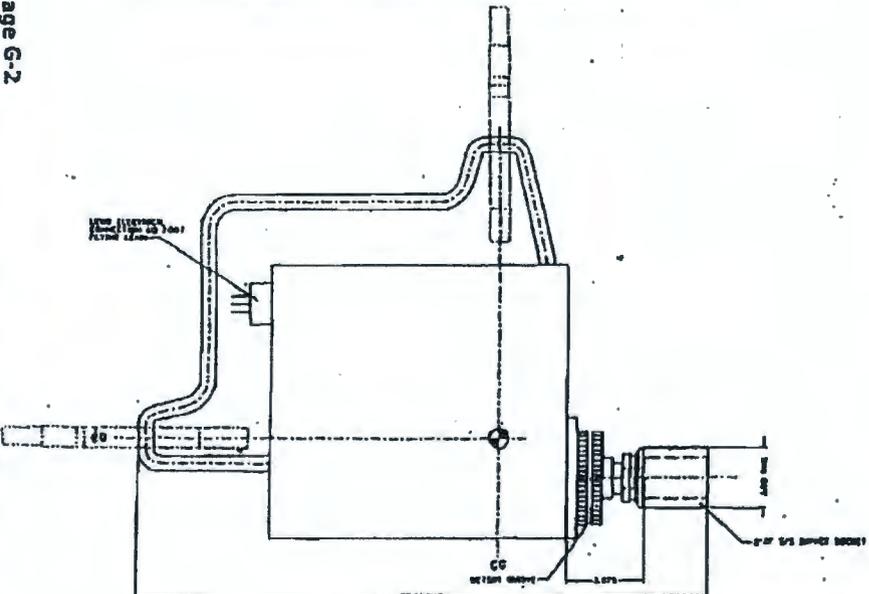
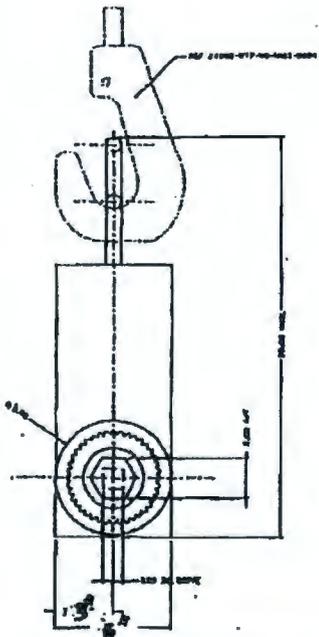
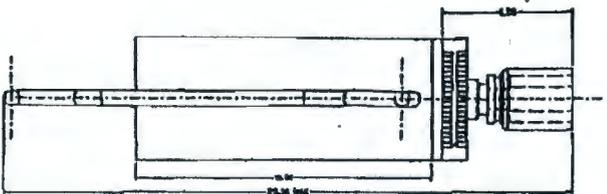
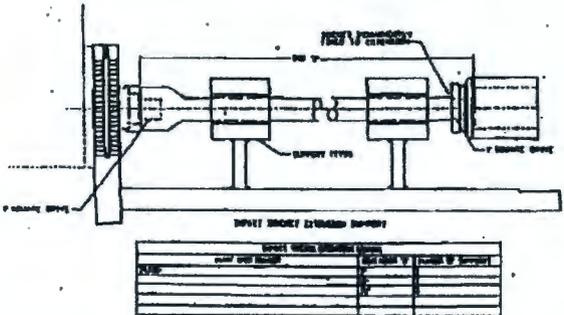
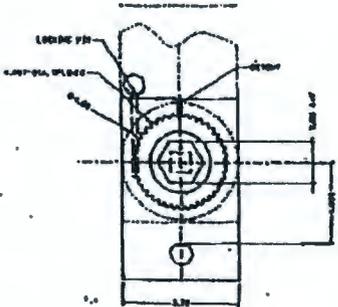
## APPENDIX G

### HOT CELL REMOTE IMPACT WRENCH

24590-PTF-3PS-MEVV-T00001, Rev. 2  
 Forced Circulation Vacuum Evaporator System

**NOTES:**

1. All dimensions are in inches.
2. MATERIALS OF CONSTRUCTION SPECIFIED ON THIS DRAWING IS THE MINIMUM QUALITY. THE CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE QUALITY OF THE MATERIALS AND THE WORKMANSHIP OF THE FABRICATOR.
3. POWER SUPPLY TO BE SUPPLIED BY THE USER. THE USER SHALL BE RESPONSIBLE FOR VERIFYING THE QUALITY OF THE SUPPLY AND THE WORKMANSHIP OF THE FABRICATOR.
4. IMPACT WRENCH TO BE USED TO REMOVE THE REMOTE IMPACT WRENCH FROM THE SYSTEM.



Page G-2

		PROJECT NUMBER: 24590-PTF-3PS-MEVV-T00001 DRAWING NUMBER: 24590-PTF-3PS-MEVV-T00001-00001	
TITLE: WTP VITRIFICATION FACILITY DESIGN PROPOSAL DRAWING REMOTE IMPACT WRENCH		DATE: 11/17/2006 DRAWN BY: [Name] CHECKED BY: [Name]	
REVISIONS:		SCALE: 1:1	

## APPENDIX H

Deleted

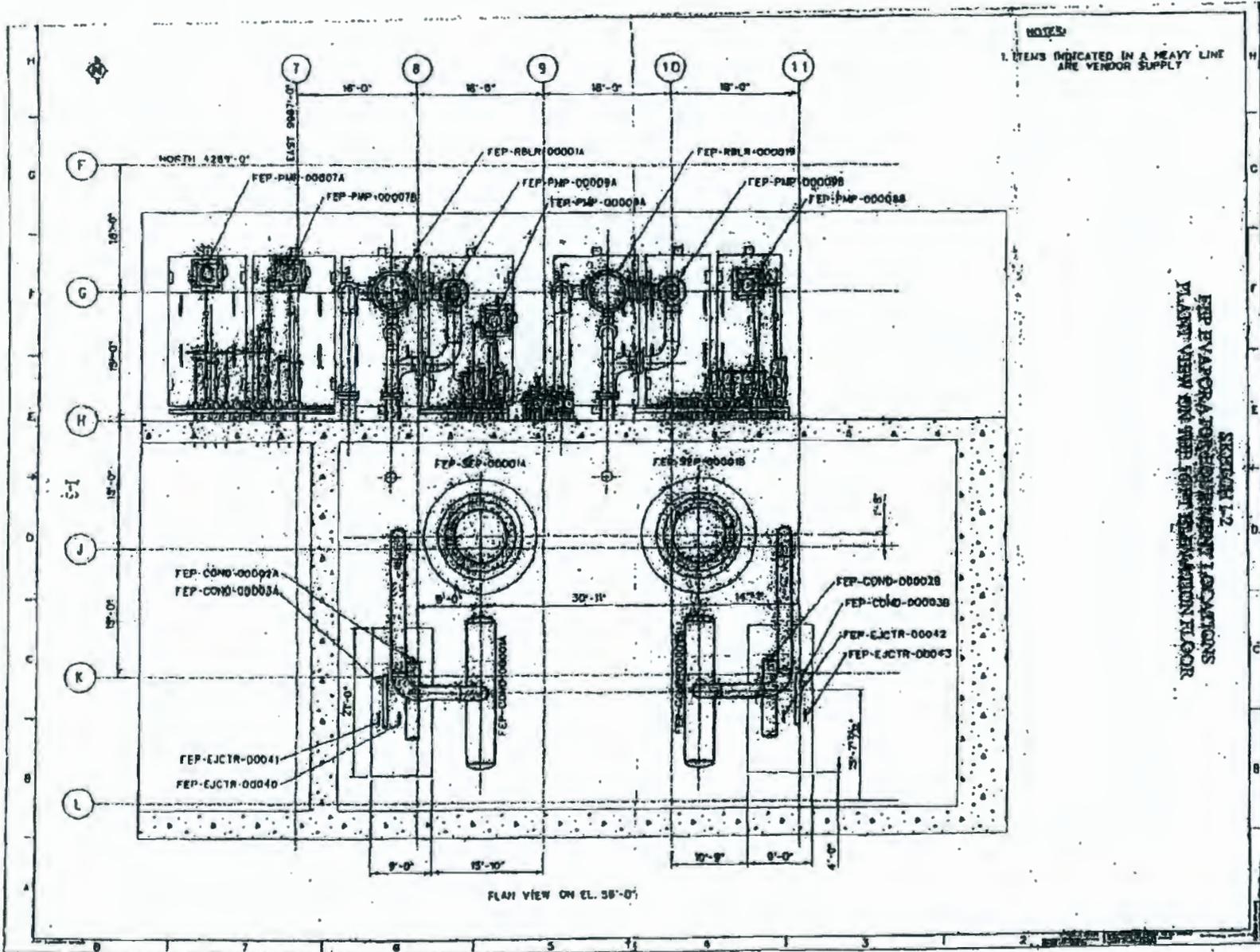
**APPENDIX I**

**FEP EVAPORATOR EQUIPMENT SKIDS  
LOCATION AND LAYOUT SKETCHES**



24590-G04B-F00019 Rev 4 (1/17/2006)

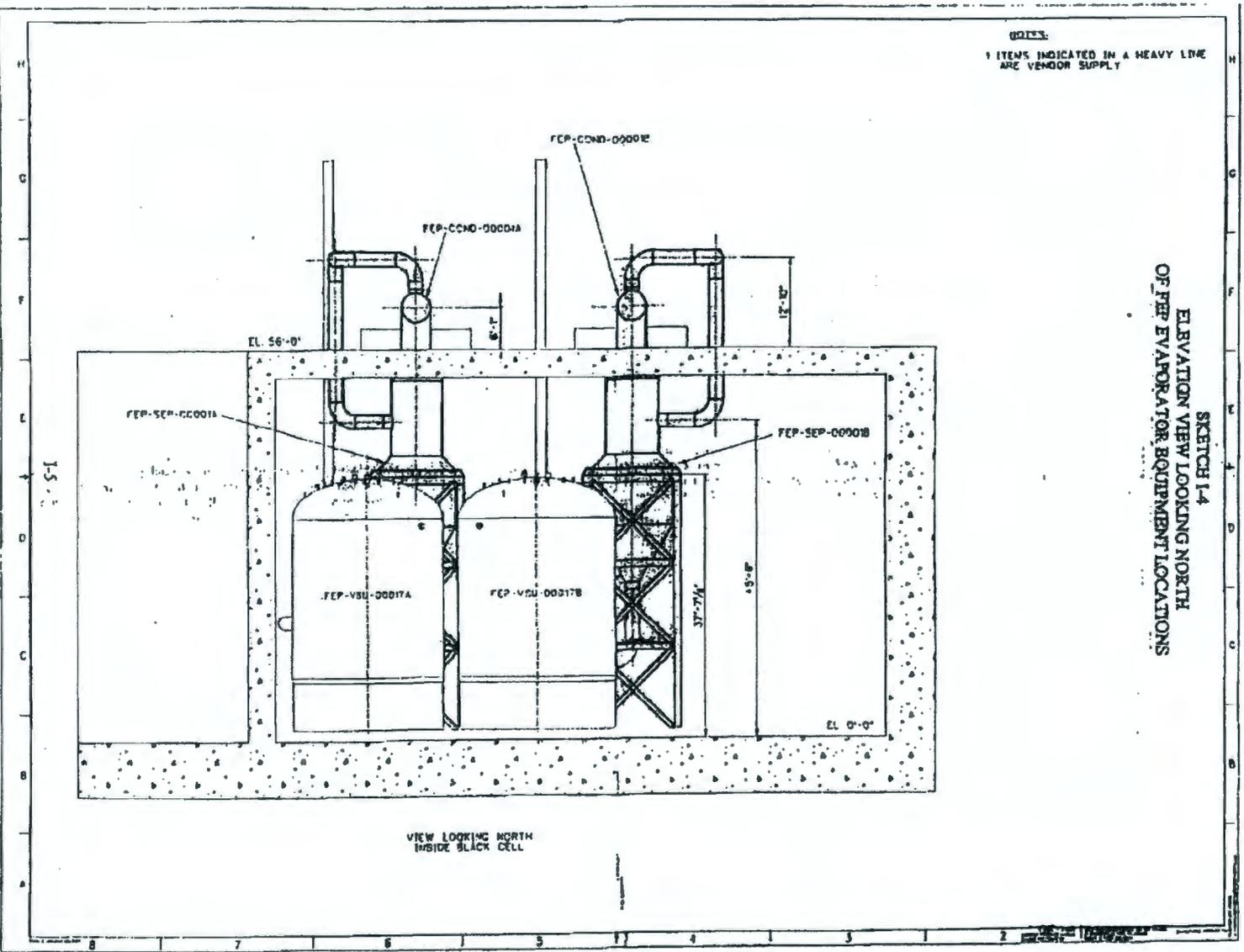
Ref: 24590-WTP-3DP-G04B-00049



24590-PTF-3PS-MEVV-10001, Rev. 2  
Forced Circulation Vacuum Evaporator System

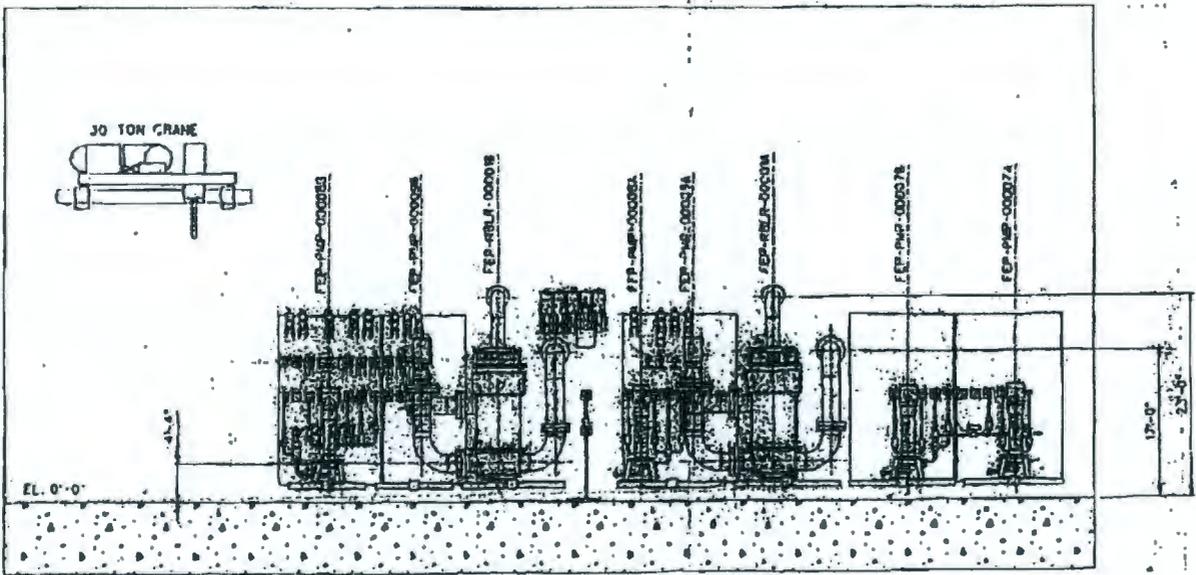


SKETCH I4  
ELEVATION VIEW LOOKING NORTH  
OF FEP EVAPORATOR EQUIPMENT LOCATIONS



SECTION 1-5  
 ELEVATION VIEW LOOKING SOUTH  
 OF REE EVAPORATOR EQUIPMENT LOCATIONS

NOTES  
 ITEMS INDICATED IN A HEAVY LINE  
 ARE VENDOR SUPPLY



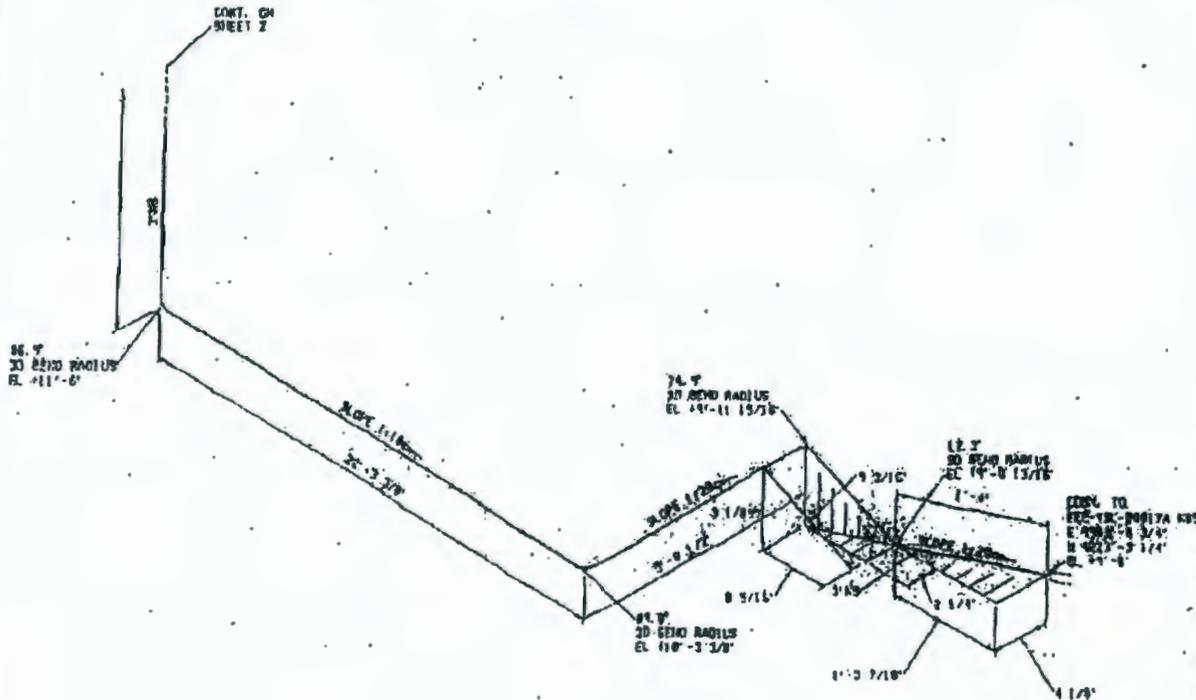
VIEW LOOKING SOUTH  
 INSIDE HOT CELL

1-6

24590-G04B-F00019 Rev 4 (1/17/2006)

Ref: 24590-WTP-3DP-G04B-00049

**SKETCH #4**  
**ISOMETRIC SKETCH OF FEP EVAPORATOR FEED**  
**FROM FRED VESSEL TO FEP PUMP**



- NOTES:
1. FOR GENERAL NOTES AND LEGEND SEE SHEET 24590-WTP-3DP-00001
  2. SEE DWG. 24590-WTP-3DP-00001 FOR CONVERSION FROM PFD FACILITY ELEVATIONS TO SITE ELEVATIONS. PFD FACILITY ELEVATION 0'-0" EQUATES SITE ELEVATION 878'-0" ASL.

PART NO.	QUANTITY	DESCRIPTION	U.S. (INCHES)	QTY	REMARKS
PIPE					
1	1	PIPE, 3/4" DIA. SCH. 40, 30' LONG	3/4"	1	FOR FEP PUMP
2	1	PIPE, 1/2" DIA. SCH. 40, 30' LONG	1/2"	1	FOR FEP PUMP

24590-PTF-3P-MEVV-T0001, Rev 2  
 Forced Circulation Vacuum Evaporator System

**PRELIMINARY**

REV	DATE	DESCRIPTION	DRW	CHKD	STRESS	REV'D	APVD

REVISION HISTORY

NAME: PROJECT: PROJECT  
 TITLE: PROJECT: PROJECT  
 1500 CENTER PLACE  
 RICHMOND, VA 23131

CONTRACT NO: DE-AC27-00RV14136  
 CONST. WORK AREA:

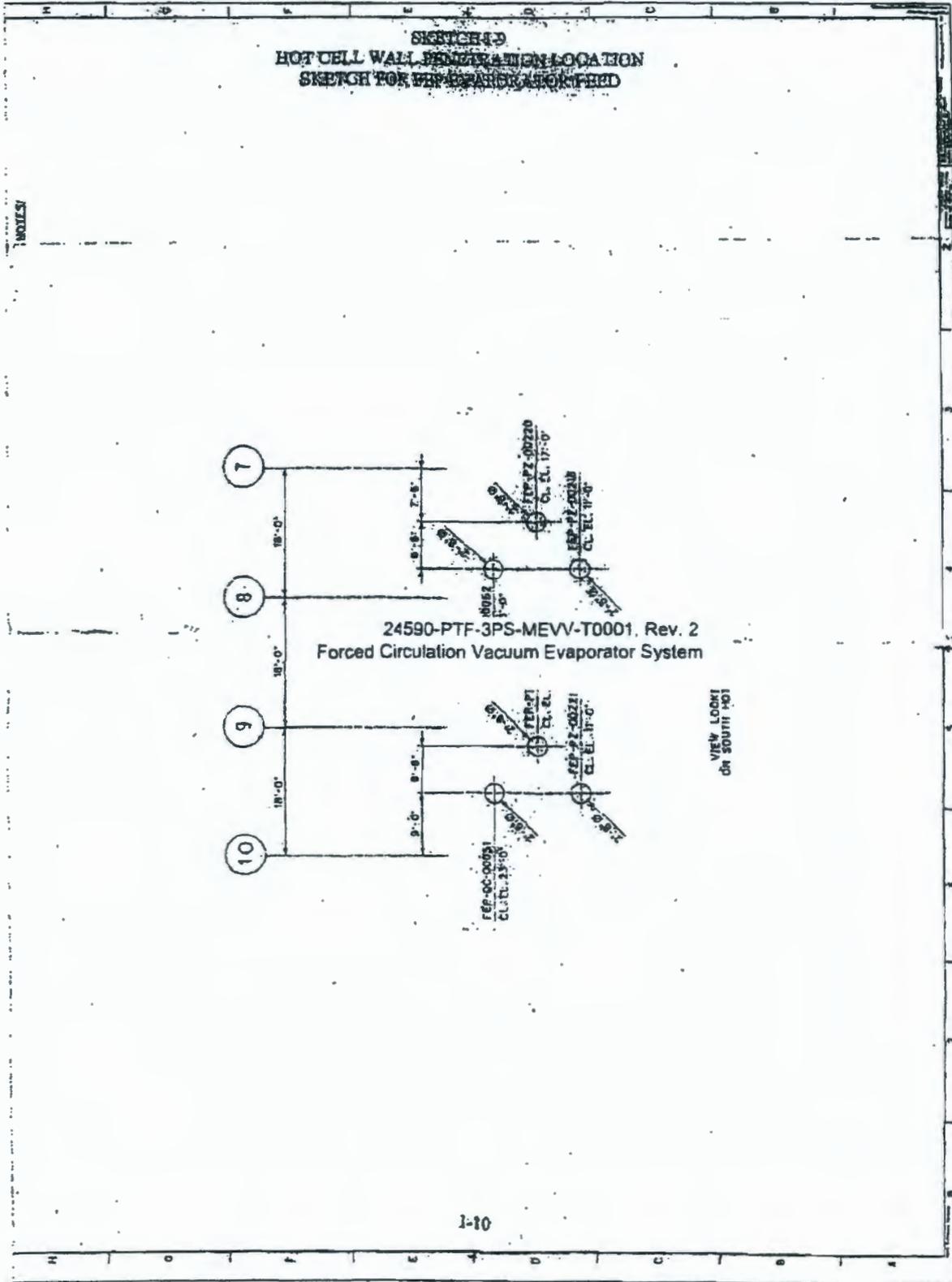
PRETREATMENT FACILITY  
 ISOMETRIC

LDR NO. FEP-PZ-00239-SI 2A-3      PIPE SPEC: SI 2A  
 DRW NO.      REV.

PLOTTED BY: girding      PLOT DATE: 03/22/2003 10:47:22 AM



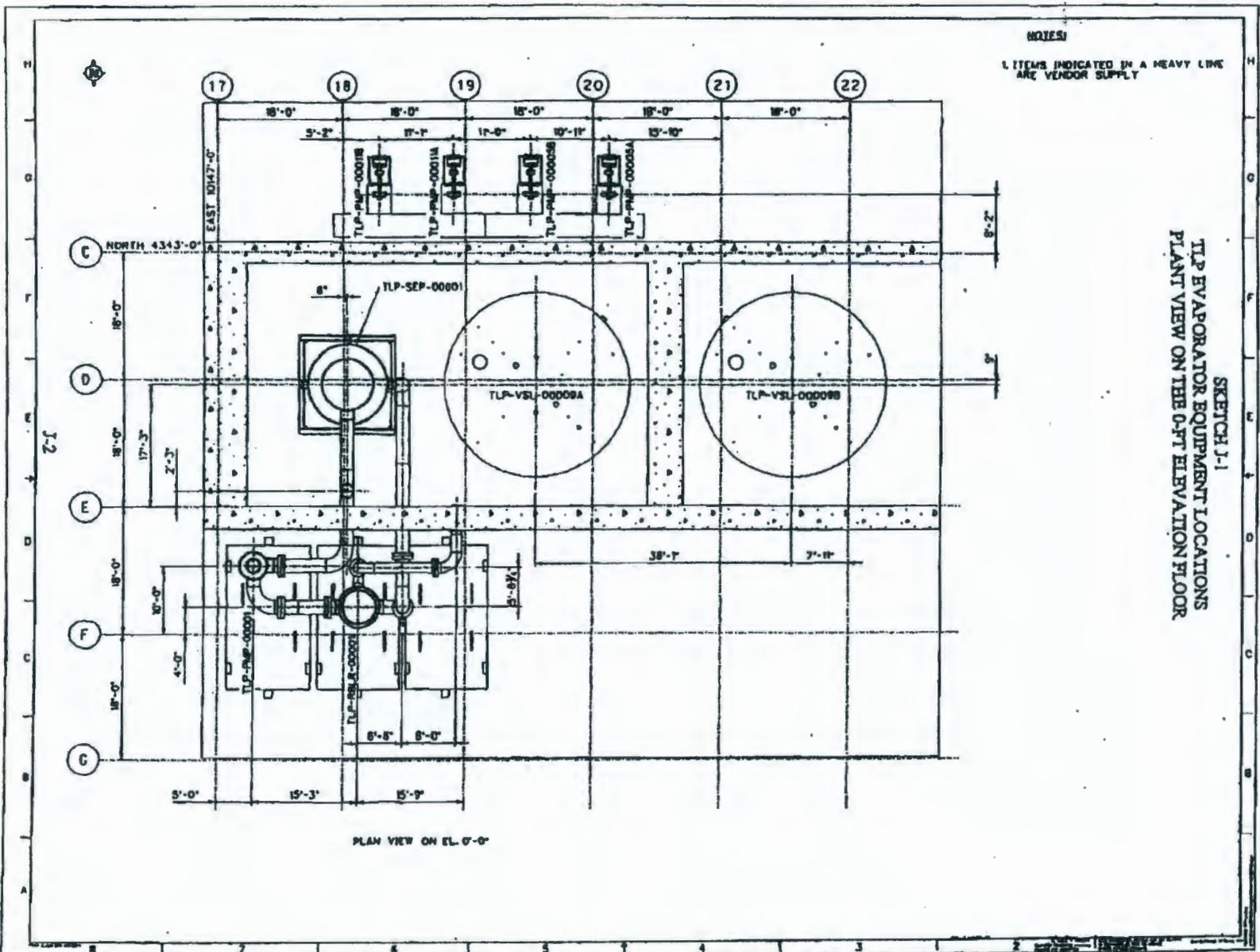




**APPENDIX J**

**TLP EVAPORATOR EQUIPMENT SKIDS  
LOCATION AND LAYOUT SKETCHES**

SKETCH J-1  
 TLP EVAPORATOR EQUIPMENT LOCATIONS  
 PLANT VIEW ON THE 0-FT ELEVATION FLOOR

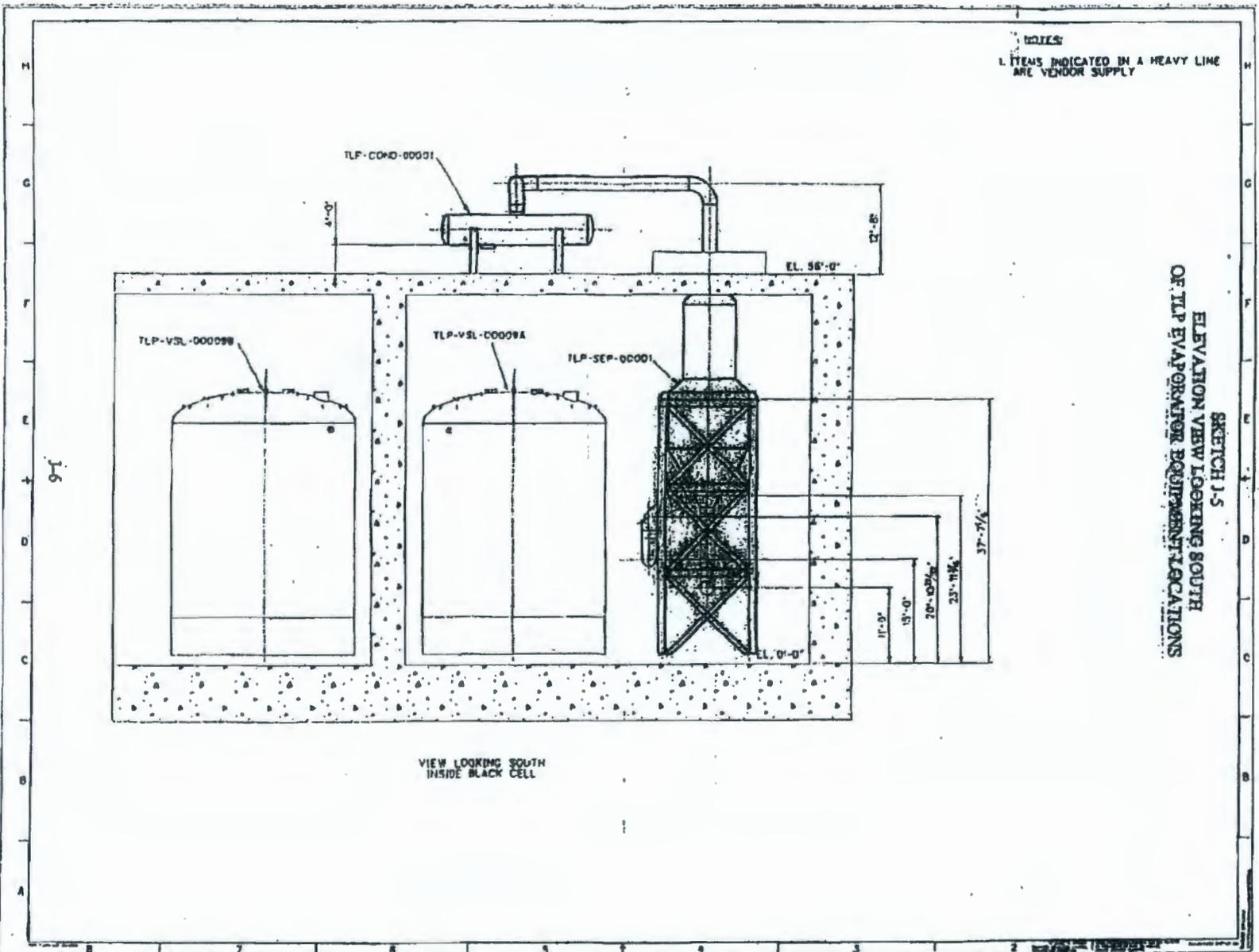




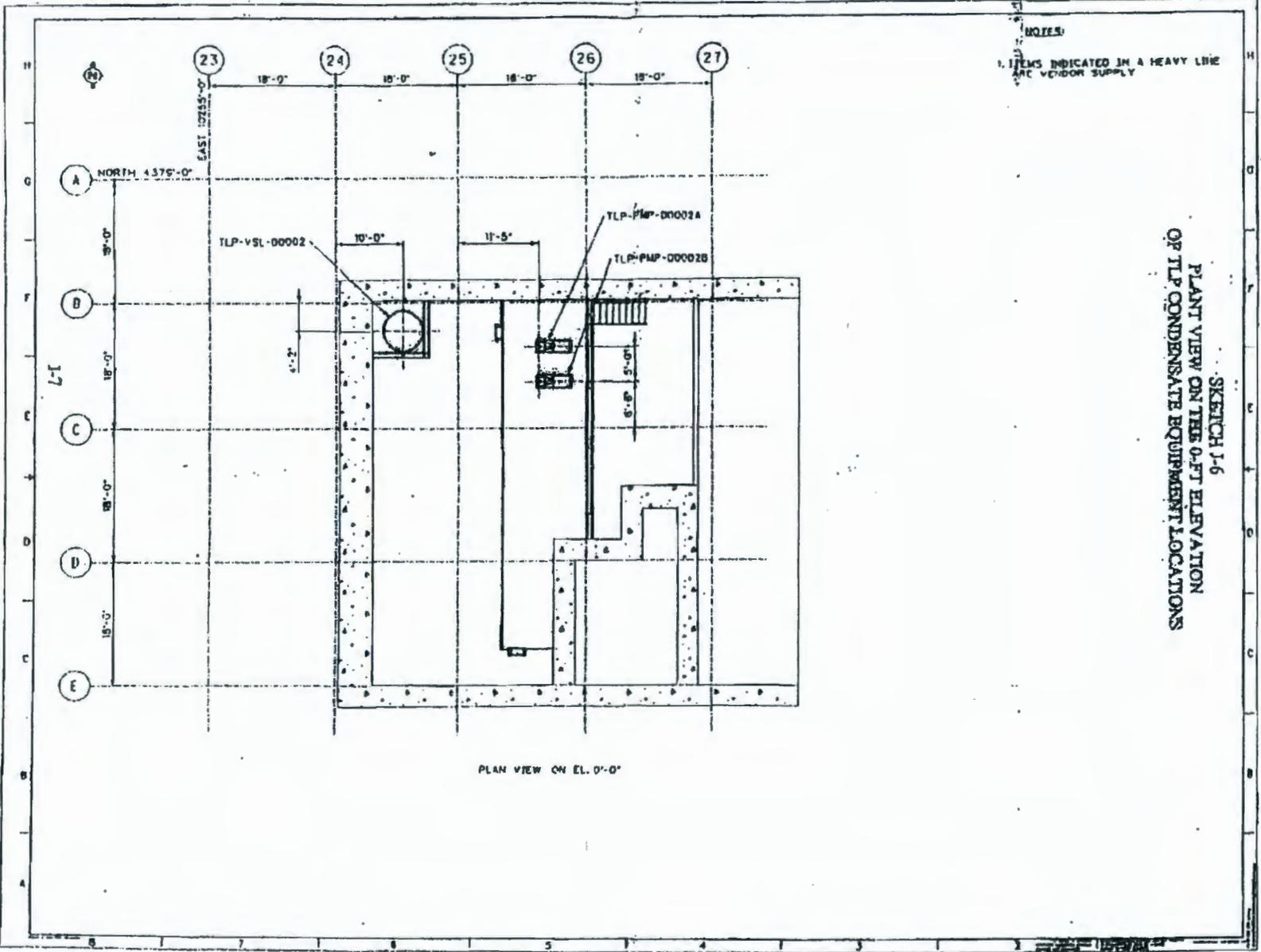




SKETCH J-5  
ELEVATION VIEW LOOKING SOUTH  
OF TLP EVAPORATOR EQUIPMENT LOCATIONS

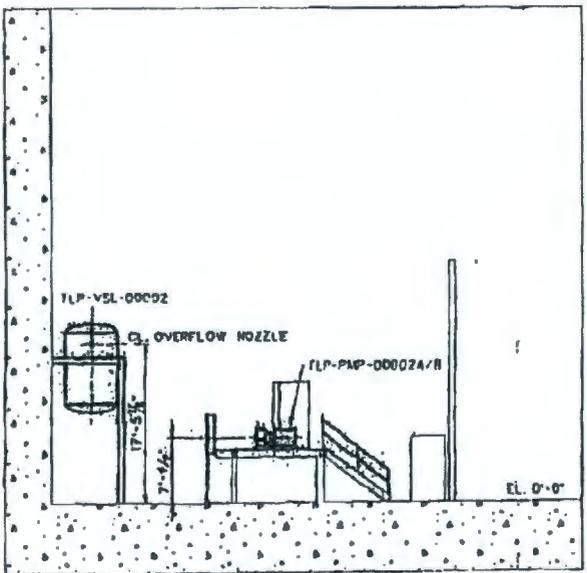


SKETCH J-6  
 PLANT VIEW ON THE 0-FT ELEVATION  
 OF TLP CONDENSATE EQUIPMENT LOCATIONS



SKETCH J-7  
ELEVATION VIEW/LOOKING NORTH  
OF T/P CONDENSATE EQUIPMENT LOCATIONS

NOTES:  
ITEMS INDICATED IN A HEAVY LINE  
ARE VENDOR SUPPLY



VIEW LOOKING NORTH

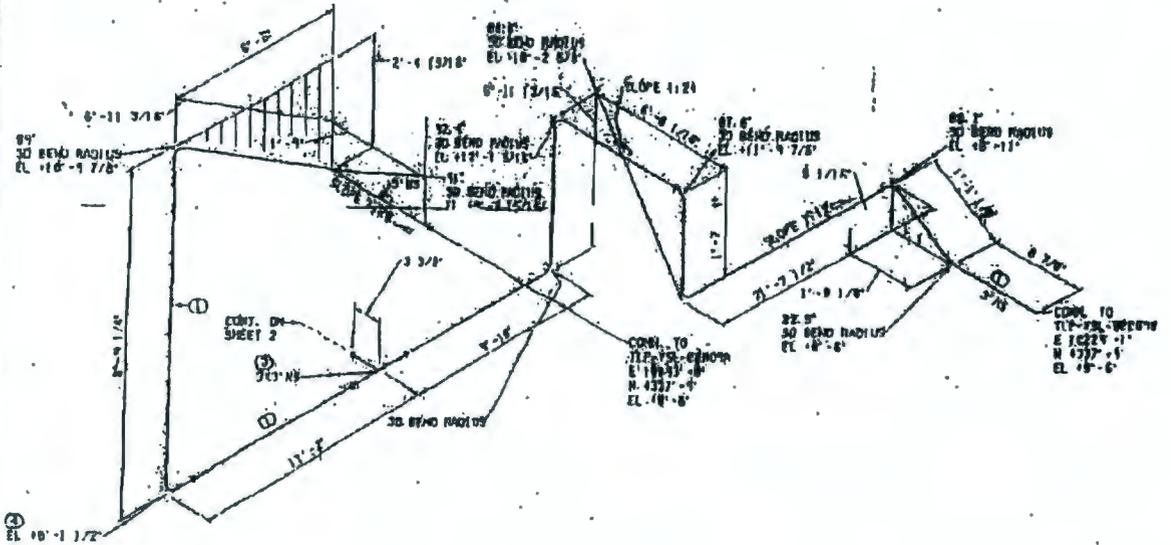
J-8

24590-G04B-F00019 Rev 4 (1/17/2006)

Ref: 24590-WTP-3DP-G04B-00049



ISOMETRIC SWITCH FOR THE EVAPORATOR FEED FROM FEED VESSEL TO FEED PUMP



- NOTES:
- FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTP-3DP-00019
  - SEE DWG. 24590-WTP-3DP-00002 FOR CONVERSION FROM PTF FACILITY ELEVATIONS TO SITE ELEVATIONS. PTF FACILITY ELEVATION 0'-0" EQUALS SITE ELEVATION 876'-0" USL.

3.9

CONTENT APPLICABLE TO ALARM  YES  NO

APP. NO. \_\_\_\_\_ REV. \_\_\_\_\_

QUALITY LEVEL: OL-2    SPECIAL CAT.    SC-11

LINE NO.	SYMBOL DESCRIPTION	SIZE	TYPE	REMARKS
1	PIPE, 100% SDR, 1/2" DIA., 304L, SCH. 40S, BK	1/2"	1/2"	FOR FEED PUMP
2	PIPE, 100% SDR, 1/2" DIA., 304L, SCH. 40S, BK	1/2"	1/2"	FOR FEED PUMP
3	TE. 80' 40" DIA., 304L, SCH. 40S	80'	1"	FOR FEED PUMP
4	TE. 80' 40" DIA., 304L, SCH. 40S	80'	1"	FOR FEED PUMP

24590-PTF-3PS-MEVV-10001, Rev. 2  
Forced Circulation Vacuum Evaporator System

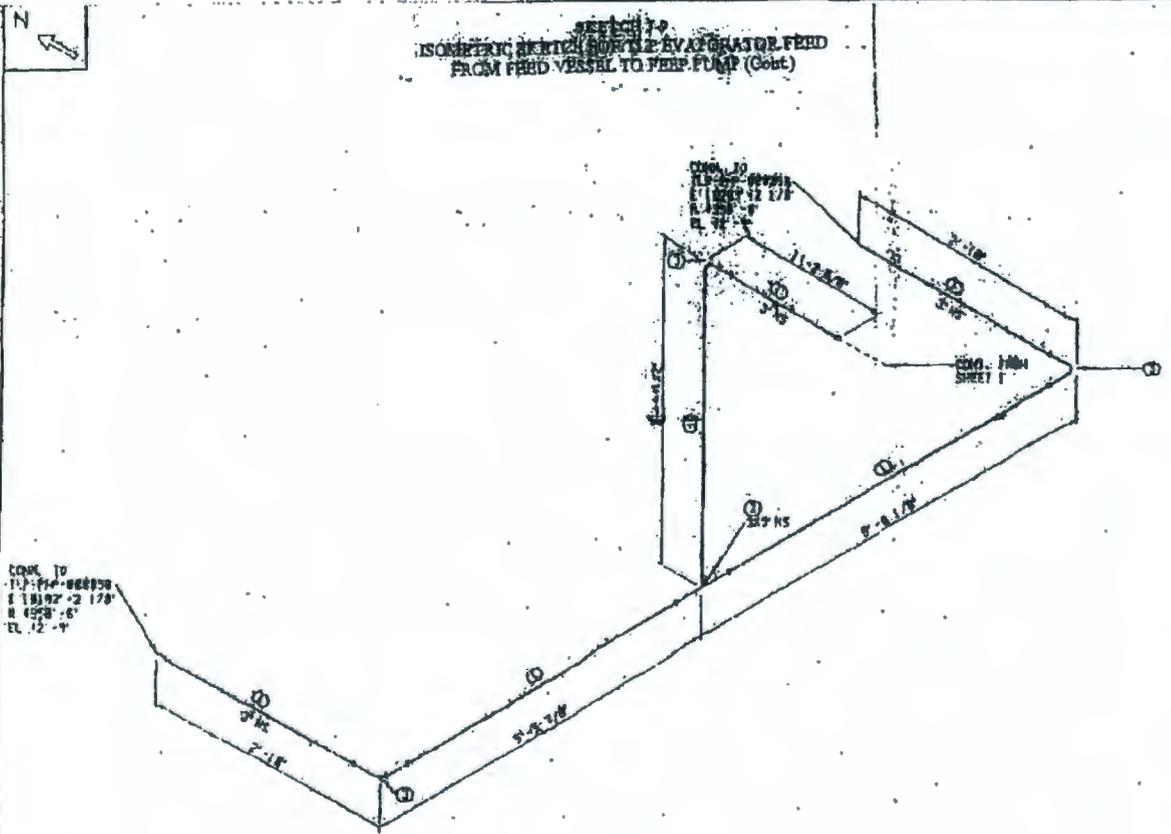
**PRELIMINARY**

REV.	DATE	DESCRIPTION	BY	APP. BY
REVISION HISTORY				
PROJECT NO. DE-1027-0017133				
PARD 24590-PTF-3DP-00019    CONST. WORK AREA				
<b>PRETREATMENT FACILITY ISOMETRIC</b>				
LINE NO. _____				PIPE SPEC. 51 2C
DWD No. _____				REV. _____
PLOT DATE: 03/24/2003 134527 AR				

24590-G04B-F00019 Rev 4 (1/17/2006)

Ref: 24590-WTP-3DP-G04B-00049

**SEECH TO**  
**ISOMETRIC SWITCH FROM LEVATOR FIRD**  
**FROM FIRD VESSEL TO FIRD PUMP (Cont)**



COORD TO  
 1) 113102+2 178  
 2) 113102+2 178  
 3) 113102+2 178  
 EL. 12'-4"

- Notes
1. FOR GENERAL NOTES AND LEGEND SEE 24590-WTP-3DP-G04B-00049.
  2. SEE 24590-WTP-3DP-G04B-00049 FOR CONVERSION FROM PIPING FACILITY ELEVATIONS TO SITE ELEVATIONS. PIPING FACILITY ELEVATIONS 0-9 EQUALS SITE ELEVATION 874'-0" MSL.

3-10

CONTENT APPLICABLE TO ALBRAT  YES  NO  
 NO. REV.  
 QUALITY LEVEL: 0-2 SEISMIC CAT: 0C-11

ITEM NO.	DESCRIPTION	A.C. (INCHES)	QTY	WORKS SHEET CODE
1	PIPE, ASTM A106 GR. B, SCH. 40	17"	3	PTF0000007
<b>FITTINGS</b>				
2	90° EL. WELD, ASTM A106 GR. B, SCH. 40	3"	1	PTF0000008
3	90° EL. WELD, ASTM A106 GR. B, SCH. 40	3"	3	PTF0000009

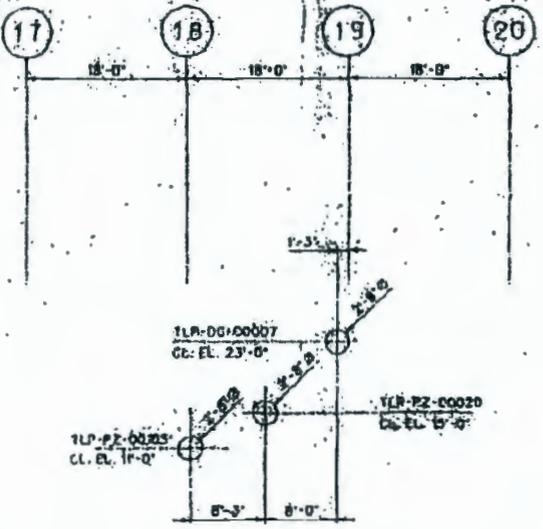
24590-PTF-3PS-MEVV-10001, Rev. 2  
 Forced Circulation Vacuum Evaporator System

**PRELIMINARY**

REV.	DATE	DESCRIPTION	BY	CHKD.	STRESS	HYDRO	PIPE
REVISION HISTORY							
PROJECT NO. 24590-PTF-3PS-MEVV-10001				CONTRACT NO. DETAIL NO. 000000000			
FACILITY: PRETREATMENT FACILITY				ISOMETRIC			
LINE NO.						PIPE SPEC. SI 2C	
DWG. NO.						2	
PLOTTED BY: [Signature]						PLOT DATE: 03/24/2003, 11:37:20 AM	

SECTION J-10  
 HOT CELL VACUUM EVAPORATOR SYSTEM LOCATION  
 SYSTEM COMPONENTS AND CONNECTIONS

NOTES



VIEW LOOKING NORTH  
 ON NORTH HOT CELL WALL

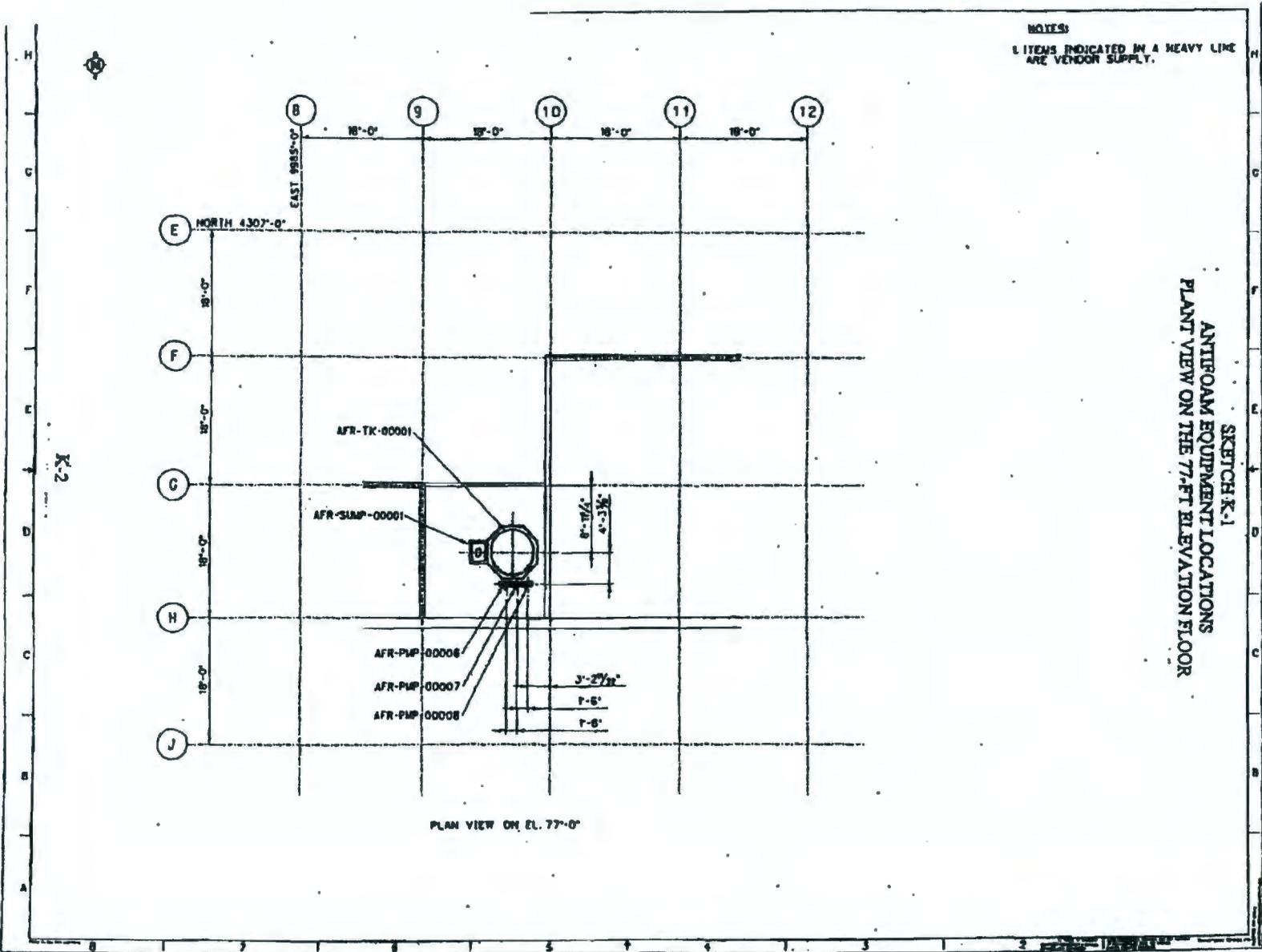
J-11

**APPENDIX K**

**ANTIFOAM EQUIPMENT SKIDS  
LOCATION AND LAYOUT SKETCHES**

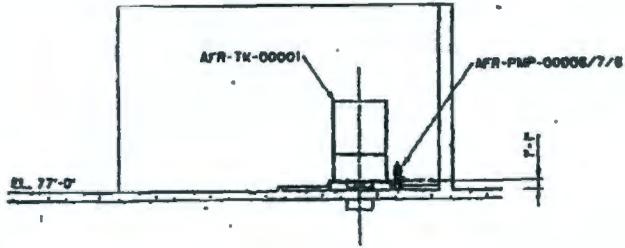
NOTES:  
1. ITEMS INDICATED IN A HEAVY LINE  
ARE VENDOR SUPPLY.

SKETCH K-1  
ANTI-OAM EQUIPMENT LOCATIONS  
PLANT VIEW ON THE 77.0' ELEVATION FLOOR



NOTES:  
1. ITEMS INDICATED IN A HEAVY LINE  
ARE VENDOR SUPPLY.

SKETCH K-3  
ELEVATION VIEW LOOKING EAST  
OF ANTISOAM EQUIPMENT LOCATIONS



VIEW LOOKING EAST

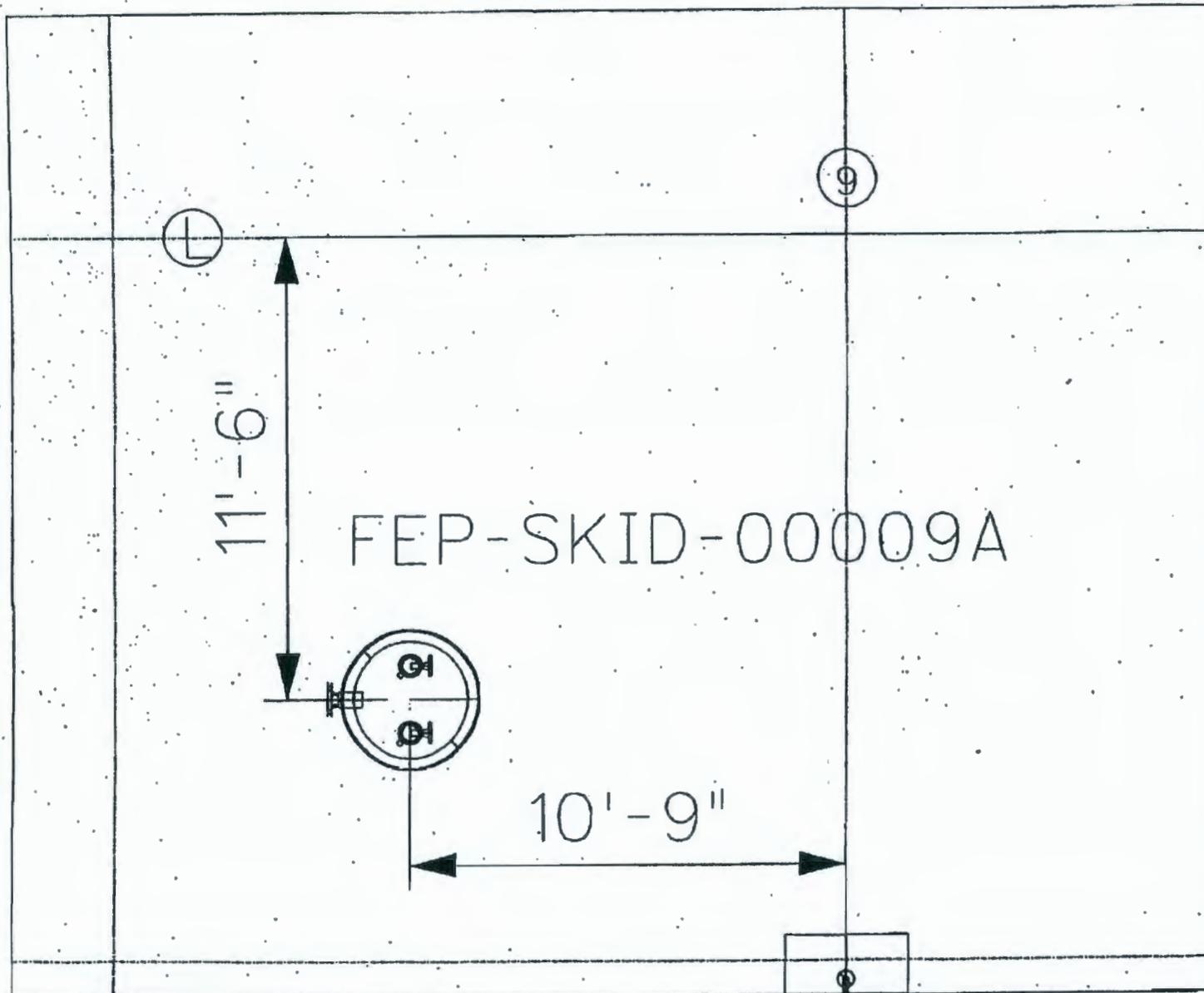
K-3

**APPENDIX L**

**Reboiler Steam Condensate Transfer Stations  
Location and Layout Sketches**

SKETCH L-1

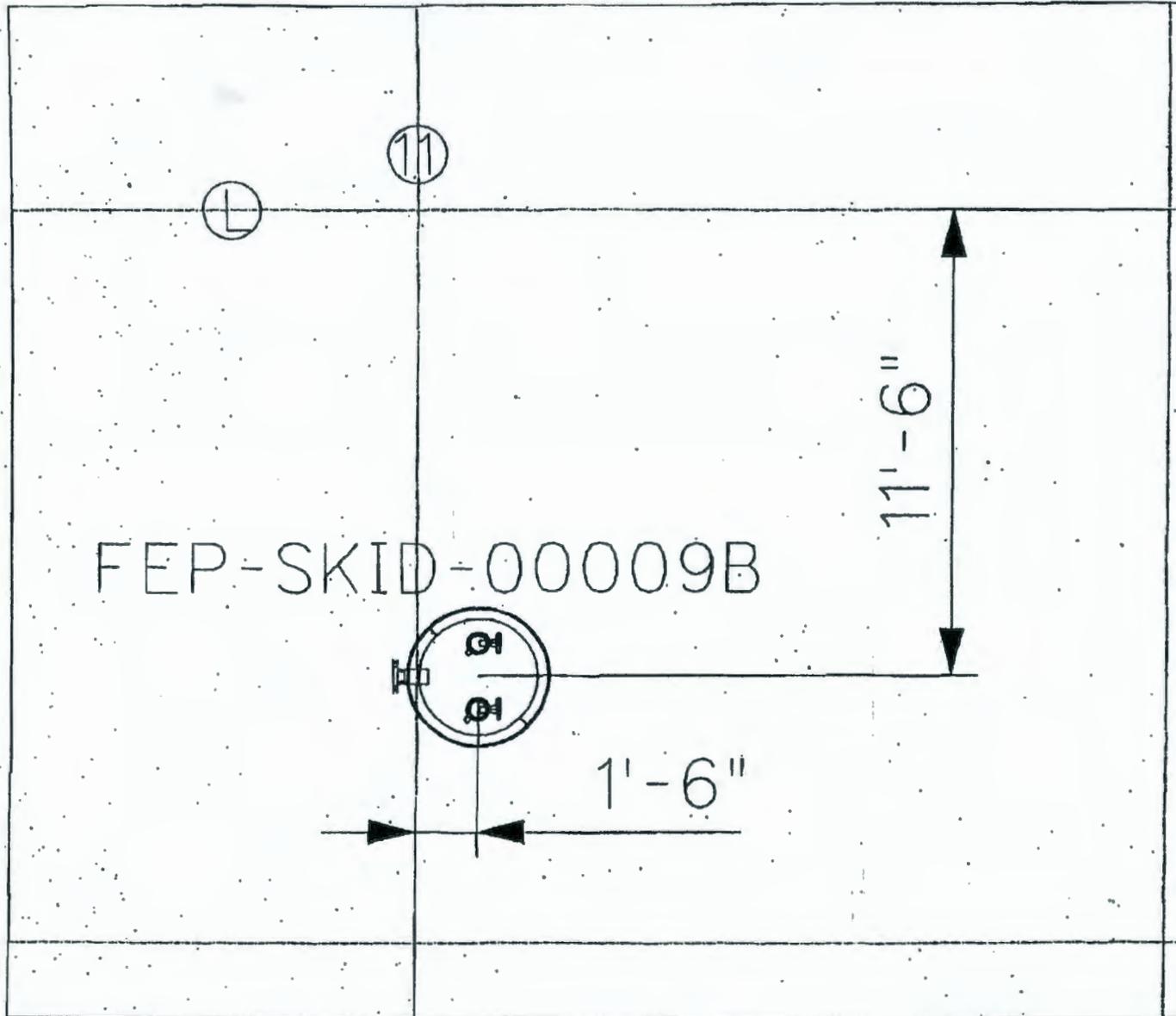
24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



PLAN VIEW  
@ 0'-0" Elevation

SKETCH L-2

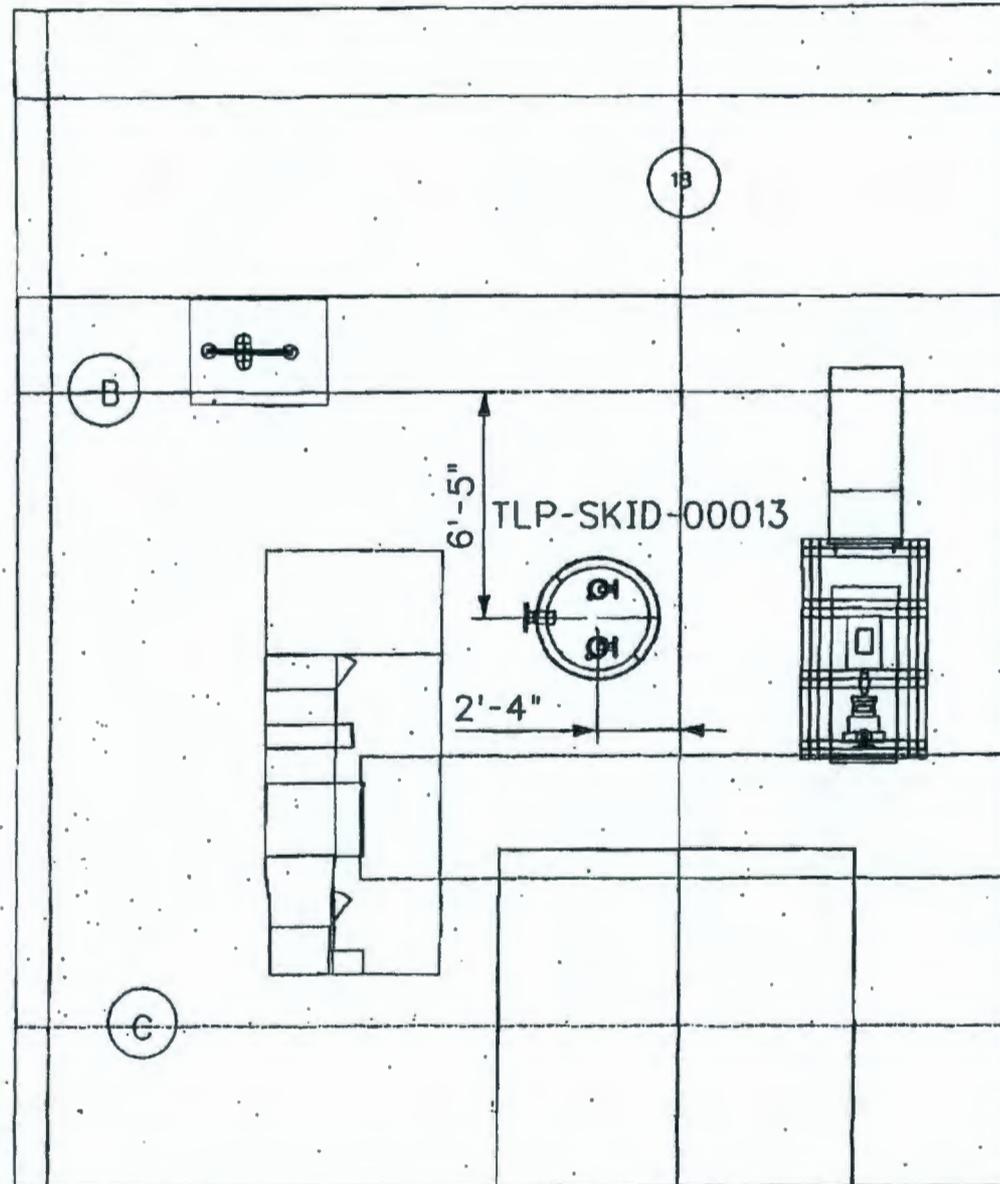
24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



PLAN VIEW  
@ 0'-0" Elevation

SKETCH L-3

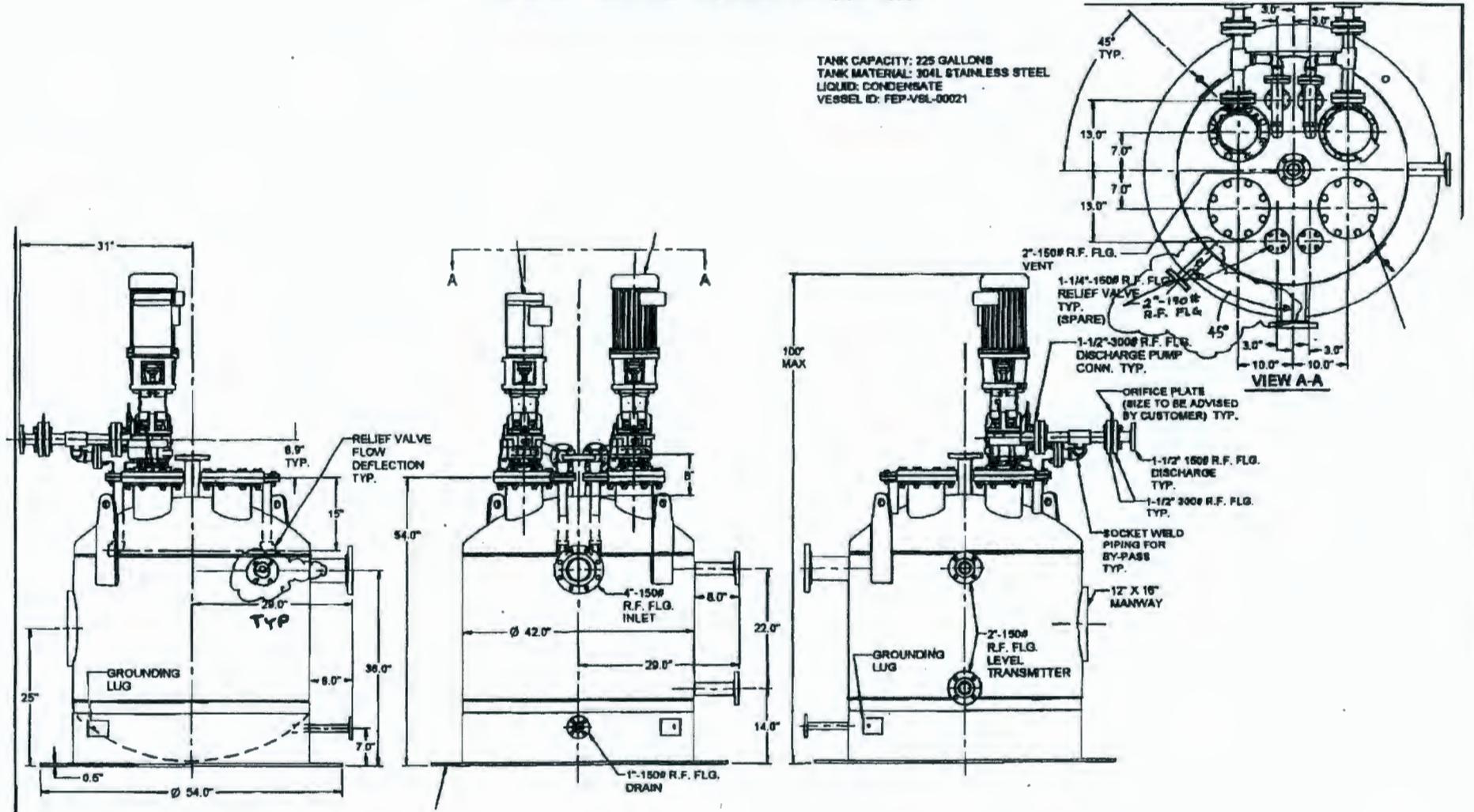
24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



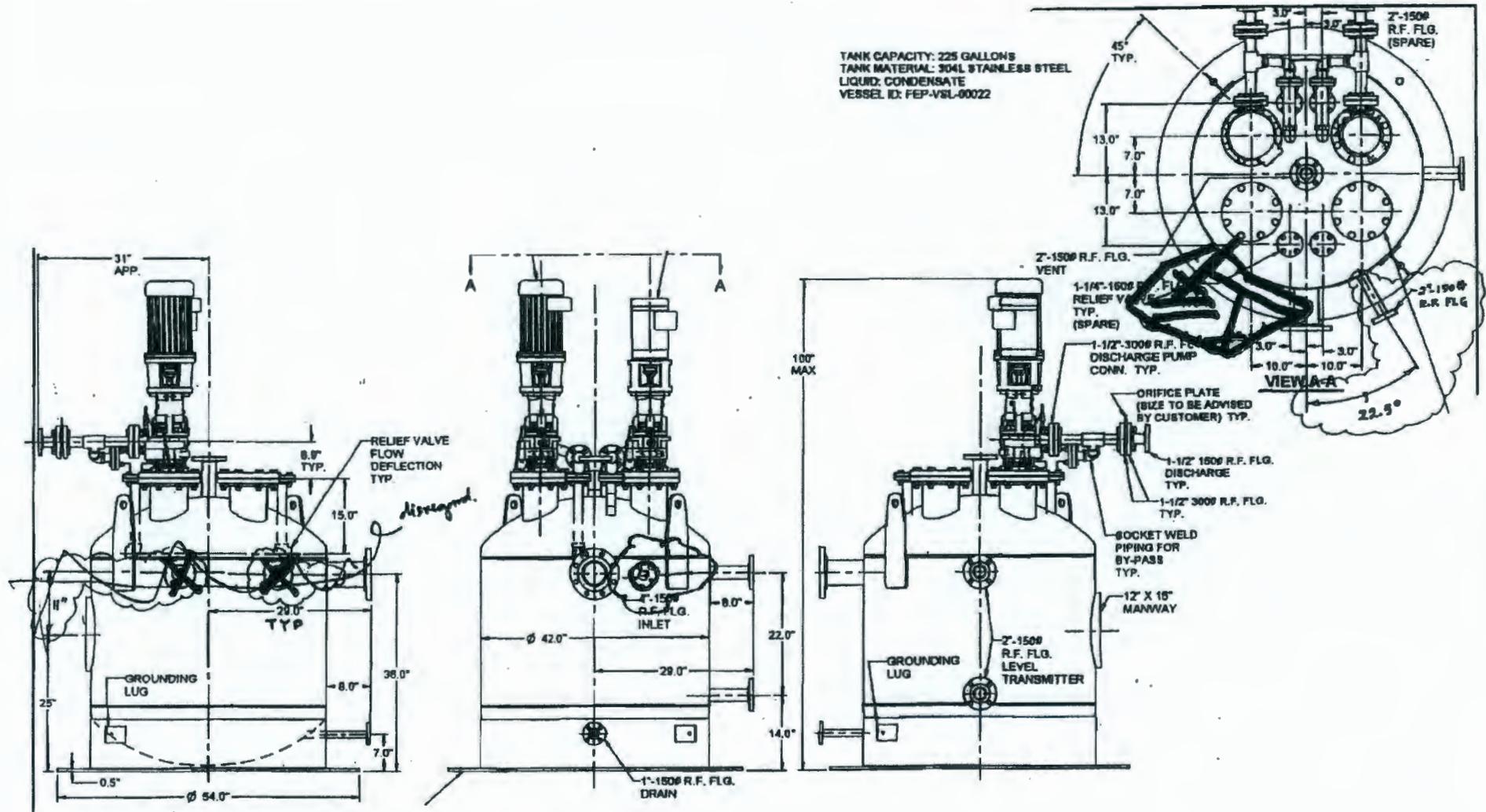
PLAN VIEW  
@ 0'-0" Elevation

Sketch L-4  
 Location of 2"-150# R.F. FLG inlet nozzle  
 on Roth Vessel FEP-VSL-00021 for DSH drain

TANK CAPACITY: 225 GALLONS  
 TANK MATERIAL: 304L STAINLESS STEEL  
 LIQUID: CONDENSATE  
 VESSEL ID: FEP-VSL-00021

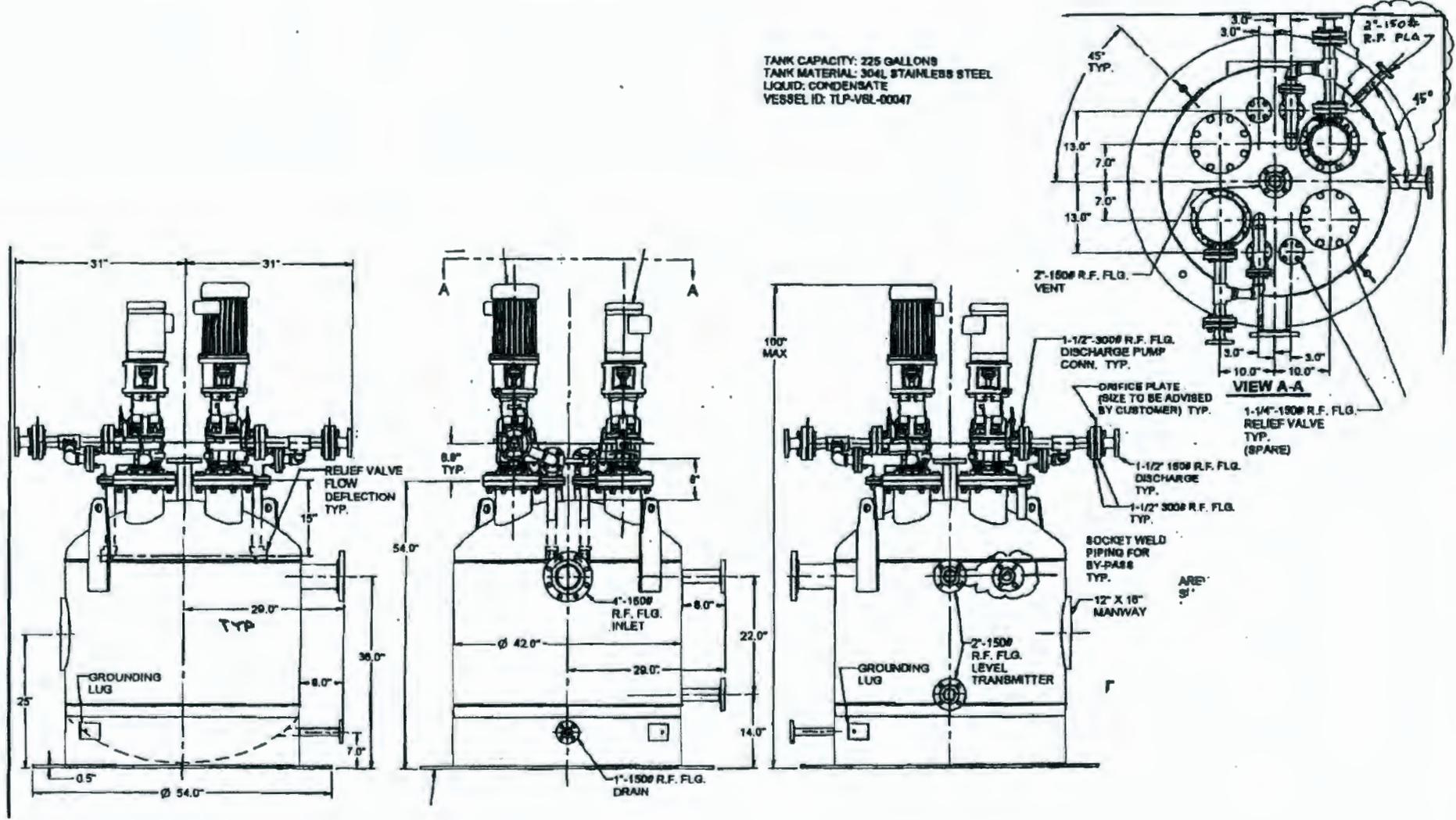


Sketch L-5  
 Location of 2"-150# R.F. FLG inlet nozzle  
 on Roth Vessel FEP-VSL-00022 for DSH drain



Sketch L-6  
 Location of 2"-150# R.F. FLG inlet nozzle  
 on Roth Vessel TLP-VSL-00047 for DSH drain

TANK CAPACITY: 225 GALLONS  
 TANK MATERIAL: 304L STAINLESS STEEL  
 LIQUID: CONDENSATE  
 VESSEL ID: TLP-VSL-00047



**APPENDIX M**

**DELETED**

**APPENDIX N**

**DELETED**

## APPENDIX O

### Nondestructive Examination (NDE) of Fabricated Pipe Welds

**Non-Destructive Examination (NDE) of Fabricated Pipe Welds**

<b>ASME B31.3 Process Piping</b>							
Type of Weld	Cat. D	Normal Fluid Service Less than Class 1500	Normal Fluid Service Class 1500 and Greater	Cat. M Black Cells	Cat. M Dual Containment Pipe		Cat. M All Others
					Inner Pipe	Jacket	
Girth and Miter Welds	100 % VT	100 % VT 5 % RT	100 % VT 100 % RT	100 % VT & RT (1)	100 % VT & RT (1)	100 % VT 5 % RT (3)	100 % VT 20 % PT/MT
Branch Connection Welds and Fillet Welds including Socket and Attachment Welds for Branch Reinforcement and Support Welds	100 % VT	100 % VT	100 % VT	100 % PT/MT (2)	100 % PT/MT (2)	100 % VT	100 % VT 20 % PT/MT

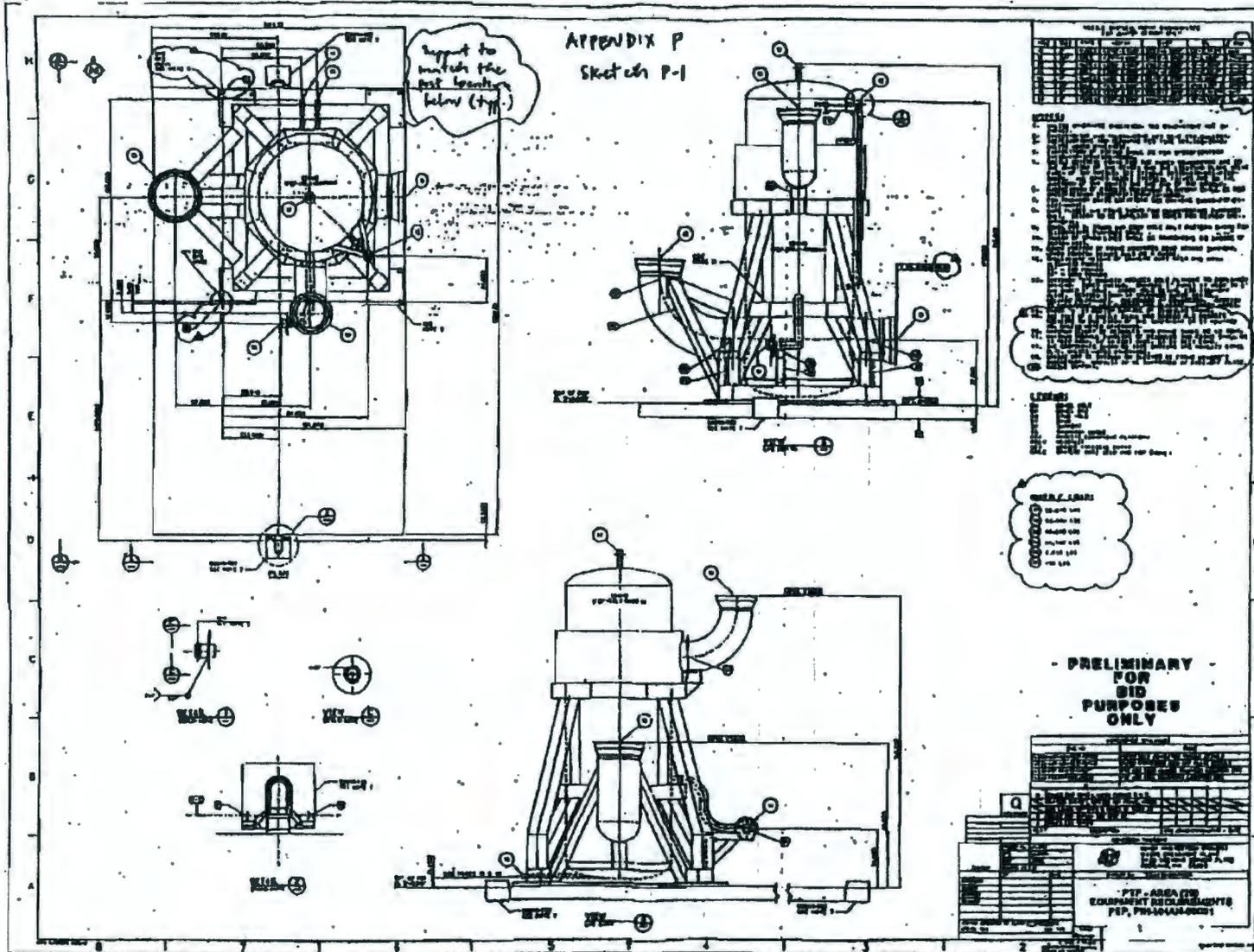
**NOTES:**

1. The radiographic acceptance criteria for normal fluid service applies except that incomplete penetration and undercut are not permitted.
2. The penetrant and magnetic particle test acceptance criteria shall be in accordance with B31.3 para. 344.4, except that no cracks are permitted.
3. A 5 % random in-process examination shall be performed in lieu of RT in accordance with ASME B31.3, Para. 341.4.1 & 344.7.
4. Black cells include Rm. No's. P-102, 104, 106, 108, 109, 111, 112, 113, 114 & 116 in the PT Building and Rm. No's. H-B005A, B032, B014, B021, B0005, B005A, B015, H-302 & H-308 in the HLW Building.

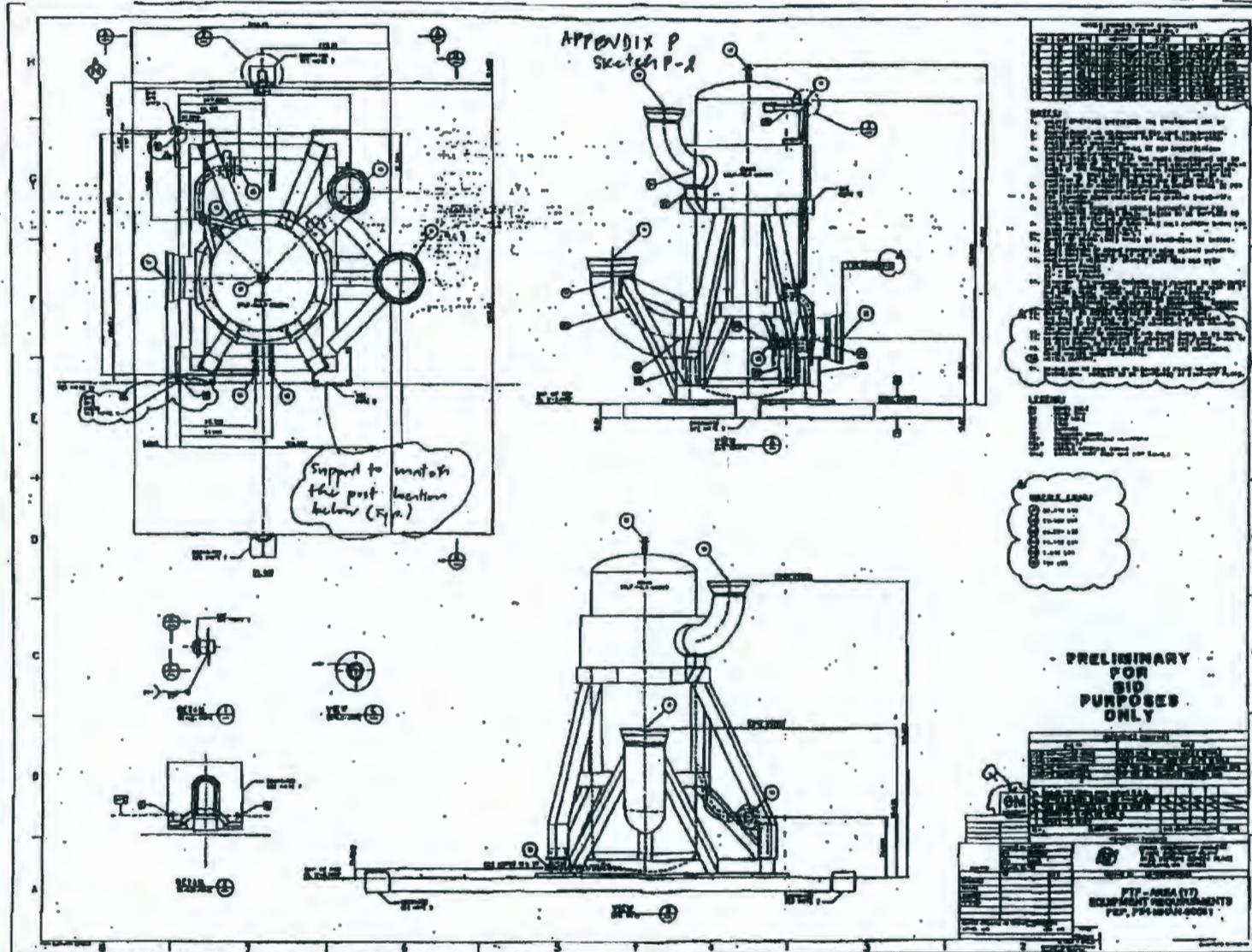
**LEGEND:**  
 RT - Radiographic Examination, PT/MT - Liquid Penetrant or Magnetic Particle Examination, VT - Visual Examination

**APPENDIX P**

**Reboiler Skids and Preliminary Nozzle Loads  
At Grayloc Connections**



24590-PTF-3PS-MEVV-T0001, Rev. 2  
 Forced Circulation Vacuum Evaporator System

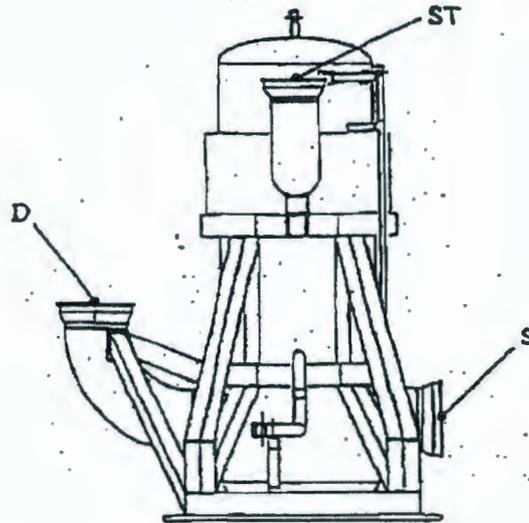


APPENDIX P

FEP / TLP Large Bore Reboiler Connector Loads

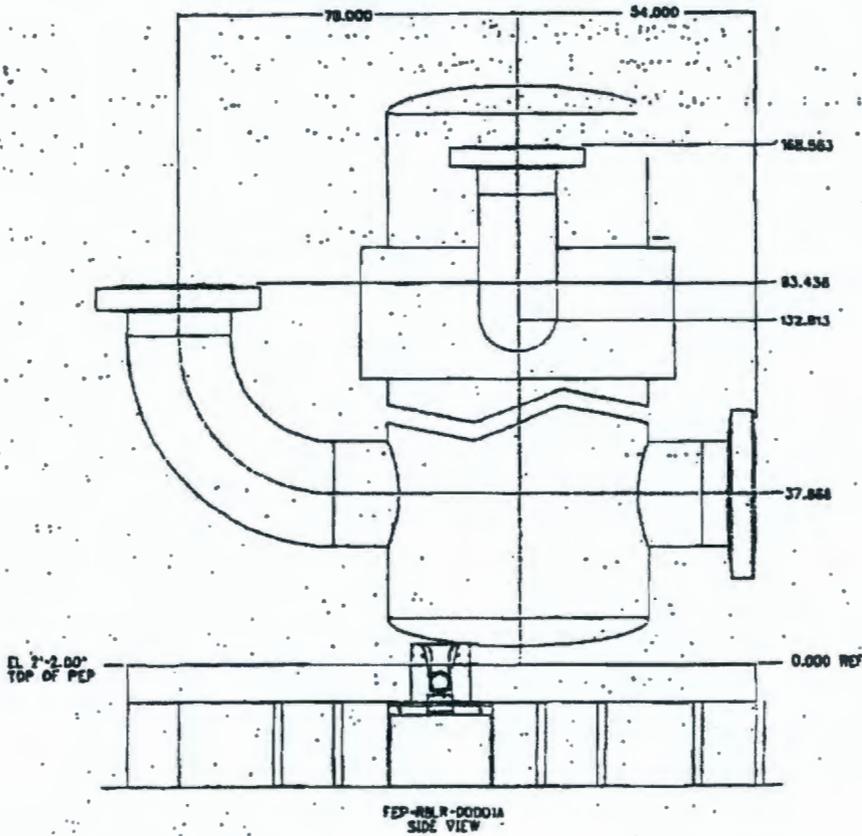
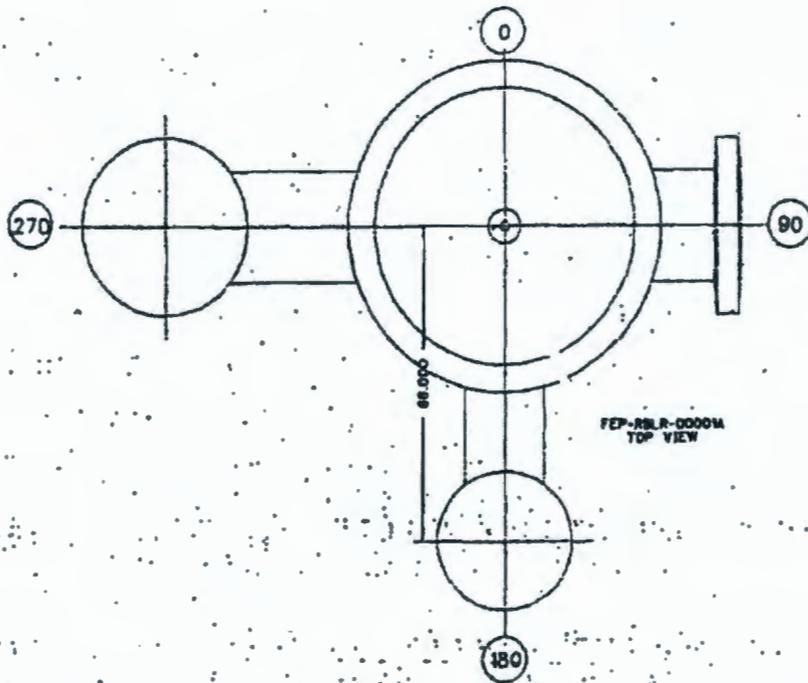
	System	Force		Moment	
		Axial lbf	Resultant Shear lbf	Torsion ft-lbf	Resultant Bending ft-lbf
24-Inch					
AREA 17S	TLP	6400	15400	4300	33900
AREA 17D	TLP	11600	13900	31400	24000
AREA 26S	FEP	2100	8200	17100	30800
AREA 26D	FEP	14600	9900	19100	29300
AREA 27S	FEP	2100	8200	17100	30800
AREA 27D	FEP	14600	9900	19100	29300
18-Inch					
AREA 17ST	TLP	7600	3700	9000	6900
AREA 26ST	FEP	6700	4900	4600	11000
AREA 27ST	FEP	6700	4900	4600	11000

S - Suction      D - Discharge      ST - Steam

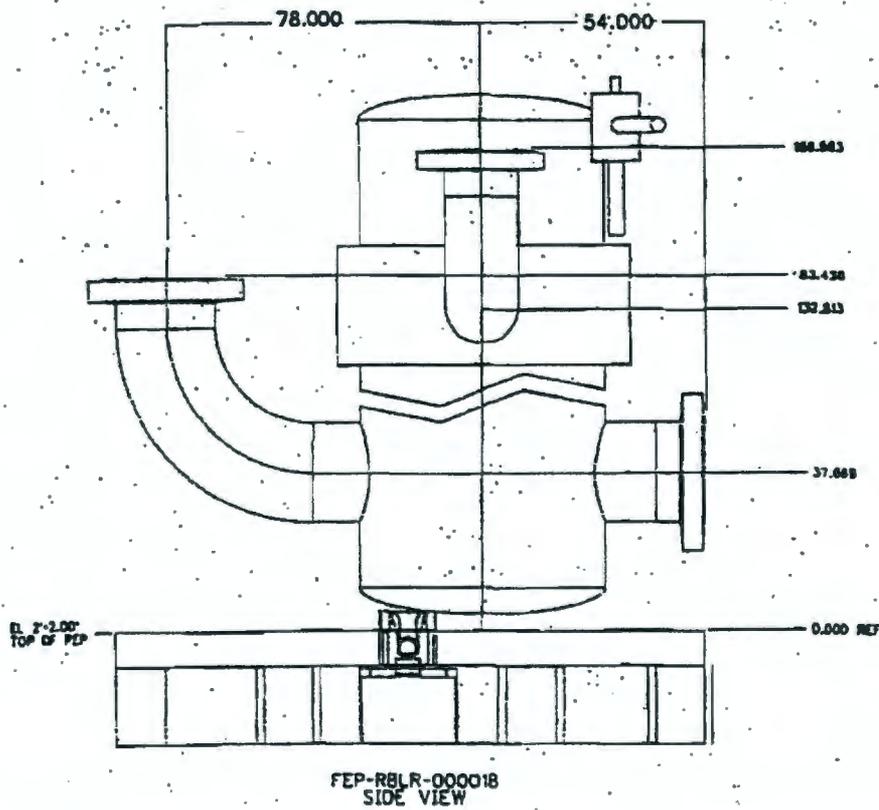
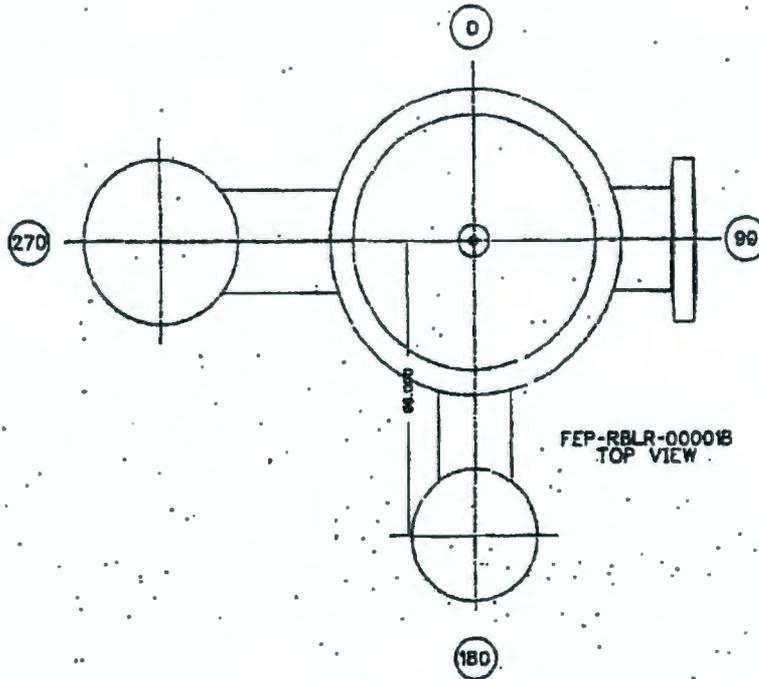


\* The loads displayed in the table above are taken from unchecked / preliminary calculations. Loads occur at hub interface as shown in figure above.

APPENDIX P

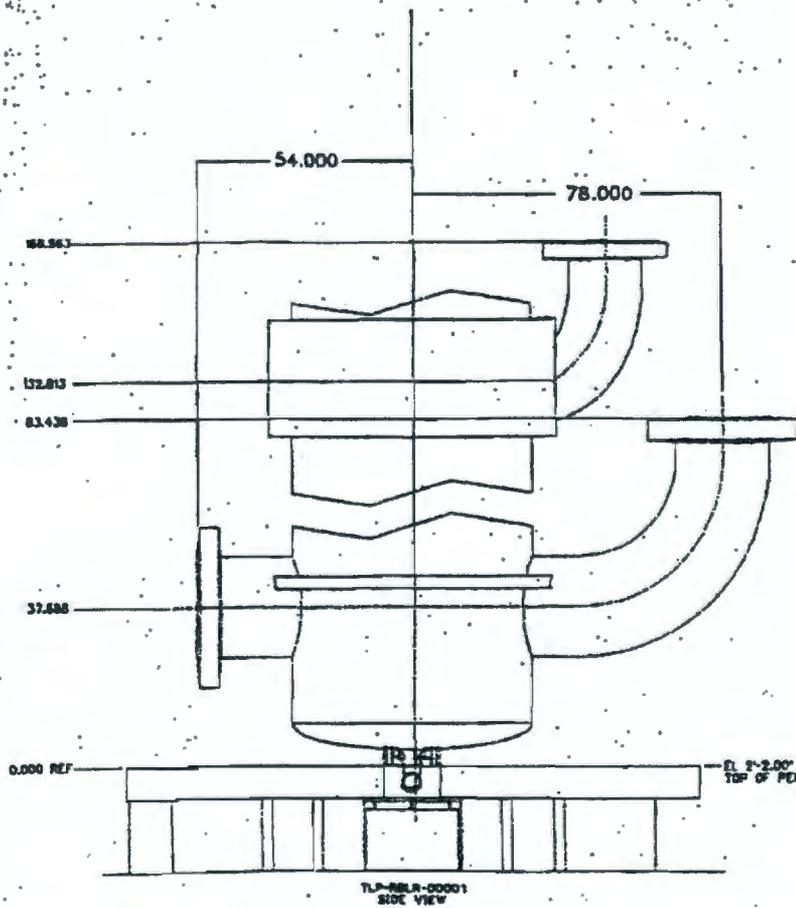
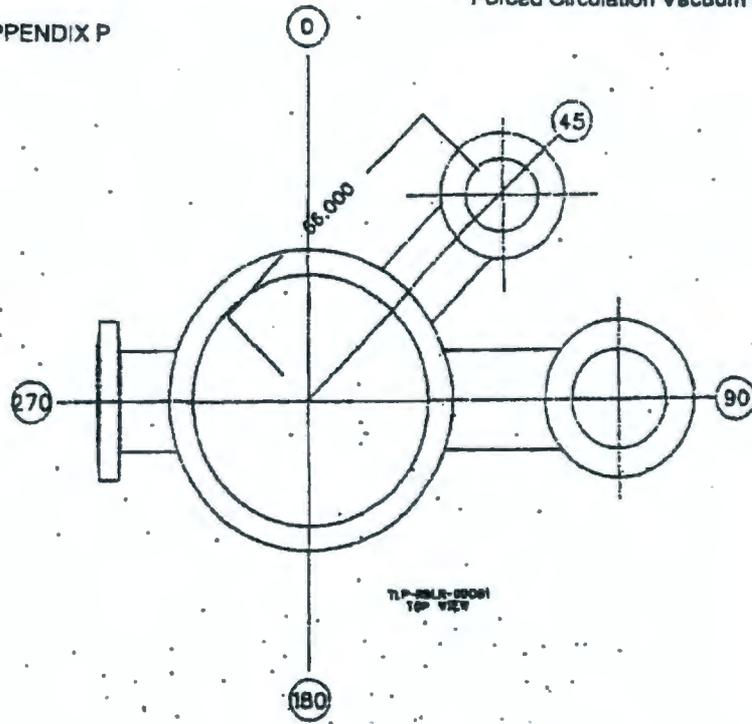


NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE  
FEP-RBLR-00001A



NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE  
FEP-RBLR-000018

APPENDIX P

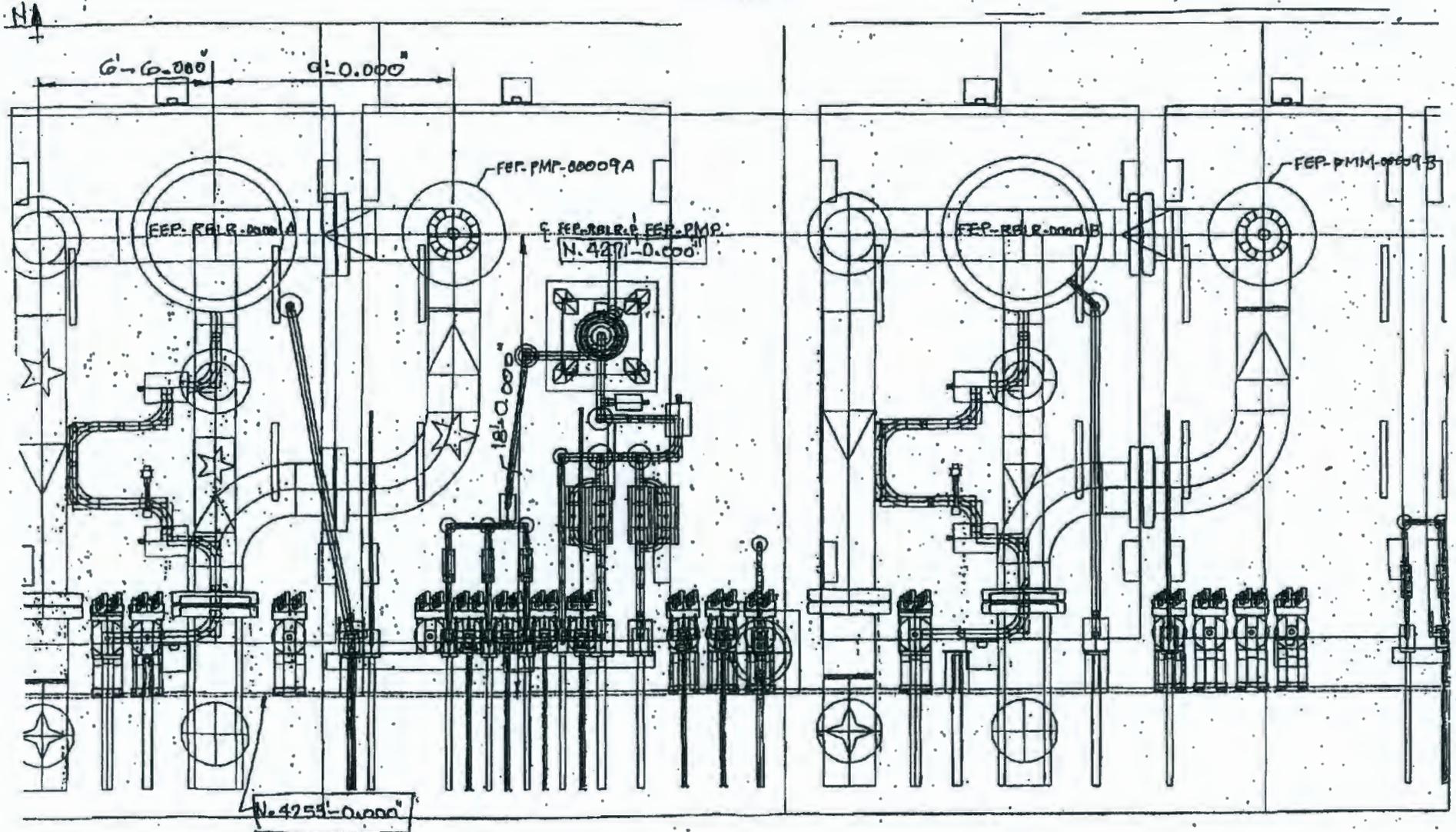


NOZZLE ORIENTATION, ELEVATION, AND DISTANCE FROM CENTERLINE  
TLP-RBLR-00001

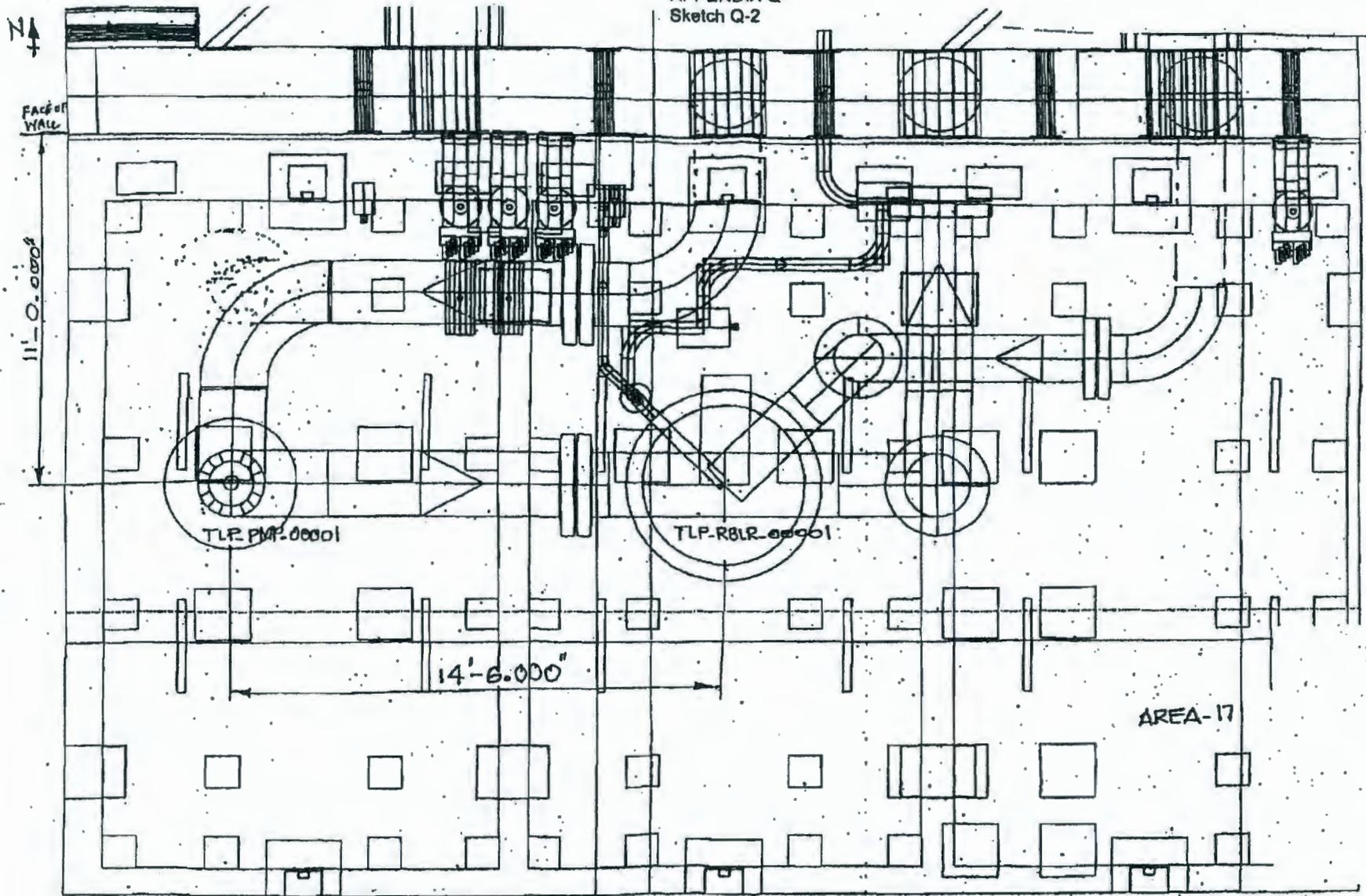
## APPENDIX Q

### Reboilers and Recirculation Pumps Layout

APPENDIX Q  
SKETCH Q-1



APPENDIX Q  
Sketch Q-2



**APPENDIX R**

**Deleted**

**APPENDIX S**

**Manufacturers Standard Coating Data Sheet**

## Manufacturers Standard Coating Data Sheet

The SELLER proposes the following Manufacturers Standard (Mfg. Std.) or alternate coating system that is suitable for the exposure conditions of steel items and equipment in radiation and non-radiation areas.

1. **Equipment Description:** \_\_\_\_\_
  - A. Tag Number \_\_\_\_\_
  - B. Part(s) i.e. skirt, shell, channels, lugs, etc.\* \_\_\_\_\_
  - C. Design/Operating Temperatures, designate °F or °C..... \_\_\_\_\_ °F      °C
  - D. Does Equipment Receive Steam out (Yes/No), Temperature \_\_\_\_\_ °F      °C
  - E. Insulated/Uninsulated \_\_\_\_\_
  - F. Fireproofing (Yes/No) \_\_\_\_\_
  - G. Carbon Steel (CS), Stainless Steel (SS), other (List) \_\_\_\_\_
2. **Seller:** \_\_\_\_\_
3. **Surface Preparation:** SSPC No./Profile \_\_\_\_\_ / \_\_\_\_\_
4. **Coating System Designation:** (Code) \_\_\_\_\_
 

	First Coat	Second Coat	Third Coat
A. Type of Coating.....	_____	_____	_____
B. Coating Mfg./No.** .....	_____	_____	_____
C. Dry Film Thickness (Min/Max in mils)/(µm) ...	_____	_____	_____
D. Wet/Film Thickness (Min/Max in mils)/(µm) _____	_____	_____	_____
E. Curing Method.....	_____	_____	_____
F. Color.....	_____	_____	_____
G. Dry to Recoat .....	_____	_____	_____
H. Pot Life .....	_____	_____	_____
L. Thinner / % .....	_____	_____	_____
5. **Total DFT of System:** (Mils/µm)(Min/Max)..... \_\_\_\_\_ / \_\_\_\_\_ Min.      Max.
6. **Material Storage:** Temperature Requirements (Min/Max) \_\_\_\_\_ / \_\_\_\_\_
7. **Shelf Life:** ..... \_\_\_\_\_ Months
8. **Application Environmental Limits:**
  - A. Temperature Ambient and Surface (Min/Max) ..... \_\_\_\_\_ / \_\_\_\_\_
  - B. Humidity (Min/Max)..... \_\_\_\_\_ / \_\_\_\_\_
  - C. Dew Point ≥5°F above surface temp. (Yes/No)..... \_\_\_\_\_
9. **Protection of surfaces that will be inaccessible after equipment installation (such as underside of base plates, interior of fans, vessels or equipment housings)** \_\_\_\_\_
10. **Rust Preventative for machined faces: (\*\*Mfg./No.)** \_\_\_\_\_
11. **Quantity of touch-up coating supplied:** \_\_\_\_\_
12. **Additional information: (attach extra page as necessary)** \_\_\_\_\_

\* Use additional copies of this form for each part described in 1 above that requires a different coating system. A completed copy of this data sheet shall be submitted to CONTRACTOR/BUYER with the initial vendor data submittal.

\*\* Include manufacturers technical data sheets and MSDS' for each proposed coating, preservative & solvent

## APPENDIX T

### Design Evolution Inputs

### T.1 Recirculation Pump Remote Connector Design Inputs

*Design Input #1:* The Hanford connector loads are 2000 lbs resultant force and 2900 ft-lbs resultant moment.

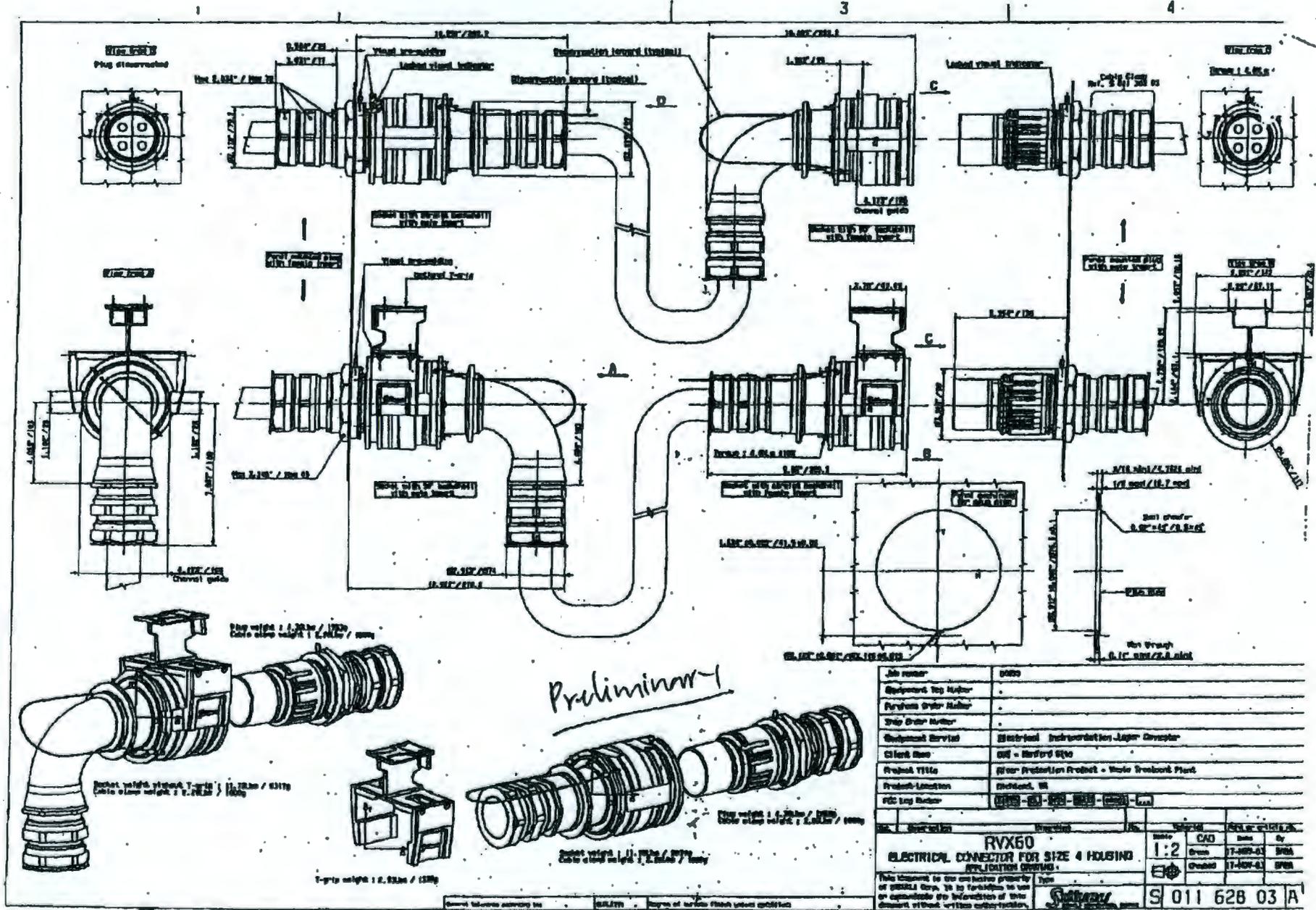
*Design Input #2:* See attached reference # 2 for Staubli connector drawings. It is recommended to use connector types as shown on drawings S-01162803-A and S-01142503-A for power and signal. Also see sketches provided in this section T.1 for additional design inputs. The Staubli connector force requirement is 400 lbf in any direction.

*Design Input #3:* For seal water and grease connections, the male plug located on the pump seals which has been called out as a Staubli part number RBE 19.6204/IC will change to Staubli part number N 011.612 04. See sketches # S-01249904-F, # S-00122805-A, # S-00119705-B, and S-111610-04-D provided in this section. The Staubli Fluids Connector shall use Keying #35 for for the seal water and grease connection.

*Design Input #4:* Remote impact wrench specification on studs

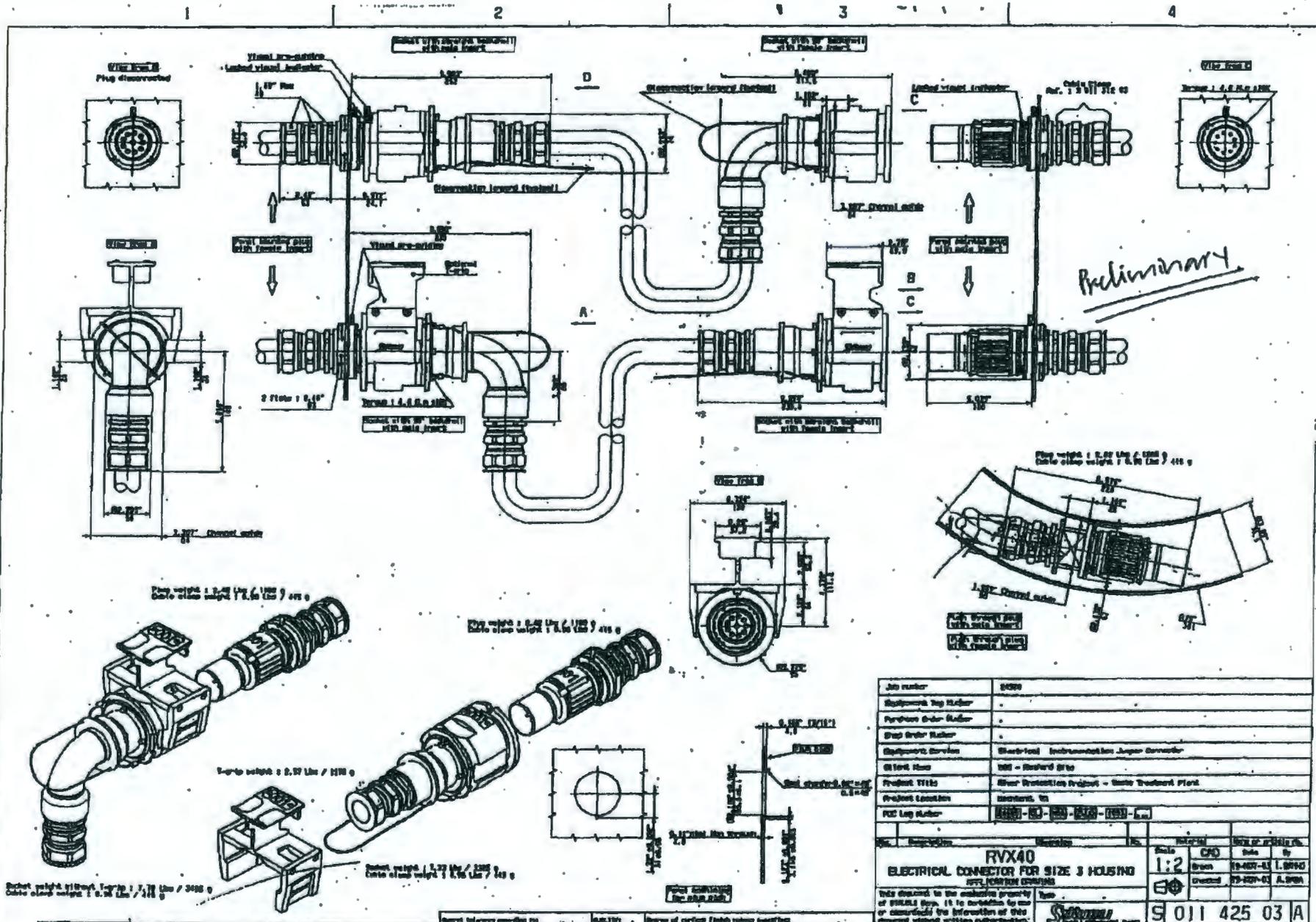
- a) Loosen 750 ft-lbs
- b) Tighten  $400 \pm 25$  ft-lbs
- c) Range 100 - 400 ft-lbs

*Design Input #5:* Recirculation pump shall be designed to incorporate remote grease application to thrust bearing.



24590-PTF-3PS-MEUV-T0001, Rev. 2  
 Forced Circulation Vacuum Evaporator System

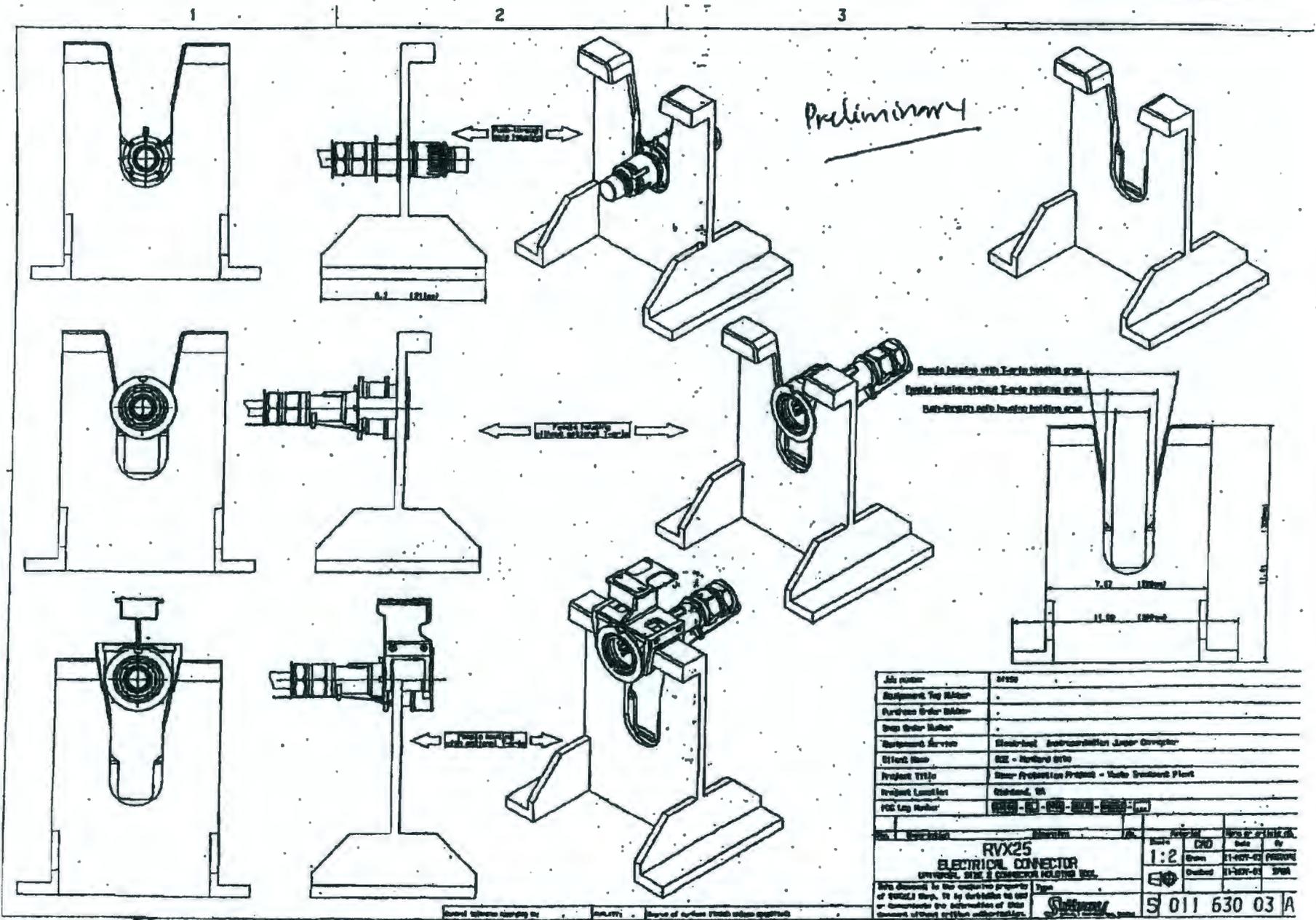
For signal cable (prefer)

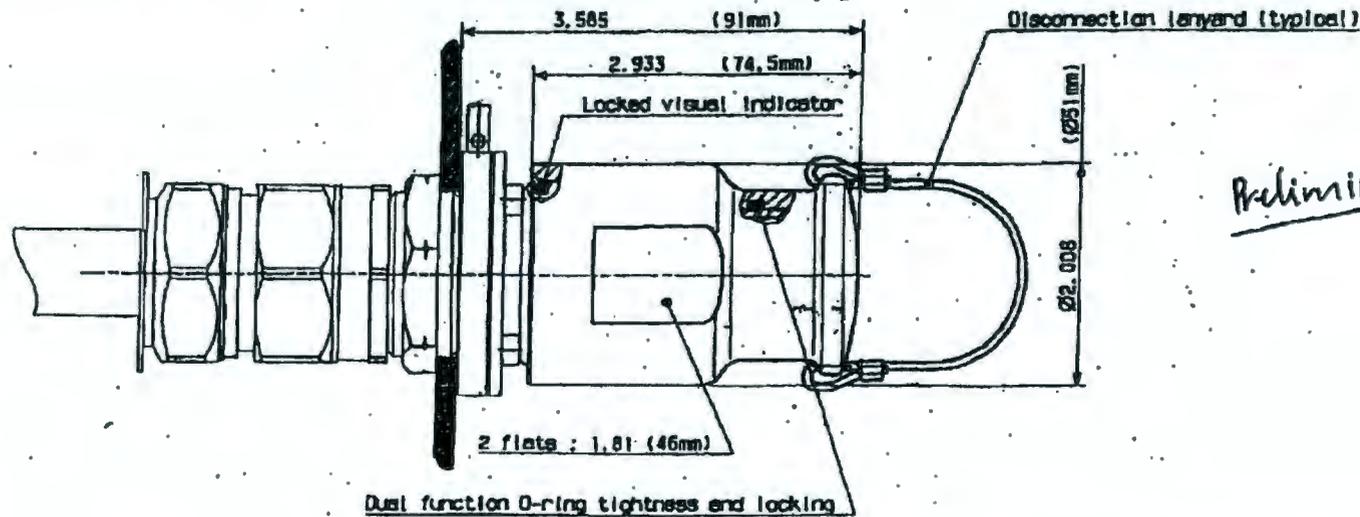


*Preliminary*

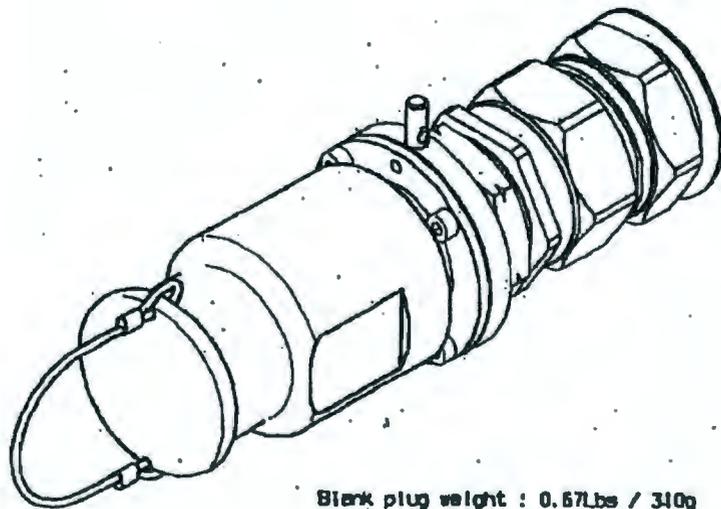
Job number	84390				
Equipment Tag Number					
Partwork Order Number					
Shop Order Number					
Equipment Section	Shielded Instrumentation Support Connector				
Alt Part Name	100 - Standard Size				
Product Title	Shield Protection Plugout - State Treatment Plant				
Product Location	Hammond, IN				
PCB Log Number	84390-80-000-000-000-000				
Rev.	Material	Scale	CPD	Date	By
	<b>RFX40</b>	<b>1:2</b>	Drawn	19-007-01	L. S. 0040
<b>ELECTRICAL CONNECTOR FOR SIZE 3 HOUSING</b>					
This drawing is the exclusive property of SULLS Inc. It is loaned to you or furnished for information of this drawing without written authorization.					
SULLS Inc.				S 011 425 03 A	







*Preliminary*



Blank plug weight : 0.67lbs / 310g

Job number	24590
Equipment Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipment Service	Electrical Instrumentation Jumper Connector
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, VA
FDC Log Number	24590 - 01 - MRA - EMOJ - 00003 - ...

Rev.	Description	Dimension	No.	Notes	Scale	Material	Drawn	Date	By
					1	CAD			
						Drawn		19-NOV-03	PISTORE
						Checked		19-NOV-03	SABA

**RVX25**  
 ELECTRICAL CONNECTOR BLANK PLUG FOR SIZE 2 HOUSING  
 APPLICATION DRAWING

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STARBUCCI  
 SPECIAL INSTRUMENTATION GROUP

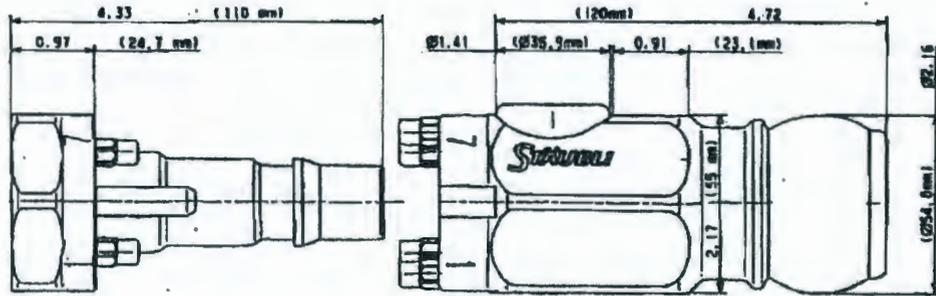
General tolerances according to: QUALITY: Degree of surface finish unless specified:

S 011 494 03 A

A3

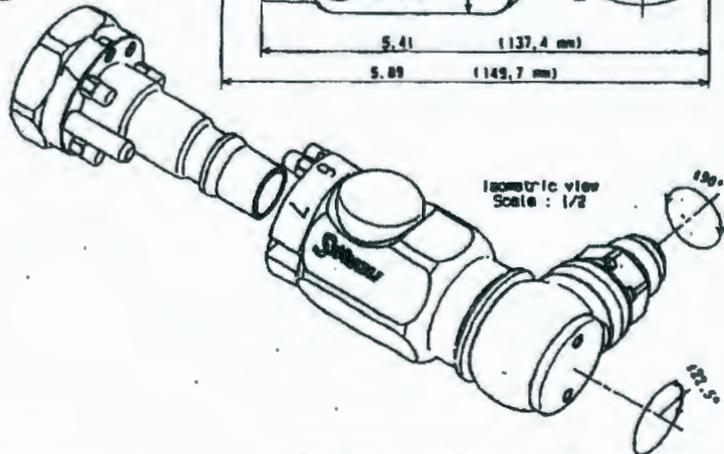
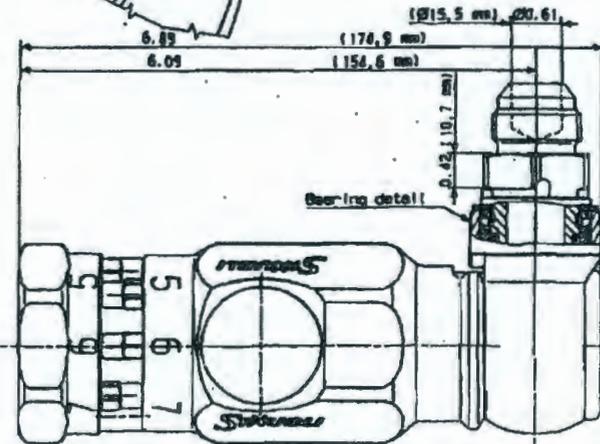
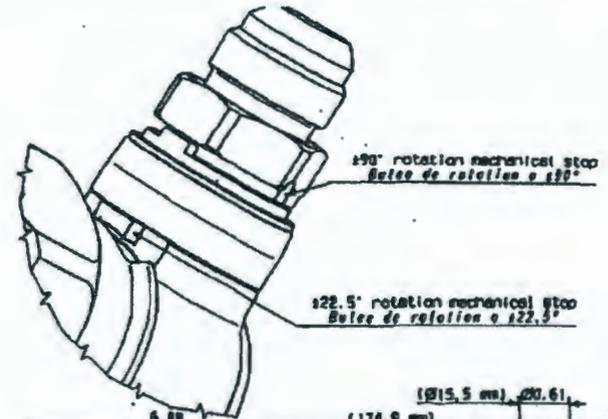
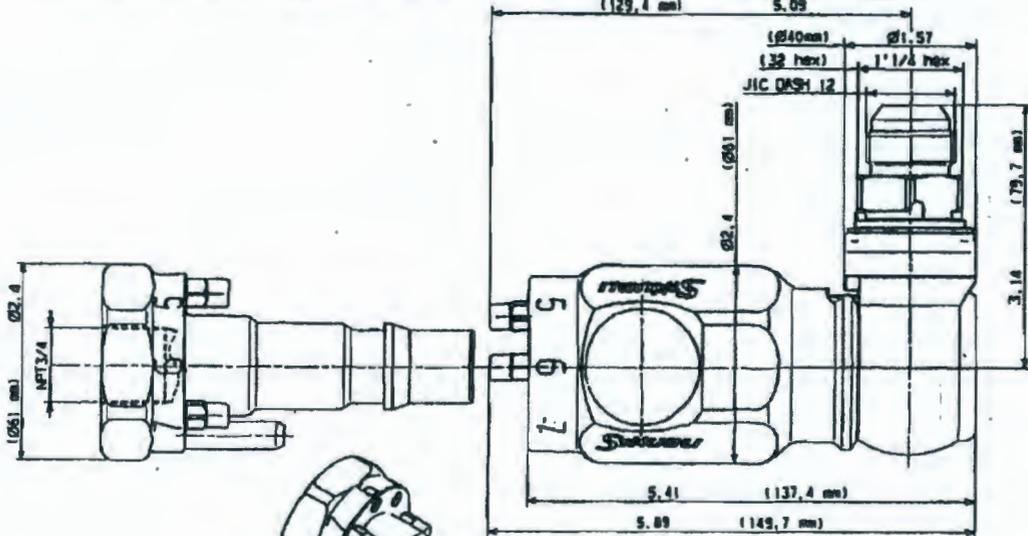
T-7

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



Male connector N 01 612 04

Female connector N 01 611 04  
(129.4 mm) 5.09



Job number	24590
Equipment Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipment Service	Flexible pneumatic / Process Jumper fabrication
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
PDC Log Number	24590 - 04 - IPR - PFD - 00003 - ...

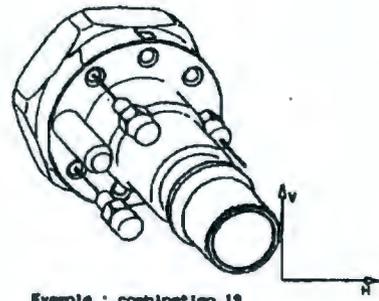
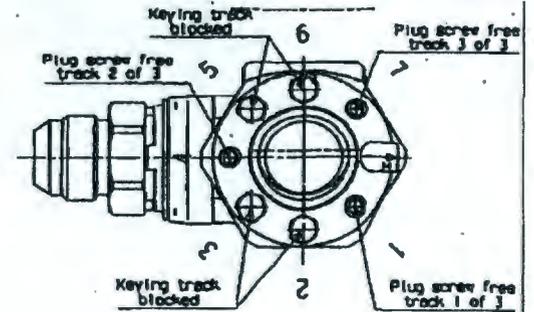
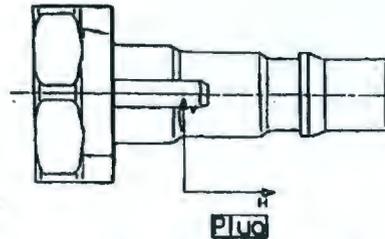
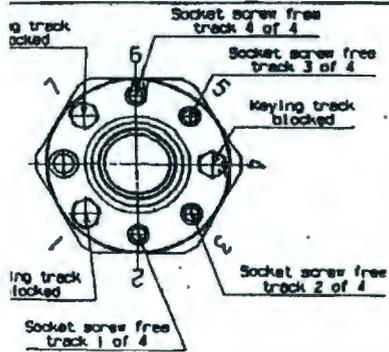
REV	DESCRIPTION	DATE	BY
1	REVISED	08-10-06	PISTONE
2	REVISED	08-10-06	CHYZNE

REB 19CM  
PNEUMATIC CONNECTOR  
WPS 1001 NOT LISTED

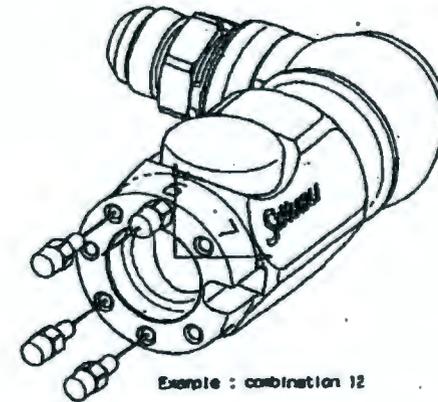
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012 499 04 F

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



Exemple : combination 12



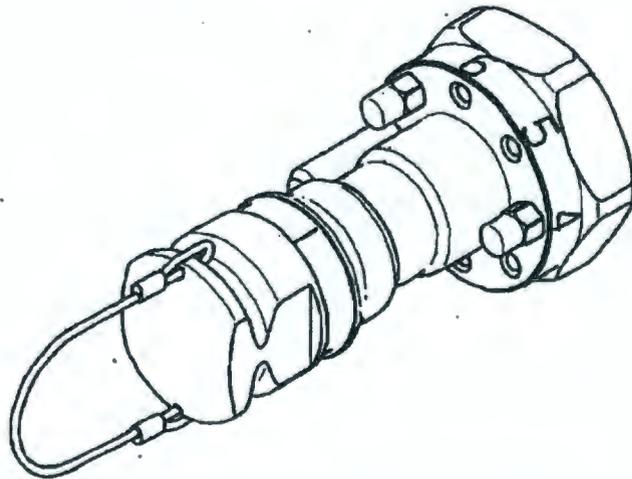
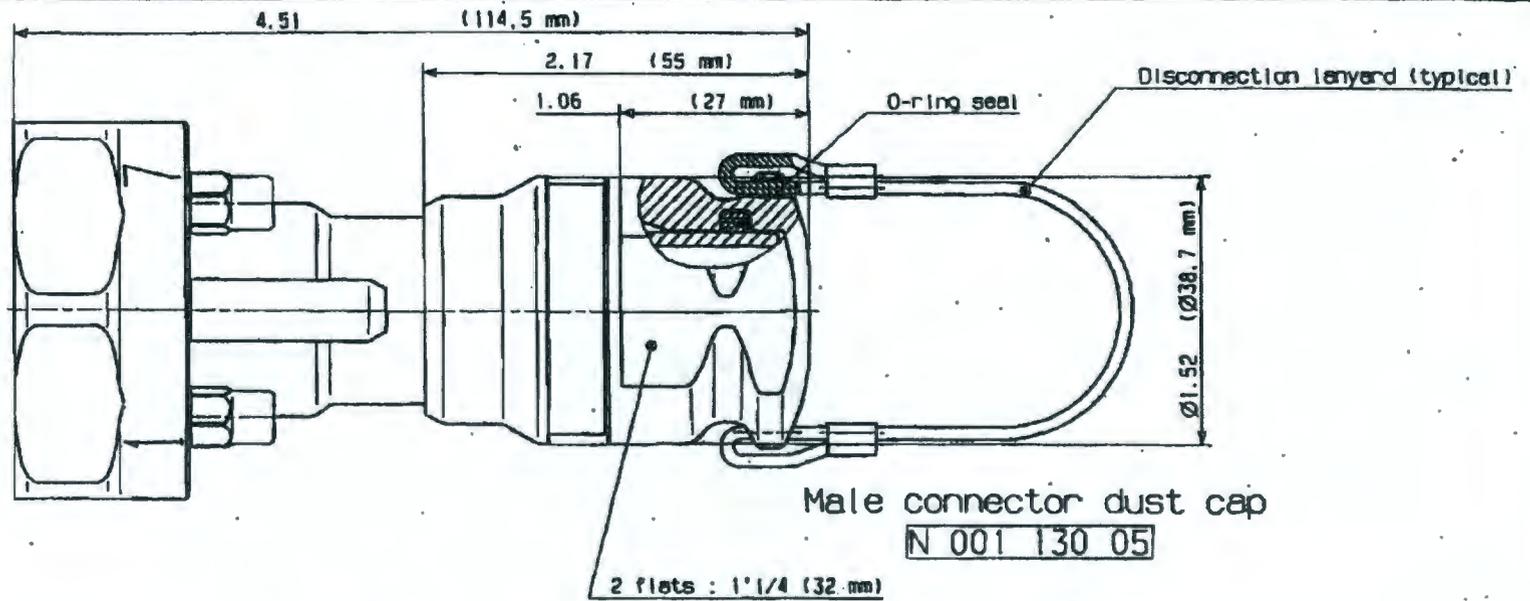
Exemple : combination 12

Comb.	Screw 1	Screw 2	Screw 3
01	Track 1	Track 2	Track 3
02	Track 1	Track 2	Track 4
03	Track 1	Track 2	Track 5
04	Track 1	Track 2	Track 6
05	Track 1	Track 2	Track 7
06	Track 1	Track 3	Track 4
07	Track 1	Track 3	Track 5
08	Track 1	Track 3	Track 6
09	Track 1	Track 3	Track 7
10	Track 1	Track 4	Track 5
11	Track 1	Track 4	Track 6
12	Track 1	Track 4	Track 7
13	Track 1	Track 5	Track 6
14	Track 1	Track 5	Track 7
15	Track 1	Track 6	Track 7
16	Track 2	Track 3	Track 4
17	Track 2	Track 3	Track 5
18	Track 2	Track 3	Track 6
19	Track 2	Track 3	Track 7
20	Track 2	Track 4	Track 5
21	Track 2	Track 4	Track 6
22	Track 2	Track 4	Track 7
23	Track 2	Track 5	Track 6
24	Track 2	Track 5	Track 7
25	Track 2	Track 6	Track 7
26	Track 3	Track 4	Track 5
27	Track 3	Track 4	Track 6
28	Track 3	Track 4	Track 7
29	Track 3	Track 5	Track 6
30	Track 3	Track 5	Track 7
31	Track 3	Track 6	Track 7
32	Track 4	Track 5	Track 6
33	Track 4	Track 5	Track 7
34	Track 4	Track 6	Track 7
35	Track 5	Track 6	Track 7

Comb.	Screw 1	Screw 2	Screw 3	Screw 4
01	Track 4	Track 5	Track 6	Track 7
02	Track 3	Track 5	Track 6	Track 7
03	Track 3	Track 4	Track 6	Track 7
04	Track 3	Track 4	Track 5	Track 7
05	Track 3	Track 4	Track 5	Track 6
06	Track 2	Track 5	Track 6	Track 7
07	Track 2	Track 4	Track 5	Track 7
08	Track 2	Track 4	Track 5	Track 6
09	Track 2	Track 4	Track 5	Track 6
10	Track 2	Track 3	Track 6	Track 7
11	Track 2	Track 3	Track 5	Track 7
12	Track 2	Track 3	Track 5	Track 6
13	Track 2	Track 3	Track 4	Track 7
14	Track 2	Track 3	Track 4	Track 6
15	Track 2	Track 3	Track 4	Track 5
16	Track 1	Track 5	Track 6	Track 7
17	Track 1	Track 4	Track 6	Track 7
18	Track 1	Track 4	Track 5	Track 7
19	Track 1	Track 4	Track 5	Track 6
20	Track 1	Track 3	Track 5	Track 7
21	Track 1	Track 3	Track 5	Track 6
22	Track 1	Track 3	Track 5	Track 6
23	Track 1	Track 3	Track 4	Track 7
24	Track 1	Track 3	Track 4	Track 6
25	Track 1	Track 3	Track 4	Track 5
26	Track 1	Track 2	Track 6	Track 7
27	Track 1	Track 2	Track 5	Track 7
28	Track 1	Track 2	Track 5	Track 6
29	Track 1	Track 2	Track 4	Track 7
30	Track 1	Track 2	Track 4	Track 6
31	Track 1	Track 2	Track 4	Track 5
32	Track 1	Track 2	Track 3	Track 7
33	Track 1	Track 2	Track 3	Track 6
34	Track 1	Track 2	Track 3	Track 5
35	Track 1	Track 2	Track 3	Track 4

For each combination the screws must be installed. screws thread lock : Loctite F2432 torque : 9,5 N.m

Job number	24590												
Equipment Tag Number	.												
Purchase Order Number	.												
Shop Order Number	.												
Equipment Service	Flexible pneumatic / Process Jumper Fabrication												
Client Name	OCE - Hanford Site												
Project Title	River Protection Project - Waste Treatment Plant												
Project Location	Rishland, WA												
POC Log Number	24590 - [CN] - [HRA] - [PFO] - 00003 - ...												
<table border="1"> <tr> <td>Serial</td> <td>Revision</td> <td>Mat.</td> <td>Notes</td> <td>Drawn by</td> <td>Checked by</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		Serial	Revision	Mat.	Notes	Drawn by	Checked by						
Serial	Revision	Mat.	Notes	Drawn by	Checked by								
<p>RBE 19CM</p> <p>Key combination sheet and assembly instructions</p> <p>Yes <input type="checkbox"/> No <input type="checkbox"/></p> <p>or comment sur le projet/lettre de travail en FRENCH / FRANCES . If not relevant d'un faire usage en de la documentation sur un intervention écrite .</p>													
<p>Subaru</p> <p>S 001 228 05 A</p>													



Job number	24590
Equipment Tag Number	.
Purchase Order Number	.
Shop Order Number	.
Equipment Service	Flexible pneumatic / Process Jumper Fabrication
Client Name	DOE - Hanford Site
Project Title	River Protection Project - Waste Treatment Plant
Project Location	Richland, WA
PDC Log Number	24590 - CH - MRA - PF00 - 00003 - ...

Qty.	Description	Dimension	No.	Material	Part or article no.
	RBE19CM PNEUMATIC CONNECTOR DUST CAP APPLICATION DRAWING			Scale 1	Drawn 26-JAN-05 PASTORE
	This document is the exclusive property of STREBL Corp. It is forbidden to use or communicate the information of this document without written authorization.			Checked 26-JAN-05 CHAPPAZ	
				S 001 197 05 B	

General tolerances according to: . QUALITY: . Degree of surface finish unless specified:

A3

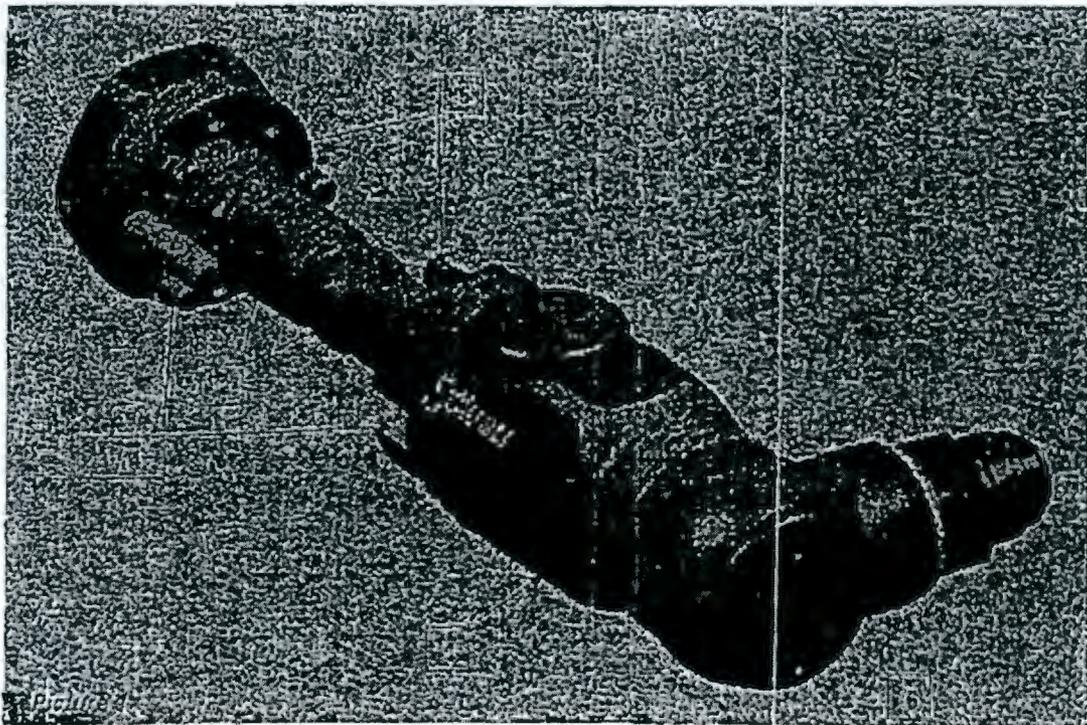


## APPLICATION

Remotely operated fluid connector for radioactive environment designed to allow a high number of keying possibilities set on site.

## CONNECTION:

1. The three sets of opposed flats on the female housing allow the manipulator jaws to grab and index the connector during operation.
2. The staged guiding helps in addressing the misalignment between the male and female connector.
3. The visual pre-guiding helps the operator to position the indexation.
4. The indexation operates before the safety keys.
5. The safety keying will then allow connection only if the female connector configuration matches the male one. (picture 2 : safety keying, picture 3 : purple screw unmaches the gray one)
6. The connection can now be completed by the automatic locking mechanism (no need to operate the locking mechanism during connection) Once the indexing is made the connectors can be pushed using the flat area located on the elbow.



1/4

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Writer : Pastore

Le : 28/01/05

Checked : Chappaz

Le : 28/01/05

**STAUBLI**

S | 111 610 04 | D

**DISCONNECTION:**

Directly push the release button for disconnection.



**KEYING:**

The connector will supply a total number of 35 non-interchangeable keys. The operator assembling the male and female connector sets all keys on site.

- Male connector (plug) setting is described on picture 1 and 3. 3 screws take place among 7 possible locations (location number engraved on the body).
- Female connector (socket) setting works the opposite way using screws taking place in the remaining locations (location number engraved on the body).



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	<b>STAUBLI</b> S 111 610 04 D			



**MATERIALS:**

Mechanical connector is 316L stainless steel with ethylene propylene soft O-ring seals.

**TECHNICAL FEATURES**

- Working temperature -25°C + 150°C (-4°F up to 302°F)
- Socket valving unvalved
- Plug valving unvalved (straight through bore)
- Seals lubrication STÄUBLI G 0 lubricant (validated for use in nuclear environment by E.D.F)
- Plug weight 0.550 Kg (1.25 Lb)
- Socket weight 1.800Kg (3.97 Lb)
- Dust cap weight 0.300 Kg (0.66 Lb)
- Connection strength 80N (without pressure)
- Disconnection strength 90N (without pressure)
- Identification Manufacturer's name, part number and week and year of manufacturing engraved on male and female connectors
- Packaging Single unit in sealed plastic bag.

**PARTNUMBERS**

Part number	Description
N 011 611 04	Female connector
N 011 612 04	Male connector
N 001 130 05	Male connector dust cap

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Written : Pastore

Le : 28/01/05

Checked : Chappaz

Le : 28/01/05



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**T.2 Reboiler Grayloc Backing Plate**

*Design Input:* It is acceptable design that the Grayloc backing plates for the 24" diameter process inlet of the reboilers FEP-RBLR-00001A/1B and TLP-RBLR-00001 can be installed after reboiler has after reboiler has been transported through airlock (inside hotcell). Furthermore, the Grayloc backing plate for the 18" diameter steam inlet of the reboiler TLP-RBLR-00001 can also be installed after the TLP reboiler has been through airlock.

**T.3 Floor loading**

*Design Input:* The uniform load is defined as floor loading transmitted by the skid to the floor without spreading of the load out through the supporting concrete slab. The floor loadings listed in the table below has been determined to be acceptable.

**Allowable Uniform Floor Loading Directly Under Skid Footprint**

Equipment	Location	Weight (Operating + Skid) (lbs)	Skid Foot Print Floor Area (ft <sup>2</sup> )	Uniform Load (Operating) (lbs/ft <sup>2</sup> )
FEP-SEP-00001A	J : 8-9 (0'-0")	134,500	400	336
FEP-SEP-00001B	J : 10-11 (0'-0")	134,500	400	336
TLP-SEP-00001	D : 18 (0'-0")	134,500	400	336
FEP Condenser Skid A	K-L : 8 (56'-0")	70,000	179	391
FEP Condenser Skid B	K-L : 10-11 (56'-0")	70,000	179	391
TLP Condenser Skid	D-E : 19-20 (56'-0")	70,000	179	391
FEP-VSL-00005	M : 7-8 (0'-0")	45,100	66	683
TLP-VSL-00002	B : 24-25 (0'-0")	24,000/4	1	6000
AFR-TK-00001	G-H : 9-10 (77'-0")	24,000	40	600
AFR Pump Skid	G-H : 9-10 (77'-0")	415	12	35

Note: Uniform load (lbs/ft<sup>2</sup>) = Total Equipment Weight (lbs) / Foot Print Area (ft<sup>2</sup>)

#### **T.4 Surface Finish for Equipment in the Hot Cell**

*Design Input #1:* A surface finish of 125 micro-inches is required for non-rotating parts such as reboiler, support stands, recirculation pump, recirculation piping, and lifting yokes. The surface finish of 125 micro inches shall be applied to machined surfaces not all surfaces

*Design Input #2:* A surface finish of 63 micro-inches is required for rotating parts such as pump shaft and impeller.

#### **T.5 Manipulator Capability for Separator Vessel Head Crane**

*Design Input:* There will be no manipulator capability for the crane on the 56-ft elevation for separator vessel head removal. The current plan is to install a monorail and hoist when there is a need to replace separator demister pads.

#### **T.6 Axial Flow Pump ASDs**

*Design Input:* The ASDs for FEP-PMP-00009A/9B will be installed in the MCC room P-417 on the 77'-0" elevation and the ASD for TLP-PMP-00009 will be installed in the MCC room P-0315 on the 56'-0" elevation. These MCC rooms are designed as R2/C2 as shown on the drawings 24590-PTF-P01T-00003 and 24590-PTF-P01T-00004. The temperature range for these MCC rooms is between 59-113 °F and the humidity range of 5 - 85 %.

#### **T.7 Instrumentation**

*Design Input #1 - Final Instrument Location Drawings:*

Seller is no longer required to provide instrument location and mounting information on the datasheet. Instrument location and mounting information will be completed by Buyer as required on the data sheets.

*Design Input #2 - BNI Instrument Details:*

Seller is no longer required to provide loop drawings that include schematic and wiring information. BNI will use Set Route and Intools for wiring information. For the 60% design stage, Seller is not required to provide environmental criteria, manufacturer or manufacturer's model number since they will be addressed at the 90% design milestone. Seller shall provide the following I&C information at 60% design:

- 1) An Instrument Index that includes the type of instrument, service description, calibration range, tag number, signal type, P&ID number and data sheet number.
- 2) Data Sheets as supplied with the contract package completed with as much information as is available, including tag numbers, calibration range, instrument range and specific process parameters, etc.
- 3) Logic diagrams which complement the system description.

### **T.8 Off-gas piping Condenser Intra-Skid Piping**

*Design Input:* No insulation is required for off-gas piping and condenser intra-skid piping. These pipes are in restrictive rooms where no personnel enter during evaporator system operations.

### **T.9 Separator Vessels**

*Design Input #1:* Separator Vessel Lower Frame:

No internal components are allowed except the use of Nelson studs on the lower ten inches of the inside surface. Seller shall provide minimum amount of grouting requirements to provide adequate stiffness for the lower frame of solid ring of 18-inches high and 19-foot square

*Design Input #2:* External Ring for Spray Nozzles:

Seller shall design and provide external rings for both the upper and lower demister pad spray nozzles. These external rings shall be connected together to provide an accessible connection at approximately 48'-0" plant elevation.

### **T.10 FEP Condensate vessel**

*Design Input:* Seller shall provide a separate FEP condensate vessel support ring plate to interface properly with floor embeds. The ring plate will be field welded to embedded plates on both sides. Vessel skirt will be filed welded to ring plate at exterior face only with partial penetration and fillet welds.

### **T.11 Equivalent Lengths for Centrifugal Pumps**

The piping equivalent length is provided on the table below for pump sizing calculation. Please be advised that the bounding values have incorporated the line size changes. However, the flow resistance due to flow restriction orifice, backpressure control valve, discharge spray nozzle has not incorporated into the bounding values because they are to be sized by Seller. Seller shall include these flow resistance in their pump sizing calculation.

For discharge lines from pumps TLP-PMP-00002A/B to separator vessel (TLP-SEP-00001) and from pumps FEP-PMP-00006A/B, FANP shall also add a flow resistance of 5 psi due to Millipore filter in the calculation. For discharge line from TLP-PMP-00005A/B to sampler, Seller shall also include sample delivery pressure of 5 psig.

Description	From	To	Straight Run	Elevation Change	Elbow (LR 90)	Eq. Length	Teer	Eq. Length	Valves	Eq. Length	Stech	Eq. Length	Entrances	Eq. Length	Other	Totals (ft)		Equivalent Values (ft)		Notes	
																(EQL)	(ABL)	(EQL)	(ABL)		
TLP-PMP-00002A/B	Suction	TLP-VSL-00002	Pump	30	2	0	33	1	20	4	20	0	0	7	0	0	112	2	180	2	
	Discharge	Pump	TLP-VSL-00002	40	18	0	25	2	30	4	18	7	13	0	0	80	173	18	289	20	1
			RLD-TK-00008A/B	250	60	25	125	4	65	8	30	7	13	0	0	80	528	60	625	65	2
			TLP-VSL-00003A/B	250	60	25	125	4	65	8	30	7	13	0	0	80	528	60	625	65	2
			TLP-SEP-00001	250	60	25	125	3	45	70	38	0	0	0	0	80	608	60	609	65	3, 4
TLP-PMP-00011A/B	Suction	TLP-SEP-00001	Pump	100	8	0	35	1	15	3	11	0	0	7	7	0	158	6	230	8	
Discharge	Pump	TLP-VSL-00002	360	60	13	68	7	10	3	8	7	0	0	0	0	374	60	450	68		
TLP-PMP-00005A/B	Suction	TLP-VSL-00008A/B	Pump	60	4	0	40	2	30	8	13	0	0	7	7	0	188	4	200	4	
	Discharge	Pump	TLP-SEP-00001	125	16	10	38	3	22.5	2	4	7	7	0	0	0	285	10	285	15	
			SAMPLER	100	70	78	80	2	28	3	8	0	0	0	0	0	298	70	390	79	6
FEP-PMP-00006A/B	Suction	FEP-VSL-00005	Pump	15	2	0	33	1	20	3	18	0	0	7	0	0	82	2	125	2	
	Discharge	Pump	FEP-VSL-00005	25	20	7	35	2	30	0	19	7	13	0	0	80	172	20	250	25	1
			RLD-TK-00008A/B	1100	60	50	250	8	90	8	38	7	13	0	0	80	1633	60	1790	65	2
			FEP-VSL-00017A/B	550	60	38	178	4	60	8	23	7	13	0	0	80	871	60	1000	65	2
			FEP-SEP-00001A/B	800	60	35	178	3	65	10	38	0	0	0	0	80	908	60	1108	65	3, 4

- Notes: Framatone Needs to also consider flow resistances due to...
1. Flow Restriction Orifice (sized by FANP)
  2. Back Pressure Control valve (sized by FANP)
  3. Millipore filter (max dP = 5 psi)
  4. Discharge spray nozzle pressure (specified by FANP)
  5. Sample Delivery pressure of 8 psig.

**T.12 Equivalent Lengths for Roth Transfer Station Pump**

The equivalent length is provided in the table below:

Description	From	To	Bounding values (ft)	
			EO. L	ABL
Discharge	FEP A SKID 9A Pump	SCW Storage Tank	2200	60
Discharge	FEP A SKID 9A Pump	Steam Cond. Skid 6A	600	80
Discharge	FEP B SKID 9B Pump	SCW Storage Tank	2000	60
Discharge	FEP B SKID 9A Pump	Steam Cond. Skid 6B	700	80
Discharge	TLP SKID Pump	SCW Storage Tank	720	60
Discharge	FEP B SKID 9A Pump	Steam Cond. Skid 8	1130	100

**T.13 Standard Kick-Off Plate**

Design Input: Buyer will provide Seller 2" and 4" PUREX nozzle with square standard kick-off plate per drawing 24590-WTP-M61-P23T-00040 for FEP/TLP reboilers.

## APPENDIX U

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**APPENDIX V**

**FEP/TLP EVAPORATOR SYSTEM COMPOSITE ANALYSES**

V1. Seller shall perform a coupled dynamic analysis of each evaporator system (using stick models to represent all components, including the piping/process jumper, vessels, frames and pumps) to qualify the recirculation piping/process jumper, and offgas piping. Seller shall provide vessel nozzle loads, Grayloc loads, and all piping/jumper support interface loads. The evaporator system model shall include the separator vessel on its frames, reboiler in its frame, recirculation pump on its frame, all interconnecting large bore piping/jumpers but excluding branch piping, offgas piping, primary condenser and condenser frame (not including the vacuum system and other attachments).

V2. The coupled dynamic analysis shall be performed using the revised ISRS curves (provided in this appendix) and shall account for the seismic differential movement between 0' floor, 56' floor, and 77' floor (provided in this appendix). Requirements for determining the percent critical damping for the couple dynamic analysis is provided in ASCE Std 4 Section 3.1.5 "Modeling of Damping".

V3. All piping dimensions, weights (including grayloc/guide assemblies), and support locations (including fixity) for each evaporator system are provided on the Isometric drawings included in this appendix shall be used as the design inputs for the coupled dynamic analysis.

V4. Although Seller has provided estimated process temperatures for various system condition and components, Seller shall define and use the maximum operating temperature in lieu of design temperature for each evaporator system.

V5. See attachment #5 for FEP/TLP recirculation pump frame conceptual designs. Seller is responsible for qualifying all support structures above 1'-4" in elevation, including all interface plates, bolts, nuts, and dowel pins for reboiler support frame and pump support frame. Seller is responsible for providing all final frame member sizes and configuration, all weld and joint designs, dowel / bolting configuration, quantity of bolts /nuts, and frame calculations to be submitted to Buyer for review. Location of dowels and location / quantity of bolts shall be provided to Buyer for review and permission to proceed.

V5.1 Top of concrete filled steel frame elevation will be 1'-4"

V5.2 Concrete filled steel frame will be rigid, e.g. 33 hz or greater

V5.3 Top of sole plate shall be 2'-2" in plant elevation for pump support. Top of sole plate for reboiler shall be 2'-2 5/16". Bottom of pump support and reboiler support frame shall be designed to interface with the corresponding sole plate without the use of shims.

V5.4 Seller shall qualify structural steel between 1'-4" and 2'-2" or 2'-2 5/16". Seller must design all weld joints and provide all weld details to Buyer. Buyer will be responsible for remotability interface and fabrication drawings.

V5.5 There will be two 4" diameter Dowel Pins per frame (opposing corners) as shown on drawings which will take the shear loads. The 4" diameter dowel pin is an assumption. Seller is responsible to verify and size the dowel pin diameter with actual loads. All Dowel pin material shall be ASTM A582 Type 416.

**V5.6 Seller shall qualify all plates, structural steel, dowel pins, the bolting interface, and all weld joint designs.**

**V5.7 Initial assumption, there are two bolts per plate. Bolts shall be 1 1/4" - 8 ACME - 2G. Stud material shall be ASTM A564 Type 630 condition H1150 and Nut material shall be ASTM A194 Grade GR8S. Seller is to determine quantity and configuration for studs. Stud location shall be submitted to Buyer for review and permission to proceed. Note: Tightening torque from impact wrench is 400 ft-lbs  $\pm$  25%. Loosening torque from impact wrench is 700 ft-lbs  $\pm$  25%. Tightening and loosening torques are not adjustable, or variable over time.**

**V5.8 Seller shall qualify recirculation pump frame. Seller must design all weld joints and provide all weld details to Buyer. Seller shall provide detail design of the frame in the form of a drawing that includes member sizes, configuration and weld design. The drawing shall be sufficient for Buyer to solicit a fabricator who can generate fabrication drawings. Buyer will be responsible for remotability interface for pump frame.**

**V6. Seller shall perform detailed Finite Element Analysis uncoupled dynamic analysis using revised ISRS curves (provided in this appendix) of individual SC-I/SC-II vessel/equipment (including recirculation pumps) of each evaporator system. Internal components, supports, and piping systems shall be analyzed the same as the parent vessel/equipment.**

**V7. The report(s) shall be officially submitted to Bechtel for review per G321-E Category 8.0. The report(s) shall include pipe/jumper stress, nozzle loads, Grayloc loads, all piping/jumper support interface loads, pipe support design recommendations, and results of the coupled dynamic analysis of each evaporator system and FEA dynamic analyses for individual SC-I/SC-II components. Seller shall use the "SC-I/II Seismic Analysis Qualification and FEA Report Check List" provided in attachment #6 to document required data in their reports.**

**V8. Listed below are design inputs to be used**

**V8a. See Attachment #3 for 24" grayloc/guide assemblies design inputs provided on the isometric sketches.**

**V8b. Revised In-Structure Response Spectra curves (see Attachment #1)**

- **RGM ISRS Figures 37, 38, 67, 68, and 24E for separator vessel (FEP-SEP-00001A/B & TLP-SEP-00001)**
- **RGM ISRS Figures 37, 38, and 121 for FEP condenser skids (FEP-SKID-00001A/B)**
- **RGM ISRS Figures 37, 38, 40, 41, and 115 for TLP condenser skid (TLP-SKID-00001)**
- **RGM ISRS Figures 21E, 22E, and 24E for reboilers (FEP-RBL-00001A/B & TLP-RBLR-00001). If the equipment support is not rigid, it shall be simulated or duplicated in the equipment seismic analysis model.**
- **RGM ISRS Figures 21E, 22E, and 24E for recirculation pumps (FEP-PMP-00009A/B & TLP-PMP-00001). If the equipment support is not rigid, it shall be simulated or duplicated in the equipment seismic analysis model.**

- RGM ISRS Figures 6E, 7E, and 149 for off-gas piping FEP-PU-00001 and FEP-PU-00005 support hangers.
- RGM ISRS Figures 6E, 7E, and 137 for off-gas piping TLP-PU-00002 support hangers

**V8c. BNI TLP Coupled Structural Analysis Draft Report (See Attachment #2)**

**V8d. FEP/TLP Evaporator recirculation Isometrics and Mid Roller details (see Attachment #3)**

**V8e. Nozzle loading for separator vessels shall be based on actual values as listed in tables 1, 2, and 3 of Attachment #4. The Seller shall use the actual nozzle load values instead of the values shown in the table in Appendix A of the Pressure Vessel Design and Fabrication Specification, 24590-WTP-3PS-MV00-T0001. The thermal reduction factor found in 24590-WTP-3PS-MV00-T0001, Section 3.7.4, shall not be applied. The nozzle load for separator vessel offgas outlet nozzle (N04), discharge nozzle (N10) and inlet nozzle (N11) shall be per Seller's design & qualification using the results of the coupled FEA. Nozzle loads for separator vessel bubblers (N01, N02, N03, N08, N09, N21, N27, and N28) due to hydrogen accumulation are not available and will be provided later.**

**V8f. Nozzle loading for condenser vessels (FEP-COND-00001A/1B/2A/2B/3A/3B and TLP-COND-00001/2/3) shall be based on nozzle design loads for non-black cell vessels provided in table 4 of Attachment #4. The Seller shall use these nozzle load values instead of the values shown in the table in Appendix A of the Pressure Vessel Design and Fabrication Specification, 24590-WTP-3PS-MV00-T0001. The thermal reduction factor found in 24590-WTP-3PS-MV00-T0001, Section 3.7.4, shall not be applied. The primary condenser offgas inlet nozzle (N01) shall be per Seller's design and qualification using the results of the coupled FEA.**

**V8g. Nozzle loading for reboiler vessels (FEP-RBLR-00001A/1B and TLP-RBLR-00001) shall be based on nozzle design loads for non-black cell vessels provided in Table 4 and Table 5 (for steam nozzle NO3) of Attachment #4. The Seller shall use these nozzle load values instead of the values shown in the table in Appendix A of the Pressure Vessel Design and Fabrication Specification, 24590-WTP-3PS-MV00-T0001. The thermal reduction factor found in 24590-WTP-3PS-MV00-T0001, Section 3.7.4, shall not be applied. The reboiler process inlet nozzle (N01) and outlet nozzle (N02) shall be per Seller's design and qualification using the results of the coupled FEA.**

**V8h. Nozzle loads for recirculation pumps shall be per Seller's design & qualification using the results of the coupled FEA.**

**V8i. For TLP-SEP-00001,**

- a. The relative floor movement at location Row D/Column 18 at elevation 0' to location Row D/Column 18 at elevation 56' is: 0.06" EW; 0.23" NS, and 0.03" vertical**
- b. The relative floor movement at location Row D/Column 18 at elevation 77' to location Row D/Column 18 at elevation 56' is: 0.04" EW; 0.12" NS, and 0.12" vertical**

**V8j. For FEP-SEP-00001A,**

- a. The relative floor movement at location Row J/Column 8.8 at elevation 0' to location Row J/Column 8.8 at elevation 56' is: 0.06" EW; 0.20" NS, and 0.08" vertical
- b. The relative floor movement at location Row J/Column 8.8 at elevation 77' to location Row J/Column 8.8 at elevation 56' is: 0.04" EW; 0.08" NS, and 0.12" vertical

**V8k. For FEP-SEP-00001B**

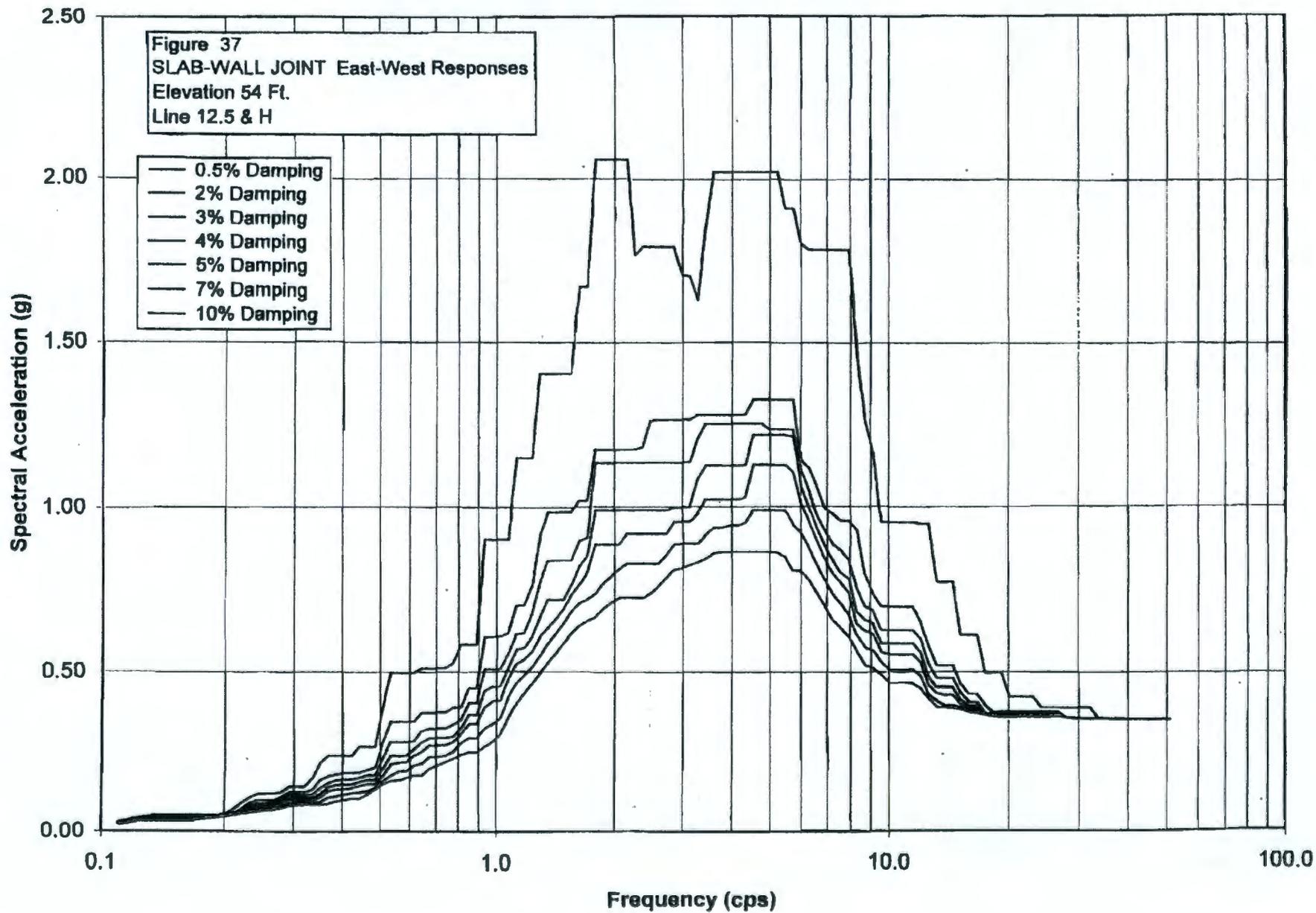
- a. The relative floor movement at location Row J/Column 10.5 at elevation 0' to location Row J/Column 10.5 at elevation 56' is: 0.06" EW; 0.21" NS, and 0.05" vertical
- b. The relative floor movement at location Row J/Column 10.5 at elevation 77' to location Row J/Column 10.5 at elevation 56' is: 0.05" EW; 0.09" NS, and 0.11" vertical

**V8L. FEP/TLP recirculation pump frame conceptual design (See attachment #5).**

**ATTACHMENT #1**

**Revised ISRS Curves  
(Ref. CCN 128490 and CCN 138088)**

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTWW037.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 37  
 SLAB-WALL JOINT East-West Responses  
 Elevation 54 Ft.  
 Line 12.5 & H

Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0314	0.1098	0.0288	0.1098	0.0276	0.1098	0.0268	0.1098	0.0261	0.1098	0.0248	0.1098	0.0232
0.115	0.0359	0.115	0.0331	0.115	0.0315	0.115	0.0301	0.115	0.029	0.115	0.0275	0.115	0.0254
0.1204	0.041	0.1204	0.0383	0.1204	0.0367	0.1204	0.0353	0.1204	0.034	0.1204	0.0316	0.1204	0.0288
0.1262	0.046	0.1262	0.0427	0.1262	0.0408	0.1262	0.0389	0.1262	0.0373	0.1262	0.0344	0.1262	0.0312
0.1322	0.0489	0.1322	0.0443	0.1322	0.0422	0.1322	0.0403	0.1322	0.0386	0.1322	0.0356	0.1322	0.0321
0.1385	0.0518	0.1385	0.0463	0.1385	0.0431	0.1385	0.0403	0.1385	0.0386	0.1385	0.0356	0.1385	0.0321
0.1451	0.0518	0.1451	0.0463	0.1451	0.0431	0.1451	0.0403	0.1451	0.0386	0.1451	0.0356	0.1451	0.0321
0.152	0.0518	0.152	0.0463	0.152	0.0431	0.152	0.0403	0.152	0.0386	0.152	0.0356	0.152	0.0321
0.1592	0.0518	0.1592	0.0463	0.1592	0.0431	0.1592	0.0403	0.1592	0.0386	0.1592	0.0356	0.1592	0.0324
0.1668	0.0518	0.1668	0.0463	0.1668	0.0431	0.1668	0.0403	0.1668	0.0384	0.1668	0.0362	0.1668	0.0351
0.1748	0.0518	0.1748	0.0463	0.1748	0.0431	0.1748	0.0409	0.1748	0.0404	0.1748	0.0394	0.1748	0.0379
0.1831	0.0518	0.1831	0.0463	0.1831	0.0454	0.1831	0.0447	0.1831	0.044	0.1831	0.0426	0.1831	0.0405
0.1918	0.0521	0.1918	0.0505	0.1918	0.0495	0.1918	0.0485	0.1918	0.0476	0.1918	0.0458	0.1918	0.0437
0.2009	0.0569	0.2009	0.0549	0.2009	0.0536	0.2009	0.0525	0.2009	0.0514	0.2009	0.0497	0.2009	0.0474
0.2105	0.0708	0.2105	0.0601	0.2105	0.0587	0.2105	0.0574	0.2105	0.0562	0.2105	0.054	0.2105	0.0517
0.2205	0.091	0.2205	0.0714	0.2205	0.0643	0.2205	0.0624	0.2205	0.061	0.2205	0.0586	0.2205	0.0558
0.231	0.1079	0.231	0.0908	0.231	0.0814	0.231	0.0735	0.231	0.0672	0.231	0.0631	0.231	0.0594
0.242	0.1195	0.242	0.0993	0.242	0.0884	0.242	0.0793	0.242	0.0716	0.242	0.0666	0.242	0.062
0.2535	0.1204	0.2535	0.0993	0.2535	0.0884	0.2535	0.0797	0.2535	0.0755	0.2535	0.0695	0.2535	0.0658
0.2656	0.1204	0.2656	0.0993	0.2656	0.0923	0.2656	0.088	0.2656	0.084	0.2656	0.0769	0.2656	0.0687
0.2783	0.1255	0.2783	0.1097	0.2783	0.1008	0.2783	0.095	0.2783	0.0907	0.2783	0.0836	0.2783	0.0755
0.2915	0.1424	0.2915	0.1248	0.2915	0.1148	0.2915	0.106	0.2915	0.0982	0.2915	0.0888	0.2915	0.0813
0.3054	0.1424	0.3054	0.1248	0.3054	0.1152	0.3054	0.1069	0.3054	0.0996	0.3054	0.091	0.3054	0.0842
0.3199	0.1424	0.3199	0.1248	0.3199	0.1152	0.3199	0.1069	0.3199	0.0996	0.3199	0.091	0.3199	0.0847
0.3352	0.1711	0.3352	0.1348	0.3352	0.1186	0.3352	0.1069	0.3352	0.0996	0.3352	0.091	0.3352	0.0847
0.3511	0.2174	0.3511	0.1631	0.3511	0.137	0.3511	0.1169	0.3511	0.1078	0.3511	0.0932	0.3511	0.0847
0.3678	0.2401	0.3678	0.1757	0.3678	0.1532	0.3678	0.1396	0.3678	0.1277	0.3678	0.108	0.3678	0.0887

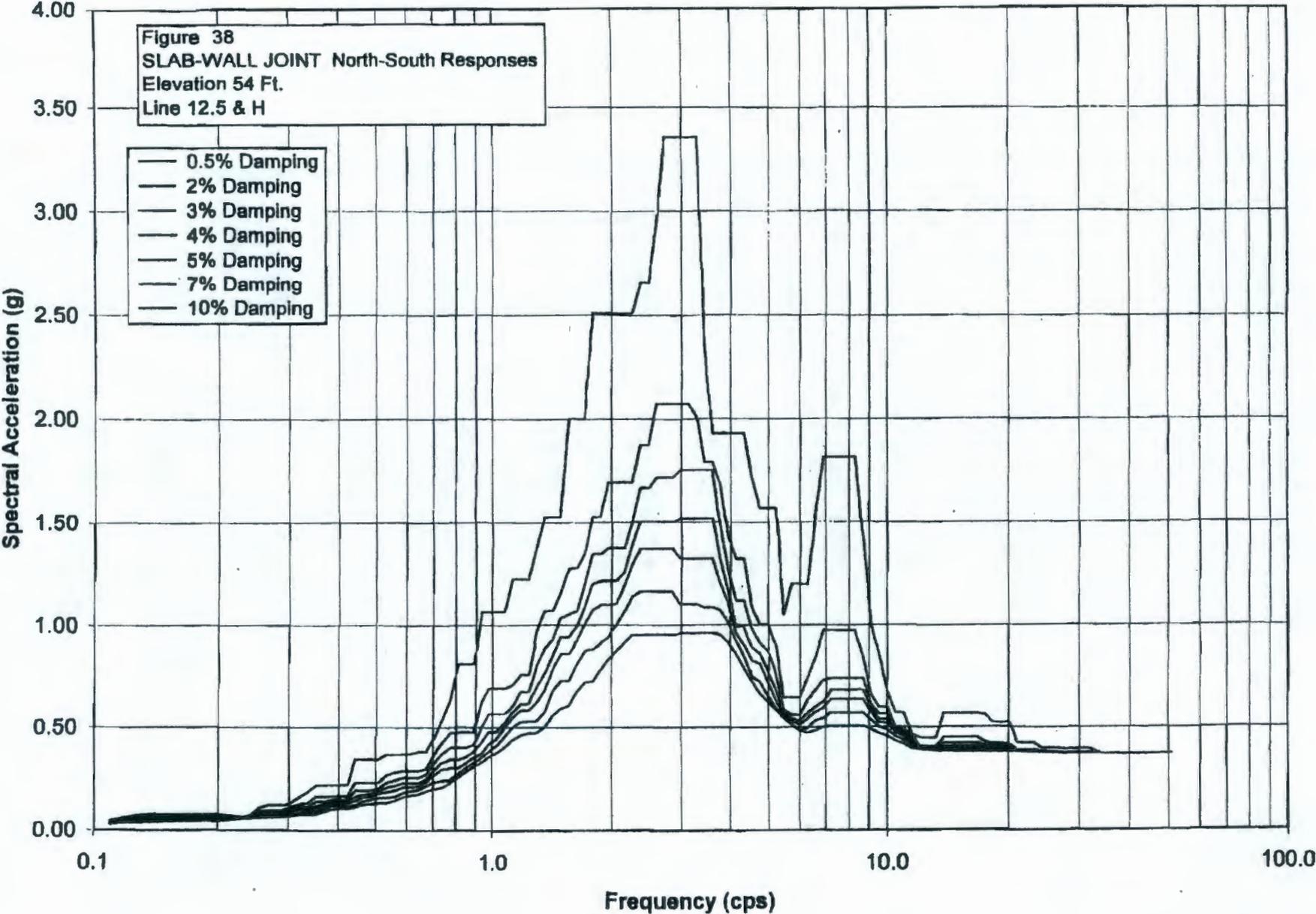
S\_PTWW037.grf

0.3853	0.2401	0.3853	0.1802	0.3853	0.1621	0.3853	0.1466	0.3853	0.1334	0.3853	0.1123	0.3853	0.0951
0.4037	0.2401	0.4037	0.1853	0.4037	0.165	0.4037	0.1482	0.4037	0.1342	0.4037	0.1165	0.4037	0.0995
0.4229	0.2401	0.4229	0.1853	0.4229	0.165	0.4229	0.1498	0.4229	0.1363	0.4229	0.122	0.4229	0.1052
0.4431	0.2697	0.4431	0.1872	0.4431	0.1712	0.4431	0.1571	0.4431	0.1446	0.4431	0.1243	0.4431	0.1052
0.4642	0.2697	0.4642	0.1964	0.4642	0.1791	0.4642	0.1638	0.4642	0.1504	0.4642	0.128	0.4642	0.1178
0.4863	0.2697	0.4863	0.2048	0.4863	0.1795	0.4863	0.1638	0.4863	0.1504	0.4863	0.1397	0.4863	0.1335
0.5094	0.3933	0.5094	0.2804	0.5094	0.2338	0.5094	0.2006	0.5094	0.1758	0.5094	0.1597	0.5094	0.1485
0.5337	0.498	0.5337	0.3467	0.5337	0.2831	0.5337	0.2392	0.5337	0.2125	0.5337	0.1765	0.5337	0.159
0.5591	0.498	0.5591	0.3467	0.5591	0.2831	0.5591	0.2392	0.5591	0.2173	0.5591	0.1897	0.5591	0.1607
0.5857	0.498	0.5857	0.3467	0.5857	0.2831	0.5857	0.2392	0.5857	0.2173	0.5857	0.1897	0.5857	0.1683
0.6136	0.498	0.6136	0.3467	0.6136	0.2856	0.6136	0.2598	0.6136	0.2393	0.6136	0.2082	0.6136	0.1768
0.6428	0.5114	0.6428	0.3731	0.6428	0.3181	0.6428	0.2803	0.6428	0.2522	0.6428	0.2127	0.6428	0.1788
0.6734	0.5114	0.6734	0.3731	0.6734	0.3249	0.6734	0.296	0.6734	0.2724	0.6734	0.236	0.6734	0.1983
0.7055	0.5114	0.7055	0.3731	0.7055	0.3249	0.7055	0.296	0.7055	0.2724	0.7055	0.236	0.7055	0.2086
0.7391	0.5114	0.7391	0.3731	0.7391	0.3249	0.7391	0.296	0.7391	0.2724	0.7391	0.239	0.7391	0.2174
0.7743	0.528	0.7743	0.3894	0.7743	0.3374	0.7743	0.3002	0.7743	0.2812	0.7743	0.2527	0.7743	0.2293
0.8111	0.5842	0.8111	0.3894	0.8111	0.3513	0.8111	0.3253	0.8111	0.3078	0.8111	0.2783	0.8111	0.2431
0.8497	0.5842	0.8497	0.4479	0.8497	0.4022	0.8497	0.367	0.8497	0.3388	0.8497	0.2955	0.8497	0.2503
0.8902	0.5842	0.8902	0.4479	0.8902	0.4022	0.8902	0.367	0.8902	0.3388	0.8902	0.2955	0.8902	0.2503
0.9326	0.8989	0.9326	0.6071	0.9326	0.5073	0.9326	0.4398	0.9326	0.3912	0.9326	0.3262	0.9326	0.2684
0.977	0.8989	0.977	0.6071	0.977	0.5073	0.977	0.4541	0.977	0.4086	0.977	0.3405	0.977	0.2839
1.0235	0.8989	1.0235	0.6071	1.0235	0.5073	1.0235	0.4541	1.0235	0.4086	1.0235	0.3559	1.0235	0.3074
1.0723	0.8989	1.0723	0.6169	1.0723	0.5578	1.0723	0.512	1.0723	0.4768	1.0723	0.4199	1.0723	0.3581
1.1233	1.1502	1.1233	0.6991	1.1233	0.614	1.1233	0.5663	1.1233	0.5238	1.1233	0.4629	1.1233	0.4004
1.1768	1.1502	1.1768	0.7013	1.1768	0.6178	1.1768	0.574	1.1768	0.5383	1.1768	0.4888	1.1768	0.4326
1.2328	1.1502	1.2328	0.7596	1.2328	0.6754	1.2328	0.6064	1.2328	0.5615	1.2328	0.5147	1.2328	0.4624
1.2916	1.4068	1.2916	0.9098	1.2916	0.7736	1.2916	0.6645	1.2916	0.6073	1.2916	0.5502	1.2916	0.4952
1.353	1.4068	1.353	0.9837	1.353	0.8352	1.353	0.7185	1.353	0.6331	1.353	0.5866	1.353	0.5279
1.4175	1.4068	1.4175	0.9837	1.4175	0.8352	1.4175	0.7185	1.4175	0.6595	1.4175	0.6157	1.4175	0.5573
1.485	1.4068	1.485	0.9837	1.485	0.8352	1.485	0.7185	1.485	0.6887	1.485	0.6451	1.485	0.5868
1.5557	1.4068	1.5557	0.9837	1.5557	0.8352	1.5557	0.7621	1.5557	0.7323	1.5557	0.6811	1.5557	0.6154
1.6298	1.6671	1.6298	1.0185	1.6298	0.8939	1.6298	0.8172	1.6298	0.764	1.6298	0.7078	1.6298	0.6397
1.7074	1.6671	1.7074	1.0185	1.7074	0.9033	1.7074	0.8484	1.7074	0.8	1.7074	0.7196	1.7074	0.6548
1.7887	2.06	1.7887	1.175	1.7887	1.1351	1.7887	0.9877	1.7887	0.8836	1.7887	0.7359	1.7887	0.6657
1.8738	2.06	1.8738	1.175	1.8738	1.1351	1.8738	0.9877	1.8738	0.8836	1.8738	0.767	1.8738	0.691
1.963	2.06	1.963	1.175	1.963	1.1351	1.963	0.9877	1.963	0.8836	1.963	0.7893	1.963	0.7111
2.0565	2.06	2.0565	1.175	2.0565	1.1351	2.0565	0.9877	2.0565	0.8836	2.0565	0.809	2.0565	0.7233
2.1544	2.06	2.1544	1.175	2.1544	1.1351	2.1544	0.9877	2.1544	0.9145	2.1544	0.8248	2.1544	0.7233
2.257	1.7633	2.257	1.175	2.257	1.1351	2.257	0.9877	2.257	0.9145	2.257	0.8248	2.257	0.7233

2.3645	1.7905	2.3645	1.1812	2.3645	1.1351	2.3645	0.9877	2.3645	0.9145	2.3645	0.8248	2.3645	0.7233
2.4771	1.7905	2.4771	1.2641	2.4771	1.1351	2.4771	0.9877	2.4771	0.9145	2.4771	0.8248	2.4771	0.7363
2.595	1.7905	2.595	1.2669	2.595	1.1351	2.595	0.9877	2.595	0.9145	2.595	0.8248	2.595	0.7588
2.7186	1.7905	2.7186	1.2669	2.7186	1.1351	2.7186	0.9877	2.7186	0.9145	2.7186	0.8512	2.7186	0.7851
2.848	1.7905	2.848	1.2669	2.848	1.1351	2.848	0.9964	2.848	0.9535	2.848	0.8827	2.848	0.8066
2.9836	1.7027	2.9836	1.2669	2.9836	1.1351	2.9836	0.9964	2.9836	0.9535	2.9836	0.8849	2.9836	0.8127
3.1257	1.6996	3.1257	1.2669	3.1257	1.1351	3.1257	0.9964	3.1257	0.9535	3.1257	0.8849	3.1257	0.8201
3.2745	1.6283	3.2745	1.2808	3.2745	1.2073	3.2745	1.0843	3.2745	0.9787	3.2745	0.885	3.2745	0.8282
3.4305	1.8505	3.4305	1.2808	3.4305	1.2545	3.4305	1.1266	3.4305	1.0213	3.4305	0.9111	3.4305	0.8401
3.5938	2.0228	3.5938	1.2808	3.5938	1.2545	3.5938	1.1266	3.5938	1.0213	3.5938	0.9346	3.5938	0.8563
3.7649	2.0228	3.7649	1.2808	3.7649	1.2545	3.7649	1.1266	3.7649	1.0213	3.7649	0.9346	3.7649	0.8595
3.9442	2.0228	3.9442	1.2808	3.9442	1.2545	3.9442	1.1266	3.9442	1.0213	3.9442	0.9409	3.9442	0.8595
4.132	2.0228	4.132	1.2808	4.132	1.2545	4.132	1.1266	4.132	1.0213	4.132	0.9409	4.132	0.8598
4.3288	2.0228	4.3288	1.2808	4.3288	1.2545	4.3288	1.1266	4.3288	1.0265	4.3288	0.9503	4.3288	0.8598
4.5349	2.0228	4.5349	1.3256	4.5349	1.2545	4.5349	1.2184	4.5349	1.1271	4.5349	0.987	4.5349	0.8598
4.7508	2.0228	4.7508	1.3256	4.7508	1.2545	4.7508	1.2184	4.7508	1.1271	4.7508	0.987	4.7508	0.8598
4.977	2.0228	4.977	1.3256	4.977	1.2365	4.977	1.2184	4.977	1.1271	4.977	0.987	4.977	0.8598
5.214	2.0228	5.214	1.3256	5.214	1.2365	5.214	1.2184	5.214	1.1271	5.214	0.987	5.214	0.8574
5.4623	1.9118	5.4623	1.3256	5.4623	1.2365	5.4623	1.2184	5.4623	1.1271	5.4623	0.987	5.4623	0.8452
5.7224	1.9118	5.7224	1.3256	5.7224	1.2365	5.7224	1.2141	5.7224	1.103	5.7224	0.944	5.7224	0.8044
5.9948	1.8019	5.9948	1.1437	5.9948	1.1117	5.9948	1.0649	5.9948	1.0143	5.9948	0.919	5.9948	0.8044
6.2803	1.7825	6.2803	1.1158	6.2803	1.0505	6.2803	0.9983	6.2803	0.9528	6.2803	0.8733	6.2803	0.7753
6.5793	1.7825	6.5793	1.0616	6.5793	0.9721	6.5793	0.9326	6.5793	0.8937	6.5793	0.8232	6.5793	0.7371
6.8926	1.7825	6.8926	0.9948	6.8926	0.9254	6.8926	0.8781	6.8926	0.8395	6.8926	0.7757	6.8926	0.6988
7.2208	1.7825	7.2208	0.9766	7.2208	0.8836	7.2208	0.8362	7.2208	0.7973	7.2208	0.7333	7.2208	0.6574
7.5646	1.7825	7.5646	0.9553	7.5646	0.8653	7.5646	0.7978	7.5646	0.7657	7.5646	0.7059	7.5646	0.6333
7.9248	1.7825	7.9248	0.9553	7.9248	0.8374	7.9248	0.7789	7.9248	0.7357	7.9248	0.6724	7.9248	0.6047
8.3022	1.467	8.3022	0.9256	8.3022	0.7482	8.3022	0.6811	8.3022	0.6451	8.3022	0.6114	8.3022	0.5606
8.6975	1.2634	8.6975	0.7906	8.6975	0.6976	8.6975	0.6577	8.6975	0.6254	8.6975	0.5739	8.6975	0.5206
9.1116	1.1614	9.1116	0.734	9.1116	0.6851	9.1116	0.6466	9.1116	0.6147	9.1116	0.5844	9.1116	0.5109
9.5455	0.9513	9.5455	0.6972	9.5455	0.6272	9.5455	0.5869	9.5455	0.5603	9.5455	0.5292	9.5455	0.4915
10	0.9513	10	0.6972	10	0.6272	10	0.5869	10	0.5545	10	0.5075	10	0.4672
10.4762	0.9513	10.4762	0.6972	10.4762	0.6272	10.4762	0.5869	10.4762	0.5545	10.4762	0.5075	10.4762	0.4672
10.975	0.9513	10.975	0.6972	10.975	0.6272	10.975	0.5869	10.975	0.5545	10.975	0.5075	10.975	0.4672
11.4976	0.9513	11.4976	0.6972	11.4976	0.6272	11.4976	0.5869	11.4976	0.5545	11.4976	0.5075	11.4976	0.4637
12.045	0.9476	12.045	0.6512	12.045	0.5986	12.045	0.559	12.045	0.529	12.045	0.4872	12.045	0.4481
12.6186	0.9476	12.6186	0.5757	12.6186	0.5238	12.6186	0.4831	12.6186	0.4585	12.6186	0.4288	12.6186	0.4166
13.2194	0.7684	13.2194	0.5197	13.2194	0.4807	13.2194	0.452	13.2194	0.4333	13.2194	0.4097	13.2194	0.3907
13.8489	0.7684	13.8489	0.5197	13.8489	0.4807	13.8489	0.4508	13.8489	0.4275	13.8489	0.3956	13.8489	0.39

14.5083	0.7684	14.5083	0.5197	14.5083	0.4807	14.5083	0.4508	14.5083	0.4275	14.5083	0.3953	14.5083	0.3877
15.1991	0.6109	15.1991	0.462	15.1991	0.4357	15.1991	0.4127	15.1991	0.3986	15.1991	0.389	15.1991	0.3834
15.9228	0.6109	15.9228	0.4312	15.9228	0.4068	15.9228	0.3944	15.9228	0.3869	15.9228	0.3787	15.9228	0.3756
16.681	0.6109	16.681	0.4312	16.681	0.4068	16.681	0.3944	16.681	0.3869	16.681	0.3781	16.681	0.371
17.4753	0.4963	17.4753	0.3971	17.4753	0.3731	17.4753	0.3731	17.4753	0.3729	17.4753	0.3709	17.4753	0.367
18.3074	0.4963	18.3074	0.3731	18.3074	0.3686	18.3074	0.3667	18.3074	0.3656	18.3074	0.3639	18.3074	0.3615
19.1791	0.4963	19.1791	0.3752	19.1791	0.3678	19.1791	0.3639	19.1791	0.3615	19.1791	0.3592	19.1791	0.3588
20.0923	0.4216	20.0923	0.3752	20.0923	0.3678	20.0923	0.3639	20.0923	0.3615	20.0923	0.3593	20.0923	0.3585
21.049	0.4216	21.049	0.3752	21.049	0.3678	21.049	0.3639	21.049	0.362	21.049	0.3611	21.049	0.3597
22.0513	0.4216	22.0513	0.3757	22.0513	0.3701	22.0513	0.3666	22.0513	0.3643	22.0513	0.3616	22.0513	0.3597
23.1013	0.4216	23.1013	0.3757	23.1013	0.3701	23.1013	0.3666	23.1013	0.3643	23.1013	0.3616	23.1013	0.3597
24.2013	0.3898	24.2013	0.3757	24.2013	0.3701	24.2013	0.3666	24.2013	0.3643	24.2013	0.3616	24.2013	0.3597
25.3536	0.3898	25.3536	0.3757	25.3536	0.3701	25.3536	0.3666	25.3536	0.3643	25.3536	0.3616	25.3536	0.3597
26.5609	0.3898	26.5609	0.3757	26.5609	0.3701	26.5609	0.3666	26.5609	0.3643	26.5609	0.3616	26.5609	0.3596
27.8256	0.3898	27.8256	0.3593	27.8256	0.357	27.8256	0.358	27.8256	0.3585	27.8256	0.3585	27.8256	0.3579
29.1505	0.3898	29.1505	0.3593	29.1505	0.357	29.1505	0.3561	29.1505	0.3559	29.1505	0.3559	29.1505	0.3561
30.5386	0.3898	30.5386	0.3584	30.5386	0.356	30.5386	0.3557	30.5386	0.3555	30.5386	0.3552	30.5386	0.3549
31.9927	0.3898	31.9927	0.3564	31.9927	0.356	31.9927	0.3557	31.9927	0.3555	31.9927	0.3552	31.9927	0.3549
33.516	0.3588	33.516	0.3584	33.516	0.356	33.516	0.3557	33.516	0.3555	33.516	0.3552	33.516	0.3549
35.1119	0.3567	35.1119	0.3563	35.1119	0.356	35.1119	0.3557	35.1119	0.3555	35.1119	0.3552	35.1119	0.3549
36.7838	0.3557	36.7838	0.3556	36.7838	0.3555	36.7838	0.3553	36.7838	0.3552	36.7838	0.355	36.7838	0.3548
38.5353	0.3551	38.5353	0.355	38.5353	0.3549	38.5353	0.3549	38.5353	0.3548	38.5353	0.3547	38.5353	0.3546
40.3702	0.3546	40.3702	0.3545	40.3702	0.3545	40.3702	0.3544	40.3702	0.3544	40.3702	0.3543	40.3702	0.3543
42.2924	0.3541	42.2924	0.3541	42.2924	0.3541	42.2924	0.354	42.2924	0.354	42.2924	0.354	42.2924	0.3539
44.3062	0.3537	44.3062	0.3537	44.3062	0.3537	44.3062	0.3537	44.3062	0.3537	44.3062	0.3537	44.3062	0.3536
46.4159	0.3534	46.4159	0.3534	46.4159	0.3534	46.4159	0.3534	46.4159	0.3534	46.4159	0.3534	46.4159	0.3533
48.626	0.3531	48.626	0.3531	48.626	0.3531	48.626	0.353	48.626	0.353	48.626	0.353	48.626	0.3531
50.9414	0.3528	50.9414	0.3528	50.9414	0.3528	50.9414	0.3528	50.9414	0.3528	50.9414	0.3528	50.9414	0.3528

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTWW038.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-SOC-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 38  
 SLAB-WALL JOINT North-South Responses  
 Elevation 54 Ft.  
 Line 12.5 & H

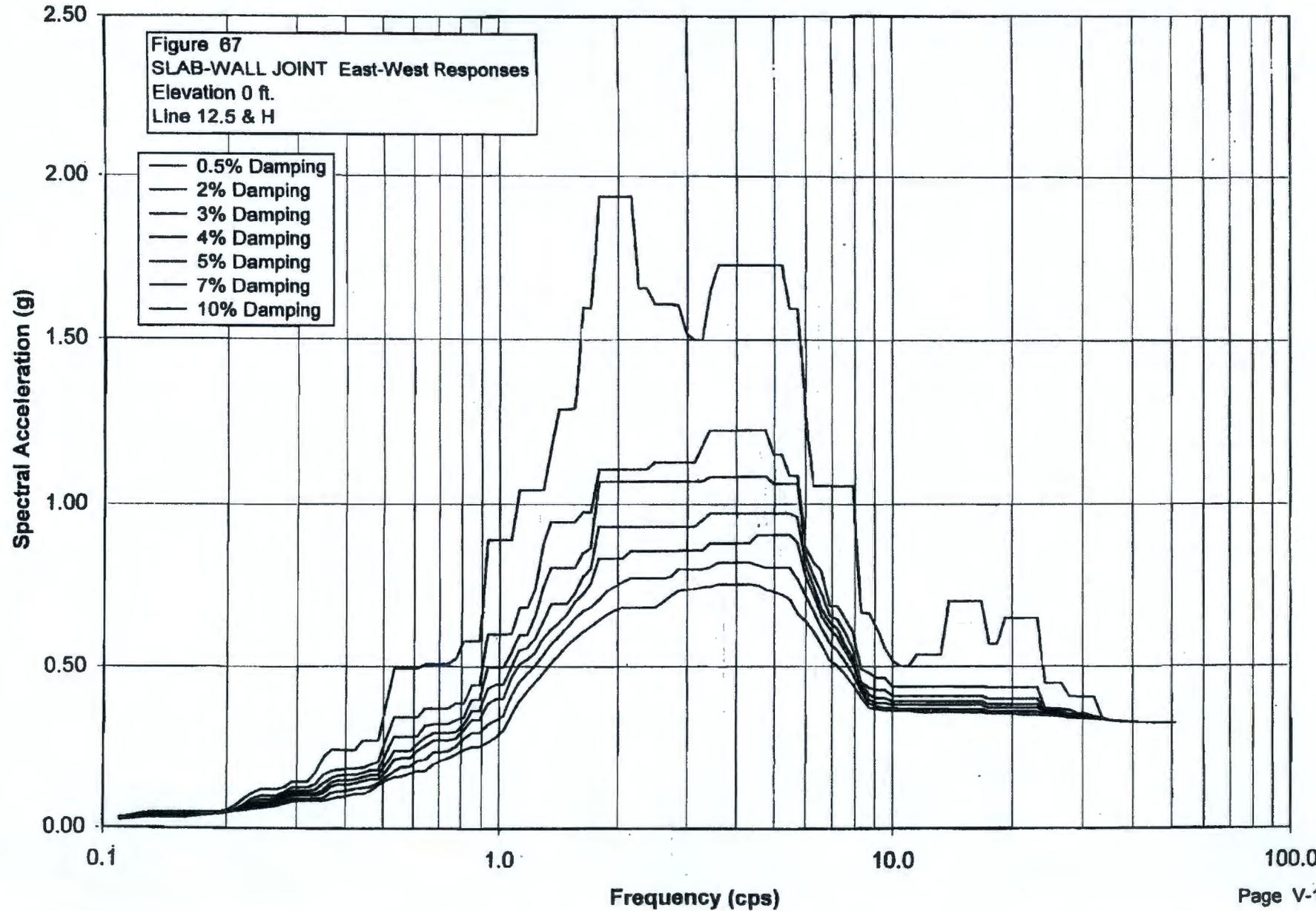
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0457	0.1098	0.0394	0.1098	0.0365	0.1098	0.0345	0.1098	0.0331	0.1098	0.0312	0.1098	0.0286
0.115	0.0556	0.115	0.0494	0.115	0.0467	0.115	0.0443	0.115	0.0422	0.115	0.0384	0.115	0.0338
0.1204	0.0648	0.1204	0.0583	0.1204	0.0546	0.1204	0.0512	0.1204	0.0481	0.1204	0.0428	0.1204	0.0365
0.1262	0.072	0.1262	0.0618	0.1262	0.0572	0.1262	0.0533	0.1262	0.0498	0.1262	0.0438	0.1262	0.0384
0.1322	0.0763	0.1322	0.0653	0.1322	0.0604	0.1322	0.0565	0.1322	0.053	0.1322	0.0471	0.1322	0.0404
0.1385	0.0786	0.1385	0.0673	0.1385	0.0609	0.1385	0.0565	0.1385	0.053	0.1385	0.0471	0.1385	0.0404
0.1451	0.0789	0.1451	0.0675	0.1451	0.0612	0.1451	0.0565	0.1451	0.053	0.1451	0.0471	0.1451	0.0412
0.152	0.0789	0.152	0.0675	0.152	0.0612	0.152	0.0568	0.152	0.0538	0.152	0.0487	0.152	0.0434
0.1592	0.0789	0.1592	0.0675	0.1592	0.0612	0.1592	0.0568	0.1592	0.0538	0.1592	0.049	0.1592	0.0442
0.1668	0.0789	0.1668	0.0675	0.1668	0.0612	0.1668	0.0568	0.1668	0.0538	0.1668	0.049	0.1668	0.0442
0.1748	0.0789	0.1748	0.0675	0.1748	0.0612	0.1748	0.0568	0.1748	0.0538	0.1748	0.049	0.1748	0.0442
0.1831	0.0789	0.1831	0.0675	0.1831	0.0612	0.1831	0.0568	0.1831	0.0538	0.1831	0.049	0.1831	0.0442
0.1918	0.0789	0.1918	0.0675	0.1918	0.0612	0.1918	0.0564	0.1918	0.0535	0.1918	0.049	0.1918	0.0442
0.2009	0.0789	0.2009	0.0675	0.2009	0.0612	0.2009	0.0564	0.2009	0.0534	0.2009	0.0483	0.2009	0.0442
0.2105	0.0737	0.2105	0.0634	0.2105	0.0597	0.2105	0.0564	0.2105	0.0534	0.2105	0.0495	0.2105	0.0481
0.2205	0.0686	0.2205	0.0626	0.2205	0.0591	0.2205	0.0563	0.2205	0.0553	0.2205	0.0536	0.2205	0.0518
0.231	0.0653	0.231	0.063	0.231	0.0616	0.231	0.0604	0.231	0.0592	0.231	0.0573	0.231	0.0552
0.242	0.0765	0.242	0.0692	0.242	0.0652	0.242	0.0639	0.242	0.0627	0.242	0.0606	0.242	0.0581
0.2535	0.1105	0.2535	0.092	0.2535	0.0827	0.2535	0.0753	0.2535	0.0694	0.2535	0.0632	0.2535	0.0604
0.2656	0.1221	0.2656	0.0955	0.2656	0.083	0.2656	0.0753	0.2656	0.0694	0.2656	0.0652	0.2656	0.0619
0.2783	0.1221	0.2783	0.0955	0.2783	0.0836	0.2783	0.0789	0.2783	0.0748	0.2783	0.0679	0.2783	0.0626
0.2915	0.1221	0.2915	0.1011	0.2915	0.0941	0.2915	0.0879	0.2915	0.0824	0.2915	0.0732	0.2915	0.0631
0.3054	0.1371	0.3054	0.1191	0.3054	0.1092	0.3054	0.1006	0.3054	0.0931	0.3054	0.0811	0.3054	0.0708
0.3199	0.1652	0.3199	0.1286	0.3199	0.1172	0.3199	0.1073	0.3199	0.0989	0.3199	0.0856	0.3199	0.0757
0.3352	0.1878	0.3352	0.1337	0.3352	0.1172	0.3352	0.1073	0.3352	0.0989	0.3352	0.0865	0.3352	0.0771
0.3511	0.2181	0.3511	0.1647	0.3511	0.1395	0.3511	0.12	0.3511	0.1078	0.3511	0.0935	0.3511	0.0785
0.3678	0.2181	0.3678	0.1647	0.3678	0.1397	0.3678	0.1283	0.3678	0.1183	0.3678	0.1047	0.3678	0.0915

0.3853	0.2181	0.3853	0.1647	0.3853	0.147	0.3853	0.138	0.3853	0.13	0.3853	0.1166	0.3853	0.1017
0.4037	0.2181	0.4037	0.1647	0.4037	0.1478	0.4037	0.1391	0.4037	0.1314	0.4037	0.1186	0.4037	0.1044
0.4229	0.2189	0.4229	0.1647	0.4229	0.1478	0.4229	0.1391	0.4229	0.1314	0.4229	0.1186	0.4229	0.1044
0.4431	0.3472	0.4431	0.2355	0.4431	0.1923	0.4431	0.1615	0.4431	0.1413	0.4431	0.1213	0.4431	0.1119
0.4642	0.3472	0.4642	0.2355	0.4642	0.1951	0.4642	0.1751	0.4642	0.1594	0.4642	0.1384	0.4642	0.1214
0.4863	0.3472	0.4863	0.2355	0.4863	0.1951	0.4863	0.1781	0.4863	0.1665	0.4863	0.1492	0.4863	0.1273
0.5094	0.3472	0.5094	0.2355	0.5094	0.2018	0.5094	0.1893	0.5094	0.178	0.5094	0.1574	0.5094	0.133
0.5337	0.3695	0.5337	0.2689	0.5337	0.232	0.5337	0.2061	0.5337	0.1852	0.5337	0.1574	0.5337	0.133
0.5591	0.3695	0.5591	0.281	0.5591	0.2442	0.5591	0.2148	0.5591	0.193	0.5591	0.1633	0.5591	0.1435
0.5857	0.3695	0.5857	0.2873	0.5857	0.2546	0.5857	0.228	0.5857	0.2062	0.5857	0.1801	0.5857	0.1608
0.6136	0.3695	0.6136	0.2873	0.6136	0.2546	0.6136	0.228	0.6136	0.2069	0.6136	0.1894	0.6136	0.1692
0.6428	0.3817	0.6428	0.2873	0.6428	0.2546	0.6428	0.2298	0.6428	0.2121	0.6428	0.1961	0.6428	0.1762
0.6734	0.3817	0.6734	0.2976	0.6734	0.2715	0.6734	0.2487	0.6734	0.2338	0.6734	0.2138	0.6734	0.1889
0.7055	0.4491	0.7055	0.37	0.7055	0.3283	0.7055	0.2935	0.7055	0.2706	0.7055	0.2341	0.7055	0.2005
0.7391	0.5365	0.7391	0.4265	0.7391	0.3742	0.7391	0.3318	0.7391	0.2971	0.7391	0.2451	0.7391	0.2071
0.7743	0.628	0.7743	0.4729	0.7743	0.4012	0.7743	0.3465	0.7743	0.3042	0.7743	0.2469	0.7743	0.2325
0.8111	0.813	0.8111	0.4774	0.8111	0.4012	0.8111	0.3465	0.8111	0.3042	0.8111	0.2755	0.8111	0.2586
0.8497	0.813	0.8497	0.4774	0.8497	0.4012	0.8497	0.3574	0.8497	0.3295	0.8497	0.3025	0.8497	0.2838
0.8902	0.813	0.8902	0.4774	0.8902	0.4159	0.8902	0.3821	0.8902	0.3545	0.8902	0.3296	0.8902	0.3085
0.9326	1.0682	0.9326	0.63	0.9326	0.502	0.9326	0.4299	0.9326	0.3762	0.9326	0.3568	0.9326	0.3336
0.977	1.0682	0.977	0.6921	0.977	0.5678	0.977	0.4802	0.977	0.4166	0.977	0.3623	0.977	0.3564
1.0235	1.0682	1.0235	0.6921	1.0235	0.5678	1.0235	0.4802	1.0235	0.4461	1.0235	0.4083	1.0235	0.3759
1.0723	1.0682	1.0723	0.6921	1.0723	0.5678	1.0723	0.5223	1.0723	0.499	1.0723	0.457	1.0723	0.4039
1.1233	1.2235	1.1233	0.7093	1.1233	0.6072	1.1233	0.5774	1.1233	0.5491	1.1233	0.5	1.1233	0.4397
1.1768	1.2235	1.1768	0.7609	1.1768	0.6761	1.1768	0.6181	1.1768	0.5844	1.1768	0.5279	1.1768	0.4629
1.2328	1.2235	1.2328	0.7609	1.2328	0.6761	1.2328	0.6181	1.2328	0.5848	1.2328	0.5319	1.2328	0.4733
1.2916	1.38	1.2916	0.9702	1.2916	0.8115	1.2916	0.7038	1.2916	0.6261	1.2916	0.5319	1.2916	0.4757
1.353	1.5277	1.353	1.0704	1.353	0.893	1.353	0.7708	1.353	0.6847	1.353	0.5767	1.353	0.5012
1.4175	1.5277	1.4175	1.0704	1.4175	0.9317	1.4175	0.8594	1.4175	0.7938	1.4175	0.6823	1.4175	0.5606
1.485	1.5277	1.485	1.1558	1.485	1.036	1.485	0.9419	1.485	0.8621	1.485	0.7311	1.485	0.5961
1.5557	1.9994	1.5557	1.2739	1.5557	1.0575	1.5557	0.9419	1.5557	0.8621	1.5557	0.7311	1.5557	0.6097
1.6298	1.9994	1.6298	1.2739	1.6298	1.0685	1.6298	0.9942	1.6298	0.9258	1.6298	0.8095	1.6298	0.6757
1.7074	1.9994	1.7074	1.3467	1.7074	1.1921	1.7074	1.0891	1.7074	1.0073	1.7074	0.8754	1.7074	0.7234
1.7887	2.5094	1.7887	1.5259	1.7887	1.3435	1.7887	1.198	1.7887	1.0737	1.7887	0.8849	1.7887	0.7284
1.8738	2.5094	1.8738	1.5259	1.8738	1.3435	1.8738	1.2126	1.8738	1.0986	1.8738	0.9122	1.8738	0.7848
1.963	2.5094	1.963	1.6919	1.963	1.3738	1.963	1.2126	1.963	1.0986	1.963	0.9419	1.963	0.8346
2.0565	2.5094	2.0565	1.6919	2.0565	1.3738	2.0565	1.2126	2.0565	1.1043	2.0565	1.0014	2.0565	0.8791
2.1544	2.5094	2.1544	1.6919	2.1544	1.3738	2.1544	1.2586	2.1544	1.1906	2.1544	1.0705	2.1544	0.9161
2.257	2.5118	2.257	1.6919	2.257	1.4972	2.257	1.3913	2.257	1.2957	2.257	1.1364	2.257	0.9527

2.3645	2.6594	2.3645	1.8721	2.3645	1.6678	2.3645	1.5032	2.3645	1.3686	2.3645	1.1626	2.3645	0.9527
2.4771	2.6594	2.4771	1.8721	2.4771	1.6678	2.4771	1.5032	2.4771	1.3686	2.4771	1.1626	2.4771	0.9527
2.595	2.9473	2.595	2.0725	2.595	1.7153	2.595	1.5032	2.595	1.3686	2.595	1.1626	2.595	0.9527
2.7186	3.3563	2.7186	2.0725	2.7186	1.7153	2.7186	1.5032	2.7186	1.3686	2.7186	1.1626	2.7186	0.9527
2.848	3.3563	2.848	2.0725	2.848	1.7153	2.848	1.5032	2.848	1.3686	2.848	1.1626	2.848	0.9527
2.9836	3.3563	2.9836	2.0725	2.9836	1.7536	2.9836	1.5166	2.9836	1.3191	2.9836	1.1021	2.9836	0.9624
3.1257	3.3563	3.1257	2.0725	3.1257	1.7536	3.1257	1.5166	3.1257	1.3191	3.1257	1.1021	3.1257	0.9624
3.2745	3.3563	3.2745	2.0076	3.2745	1.7536	3.2745	1.5166	3.2745	1.3191	3.2745	1.1021	3.2745	0.9624
3.4305	2.3492	3.4305	1.7893	3.4305	1.7536	3.4305	1.5166	3.4305	1.3191	3.4305	1.0863	3.4305	0.9624
3.5938	1.9258	3.5938	1.7893	3.5938	1.7536	3.5938	1.5166	3.5938	1.3191	3.5938	1.0863	3.5938	0.9624
3.7649	1.9258	3.7649	1.6814	3.7649	1.4648	3.7649	1.3142	3.7649	1.2046	3.7649	1.0723	3.7649	0.9532
3.9442	1.9258	3.9442	1.4249	3.9442	1.266	3.9442	1.1716	3.9442	1.1062	3.9442	1.0158	3.9442	0.9161
4.132	1.9258	4.132	1.3151	4.132	1.1186	4.132	0.9925	4.132	0.9639	4.132	0.9241	4.132	0.8565
4.3288	1.9258	4.3288	1.3151	4.3288	1.1186	4.3288	0.9925	4.3288	0.9036	4.3288	0.8451	4.3288	0.7892
4.5349	1.7138	4.5349	1.0833	4.5349	0.9804	4.5349	0.8879	4.5349	0.8266	4.5349	0.7534	4.5349	0.726
4.7508	1.5698	4.7508	1.006	4.7508	0.9133	4.7508	0.8601	4.7508	0.8104	4.7508	0.727	4.7508	0.671
4.977	1.5698	4.977	1.006	4.977	0.8727	4.977	0.7769	4.977	0.7266	4.977	0.659	4.977	0.6299
5.214	1.5698	5.214	0.8976	5.214	0.7649	5.214	0.6877	5.214	0.638	5.214	0.5985	5.214	0.5865
5.4623	1.0521	5.4623	0.6474	5.4623	0.5881	5.4623	0.5734	5.4623	0.5654	5.4623	0.5556	5.4623	0.546
5.7224	1.2	5.7224	0.6474	5.7224	0.5602	5.7224	0.5421	5.7224	0.5301	5.7224	0.5147	5.7224	0.5117
5.9948	1.2	5.9948	0.6474	5.9948	0.5599	5.9948	0.5327	5.9948	0.512	5.9948	0.4821	5.9948	0.4861
6.2803	1.2	6.2803	0.7482	6.2803	0.6357	6.2803	0.5707	6.2803	0.5436	6.2803	0.4982	6.2803	0.4735
6.5793	1.5424	6.5793	0.8479	6.5793	0.6847	6.5793	0.6018	6.5793	0.5757	6.5793	0.5344	6.5793	0.4848
6.8926	1.8136	6.8926	0.974	6.8926	0.7343	6.8926	0.6233	6.8926	0.5933	6.8926	0.5446	6.8926	0.4987
7.2208	1.8136	7.2208	0.974	7.2208	0.7423	7.2208	0.684	7.2208	0.6378	7.2208	0.5711	7.2208	0.5069
7.5646	1.8136	7.5646	0.974	7.5646	0.7423	7.5646	0.684	7.5646	0.6378	7.5646	0.5711	7.5646	0.5069
7.9248	1.8136	7.9248	0.974	7.9248	0.7423	7.9248	0.684	7.9248	0.6378	7.9248	0.5711	7.9248	0.5069
8.3022	1.8136	8.3022	0.974	8.3022	0.7423	8.3022	0.684	8.3022	0.6378	8.3022	0.5711	8.3022	0.5069
8.6975	1.4099	8.6975	0.8352	8.6975	0.7423	8.6975	0.684	8.6975	0.6378	8.6975	0.5711	8.6975	0.5069
9.1116	1.001	9.1116	0.6622	9.1116	0.6162	9.1116	0.5977	9.1116	0.5769	9.1116	0.5373	9.1116	0.4896
9.5455	0.8404	9.5455	0.5998	9.5455	0.5657	9.5455	0.5394	9.5455	0.5225	9.5455	0.5005	9.5455	0.4689
10	0.6745	10	0.5998	10	0.5857	10	0.5394	10	0.5187	10	0.4877	10	0.4553
10.4762	0.572	10.4762	0.4915	10.4762	0.487	10.4762	0.4816	10.4762	0.4736	10.4762	0.4556	10.4762	0.433
10.975	0.572	10.975	0.4915	10.975	0.4781	10.975	0.4656	10.975	0.4552	10.975	0.4378	10.975	0.4175
11.4976	0.4636	11.4976	0.4648	11.4976	0.4484	11.4976	0.4337	11.4976	0.4218	11.4976	0.4094	11.4976	0.3962
12.045	0.4491	12.045	0.4045	12.045	0.3965	12.045	0.3945	12.045	0.393	12.045	0.3913	12.045	0.3895
12.6186	0.4491	12.6186	0.4045	12.6186	0.3957	12.6186	0.392	12.6186	0.3903	12.6186	0.3885	12.6186	0.3869
13.2194	0.4491	13.2194	0.4045	13.2194	0.3957	13.2194	0.3907	13.2194	0.3882	13.2194	0.3853	13.2194	0.3846
13.8489	0.5669	13.8489	0.4508	13.8489	0.4226	13.8489	0.4077	13.8489	0.3984	13.8489	0.3876	13.8489	0.3834

14.5083	0.5669	14.5083	0.4508	14.5083	0.4226	14.5083	0.4077	14.5083	0.3984	14.5083	0.3876	14.5083	0.3822
15.1991	0.5669	15.1991	0.4508	15.1991	0.4226	15.1991	0.4077	15.1991	0.3984	15.1991	0.3876	15.1991	0.3805
15.9228	0.5669	15.9228	0.4508	15.9228	0.4226	15.9228	0.4077	15.9228	0.3984	15.9228	0.3876	15.9228	0.3804
16.681	0.5669	16.681	0.4508	16.681	0.4226	16.681	0.4077	16.681	0.3984	16.681	0.3876	16.681	0.3793
17.4753	0.5622	17.4753	0.4284	17.4753	0.4129	17.4753	0.4035	17.4753	0.3964	17.4753	0.3864	17.4753	0.3788
18.3074	0.5236	18.3074	0.4191	18.3074	0.4041	18.3074	0.397	18.3074	0.3916	18.3074	0.3843	18.3074	0.3788
19.1791	0.5236	19.1791	0.4191	19.1791	0.4041	19.1791	0.397	19.1791	0.3916	19.1791	0.3843	19.1791	0.3788
20.0923	0.5236	20.0923	0.4128	20.0923	0.4041	20.0923	0.397	20.0923	0.3916	20.0923	0.3843	20.0923	0.3788
21.049	0.4235	21.049	0.3889	21.049	0.3847	21.049	0.3848	21.049	0.3841	21.049	0.382	21.049	0.3788
22.0513	0.4235	22.0513	0.3889	22.0513	0.384	22.0513	0.3822	22.0513	0.3809	22.0513	0.3798	22.0513	0.3777
23.1013	0.4235	23.1013	0.3889	23.1013	0.384	23.1013	0.3822	23.1013	0.3807	23.1013	0.3785	23.1013	0.3762
24.2013	0.396	24.2013	0.3804	24.2013	0.3791	24.2013	0.3781	24.2013	0.3771	24.2013	0.3754	24.2013	0.3738
25.3536	0.396	25.3536	0.3788	25.3536	0.3776	25.3536	0.3766	25.3536	0.3757	25.3536	0.3743	25.3536	0.3729
26.5609	0.396	26.5609	0.3769	26.5609	0.3743	26.5609	0.3732	26.5609	0.3726	26.5609	0.372	26.5609	0.3715
27.8256	0.3933	27.8256	0.3748	27.8256	0.3724	27.8256	0.3717	27.8256	0.3711	27.8256	0.3703	27.8256	0.3703
29.1505	0.3933	29.1505	0.3735	29.1505	0.3724	29.1505	0.3717	29.1505	0.3711	29.1505	0.3703	29.1505	0.3699
30.5386	0.3933	30.5386	0.3735	30.5386	0.3724	30.5386	0.3717	30.5386	0.3711	30.5386	0.3702	30.5386	0.3695
31.9927	0.3933	31.9927	0.3729	31.9927	0.3707	31.9927	0.3699	31.9927	0.3693	31.9927	0.3687	31.9927	0.3687
33.516	0.3733	33.516	0.3719	33.516	0.3707	33.516	0.3699	33.516	0.3693	33.516	0.3685	33.516	0.3684
35.1119	0.3694	35.1119	0.3692	35.1119	0.3689	35.1119	0.3687	35.1119	0.3685	35.1119	0.3685	35.1119	0.3684
36.7838	0.3686	36.7838	0.3686	36.7838	0.3685	36.7838	0.3685	36.7838	0.3685	36.7838	0.3685	36.7838	0.3684
38.5353	0.3686	38.5353	0.3686	38.5353	0.3685	38.5353	0.3685	38.5353	0.3685	38.5353	0.3685	38.5353	0.3684
40.3702	0.3686	40.3702	0.3686	40.3702	0.3685	40.3702	0.3685	40.3702	0.3685	40.3702	0.3685	40.3702	0.3684
42.2924	0.3685	42.2924	0.3685	42.2924	0.3685	42.2924	0.3685	42.2924	0.3685	42.2924	0.3684	42.2924	0.3684
44.3062	0.3685	44.3062	0.3684	44.3062	0.3684	44.3062	0.3684	44.3062	0.3684	44.3062	0.3684	44.3062	0.3684
46.4159	0.3684	46.4159	0.3684	46.4159	0.3684	46.4159	0.3683	46.4159	0.3683	46.4159	0.3683	46.4159	0.3683
48.626	0.3683	48.626	0.3683	48.626	0.3683	48.626	0.3683	48.626	0.3683	48.626	0.3683	48.626	0.3683
50.9414	0.3682	50.9414	0.3682	50.9414	0.3682	50.9414	0.3682	50.9414	0.3682	50.9414	0.3682	50.9414	0.3682

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTWW067.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 67  
 SLAB-WALL JOINT East-West Responses  
 Elevation 0 ft.  
 Line 12.5 & H

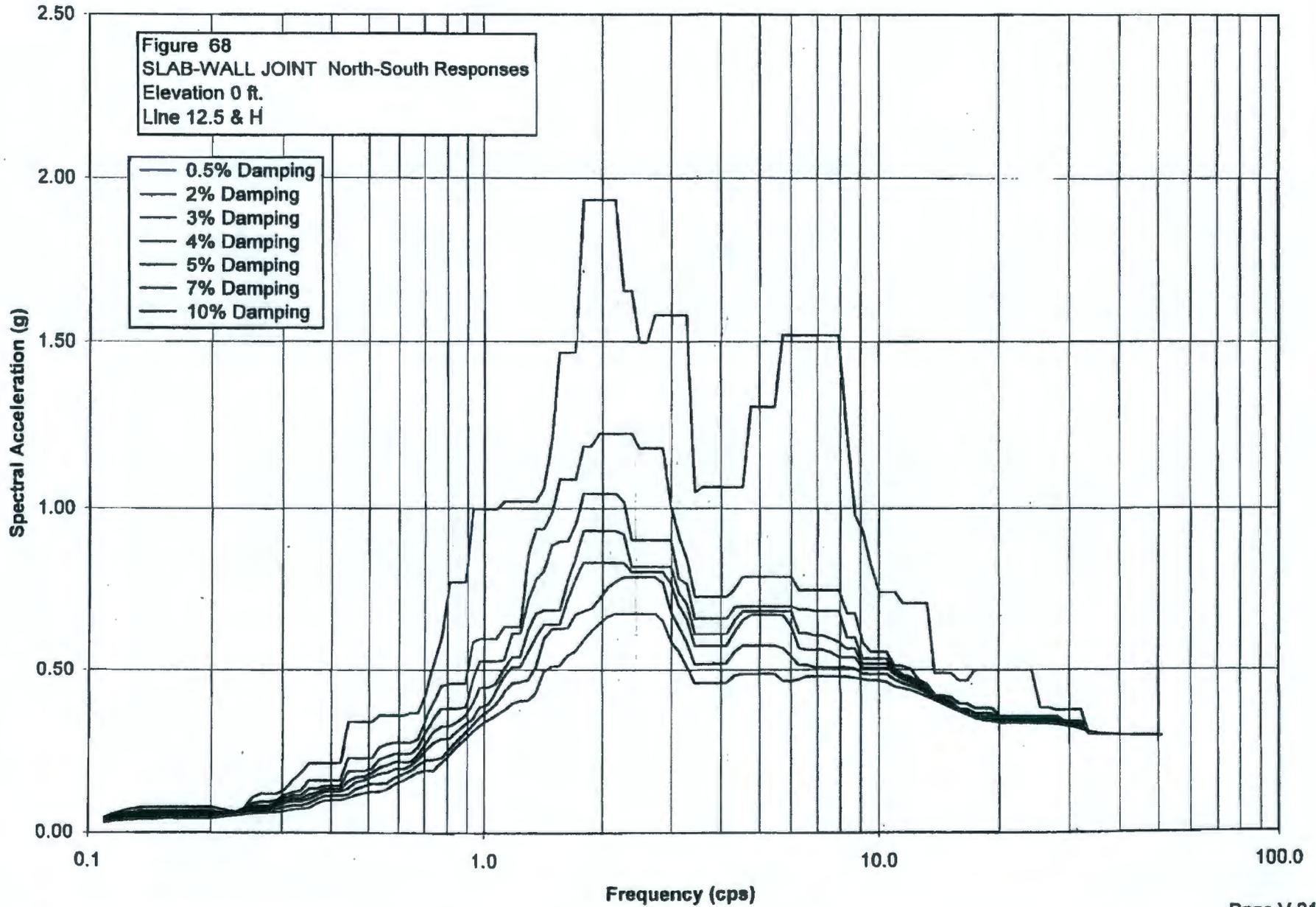
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0314	0.1098	0.0288	0.1098	0.0275	0.1098	0.0267	0.1098	0.026	0.1098	0.0247	0.1098	0.0231
0.115	0.0358	0.115	0.033	0.115	0.0314	0.115	0.03	0.115	0.0289	0.115	0.0273	0.115	0.0253
0.1204	0.041	0.1204	0.0382	0.1204	0.0366	0.1204	0.0352	0.1204	0.0339	0.1204	0.0316	0.1204	0.0287
0.1262	0.0459	0.1262	0.0426	0.1262	0.0406	0.1262	0.0389	0.1262	0.0372	0.1262	0.0344	0.1262	0.0311
0.1322	0.0488	0.1322	0.0442	0.1322	0.0421	0.1322	0.0402	0.1322	0.0385	0.1322	0.0355	0.1322	0.032
0.1385	0.0518	0.1385	0.0463	0.1385	0.0431	0.1385	0.0402	0.1385	0.0385	0.1385	0.0355	0.1385	0.032
0.1451	0.0518	0.1451	0.0463	0.1451	0.0431	0.1451	0.0402	0.1451	0.0385	0.1451	0.0355	0.1451	0.032
0.152	0.0518	0.152	0.0463	0.152	0.0431	0.152	0.0402	0.152	0.0385	0.152	0.0355	0.152	0.032
0.1592	0.0518	0.1592	0.0463	0.1592	0.0431	0.1592	0.0402	0.1592	0.0385	0.1592	0.0355	0.1592	0.0322
0.1668	0.0518	0.1668	0.0463	0.1668	0.0431	0.1668	0.0402	0.1668	0.0385	0.1668	0.0361	0.1668	0.0348
0.1748	0.0518	0.1748	0.0463	0.1748	0.0431	0.1748	0.041	0.1748	0.0403	0.1748	0.0392	0.1748	0.0375
0.1831	0.0518	0.1831	0.0463	0.1831	0.0454	0.1831	0.0446	0.1831	0.0438	0.1831	0.0424	0.1831	0.0402
0.1918	0.0521	0.1918	0.0504	0.1918	0.0494	0.1918	0.0484	0.1918	0.0474	0.1918	0.0455	0.1918	0.0433
0.2009	0.0569	0.2009	0.0549	0.2009	0.0536	0.2009	0.0524	0.2009	0.0513	0.2009	0.0494	0.2009	0.0471
0.2105	0.0707	0.2105	0.06	0.2105	0.0585	0.2105	0.0572	0.2105	0.056	0.2105	0.0538	0.2105	0.0513
0.2205	0.0909	0.2205	0.0714	0.2205	0.0642	0.2205	0.0623	0.2205	0.0608	0.2205	0.0584	0.2205	0.0554
0.231	0.1078	0.231	0.0906	0.231	0.0813	0.231	0.0735	0.231	0.0671	0.231	0.0628	0.231	0.0589
0.242	0.1194	0.242	0.0991	0.242	0.0883	0.242	0.0791	0.242	0.0714	0.242	0.0663	0.242	0.0617
0.2535	0.12	0.2535	0.0991	0.2535	0.0883	0.2535	0.0796	0.2535	0.0755	0.2535	0.069	0.2535	0.0654
0.2656	0.12	0.2656	0.0991	0.2656	0.0922	0.2656	0.0879	0.2656	0.0839	0.2656	0.0769	0.2656	0.0684
0.2783	0.1252	0.2783	0.1094	0.2783	0.1006	0.2783	0.0949	0.2783	0.0907	0.2783	0.0832	0.2783	0.0751
0.2915	0.1421	0.2915	0.1244	0.2915	0.1145	0.2915	0.1057	0.2915	0.0979	0.2915	0.0883	0.2915	0.0805
0.3054	0.1421	0.3054	0.1244	0.3054	0.115	0.3054	0.1067	0.3054	0.0994	0.3054	0.0903	0.3054	0.0832
0.3199	0.1421	0.3199	0.1244	0.3199	0.115	0.3199	0.1067	0.3199	0.0994	0.3199	0.0903	0.3199	0.0837
0.3352	0.1707	0.3352	0.1342	0.3352	0.1178	0.3352	0.1067	0.3352	0.0994	0.3352	0.0903	0.3352	0.0837
0.3511	0.2169	0.3511	0.1627	0.3511	0.1366	0.3511	0.1164	0.3511	0.107	0.3511	0.0922	0.3511	0.0837
0.3678	0.2396	0.3678	0.1754	0.3678	0.1523	0.3678	0.1387	0.3678	0.1269	0.3678	0.1073	0.3678	0.0882

0.3853	0.2396	0.3853	0.1799	0.3853	0.1818	0.3853	0.1463	0.3853	0.1331	0.3853	0.112	0.3853	0.0944
0.4037	0.2396	0.4037	0.1842	0.4037	0.164	0.4037	0.1472	0.4037	0.1332	0.4037	0.1155	0.4037	0.0992
0.4229	0.2396	0.4229	0.1842	0.4229	0.164	0.4229	0.1495	0.4229	0.1381	0.4229	0.1214	0.4229	0.1046
0.4431	0.2688	0.4431	0.1868	0.4431	0.1709	0.4431	0.1568	0.4431	0.1442	0.4431	0.1234	0.4431	0.1046
0.4642	0.2688	0.4642	0.1954	0.4642	0.1781	0.4642	0.1629	0.4642	0.1495	0.4642	0.1272	0.4642	0.1151
0.4863	0.2688	0.4863	0.2037	0.4863	0.1784	0.4863	0.1629	0.4863	0.1495	0.4863	0.1378	0.4863	0.1308
0.5094	0.3911	0.5094	0.2791	0.5094	0.2331	0.5094	0.2001	0.5094	0.1754	0.5094	0.1572	0.5094	0.1458
0.5337	0.4951	0.5337	0.3445	0.5337	0.2811	0.5337	0.237	0.5337	0.2102	0.5337	0.174	0.5337	0.1562
0.5591	0.4951	0.5591	0.3445	0.5591	0.2811	0.5591	0.237	0.5591	0.2161	0.5591	0.1886	0.5591	0.1586
0.5857	0.4951	0.5857	0.3445	0.5857	0.2811	0.5857	0.237	0.5857	0.2161	0.5857	0.1886	0.5857	0.1672
0.6136	0.4951	0.6136	0.3445	0.6136	0.2835	0.6136	0.2579	0.6136	0.2376	0.6136	0.2068	0.6136	0.1755
0.6428	0.5081	0.6428	0.3704	0.6428	0.3158	0.6428	0.2788	0.6428	0.2508	0.6428	0.2109	0.6428	0.1755
0.6734	0.5081	0.6734	0.3704	0.6734	0.3214	0.6734	0.2929	0.6734	0.2694	0.6734	0.2332	0.6734	0.1957
0.7055	0.5081	0.7055	0.3704	0.7055	0.3214	0.7055	0.2929	0.7055	0.2694	0.7055	0.2332	0.7055	0.2068
0.7391	0.5081	0.7391	0.3704	0.7391	0.3214	0.7391	0.2929	0.7391	0.2694	0.7391	0.2359	0.7391	0.2145
0.7743	0.5246	0.7743	0.3867	0.7743	0.3352	0.7743	0.2967	0.7743	0.2757	0.7743	0.2494	0.7743	0.2264
0.8111	0.5776	0.8111	0.3867	0.8111	0.3456	0.8111	0.3215	0.8111	0.3045	0.8111	0.2755	0.8111	0.2408
0.8497	0.5776	0.8497	0.444	0.8497	0.3988	0.8497	0.3642	0.8497	0.3363	0.8497	0.2936	0.8497	0.2491
0.8902	0.5776	0.8902	0.444	0.8902	0.3988	0.8902	0.3642	0.8902	0.3363	0.8902	0.2936	0.8902	0.2491
0.9326	0.8877	0.9326	0.5975	0.9326	0.4991	0.9326	0.4325	0.9326	0.3845	0.9326	0.3203	0.9326	0.2634
0.977	0.8877	0.977	0.5975	0.977	0.4991	0.977	0.4459	0.977	0.4011	0.977	0.3342	0.977	0.2792
1.0235	0.8877	1.0235	0.5975	1.0235	0.4991	1.0235	0.4459	1.0235	0.4011	1.0235	0.3491	1.0235	0.3012
1.0723	0.8877	1.0723	0.6	1.0723	0.5421	1.0723	0.5019	1.0723	0.4672	1.0723	0.4115	1.0723	0.3515
1.1233	1.0436	1.1233	0.6796	1.1233	0.5961	1.1233	0.5493	1.1233	0.5076	1.1233	0.454	1.1233	0.393
1.1768	1.0436	1.1768	0.6796	1.1768	0.5966	1.1768	0.5564	1.1768	0.5218	1.1768	0.4787	1.1768	0.424
1.2328	1.0436	1.2328	0.7363	1.2328	0.6543	1.2328	0.5857	1.2328	0.5418	1.2328	0.503	1.2328	0.452
1.2916	1.0436	1.2916	0.8733	1.2916	0.7423	1.2916	0.6374	1.2916	0.5853	1.2916	0.5346	1.2916	0.4807
1.353	1.1657	1.353	0.9454	1.353	0.8025	1.353	0.6903	1.353	0.6111	1.353	0.5663	1.353	0.5097
1.4175	1.2899	1.4175	0.9454	1.4175	0.8025	1.4175	0.6903	1.4175	0.6337	1.4175	0.5919	1.4175	0.5357
1.485	1.2899	1.485	0.9454	1.485	0.8025	1.485	0.6903	1.485	0.6584	1.485	0.617	1.485	0.5609
1.5557	1.2945	1.5557	0.9454	1.5557	0.8025	1.5557	0.7243	1.5557	0.696	1.5557	0.6469	1.5557	0.584
1.6298	1.5963	1.6298	0.9746	1.6298	0.8489	1.6298	0.7751	1.6298	0.7218	1.6298	0.6883	1.6298	0.604
1.7074	1.5963	1.7074	0.9746	1.7074	0.8647	1.7074	0.8015	1.7074	0.7551	1.7074	0.6813	1.7074	0.6226
1.7887	1.939	1.7887	1.1073	1.7887	1.0689	1.7887	0.93	1.7887	0.8319	1.7887	0.7035	1.7887	0.6419
1.8738	1.939	1.8738	1.1073	1.8738	1.0689	1.8738	0.93	1.8738	0.8319	1.8738	0.7304	1.8738	0.6589
1.963	1.939	1.963	1.1073	1.963	1.0689	1.963	0.93	1.963	0.8319	1.963	0.7451	1.963	0.671
2.0565	1.939	2.0565	1.1073	2.0565	1.0689	2.0565	0.93	2.0565	0.8319	2.0565	0.7593	2.0565	0.6798
2.1544	1.939	2.1544	1.1073	2.1544	1.0689	2.1544	0.93	2.1544	0.8543	2.1544	0.771	2.1544	0.6798
2.257	1.6562	2.257	1.1073	2.257	1.0689	2.257	0.93	2.257	0.8543	2.257	0.771	2.257	0.6798

2.3645	1.6562	2.3645	1.1073	2.3645	1.0689	2.3645	0.93	2.3645	0.8543	2.3645	0.771	2.3645	0.6798
2.4771	1.6073	2.4771	1.127	2.4771	1.0689	2.4771	0.93	2.4771	0.8543	2.4771	0.771	2.4771	0.6798
2.595	1.6073	2.595	1.127	2.595	1.0689	2.595	0.93	2.595	0.8543	2.595	0.771	2.595	0.6948
2.7186	1.6073	2.7186	1.127	2.7186	1.0689	2.7186	0.93	2.7186	0.8543	2.7186	0.775	2.7186	0.7152
2.848	1.6038	2.848	1.127	2.848	1.0689	2.848	0.93	2.848	0.8559	2.848	0.7972	2.848	0.7309
2.9836	1.5188	2.9836	1.127	2.9836	1.0689	2.9836	0.93	2.9836	0.8559	2.9836	0.7972	2.9836	0.7343
3.1257	1.4997	3.1257	1.127	3.1257	1.0689	3.1257	0.93	3.1257	0.8559	3.1257	0.7972	3.1257	0.7358
3.2745	1.4997	3.2745	1.1771	3.2745	1.0689	3.2745	0.9489	3.2745	0.8559	3.2745	0.7972	3.2745	0.7415
3.4305	1.6477	3.4305	1.2287	3.4305	1.0843	3.4305	0.9715	3.4305	0.8786	3.4305	0.8056	3.4305	0.7439
3.5938	1.729	3.5938	1.2287	3.5938	1.0843	3.5938	0.9715	3.5938	0.8786	3.5938	0.8201	3.5938	0.7521
3.7649	1.729	3.7649	1.2287	3.7649	1.0843	3.7649	0.9715	3.7649	0.8786	3.7649	0.8201	3.7649	0.7521
3.9442	1.729	3.9442	1.2287	3.9442	1.0843	3.9442	0.9715	3.9442	0.8786	3.9442	0.8201	3.9442	0.7521
4.132	1.729	4.132	1.2287	4.132	1.0843	4.132	0.9715	4.132	0.8786	4.132	0.8201	4.132	0.7521
4.3288	1.729	4.3288	1.2287	4.3288	1.0843	4.3288	0.9715	4.3288	0.8786	4.3288	0.8201	4.3288	0.7521
4.5349	1.729	4.5349	1.2287	4.5349	1.0843	4.5349	0.9715	4.5349	0.9034	4.5349	0.8114	4.5349	0.7477
4.7508	1.729	4.7508	1.2287	4.7508	1.0843	4.7508	0.9715	4.7508	0.9034	4.7508	0.8028	4.7508	0.7348
4.977	1.729	4.977	1.1517	4.977	1.0607	4.977	0.9698	4.977	0.9034	4.977	0.8028	4.977	0.7272
5.214	1.729	5.214	1.1517	5.214	1.0607	5.214	0.9698	5.214	0.9034	5.214	0.8028	5.214	0.7183
5.4623	1.5947	5.4623	1.0863	5.4623	1.0607	5.4623	0.9698	5.4623	0.9034	5.4623	0.8028	5.4623	0.7033
5.7224	1.5947	5.7224	1.0863	5.7224	1.0607	5.7224	0.9582	5.7224	0.8798	5.7224	0.767	5.7224	0.6597
5.9948	1.2803	5.9948	0.866	5.9948	0.8444	5.9948	0.8127	5.9948	0.7784	5.9948	0.714	5.9948	0.6374
6.2803	1.0548	6.2803	0.8195	6.2803	0.7776	6.2803	0.744	6.2803	0.7149	6.2803	0.6643	6.2803	0.6028
6.5793	1.0548	6.5793	0.7923	6.5793	0.7225	6.5793	0.6735	6.5793	0.6523	6.5793	0.6139	6.5793	0.5669
6.8926	1.0548	6.8926	0.6827	6.8926	0.6543	6.8926	0.635	6.8926	0.6133	6.8926	0.5713	6.8926	0.5194
7.2208	1.0548	7.2208	0.6827	7.2208	0.6434	7.2208	0.6137	7.2208	0.5893	7.2208	0.5492	7.2208	0.5024
7.5646	1.0548	7.5646	0.643	7.5646	0.5993	7.5646	0.5643	7.5646	0.5464	7.5646	0.5145	7.5646	0.476
7.9248	1.0548	7.9248	0.6	7.9248	0.5525	7.9248	0.5251	7.9248	0.5059	7.9248	0.4766	7.9248	0.444
8.3022	0.8638	8.3022	0.4935	8.3022	0.453	8.3022	0.4489	8.3022	0.4419	8.3022	0.4251	8.3022	0.4054
8.6975	0.6605	8.6975	0.4805	8.6975	0.4345	8.6975	0.413	8.6975	0.3975	8.6975	0.3855	8.6975	0.3723
9.1116	0.6123	9.1116	0.4662	9.1116	0.4277	9.1116	0.403	9.1116	0.3873	9.1116	0.3764	9.1116	0.3684
9.5455	0.5564	9.5455	0.4662	9.5455	0.4277	9.5455	0.403	9.5455	0.3873	9.5455	0.3716	9.5455	0.3649
10	0.5166	10	0.4371	10	0.4088	10	0.3922	10	0.3815	10	0.3718	10	0.3633
10.4762	0.4998	10.4762	0.4371	10.4762	0.4088	10.4762	0.3922	10.4762	0.3812	10.4762	0.37	10.4762	0.3633
10.975	0.5011	10.975	0.4371	10.975	0.4088	10.975	0.3922	10.975	0.3812	10.975	0.37	10.975	0.3633
11.4976	0.5346	11.4976	0.4371	11.4976	0.4088	11.4976	0.3922	11.4976	0.3812	11.4976	0.3678	11.4976	0.3593
12.045	0.5346	12.045	0.4371	12.045	0.4088	12.045	0.3922	12.045	0.3812	12.045	0.3678	12.045	0.3575
12.6186	0.5346	12.6186	0.4371	12.6186	0.4088	12.6186	0.3922	12.6186	0.3812	12.6186	0.3678	12.6186	0.3575
13.2194	0.5346	13.2194	0.4371	13.2194	0.4088	13.2194	0.3922	13.2194	0.3812	13.2194	0.3678	13.2194	0.3575
13.8489	0.6983	13.8489	0.4371	13.8489	0.4088	13.8489	0.3922	13.8489	0.3812	13.8489	0.3678	13.8489	0.3575

14.5083	0.6983	14.5083	0.4371	14.5083	0.4088	14.5083	0.3922	14.5083	0.3812	14.5083	0.3678	14.5083	0.3575
15.1991	0.6983	15.1991	0.4371	15.1991	0.4088	15.1991	0.3922	15.1991	0.3812	15.1991	0.3678	15.1991	0.3575
15.9228	0.6983	15.9228	0.4371	15.9228	0.4088	15.9228	0.3922	15.9228	0.3812	15.9228	0.3678	15.9228	0.3575
16.681	0.6983	16.681	0.4371	16.681	0.4088	16.681	0.3922	16.681	0.3812	16.681	0.3678	16.681	0.3575
17.4753	0.5675	17.4753	0.4359	17.4753	0.4009	17.4753	0.3832	17.4753	0.3725	17.4753	0.3623	17.4753	0.3546
18.3074	0.5675	18.3074	0.4359	18.3074	0.4009	18.3074	0.3832	18.3074	0.3725	18.3074	0.3623	18.3074	0.3546
19.1791	0.6461	19.1791	0.4359	19.1791	0.4009	19.1791	0.3832	19.1791	0.3725	19.1791	0.3623	19.1791	0.3546
20.0923	0.6461	20.0923	0.4359	20.0923	0.4009	20.0923	0.3832	20.0923	0.3725	20.0923	0.3623	20.0923	0.3546
21.049	0.6461	21.049	0.4359	21.049	0.4009	21.049	0.3832	21.049	0.3725	21.049	0.3601	21.049	0.3508
22.0513	0.6461	22.0513	0.4359	22.0513	0.4009	22.0513	0.3832	22.0513	0.3725	22.0513	0.3601	22.0513	0.3504
23.1013	0.6461	23.1013	0.4359	23.1013	0.4009	23.1013	0.3832	23.1013	0.3725	23.1013	0.3601	23.1013	0.3504
24.2013	0.4489	24.2013	0.3721	24.2013	0.3669	24.2013	0.3636	24.2013	0.3605	24.2013	0.3546	24.2013	0.3479
25.3536	0.4489	25.3536	0.3675	25.3536	0.3609	25.3536	0.3581	25.3536	0.3561	25.3536	0.3522	25.3536	0.3477
26.5609	0.4489	26.5609	0.3675	26.5609	0.3609	26.5609	0.3565	26.5609	0.3534	26.5609	0.3491	26.5609	0.3452
27.8256	0.4073	27.8256	0.3647	27.8256	0.3523	27.8256	0.3488	27.8256	0.3467	27.8256	0.3435	27.8256	0.3406
29.1505	0.4073	29.1505	0.3548	29.1505	0.3516	29.1505	0.3488	29.1505	0.3467	29.1505	0.3435	29.1505	0.3402
30.5386	0.4073	30.5386	0.3548	30.5386	0.3516	30.5386	0.3488	30.5386	0.3467	30.5386	0.3435	30.5386	0.3402
31.9927	0.4073	31.9927	0.3465	31.9927	0.345	31.9927	0.3447	31.9927	0.3438	31.9927	0.3417	31.9927	0.3392
33.516	0.3423	33.516	0.3426	33.516	0.3419	33.516	0.341	33.516	0.3401	33.516	0.3386	33.516	0.3369
35.1119	0.3337	35.1119	0.3344	35.1119	0.3347	35.1119	0.3349	35.1119	0.3349	35.1119	0.3348	35.1119	0.3343
36.7838	0.3313	36.7838	0.3316	36.7838	0.3318	36.7838	0.3319	36.7838	0.332	36.7838	0.3321	36.7838	0.332
38.5353	0.3298	38.5353	0.3299	38.5353	0.33	38.5353	0.3301	38.5353	0.3302	38.5353	0.3303	38.5353	0.3303
40.3702	0.3286	40.3702	0.3287	40.3702	0.3288	40.3702	0.3289	40.3702	0.3289	40.3702	0.329	40.3702	0.3291
42.2924	0.3277	42.2924	0.3278	42.2924	0.3278	42.2924	0.3279	42.2924	0.3279	42.2924	0.328	42.2924	0.328
44.3062	0.327	44.3062	0.327	44.3062	0.3271	44.3062	0.3271	44.3062	0.3271	44.3062	0.3271	44.3062	0.3272
46.4159	0.3263	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3265
48.626	0.3257	48.626	0.3257	48.626	0.3257	48.626	0.3257	48.626	0.3258	48.626	0.3258	48.626	0.3258
50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252

RPP-WTP Pretreatment Facility ISRS  
Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTWW068.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 68  
 SLAB-WALL JOINT North-South Responses  
 Elevation 0 ft.  
 Line 12.5 & H

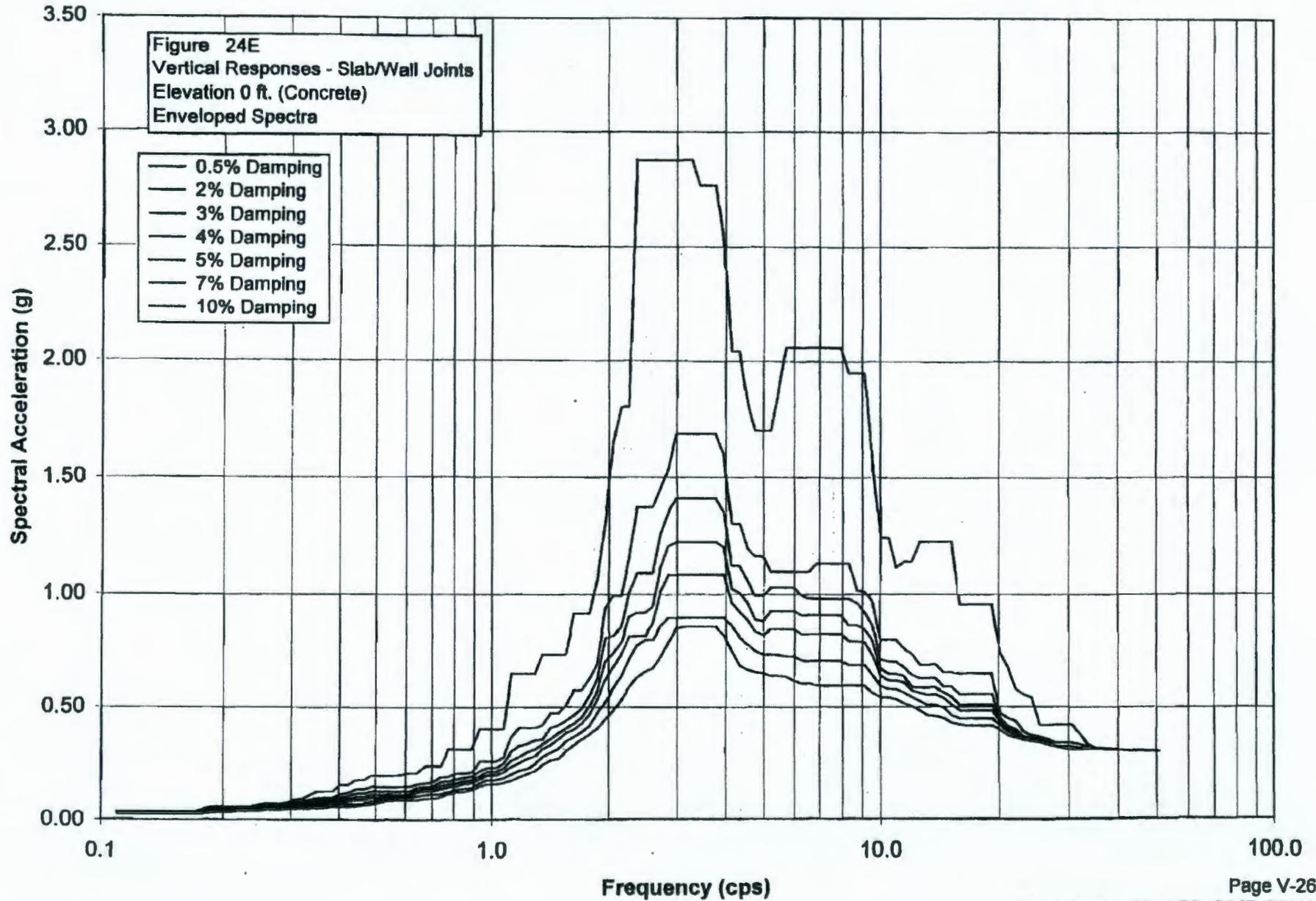
Damping	0.50%	Damping	2%	Damping	3%	Damping	4%	Damping	5%	Damping	7%	Damping	10%
Freq.	Accel.												
0.1098	0.0456	0.1098	0.0394	0.1098	0.0365	0.1098	0.0343	0.1098	0.0327	0.1098	0.0305	0.1098	0.028
0.115	0.0555	0.115	0.0492	0.115	0.0464	0.115	0.0438	0.115	0.0416	0.115	0.0378	0.115	0.0332
0.1204	0.0647	0.1204	0.058	0.1204	0.0542	0.1204	0.0508	0.1204	0.0478	0.1204	0.0424	0.1204	0.038
0.1262	0.0719	0.1262	0.0617	0.1262	0.0571	0.1262	0.0532	0.1262	0.0497	0.1262	0.0437	0.1262	0.0378
0.1322	0.0761	0.1322	0.0652	0.1322	0.06	0.1322	0.0561	0.1322	0.0525	0.1322	0.0466	0.1322	0.0398
0.1385	0.0785	0.1385	0.0671	0.1385	0.0608	0.1385	0.0561	0.1385	0.0525	0.1385	0.0466	0.1385	0.0398
0.1451	0.0789	0.1451	0.0676	0.1451	0.0612	0.1451	0.0561	0.1451	0.0525	0.1451	0.0466	0.1451	0.0407
0.152	0.0789	0.152	0.0676	0.152	0.0612	0.152	0.0584	0.152	0.0534	0.152	0.0482	0.152	0.0426
0.1592	0.0789	0.1592	0.0676	0.1592	0.0612	0.1592	0.0584	0.1592	0.0534	0.1592	0.0482	0.1592	0.0435
0.1668	0.0789	0.1668	0.0676	0.1668	0.0612	0.1668	0.0584	0.1668	0.0534	0.1668	0.0482	0.1668	0.0435
0.1748	0.0789	0.1748	0.0676	0.1748	0.0612	0.1748	0.0584	0.1748	0.0534	0.1748	0.0482	0.1748	0.0435
0.1831	0.0789	0.1831	0.0676	0.1831	0.0612	0.1831	0.0584	0.1831	0.0534	0.1831	0.0482	0.1831	0.0435
0.1918	0.0789	0.1918	0.0676	0.1918	0.0612	0.1918	0.0562	0.1918	0.0532	0.1918	0.048	0.1918	0.0435
0.2009	0.0789	0.2009	0.0676	0.2009	0.0612	0.2009	0.0582	0.2009	0.0532	0.2009	0.0478	0.2009	0.0435
0.2105	0.0734	0.2105	0.0632	0.2105	0.0596	0.2105	0.0562	0.2105	0.0532	0.2105	0.049	0.2105	0.0468
0.2205	0.0683	0.2205	0.0622	0.2205	0.0587	0.2205	0.0559	0.2205	0.0547	0.2205	0.0527	0.2205	0.0501
0.231	0.0647	0.231	0.0623	0.231	0.0609	0.231	0.0595	0.231	0.0583	0.231	0.056	0.231	0.0532
0.242	0.0759	0.242	0.0684	0.242	0.0646	0.242	0.0627	0.242	0.0614	0.242	0.0589	0.242	0.0561
0.2535	0.1087	0.2535	0.0914	0.2535	0.0822	0.2535	0.0748	0.2535	0.069	0.2535	0.0615	0.2535	0.0585
0.2656	0.1215	0.2656	0.0949	0.2656	0.0825	0.2656	0.0748	0.2656	0.069	0.2656	0.0636	0.2656	0.0602
0.2783	0.1215	0.2783	0.0949	0.2783	0.0825	0.2783	0.0776	0.2783	0.0734	0.2783	0.0664	0.2783	0.0612
0.2915	0.1215	0.2915	0.1001	0.2915	0.0932	0.2915	0.0871	0.2915	0.0817	0.2915	0.0726	0.2915	0.0624
0.3054	0.1358	0.3054	0.1179	0.3054	0.1078	0.3054	0.099	0.3054	0.0914	0.3054	0.0795	0.3054	0.0671
0.3199	0.164	0.3199	0.1266	0.3199	0.1152	0.3199	0.1054	0.3199	0.097	0.3199	0.0837	0.3199	0.0716
0.3352	0.1864	0.3352	0.1319	0.3352	0.1152	0.3352	0.1054	0.3352	0.097	0.3352	0.0843	0.3352	0.0745
0.3511	0.2149	0.3511	0.1624	0.3511	0.1375	0.3511	0.1182	0.3511	0.1047	0.3511	0.0907	0.3511	0.0782
0.3678	0.2149	0.3678	0.1624	0.3678	0.1375	0.3678	0.1252	0.3678	0.1164	0.3678	0.104	0.3678	0.09

0.3853	0.2149	0.3853	0.1624	0.3853	0.1446	0.3853	0.1356	0.3853	0.1276	0.3853	0.1141	0.3853	0.0986
0.4037	0.2149	0.4037	0.1624	0.4037	0.1446	0.4037	0.1356	0.4037	0.1276	0.4037	0.1144	0.4037	0.1004
0.4229	0.2162	0.4229	0.1627	0.4229	0.1446	0.4229	0.1358	0.4229	0.1276	0.4229	0.1144	0.4229	0.1004
0.4431	0.3426	0.4431	0.2319	0.4431	0.1895	0.4431	0.1592	0.4431	0.1381	0.4431	0.1184	0.4431	0.1069
0.4642	0.3426	0.4642	0.2319	0.4642	0.1921	0.4642	0.1724	0.4642	0.1573	0.4642	0.1361	0.4642	0.116
0.4863	0.3426	0.4863	0.2319	0.4863	0.1921	0.4863	0.1742	0.4863	0.1618	0.4863	0.1445	0.4863	0.1231
0.5094	0.3426	0.5094	0.2319	0.5094	0.1986	0.5094	0.1844	0.5094	0.1729	0.5094	0.1523	0.5094	0.1276
0.5337	0.3621	0.5337	0.2644	0.5337	0.2284	0.5337	0.2033	0.5337	0.1829	0.5337	0.1523	0.5337	0.1276
0.5591	0.3621	0.5591	0.2742	0.5591	0.238	0.5591	0.2093	0.5591	0.1863	0.5591	0.1548	0.5591	0.1353
0.5857	0.3621	0.5857	0.2791	0.5857	0.2469	0.5857	0.2206	0.5857	0.1991	0.5857	0.1715	0.5857	0.1521
0.6136	0.3621	0.6136	0.2791	0.6136	0.2469	0.6136	0.2206	0.6136	0.1993	0.6136	0.1818	0.6136	0.1615
0.6428	0.3694	0.6428	0.2791	0.6428	0.2469	0.6428	0.2213	0.6428	0.2086	0.6428	0.1933	0.6428	0.1748
0.6734	0.3694	0.6734	0.2908	0.6734	0.2657	0.6734	0.2429	0.6734	0.2288	0.6734	0.2108	0.6734	0.1877
0.7055	0.4317	0.7055	0.3543	0.7055	0.3133	0.7055	0.279	0.7055	0.2569	0.7055	0.2257	0.7055	0.1944
0.7391	0.5134	0.7391	0.4029	0.7391	0.3524	0.7391	0.3115	0.7391	0.278	0.7391	0.2281	0.7391	0.1944
0.7743	0.5998	0.7743	0.4518	0.7743	0.3831	0.7743	0.331	0.7743	0.2909	0.7743	0.2351	0.7743	0.2186
0.8111	0.7728	0.8111	0.458	0.8111	0.3831	0.8111	0.331	0.8111	0.2909	0.8111	0.2586	0.8111	0.2434
0.8497	0.7728	0.8497	0.458	0.8497	0.3831	0.8497	0.3436	0.8497	0.3138	0.8497	0.2842	0.8497	0.2671
0.8902	0.7728	0.8902	0.458	0.8902	0.388	0.8902	0.3627	0.8902	0.3375	0.8902	0.3097	0.8902	0.2901
0.9326	0.9974	0.9326	0.5856	0.9326	0.4664	0.9326	0.3986	0.9326	0.3523	0.9326	0.3345	0.9326	0.3123
0.977	0.9974	0.977	0.5962	0.977	0.5269	0.977	0.4456	0.977	0.3864	0.977	0.3568	0.977	0.3322
1.0235	0.9974	1.0235	0.5962	1.0235	0.5269	1.0235	0.4456	1.0235	0.3963	1.0235	0.375	1.0235	0.3489
1.0723	0.9974	1.0723	0.5962	1.0723	0.5269	1.0723	0.4578	1.0723	0.4362	1.0723	0.3969	1.0723	0.362
1.1233	1.022	1.1233	0.6338	1.1233	0.5306	1.1233	0.5028	1.1233	0.4775	1.1233	0.432	1.1233	0.3768
1.1768	1.022	1.1768	0.6338	1.1768	0.6129	1.1768	0.5399	1.1768	0.5088	1.1768	0.4574	1.1768	0.3977
1.2328	1.022	1.2328	0.6338	1.2328	0.6129	1.2328	0.5399	1.2328	0.5088	1.2328	0.4606	1.2328	0.4062
1.2916	1.022	1.2916	0.8562	1.2916	0.7174	1.2916	0.624	1.2916	0.5564	1.2916	0.4677	1.2916	0.4071
1.353	1.022	1.353	0.9365	1.353	0.781	1.353	0.6757	1.353	0.6023	1.353	0.5084	1.353	0.4311
1.4175	1.0636	1.4175	0.9365	1.4175	0.8087	1.4175	0.6853	1.4175	0.6424	1.4175	0.5953	1.4175	0.4919
1.485	1.2052	1.485	0.988	1.485	0.8866	1.485	0.6853	1.485	0.6424	1.485	0.6264	1.485	0.511
1.5557	1.4673	1.5557	1.0882	1.5557	0.8988	1.5557	0.6853	1.5557	0.6427	1.5557	0.6264	1.5557	0.5133
1.6298	1.4673	1.6298	1.0882	1.6298	0.8988	1.6298	0.7781	1.6298	0.7205	1.6298	0.6315	1.6298	0.5443
1.7074	1.4673	1.7074	1.0882	1.7074	0.9509	1.7074	0.8465	1.7074	0.7818	1.7074	0.6721	1.7074	0.5582
1.7887	1.9337	1.7887	1.1866	1.7887	1.0454	1.7887	0.9314	1.7887	0.8343	1.7887	0.6827	1.7887	0.5914
1.8738	1.9337	1.8738	1.1866	1.8738	1.0454	1.8738	0.9314	1.8738	0.8343	1.8738	0.6909	1.8738	0.6195
1.963	1.9337	1.963	1.2264	1.963	1.0454	1.963	0.9314	1.963	0.8343	1.963	0.7213	1.963	0.6444
2.0565	1.9337	2.0565	1.2264	2.0565	1.0454	2.0565	0.9314	2.0565	0.8343	2.0565	0.7554	2.0565	0.6649
2.1544	1.9337	2.1544	1.2264	2.1544	1.0454	2.1544	0.9314	2.1544	0.8343	2.1544	0.7745	2.1544	0.6753
2.257	1.6526	2.257	1.2264	2.257	1.0189	2.257	0.9197	2.257	0.8328	2.257	0.7876	2.257	0.6753

2.3645	1.6526	2.3645	1.2264	2.3645	0.9027	2.3645	0.8216	2.3645	0.8042	2.3645	0.7876	2.3645	0.6753
2.4771	1.4968	2.4771	1.1813	2.4771	0.9027	2.4771	0.8216	2.4771	0.8042	2.4771	0.7876	2.4771	0.6753
2.595	1.4968	2.595	1.1813	2.595	0.9027	2.595	0.8216	2.595	0.8042	2.595	0.7876	2.595	0.6753
2.7186	1.5785	2.7186	1.1813	2.7186	0.9027	2.7186	0.8216	2.7186	0.8042	2.7186	0.7876	2.7186	0.6751
2.848	1.5785	2.848	1.1813	2.848	0.9027	2.848	0.8216	2.848	0.8042	2.848	0.771	2.848	0.6514
2.9836	1.5785	2.9836	1.0072	2.9836	0.9027	2.9836	0.8216	2.9836	0.7681	2.9836	0.6806	2.9836	0.5889
3.1257	1.5785	3.1257	0.9135	3.1257	0.7834	3.1257	0.7396	3.1257	0.7002	3.1257	0.6334	3.1257	0.5581
3.2745	1.5785	3.2745	0.8453	3.2745	0.7676	3.2745	0.706	3.2745	0.6569	3.2745	0.5846	3.2745	0.5121
3.4305	1.0503	3.4305	0.7273	3.4305	0.6584	3.4305	0.6105	3.4305	0.5739	3.4305	0.5184	3.4305	0.4584
3.5938	1.0648	3.5938	0.7273	3.5938	0.6584	3.5938	0.6105	3.5938	0.5739	3.5938	0.5184	3.5938	0.4584
3.7649	1.0648	3.7649	0.7273	3.7649	0.6584	3.7649	0.6105	3.7649	0.5739	3.7649	0.5184	3.7649	0.4584
3.9442	1.0648	3.9442	0.7273	3.9442	0.6584	3.9442	0.6105	3.9442	0.5739	3.9442	0.5184	3.9442	0.4584
4.132	1.0648	4.132	0.7273	4.132	0.6584	4.132	0.6105	4.132	0.5739	4.132	0.5204	4.132	0.4587
4.3288	1.0648	4.3288	0.7521	4.3288	0.6945	4.3288	0.6539	4.3288	0.6178	4.3288	0.5556	4.3288	0.4808
4.5349	1.0648	4.5349	0.7892	4.5349	0.6979	4.5349	0.6817	4.5349	0.6537	4.5349	0.5747	4.5349	0.4858
4.7508	1.3052	4.7508	0.7892	4.7508	0.6979	4.7508	0.6817	4.7508	0.6702	4.7508	0.5747	4.7508	0.4858
4.977	1.3052	4.977	0.7892	4.977	0.6979	4.977	0.6817	4.977	0.6702	4.977	0.5747	4.977	0.4858
5.214	1.3052	5.214	0.7892	5.214	0.6979	5.214	0.6817	5.214	0.6702	5.214	0.5747	5.214	0.4858
5.4623	1.3052	5.4623	0.7892	5.4623	0.6979	5.4623	0.6817	5.4623	0.6702	5.4623	0.5747	5.4623	0.4858
5.7224	1.5193	5.7224	0.7892	5.7224	0.6979	5.7224	0.6817	5.7224	0.6702	5.7224	0.568	5.7224	0.4651
5.9948	1.5193	5.9948	0.7892	5.9948	0.6979	5.9948	0.6817	5.9948	0.6343	5.9948	0.5423	5.9948	0.4627
6.2803	1.5193	6.2803	0.7477	6.2803	0.6873	6.2803	0.6133	6.2803	0.5671	6.2803	0.5154	6.2803	0.4687
6.5793	1.5193	6.5793	0.7477	6.5793	0.6873	6.5793	0.6133	6.5793	0.5619	6.5793	0.5154	6.5793	0.4777
6.8926	1.5193	6.8926	0.7477	6.8926	0.6832	6.8926	0.6059	6.8926	0.5619	6.8926	0.5081	6.8926	0.4777
7.2208	1.5193	7.2208	0.7477	7.2208	0.6832	7.2208	0.6059	7.2208	0.5619	7.2208	0.5081	7.2208	0.4777
7.5646	1.5193	7.5646	0.7477	7.5646	0.6832	7.5646	0.5969	7.5646	0.5534	7.5646	0.5081	7.5646	0.4777
7.9248	1.5193	7.9248	0.7477	7.9248	0.6832	7.9248	0.5857	7.9248	0.5403	7.9248	0.5081	7.9248	0.4777
8.3022	1.2327	8.3022	0.6751	8.3022	0.5995	8.3022	0.5656	8.3022	0.5394	8.3022	0.508	8.3022	0.4774
8.6975	0.9775	8.6975	0.6751	8.6975	0.5995	8.6975	0.5656	8.6975	0.5394	8.6975	0.5041	8.6975	0.4735
9.1116	0.9295	9.1116	0.5846	9.1116	0.5348	9.1116	0.5193	9.1116	0.5065	9.1116	0.4867	9.1116	0.4695
9.5455	0.823	9.5455	0.5551	9.5455	0.5348	9.5455	0.5193	9.5455	0.5065	9.5455	0.4859	9.5455	0.4651
10	0.742	10	0.5551	10	0.5348	10	0.5193	10	0.5065	10	0.4859	10	0.4651
10.4762	0.742	10.4762	0.5551	10.4762	0.5348	10.4762	0.5193	10.4762	0.5065	10.4762	0.4855	10.4762	0.4609
10.975	0.742	10.975	0.5121	10.975	0.5044	10.975	0.4954	10.975	0.4859	10.975	0.4687	10.975	0.4468
11.4976	0.7067	11.4976	0.5121	11.4976	0.4824	11.4976	0.4755	11.4976	0.4693	11.4976	0.4577	11.4976	0.4423
12.045	0.7067	12.045	0.5026	12.045	0.4753	12.045	0.4651	12.045	0.4586	12.045	0.4489	12.045	0.436
12.6186	0.7067	12.6186	0.4664	12.6186	0.4572	12.6186	0.4527	12.6186	0.4481	12.6186	0.4393	12.6186	0.4274
13.2194	0.7067	13.2194	0.4531	13.2194	0.4433	13.2194	0.4378	13.2194	0.4336	13.2194	0.4263	13.2194	0.4166
13.8489	0.4879	13.8489	0.4205	13.8489	0.4173	13.8489	0.4169	13.8489	0.4158	13.8489	0.412	13.8489	0.4049

14.5083	0.4879	14.5083	0.4205	14.5083	0.4147	14.5083	0.4103	14.5083	0.4068	14.5083	0.4011	14.5083	0.394
15.1991	0.4879	15.1991	0.4145	15.1991	0.4024	15.1991	0.3986	15.1991	0.393	15.1991	0.3882	15.1991	0.3825
15.9228	0.464	15.9228	0.3946	15.9228	0.3783	15.9228	0.3773	15.9228	0.3774	15.9228	0.3753	15.9228	0.3712
16.681	0.464	16.681	0.3946	16.681	0.3783	16.681	0.3694	16.681	0.386	16.681	0.3635	16.681	0.3605
17.4753	0.497	17.4753	0.3813	17.4753	0.3644	17.4753	0.3552	17.4753	0.3513	17.4753	0.352	17.4753	0.3511
18.3074	0.497	18.3074	0.3813	18.3074	0.3644	18.3074	0.3552	18.3074	0.35	18.3074	0.3471	18.3074	0.3445
19.1791	0.497	19.1791	0.3813	19.1791	0.3644	19.1791	0.3552	19.1791	0.35	19.1791	0.3448	19.1791	0.3419
20.0923	0.497	20.0923	0.3574	20.0923	0.3499	20.0923	0.347	20.0923	0.3445	20.0923	0.3407	20.0923	0.3381
21.049	0.497	21.049	0.3574	21.049	0.3499	21.049	0.347	21.049	0.3445	21.049	0.3407	21.049	0.3371
22.0513	0.497	22.0513	0.3574	22.0513	0.3499	22.0513	0.347	22.0513	0.3445	22.0513	0.3407	22.0513	0.3371
23.1013	0.497	23.1013	0.3574	23.1013	0.3521	23.1013	0.3479	23.1013	0.3445	23.1013	0.3407	23.1013	0.3371
24.2013	0.497	24.2013	0.3574	24.2013	0.3521	24.2013	0.3479	24.2013	0.3445	24.2013	0.3407	24.2013	0.3371
25.3536	0.3847	25.3536	0.3574	25.3536	0.3521	25.3536	0.3479	25.3536	0.3445	25.3536	0.3396	25.3536	0.3356
26.5609	0.3847	26.5609	0.3574	26.5609	0.3521	26.5609	0.3479	26.5609	0.3445	26.5609	0.3396	26.5609	0.3356
27.8256	0.3766	27.8256	0.3574	27.8256	0.3521	27.8256	0.3479	27.8256	0.3445	27.8256	0.3393	27.8256	0.334
29.1505	0.3766	29.1505	0.3422	29.1505	0.3374	29.1505	0.335	29.1505	0.3348	29.1505	0.3331	29.1505	0.3297
30.5386	0.3766	30.5386	0.3422	30.5386	0.3374	30.5386	0.3349	30.5386	0.3325	30.5386	0.3287	30.5386	0.3247
31.9927	0.3766	31.9927	0.3422	31.9927	0.3313	31.9927	0.326	31.9927	0.323	31.9927	0.3199	31.9927	0.3178
33.516	0.3014	33.516	0.3015	33.516	0.3016	33.516	0.3036	33.516	0.306	33.516	0.3088	33.516	0.3105
35.1119	0.3014	35.1119	0.3015	35.1119	0.3016	35.1119	0.3019	35.1119	0.3025	35.1119	0.3043	35.1119	0.3061
36.7838	0.3014	36.7838	0.3015	36.7838	0.3016	36.7838	0.3019	36.7838	0.3022	36.7838	0.3029	36.7838	0.3039
38.5353	0.3014	38.5353	0.3015	38.5353	0.3016	38.5353	0.3017	38.5353	0.3018	38.5353	0.3021	38.5353	0.3027
40.3702	0.301	40.3702	0.301	40.3702	0.3011	40.3702	0.3011	40.3702	0.3012	40.3702	0.3014	40.3702	0.3016
42.2924	0.3004	42.2924	0.3004	42.2924	0.3004	42.2924	0.3004	42.2924	0.3005	42.2924	0.3006	42.2924	0.3007
44.3062	0.2996	44.3062	0.2997	44.3062	0.2997	44.3062	0.2997	44.3062	0.2997	44.3062	0.2998	44.3062	0.2999
46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.299	46.4159	0.2991
48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2983
50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTEE024.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 24E  
 Vertical Responses - Slab/Wall Joints  
 Elevation 0 ft. (Concrete)  
 Enveloped Spectra

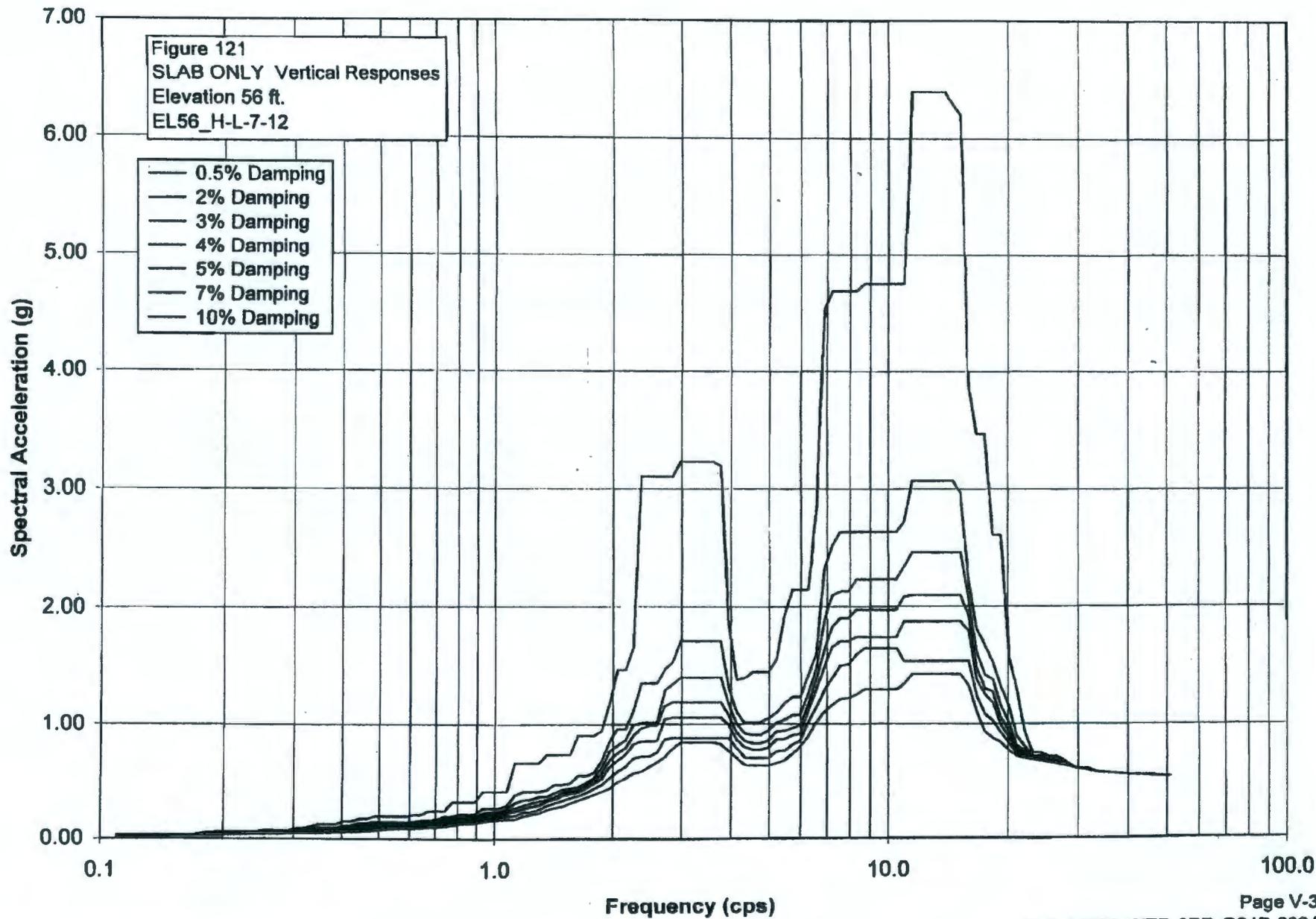
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0329	0.1098	0.0294	0.1098	0.0275	0.1098	0.0263	0.1098	0.0254	0.1098	0.0236	0.1098	0.0217
0.115	0.0347	0.115	0.0311	0.115	0.029	0.115	0.0271	0.115	0.0257	0.115	0.024	0.115	0.022
0.1204	0.0347	0.1204	0.0312	0.1204	0.0291	0.1204	0.0272	0.1204	0.0257	0.1204	0.024	0.1204	0.022
0.1262	0.0349	0.1262	0.0312	0.1262	0.0291	0.1262	0.0272	0.1262	0.0257	0.1262	0.024	0.1262	0.022
0.1322	0.0349	0.1322	0.0312	0.1322	0.0291	0.1322	0.0272	0.1322	0.0257	0.1322	0.024	0.1322	0.0221
0.1385	0.035	0.1385	0.0313	0.1385	0.0292	0.1385	0.0272	0.1385	0.0261	0.1385	0.0243	0.1385	0.0223
0.1451	0.035	0.1451	0.0313	0.1451	0.0292	0.1451	0.0273	0.1451	0.0261	0.1451	0.0243	0.1451	0.0223
0.152	0.0351	0.152	0.0313	0.152	0.0292	0.152	0.0273	0.152	0.0262	0.152	0.0249	0.152	0.0235
0.1592	0.0351	0.1592	0.0313	0.1592	0.0292	0.1592	0.0282	0.1592	0.0275	0.1592	0.0262	0.1592	0.0246
0.1668	0.0351	0.1668	0.0313	0.1668	0.0297	0.1668	0.0289	0.1668	0.0282	0.1668	0.0269	0.1668	0.0252
0.1748	0.0422	0.1748	0.0358	0.1748	0.0323	0.1748	0.0298	0.1748	0.0282	0.1748	0.0269	0.1748	0.0257
0.1831	0.0535	0.1831	0.0445	0.1831	0.0398	0.1831	0.0358	0.1831	0.0324	0.1831	0.0272	0.1831	0.026
0.1918	0.0577	0.1918	0.0478	0.1918	0.0425	0.1918	0.038	0.1918	0.0347	0.1918	0.0319	0.1918	0.0287
0.2009	0.0577	0.2009	0.0478	0.2009	0.0425	0.2009	0.0392	0.2009	0.0373	0.2009	0.034	0.2009	0.0302
0.2105	0.0577	0.2105	0.0478	0.2105	0.0425	0.2105	0.0392	0.2105	0.0374	0.2105	0.0347	0.2105	0.0322
0.2205	0.0577	0.2205	0.0478	0.2205	0.0432	0.2205	0.0418	0.2205	0.0402	0.2205	0.0377	0.2205	0.0346
0.231	0.058	0.231	0.0493	0.231	0.0463	0.231	0.0438	0.231	0.0422	0.231	0.0392	0.231	0.0355
0.242	0.0624	0.242	0.0554	0.242	0.0513	0.242	0.0476	0.242	0.0442	0.242	0.0392	0.242	0.0355
0.2535	0.0713	0.2535	0.0623	0.2535	0.0574	0.2535	0.0532	0.2535	0.0496	0.2535	0.044	0.2535	0.0384
0.2656	0.0713	0.2656	0.0623	0.2656	0.0574	0.2656	0.0532	0.2656	0.0496	0.2656	0.044	0.2656	0.0384
0.2783	0.0713	0.2783	0.0623	0.2783	0.0574	0.2783	0.0532	0.2783	0.0496	0.2783	0.044	0.2783	0.0396
0.2915	0.0743	0.2915	0.0666	0.2915	0.0624	0.2915	0.0587	0.2915	0.0554	0.2915	0.0502	0.2915	0.0442
0.3054	0.0875	0.3054	0.0758	0.3054	0.0693	0.3054	0.0641	0.3054	0.0603	0.3054	0.0539	0.3054	0.0468
0.3199	0.0921	0.3199	0.0797	0.3199	0.0728	0.3199	0.067	0.3199	0.0619	0.3199	0.0539	0.3199	0.0469
0.3352	0.1105	0.3352	0.0889	0.3352	0.0786	0.3352	0.0705	0.3352	0.0642	0.3352	0.0553	0.3352	0.0475
0.3511	0.1251	0.3511	0.0953	0.3511	0.0825	0.3511	0.0725	0.3511	0.0663	0.3511	0.0577	0.3511	0.0492
0.3678	0.1251	0.3678	0.0953	0.3678	0.0848	0.3678	0.0775	0.3678	0.0712	0.3678	0.0613	0.3678	0.0512

0.3853	0.1251	0.3853	0.0957	0.3853	0.0881	0.3853	0.0808	0.3853	0.0753	0.3853	0.0657	0.3853	0.0549
0.4037	0.1549	0.4037	0.1124	0.4037	0.0974	0.4037	0.0858	0.4037	0.0767	0.4037	0.0657	0.4037	0.0549
0.4229	0.1549	0.4229	0.1189	0.4229	0.1035	0.4229	0.0812	0.4229	0.0813	0.4229	0.0671	0.4229	0.0549
0.4431	0.1769	0.4431	0.1354	0.4431	0.1155	0.4431	0.0999	0.4431	0.0876	0.4431	0.0699	0.4431	0.0582
0.4642	0.1769	0.4642	0.1354	0.4642	0.1155	0.4642	0.0999	0.4642	0.0876	0.4642	0.0733	0.4642	0.063
0.4863	0.1981	0.4863	0.1469	0.4863	0.1252	0.4863	0.1094	0.4863	0.0976	0.4863	0.0813	0.4863	0.0674
0.5094	0.1981	0.5094	0.1469	0.5094	0.1252	0.5094	0.1094	0.5094	0.0976	0.5094	0.0854	0.5094	0.0741
0.5337	0.1981	0.5337	0.1469	0.5337	0.1252	0.5337	0.111	0.5337	0.1042	0.5337	0.0936	0.5337	0.0818
0.5591	0.1981	0.5591	0.1469	0.5591	0.1252	0.5591	0.111	0.5591	0.1047	0.5591	0.0963	0.5591	0.0856
0.5857	0.2017	0.5857	0.1489	0.5857	0.1267	0.5857	0.111	0.5857	0.1056	0.5857	0.0968	0.5857	0.086
0.6136	0.2095	0.6136	0.1489	0.6136	0.1267	0.6136	0.1134	0.6136	0.1056	0.6136	0.0968	0.6136	0.086
0.6428	0.2095	0.6428	0.1592	0.6428	0.144	0.6428	0.1315	0.6428	0.1212	0.6428	0.1051	0.6428	0.0888
0.6734	0.2431	0.6734	0.1645	0.6734	0.1488	0.6734	0.1378	0.6734	0.1281	0.6734	0.112	0.6734	0.0942
0.7055	0.2431	0.7055	0.1697	0.7055	0.1488	0.7055	0.1378	0.7055	0.1281	0.7055	0.1134	0.7055	0.0964
0.7391	0.2431	0.7391	0.1929	0.7391	0.1715	0.7391	0.1536	0.7391	0.1387	0.7391	0.1162	0.7391	0.102
0.7743	0.3175	0.7743	0.1939	0.7743	0.1721	0.7743	0.1574	0.7743	0.145	0.7743	0.1247	0.7743	0.1138
0.8111	0.3175	0.8111	0.209	0.8111	0.1824	0.8111	0.1628	0.8111	0.1507	0.8111	0.1354	0.8111	0.1227
0.8497	0.3175	0.8497	0.2096	0.8497	0.1901	0.8497	0.1739	0.8497	0.1602	0.8497	0.1387	0.8497	0.1251
0.8902	0.3175	0.8902	0.2137	0.8902	0.1942	0.8902	0.1779	0.8902	0.1643	0.8902	0.143	0.8902	0.1326
0.9326	0.4048	0.9326	0.2629	0.9326	0.221	0.9326	0.1968	0.9326	0.1816	0.9326	0.1635	0.9326	0.1486
0.977	0.4048	0.977	0.2629	0.977	0.2351	0.977	0.2163	0.977	0.2009	0.977	0.1792	0.977	0.1594
1.0235	0.4048	1.0235	0.2629	1.0235	0.2351	1.0235	0.2163	1.0235	0.2009	1.0235	0.1799	1.0235	0.1605
1.0723	0.4048	1.0723	0.284	1.0723	0.2556	1.0723	0.2329	1.0723	0.2147	1.0723	0.1885	1.0723	0.1656
1.1233	0.6478	1.1233	0.3694	1.1233	0.3066	1.1233	0.2666	1.1233	0.2389	1.1233	0.2034	1.1233	0.1728
1.1768	0.6478	1.1768	0.4092	1.1768	0.3316	1.1768	0.2847	1.1768	0.2551	1.1768	0.2216	1.1768	0.1912
1.2328	0.6478	1.2328	0.4092	1.2328	0.338	1.2328	0.3029	1.2328	0.2737	1.2328	0.2287	1.2328	0.2053
1.2916	0.6478	1.2916	0.4092	1.2916	0.354	1.2916	0.3182	1.2916	0.2852	1.2916	0.251	1.2916	0.2185
1.353	0.7347	1.353	0.4213	1.353	0.3577	1.353	0.336	1.353	0.3164	1.353	0.2841	1.353	0.2475
1.4175	0.7347	1.4175	0.4733	1.4175	0.4091	1.4175	0.3602	1.4175	0.3347	1.4175	0.3026	1.4175	0.2665
1.485	0.7347	1.485	0.4733	1.485	0.4217	1.485	0.3846	1.485	0.3589	1.485	0.318	1.485	0.2749
1.5557	0.7347	1.5557	0.5093	1.5557	0.4416	1.5557	0.4075	1.5557	0.3855	1.5557	0.3483	1.5557	0.3069
1.6298	0.9163	1.6298	0.5735	1.6298	0.4647	1.6298	0.4283	1.6298	0.4013	1.6298	0.3692	1.6298	0.3333
1.7074	0.9163	1.7074	0.5735	1.7074	0.4912	1.7074	0.4549	1.7074	0.4281	1.7074	0.3889	1.7074	0.3565
1.7887	0.9163	1.7887	0.6252	1.7887	0.5523	1.7887	0.5058	1.7887	0.4672	1.7887	0.4188	1.7887	0.3802
1.8738	1.0657	1.8738	0.6899	1.8738	0.6207	1.8738	0.5714	1.8738	0.5353	1.8738	0.4752	1.8738	0.4067
1.963	1.309	1.963	0.9405	1.963	0.8061	1.963	0.7024	1.963	0.6201	1.963	0.5214	1.963	0.447
2.0565	1.6458	2.0565	0.9926	2.0565	0.8189	2.0565	0.7387	2.0565	0.6771	2.0565	0.5832	2.0565	0.4847
2.1544	1.8009	2.1544	0.9926	2.1544	0.8564	2.1544	0.7912	2.1544	0.735	2.1544	0.6387	2.1544	0.5339
2.257	1.8009	2.257	1.1559	2.257	1.0045	2.257	0.9012	2.257	0.8146	2.257	0.7109	2.257	0.5868

2.3645	2.8799	2.3645	1.3727	2.3645	1.0904	2.3645	0.9196	2.3645	0.8166	2.3645	0.7747	2.3645	0.6314
2.4771	2.8799	2.4771	1.3727	2.4771	1.0904	2.4771	0.9196	2.4771	0.8166	2.4771	0.7973	2.4771	0.6564
2.595	2.8799	2.595	1.3727	2.595	1.0904	2.595	0.9452	2.595	0.8693	2.595	0.7973	2.595	0.6708
2.7186	2.8799	2.7186	1.4539	2.7186	1.2603	2.7186	1.1174	2.7186	1.0126	2.7186	0.8596	2.7186	0.723
2.848	2.8799	2.848	1.5317	2.848	1.354	2.848	1.2068	2.848	1.0834	2.848	0.8973	2.848	0.7882
2.9836	2.8799	2.9836	1.6869	2.9836	1.4122	2.9836	1.2244	2.9836	1.0848	2.9836	0.8973	2.9836	0.8498
3.1257	2.8799	3.1257	1.6869	3.1257	1.4122	3.1257	1.2244	3.1257	1.0848	3.1257	0.8973	3.1257	0.8582
3.2745	2.8799	3.2745	1.6869	3.2745	1.4122	3.2745	1.2244	3.2745	1.0848	3.2745	0.8973	3.2745	0.8582
3.4305	2.7652	3.4305	1.6869	3.4305	1.4122	3.4305	1.2244	3.4305	1.0848	3.4305	0.8973	3.4305	0.8582
3.5938	2.7652	3.5938	1.6869	3.5938	1.4122	3.5938	1.2244	3.5938	1.0848	3.5938	0.8973	3.5938	0.8582
3.7649	2.7652	3.7649	1.6869	3.7649	1.4122	3.7649	1.2244	3.7649	1.0848	3.7649	0.8973	3.7649	0.8582
3.9442	2.5281	3.9442	1.5986	3.9442	1.3527	3.9442	1.2028	3.9442	1.0834	3.9442	0.8973	3.9442	0.817
4.132	2.0437	4.132	1.301	4.132	1.1226	4.132	1.0243	4.132	0.9633	4.132	0.8631	4.132	0.7478
4.3288	2.0437	4.3288	1.301	4.3288	1.1226	4.3288	1.0061	4.3288	0.9227	4.3288	0.8061	4.3288	0.6837
4.5349	1.8207	4.5349	1.1967	4.5349	1.0554	4.5349	0.9611	4.5349	0.8876	4.5349	0.7772	4.5349	0.6655
4.7508	1.7008	4.7508	1.1624	4.7508	0.9915	4.7508	0.8891	4.7508	0.8354	4.7508	0.7494	4.7508	0.6545
4.977	1.7008	4.977	1.1624	4.977	0.9915	4.977	0.8809	4.977	0.8192	4.977	0.7321	4.977	0.65
5.214	1.7008	5.214	1.0975	5.214	1.0304	5.214	0.9266	5.214	0.846	5.214	0.7319	5.214	0.6389
5.4623	1.8735	5.4623	1.0975	5.4623	1.0304	5.4623	0.9266	5.4623	0.846	5.4623	0.7319	5.4623	0.6389
5.7224	2.0602	5.7224	1.0975	5.7224	1.0304	5.7224	0.9266	5.7224	0.846	5.7224	0.726	5.7224	0.6355
5.9948	2.0602	5.9948	1.0975	5.9948	1.0304	5.9948	0.9266	5.9948	0.846	5.9948	0.726	5.9948	0.6171
6.2803	2.0602	6.2803	1.0975	6.2803	0.9936	6.2803	0.9089	6.2803	0.8253	6.2803	0.7087	6.2803	0.6055
6.5793	2.0602	6.5793	1.0975	6.5793	0.9797	6.5793	0.9089	6.5793	0.8253	6.5793	0.7045	6.5793	0.6033
6.8926	2.0602	6.8926	1.1327	6.8926	0.9797	6.8926	0.9089	6.8926	0.8253	6.8926	0.7045	6.8926	0.596
7.2208	2.0602	7.2208	1.1327	7.2208	0.9797	7.2208	0.9089	7.2208	0.8253	7.2208	0.7045	7.2208	0.5928
7.5646	2.0602	7.5646	1.1327	7.5646	0.9797	7.5646	0.9089	7.5646	0.8253	7.5646	0.7045	7.5646	0.5938
7.9248	2.0602	7.9248	1.1327	7.9248	0.9797	7.9248	0.9089	7.9248	0.8253	7.9248	0.7045	7.9248	0.5938
8.3022	1.9504	8.3022	1.1327	8.3022	0.9797	8.3022	0.8643	8.3022	0.7929	8.3022	0.6856	8.3022	0.5938
8.6975	1.9504	8.6975	1.0187	8.6975	0.9639	8.6975	0.8643	8.6975	0.7929	8.6975	0.6856	8.6975	0.5938
9.1116	1.9504	9.1116	1.0121	9.1116	0.9236	9.1116	0.8486	9.1116	0.788	9.1116	0.6856	9.1116	0.5938
9.5455	1.5548	9.5455	0.9674	9.5455	0.8614	9.5455	0.7897	9.5455	0.7297	9.5455	0.641	9.5455	0.5801
10	1.2412	10	0.7976	10	0.711	10	0.6704	10	0.6403	10	0.5913	10	0.5423
10.4762	1.2412	10.4762	0.7976	10.4762	0.7005	10.4762	0.6467	10.4762	0.616	10.4762	0.5777	10.4762	0.5402
10.975	1.1134	10.975	0.7976	10.975	0.7005	10.975	0.6467	10.975	0.616	10.975	0.5777	10.975	0.5337
11.4976	1.1405	11.4976	0.7588	11.4976	0.6751	11.4976	0.6377	11.4976	0.6083	11.4976	0.5631	11.4976	0.5155
12.045	1.1405	12.045	0.7357	12.045	0.6444	12.045	0.589	12.045	0.5732	12.045	0.5422	12.045	0.5023
12.6186	1.2275	12.6186	0.6893	12.6186	0.6274	12.6186	0.5862	12.6186	0.5625	12.6186	0.5262	12.6186	0.4844
13.2194	1.2275	13.2194	0.6871	13.2194	0.6274	13.2194	0.5862	13.2194	0.5538	13.2194	0.5083	13.2194	0.4638
13.8489	1.2275	13.8489	0.6871	13.8489	0.6274	13.8489	0.5862	13.8489	0.5538	13.8489	0.5083	13.8489	0.4598

14.5083	1.2275	14.5083	0.6536	14.5083	0.5901	14.5083	0.5632	14.5083	0.5383	14.5083	0.4957	14.5083	0.4501
15.1991	1.2275	15.1991	0.6536	15.1991	0.5893	15.1991	0.5436	15.1991	0.5098	15.1991	0.4637	15.1991	0.431
15.9228	0.9578	15.9228	0.648	15.9228	0.557	15.9228	0.5105	15.9228	0.4847	15.9228	0.45	15.9228	0.4229
16.681	0.9578	16.681	0.648	16.681	0.557	16.681	0.5105	16.681	0.4847	16.681	0.45	16.681	0.4185
17.4753	0.9578	17.4753	0.648	17.4753	0.557	17.4753	0.5105	17.4753	0.4847	17.4753	0.45	17.4753	0.4181
18.3074	0.9578	18.3074	0.648	18.3074	0.557	18.3074	0.5105	18.3074	0.4847	18.3074	0.45	18.3074	0.4181
19.1791	0.9578	19.1791	0.648	19.1791	0.557	19.1791	0.5105	19.1791	0.4847	19.1791	0.45	19.1791	0.4181
20.0923	0.7395	20.0923	0.4726	20.0923	0.4506	20.0923	0.4448	20.0923	0.4372	20.0923	0.4208	20.0923	0.3993
21.049	0.6778	21.049	0.4505	21.049	0.4139	21.049	0.4083	21.049	0.4023	21.049	0.3903	21.049	0.3744
22.0513	0.5811	22.0513	0.4381	22.0513	0.4001	22.0513	0.3907	22.0513	0.3854	22.0513	0.378	22.0513	0.3641
23.1013	0.5542	23.1013	0.392	23.1013	0.3693	23.1013	0.3648	23.1013	0.3627	23.1013	0.3583	23.1013	0.3544
24.2013	0.5425	24.2013	0.3749	24.2013	0.3654	24.2013	0.3619	24.2013	0.3593	24.2013	0.355	24.2013	0.3497
25.3536	0.4219	25.3536	0.3696	25.3536	0.3651	25.3536	0.3607	25.3536	0.3568	25.3536	0.3507	25.3536	0.3446
26.5809	0.4219	26.5809	0.36	26.5809	0.3524	26.5809	0.3478	26.5809	0.3444	26.5809	0.3397	26.5809	0.3359
27.8256	0.4219	27.8256	0.3433	27.8256	0.3297	27.8256	0.3277	27.8256	0.3262	27.8256	0.3247	27.8256	0.3258
29.1505	0.4219	29.1505	0.3433	29.1505	0.3274	29.1505	0.3214	29.1505	0.3202	29.1505	0.3186	29.1505	0.3186
30.5386	0.4219	30.5386	0.3433	30.5386	0.3274	30.5386	0.3214	30.5386	0.3167	30.5386	0.316	30.5386	0.3153
31.9927	0.3814	31.9927	0.3366	31.9927	0.3197	31.9927	0.3172	31.9927	0.3167	31.9927	0.316	31.9927	0.3153
33.516	0.3355	33.516	0.3269	33.516	0.3197	33.516	0.3172	33.516	0.3167	33.516	0.316	33.516	0.3153
35.1119	0.319	35.1119	0.3183	35.1119	0.3177	35.1119	0.3172	35.1119	0.3167	35.1119	0.316	35.1119	0.3153
36.7838	0.3163	36.7838	0.316	36.7838	0.3158	36.7838	0.3157	36.7838	0.3155	36.7838	0.3151	36.7838	0.3146
38.5353	0.3145	38.5353	0.3144	38.5353	0.3143	38.5353	0.3142	38.5353	0.3141	38.5353	0.3139	38.5353	0.3136
40.3702	0.3131	40.3702	0.313	40.3702	0.3129	40.3702	0.3129	40.3702	0.3128	40.3702	0.3128	40.3702	0.3126
42.2924	0.3119	42.2924	0.3118	42.2924	0.3118	42.2924	0.3118	42.2924	0.3117	42.2924	0.3117	42.2924	0.3116
44.3062	0.3108	44.3062	0.3108	44.3062	0.3108	44.3062	0.3108	44.3062	0.3108	44.3062	0.3107	44.3062	0.3107
46.4159	0.3099	46.4159	0.3099	46.4159	0.3099	46.4159	0.3098	46.4159	0.3098	46.4159	0.3098	46.4159	0.3098
48.626	0.309	48.626	0.309	48.626	0.309	48.626	0.309	48.626	0.309	48.626	0.309	48.626	0.309
50.9414	0.3083	50.9414	0.3083	50.9414	0.3083	50.9414	0.3084	50.9414	0.3084	50.9414	0.3084	50.9414	0.3084

RPP-WTP Pretreatment Facility ISRS  
Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTWW121.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 121  
 SLAB ONLY Vertical Responses  
 Elevation 56 ft.  
 EL56\_H-L-7-12

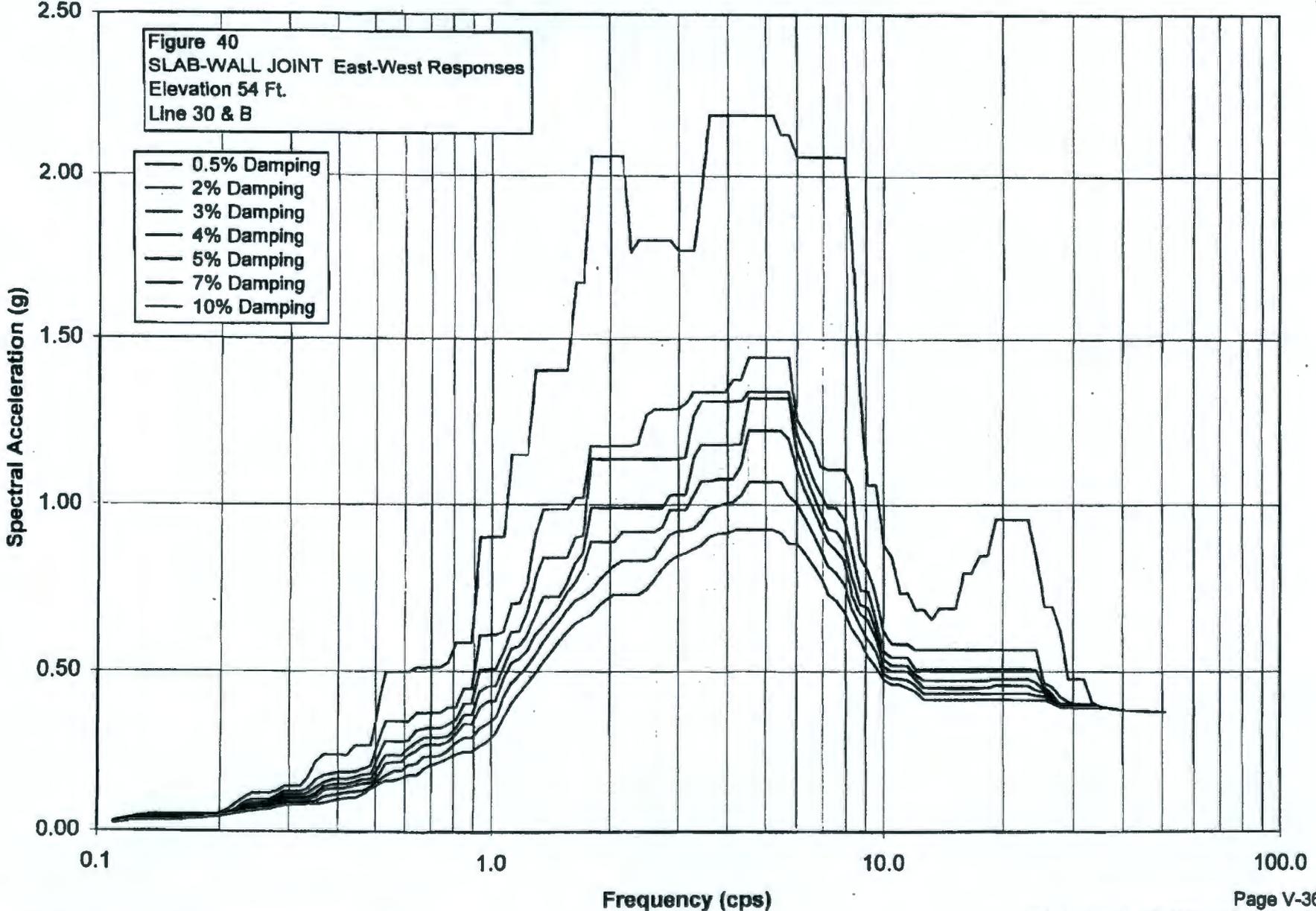
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.033	0.1098	0.0295	0.1098	0.0276	0.1098	0.0264	0.1098	0.0255	0.1098	0.0238	0.1098	0.0219
0.115	0.0348	0.115	0.0311	0.115	0.0291	0.115	0.0272	0.115	0.0258	0.115	0.0241	0.115	0.0223
0.1204	0.0348	0.1204	0.0312	0.1204	0.0291	0.1204	0.0272	0.1204	0.0258	0.1204	0.0241	0.1204	0.0223
0.1262	0.0349	0.1262	0.0312	0.1262	0.0291	0.1262	0.0272	0.1262	0.0258	0.1262	0.0241	0.1262	0.0223
0.1322	0.0349	0.1322	0.0312	0.1322	0.0291	0.1322	0.0272	0.1322	0.0258	0.1322	0.0241	0.1322	0.0223
0.1385	0.0349	0.1385	0.0312	0.1385	0.0291	0.1385	0.0272	0.1385	0.0259	0.1385	0.0242	0.1385	0.0223
0.1451	0.0349	0.1451	0.0312	0.1451	0.0291	0.1451	0.0272	0.1451	0.0259	0.1451	0.0242	0.1451	0.0225
0.152	0.0349	0.152	0.0312	0.152	0.0291	0.152	0.0272	0.152	0.0265	0.152	0.0252	0.152	0.0241
0.1592	0.0349	0.1592	0.0312	0.1592	0.0291	0.1592	0.0284	0.1592	0.0277	0.1592	0.0267	0.1592	0.0254
0.1668	0.0349	0.1668	0.0312	0.1668	0.0298	0.1668	0.0291	0.1668	0.0285	0.1668	0.0274	0.1668	0.0261
0.1748	0.0423	0.1748	0.0358	0.1748	0.0324	0.1748	0.0297	0.1748	0.0285	0.1748	0.0274	0.1748	0.0265
0.1831	0.0536	0.1831	0.0446	0.1831	0.0398	0.1831	0.0358	0.1831	0.0325	0.1831	0.0275	0.1831	0.0268
0.1918	0.0577	0.1918	0.0478	0.1918	0.0425	0.1918	0.0381	0.1918	0.0349	0.1918	0.0321	0.1918	0.0291
0.2009	0.0577	0.2009	0.0478	0.2009	0.0425	0.2009	0.0393	0.2009	0.0375	0.2009	0.0344	0.2009	0.0306
0.2105	0.0577	0.2105	0.0478	0.2105	0.0425	0.2105	0.0397	0.2105	0.038	0.2105	0.0352	0.2105	0.0328
0.2205	0.0577	0.2205	0.0478	0.2205	0.0434	0.2205	0.0419	0.2205	0.0406	0.2205	0.0383	0.2205	0.0353
0.231	0.0581	0.231	0.0495	0.231	0.0465	0.231	0.0443	0.231	0.0427	0.231	0.0397	0.231	0.0362
0.242	0.0625	0.242	0.0555	0.242	0.0514	0.242	0.0477	0.242	0.0444	0.242	0.0397	0.242	0.0362
0.2535	0.0716	0.2535	0.0626	0.2535	0.0577	0.2535	0.0534	0.2535	0.0499	0.2535	0.0445	0.2535	0.0389
0.2656	0.0716	0.2656	0.0626	0.2656	0.0577	0.2656	0.0534	0.2656	0.0499	0.2656	0.0445	0.2656	0.0389
0.2783	0.0716	0.2783	0.0626	0.2783	0.0577	0.2783	0.0534	0.2783	0.0499	0.2783	0.0445	0.2783	0.0401
0.2915	0.0747	0.2915	0.0669	0.2915	0.0624	0.2915	0.0588	0.2915	0.0558	0.2915	0.0508	0.2915	0.0451
0.3054	0.0877	0.3054	0.076	0.3054	0.0697	0.3054	0.0646	0.3054	0.0609	0.3054	0.0546	0.3054	0.0477
0.3199	0.0922	0.3199	0.0798	0.3199	0.073	0.3199	0.0671	0.3199	0.062	0.3199	0.0546	0.3199	0.0477
0.3352	0.111	0.3352	0.0894	0.3352	0.079	0.3352	0.0711	0.3352	0.0649	0.3352	0.0562	0.3352	0.0484
0.3511	0.1257	0.3511	0.0957	0.3511	0.0829	0.3511	0.0729	0.3511	0.067	0.3511	0.0585	0.3511	0.0501
0.3678	0.1257	0.3678	0.0957	0.3678	0.0851	0.3678	0.078	0.3678	0.0719	0.3678	0.062	0.3678	0.0521

0.3853	0.1257	0.3853	0.0961	0.3853	0.0884	0.3853	0.0817	0.3853	0.0762	0.3853	0.0667	0.3853	0.0559
0.4037	0.1552	0.4037	0.113	0.4037	0.0981	0.4037	0.0865	0.4037	0.0773	0.4037	0.0667	0.4037	0.0559
0.4229	0.1552	0.4229	0.1191	0.4229	0.1039	0.4229	0.0918	0.4229	0.082	0.4229	0.0675	0.4229	0.0559
0.4431	0.1777	0.4431	0.1362	0.4431	0.1163	0.4431	0.1007	0.4431	0.0885	0.4431	0.0709	0.4431	0.0607
0.4642	0.1777	0.4642	0.1362	0.4642	0.1163	0.4642	0.1007	0.4642	0.0885	0.4642	0.0743	0.4642	0.0645
0.4863	0.1985	0.4863	0.1471	0.4863	0.1253	0.4863	0.1094	0.4863	0.0974	0.4863	0.0814	0.4863	0.0687
0.5094	0.1985	0.5094	0.1471	0.5094	0.1253	0.5094	0.1094	0.5094	0.0989	0.5094	0.087	0.5094	0.076
0.5337	0.1985	0.5337	0.1471	0.5337	0.1253	0.5337	0.1121	0.5337	0.1057	0.5337	0.0953	0.5337	0.0834
0.5591	0.1985	0.5591	0.1471	0.5591	0.1253	0.5591	0.1121	0.5591	0.1057	0.5591	0.0974	0.5591	0.0867
0.5857	0.2005	0.5857	0.1488	0.5857	0.1268	0.5857	0.1121	0.5857	0.1057	0.5857	0.0974	0.5857	0.0867
0.6136	0.2118	0.6136	0.1488	0.6136	0.1268	0.6136	0.113	0.6136	0.1057	0.6136	0.0974	0.6136	0.0867
0.6428	0.2118	0.6428	0.161	0.6428	0.1458	0.6428	0.1335	0.6428	0.1231	0.6428	0.1073	0.6428	0.0909
0.6734	0.2446	0.6734	0.1647	0.6734	0.1502	0.6734	0.1391	0.6734	0.1296	0.6734	0.1141	0.6734	0.0975
0.7055	0.2446	0.7055	0.1702	0.7055	0.1502	0.7055	0.1391	0.7055	0.1297	0.7055	0.1156	0.7055	0.0986
0.7391	0.2446	0.7391	0.1967	0.7391	0.175	0.7391	0.1569	0.7391	0.1417	0.7391	0.1186	0.7391	0.1045
0.7743	0.3214	0.7743	0.1967	0.7743	0.1771	0.7743	0.1625	0.7743	0.1502	0.7743	0.1301	0.7743	0.1169
0.8111	0.3214	0.8111	0.213	0.8111	0.1859	0.8111	0.1665	0.8111	0.1543	0.8111	0.1391	0.8111	0.1261
0.8497	0.3214	0.8497	0.2135	0.8497	0.1935	0.8497	0.1767	0.8497	0.1633	0.8497	0.1432	0.8497	0.1288
0.8902	0.3214	0.8902	0.2172	0.8902	0.1977	0.8902	0.1814	0.8902	0.1678	0.8902	0.1464	0.8902	0.1364
0.9326	0.4138	0.9326	0.2697	0.9326	0.2279	0.9326	0.2035	0.9326	0.1879	0.9326	0.1688	0.9326	0.1524
0.977	0.4138	0.977	0.2697	0.977	0.2419	0.977	0.2225	0.977	0.2066	0.977	0.1839	0.977	0.1636
1.0235	0.4138	1.0235	0.2697	1.0235	0.2419	1.0235	0.2225	1.0235	0.2066	1.0235	0.1863	1.0235	0.1646
1.0723	0.4138	1.0723	0.2936	1.0723	0.285	1.0723	0.2418	1.0723	0.2238	1.0723	0.1974	1.0723	0.1722
1.1233	0.6656	1.1233	0.3815	1.1233	0.3148	1.1233	0.2725	1.1233	0.2434	1.1233	0.2056	1.1233	0.1743
1.1768	0.6656	1.1768	0.4149	1.1768	0.3396	1.1768	0.292	1.1768	0.2651	1.1768	0.2307	1.1768	0.1986
1.2328	0.6656	1.2328	0.4149	1.2328	0.3472	1.2328	0.3122	1.2328	0.2829	1.2328	0.2384	1.2328	0.2121
1.2916	0.6656	1.2916	0.4154	1.2916	0.3673	1.2916	0.3281	1.2916	0.2961	1.2916	0.258	1.2916	0.2233
1.353	0.7352	1.353	0.4269	1.353	0.3673	1.353	0.3448	1.353	0.3251	1.353	0.2922	1.353	0.2546
1.4175	0.7352	1.4175	0.4722	1.4175	0.4009	1.4175	0.3625	1.4175	0.3436	1.4175	0.3109	1.4175	0.2743
1.485	0.7352	1.485	0.4722	1.485	0.4287	1.485	0.3999	1.485	0.3751	1.485	0.3332	1.485	0.2839
1.5557	0.7352	1.5557	0.4852	1.5557	0.4395	1.5557	0.415	1.5557	0.3934	1.5557	0.3559	1.5557	0.3097
1.6298	0.9015	1.6298	0.5521	1.6298	0.4513	1.6298	0.4238	1.6298	0.4018	1.6298	0.3721	1.6298	0.3337
1.7074	0.9015	1.7074	0.5521	1.7074	0.4862	1.7074	0.4612	1.7074	0.4392	1.7074	0.3978	1.7074	0.3566
1.7887	0.9015	1.7887	0.5762	1.7887	0.5303	1.7887	0.5052	1.7887	0.4812	1.7887	0.4371	1.7887	0.3827
1.8738	0.9435	1.8738	0.683	1.8738	0.6193	1.8738	0.5672	1.8738	0.5244	1.8738	0.4712	1.8738	0.4109
1.963	1.1781	1.963	0.8458	1.963	0.7609	1.963	0.6885	1.963	0.6261	1.963	0.53	1.963	0.4366
2.0565	1.4722	2.0565	0.9587	2.0565	0.8148	2.0565	0.7472	2.0565	0.6869	2.0565	0.5856	2.0565	0.4943
2.1544	1.4722	2.1544	0.9587	2.1544	0.8589	2.1544	0.7934	2.1544	0.7347	2.1544	0.6319	2.1544	0.5285
2.257	1.6581	2.257	1.1094	2.257	0.9923	2.257	0.8986	2.257	0.8226	2.257	0.7018	2.257	0.5689

2.3645	3.1044	2.3645	1.3561	2.3645	1.0122	2.3645	0.9664	2.3645	0.8503	2.3645	0.719	2.3645	0.5849
2.4771	3.1044	2.4771	1.3561	2.4771	1.0122	2.4771	0.9901	2.4771	0.8519	2.4771	0.719	2.4771	0.6283
2.595	3.1044	2.595	1.3561	2.595	1.0122	2.595	0.9901	2.595	0.8519	2.595	0.7497	2.595	0.6688
2.7186	3.1044	2.7186	1.4793	2.7186	1.2977	2.7186	1.1587	2.7186	1.0446	2.7186	0.8675	2.7186	0.7137
2.848	3.1044	2.848	1.5392	2.848	1.349	2.848	1.1927	2.848	1.0583	2.848	0.8783	2.848	0.7856
2.9836	3.2341	2.9836	1.714	2.9836	1.407	2.9836	1.1927	2.9836	1.0583	2.9836	0.8783	2.9836	0.8371
3.1257	3.2341	3.1257	1.714	3.1257	1.407	3.1257	1.1927	3.1257	1.0583	3.1257	0.8783	3.1257	0.8371
3.2745	3.2341	3.2745	1.714	3.2745	1.407	3.2745	1.1927	3.2745	1.0583	3.2745	0.8783	3.2745	0.8371
3.4305	3.2341	3.4305	1.714	3.4305	1.407	3.4305	1.1927	3.4305	1.0583	3.4305	0.8783	3.4305	0.8371
3.5938	3.2341	3.5938	1.714	3.5938	1.407	3.5938	1.1927	3.5938	1.0583	3.5938	0.8783	3.5938	0.8371
3.7649	3.1962	3.7649	1.714	3.7649	1.407	3.7649	1.1927	3.7649	1.0583	3.7649	0.8783	3.7649	0.823
3.9442	1.8572	3.9442	1.3131	3.9442	1.1798	3.9442	1.0801	3.9442	0.9935	3.9442	0.8783	3.9442	0.7625
4.132	1.3859	4.132	1.1101	4.132	1.0059	4.132	0.9267	4.132	0.8638	4.132	0.7879	4.132	0.7016
4.3288	1.4004	4.3288	1.01	4.3288	0.9193	4.3288	0.8523	4.3288	0.7981	4.3288	0.7074	4.3288	0.644
4.5349	1.453	4.5349	1.0165	4.5349	0.9043	4.5349	0.8298	4.5349	0.7728	4.5349	0.702	4.5349	0.6353
4.7508	1.453	4.7508	1.0165	4.7508	0.9043	4.7508	0.8298	4.7508	0.7728	4.7508	0.702	4.7508	0.6353
4.977	1.453	4.977	1.0527	4.977	0.9446	4.977	0.8574	4.977	0.7946	4.977	0.7059	4.977	0.6353
5.214	1.5622	5.214	1.1002	5.214	1.013	5.214	0.934	5.214	0.8657	5.214	0.7586	5.214	0.6576
5.4623	1.9198	5.4623	1.1825	5.4623	1.0375	5.4623	0.9404	5.4623	0.8658	5.4623	0.7636	5.4623	0.6822
5.7224	2.1413	5.7224	1.2391	5.7224	1.0781	5.7224	0.9658	5.7224	0.9004	5.7224	0.8178	5.7224	0.7373
5.9948	2.1413	5.9948	1.2391	5.9948	1.0821	5.9948	0.9888	5.9948	0.9125	5.9948	0.8549	5.9948	0.8006
6.2803	2.1413	6.2803	1.4291	6.2803	1.2694	6.2803	1.1734	6.2803	1.1115	6.2803	1.0135	6.2803	0.8904
6.5793	2.8254	6.5793	1.6044	6.5793	1.4817	6.5793	1.3887	6.5793	1.3019	6.5793	1.1439	6.5793	1.0139
6.8926	4.5401	6.8926	2.3318	6.8926	1.8873	6.8926	1.6445	6.8926	1.502	6.8926	1.2963	6.8926	1.1085
7.2208	4.6887	7.2208	2.5167	7.2208	2.0952	7.2208	1.8287	7.2208	1.663	7.2208	1.4026	7.2208	1.1658
7.5646	4.6887	7.5646	2.633	7.5646	2.1261	7.5646	1.9026	7.5646	1.7092	7.5646	1.5057	7.5646	1.2197
7.9248	4.6887	7.9248	2.633	7.9248	2.1261	7.9248	1.9026	7.9248	1.7092	7.9248	1.5186	7.9248	1.2293
8.3022	4.6887	8.3022	2.633	8.3022	2.2308	8.3022	1.9713	8.3022	1.7431	8.3022	1.5994	8.3022	1.2573
8.6975	4.7522	8.6975	2.633	8.6975	2.2308	8.6975	1.9713	8.6975	1.7431	8.6975	1.6517	8.6975	1.3022
9.1116	4.7522	9.1116	2.633	9.1116	2.2308	9.1116	1.9713	9.1116	1.7431	9.1116	1.6517	9.1116	1.3022
9.5455	4.7522	9.5455	2.633	9.5455	2.2308	9.5455	1.9713	9.5455	1.7431	9.5455	1.6517	9.5455	1.3022
10	4.7522	10	2.633	10	2.2308	10	1.9713	10	1.7431	10	1.6517	10	1.3022
10.4762	4.7522	10.4762	2.633	10.4762	2.2308	10.4762	1.9713	10.4762	1.7431	10.4762	1.6517	10.4762	1.3022
10.975	4.7522	10.975	2.7198	10.975	2.3406	10.975	2.0833	10.975	1.8722	10.975	1.5448	10.975	1.3465
11.4976	6.3932	11.4976	3.0713	11.4976	2.4592	11.4976	2.0954	11.4976	1.8722	11.4976	1.5448	11.4976	1.436
12.045	6.3932	12.045	3.0713	12.045	2.4592	12.045	2.0954	12.045	1.8722	12.045	1.5448	12.045	1.436
12.6186	6.3932	12.6186	3.0713	12.6186	2.4592	12.6186	2.0954	12.6186	1.8722	12.6186	1.5448	12.6186	1.436
13.2194	6.3932	13.2194	3.0713	13.2194	2.4592	13.2194	2.0954	13.2194	1.8722	13.2194	1.5448	13.2194	1.436
13.8489	6.3932	13.8489	3.0713	13.8489	2.4592	13.8489	2.0954	13.8489	1.8722	13.8489	1.5448	13.8489	1.436

14.5083	6.2879	14.5083	3.0713	14.5083	2.4592	14.5083	2.0954	14.5083	1.8722	14.5083	1.5448	14.5083	1.4308
15.1991	6.1979	15.1991	2.9655	15.1991	2.4592	15.1991	2.0954	15.1991	1.8722	15.1991	1.5448	15.1991	1.4308
15.9228	3.8738	15.9228	2.2164	15.9228	2.0844	15.9228	1.922	15.9228	1.7933	15.9228	1.5448	15.9228	1.3311
16.681	3.4691	16.681	1.8084	16.681	1.6216	16.681	1.4892	16.681	1.3822	16.681	1.2458	16.681	1.1088
17.4753	3.4691	17.4753	1.8784	17.4753	1.4303	17.4753	1.3119	17.4753	1.2584	17.4753	1.0884	17.4753	0.932
18.3074	2.6063	18.3074	1.5361	18.3074	1.3831	18.3074	1.2784	18.3074	1.1859	18.3074	1.0285	18.3074	0.874
19.1791	2.6063	19.1791	1.3209	19.1791	1.1588	19.1791	1.0576	19.1791	0.9944	19.1791	0.9231	19.1791	0.8367
20.0923	1.5805	20.0923	1.1546	20.0923	1.0136	20.0923	0.9361	20.0923	0.8832	20.0923	0.8312	20.0923	0.7647
21.049	1.3004	21.049	0.8944	21.049	0.8148	21.049	0.7857	21.049	0.758	21.049	0.7323	21.049	0.7132
22.0513	0.9281	22.0513	0.8029	22.0513	0.7675	22.0513	0.7403	22.0513	0.7306	22.0513	0.7155	22.0513	0.6984
23.1013	0.7455	23.1013	0.7175	23.1013	0.7113	23.1013	0.7103	23.1013	0.7074	23.1013	0.6997	23.1013	0.687
24.2013	0.7455	24.2013	0.7175	24.2013	0.7063	24.2013	0.6988	24.2013	0.6932	24.2013	0.6846	24.2013	0.6737
25.3536	0.7105	25.3536	0.6836	25.3536	0.6748	25.3536	0.6729	25.3536	0.6722	25.3536	0.6681	25.3536	0.6599
26.5609	0.7105	26.5609	0.6836	26.5609	0.6748	26.5609	0.6686	26.5609	0.6637	26.5609	0.658	26.5609	0.6468
27.8256	0.6713	27.8256	0.6593	27.8256	0.654	27.8256	0.6496	27.8256	0.6459	27.8256	0.6395	27.8256	0.632
29.1505	0.6193	29.1505	0.6233	29.1505	0.6233	29.1505	0.6227	29.1505	0.6218	29.1505	0.6196	29.1505	0.6158
30.5386	0.6069	30.5386	0.5987	30.5386	0.601	30.5386	0.602	30.5386	0.6025	30.5386	0.6024	30.5386	0.6011
31.9927	0.6069	31.9927	0.5931	31.9927	0.5907	31.9927	0.5898	31.9927	0.5896	31.9927	0.5894	31.9927	0.589
33.516	0.5732	33.516	0.5757	33.516	0.5772	33.516	0.5781	33.516	0.5787	33.516	0.5792	33.516	0.5793
35.1119	0.5711	35.1119	0.5711	35.1119	0.5711	35.1119	0.5712	35.1119	0.5713	35.1119	0.5715	35.1119	0.5715
36.7838	0.5654	36.7838	0.5653	36.7838	0.5653	36.7838	0.5653	36.7838	0.5652	36.7838	0.5652	36.7838	0.565
38.5353	0.5598	38.5353	0.5598	38.5353	0.5598	38.5353	0.5597	38.5353	0.5597	38.5353	0.5596	38.5353	0.5594
40.3702	0.5548	40.3702	0.5547	40.3702	0.5547	40.3702	0.5546	40.3702	0.5546	40.3702	0.5545	40.3702	0.5544
42.2924	0.5501	42.2924	0.5501	42.2924	0.55	42.2924	0.55	42.2924	0.55	42.2924	0.5499	42.2924	0.5498
44.3062	0.5458	44.3062	0.5458	44.3062	0.5458	44.3062	0.5458	44.3062	0.5458	44.3062	0.5457	44.3062	0.5457
46.4159	0.5419	46.4159	0.5419	46.4159	0.5419	46.4159	0.5419	46.4159	0.5419	46.4159	0.5419	46.4159	0.5419
48.626	0.5382	48.626	0.5382	48.626	0.5382	48.626	0.5382	48.626	0.5383	48.626	0.5383	48.626	0.5384
50.9414	0.5347	50.9414	0.5347	50.9414	0.5348	50.9414	0.5348	50.9414	0.5348	50.9414	0.5349	50.9414	0.5351

RPP-WTP Pretreatment Facility ISRS  
Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTWW040.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-SOC-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 40  
 SLAB-WALL JOINT East-West Responses  
 Elevation 54 Ft.  
 Line 30 & B

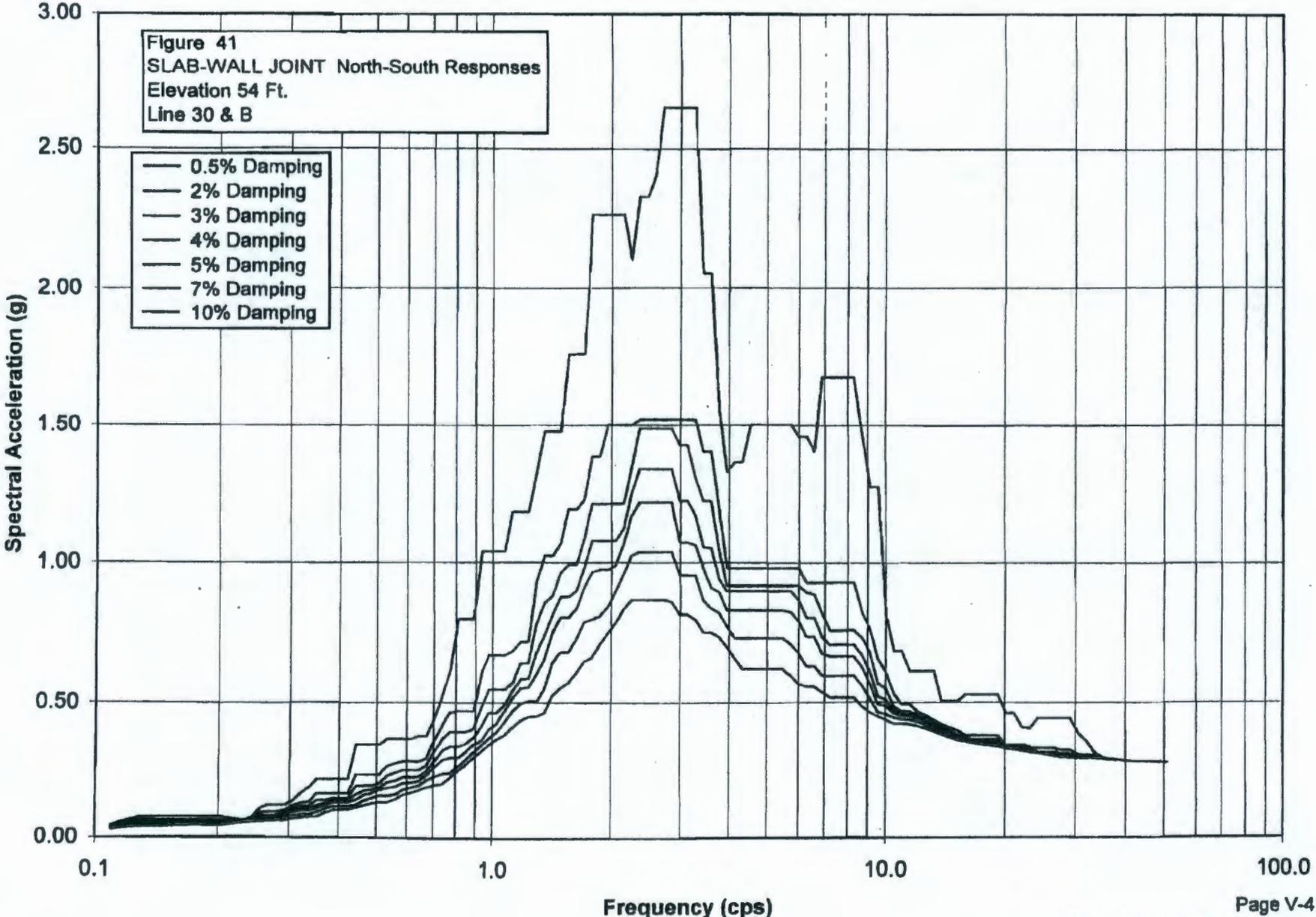
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0314	0.1098	0.0288	0.1098	0.0276	0.1098	0.0288	0.1098	0.0261	0.1098	0.0248	0.1098	0.0232
0.115	0.0359	0.115	0.033	0.115	0.0315	0.115	0.0301	0.115	0.029	0.115	0.0275	0.115	0.0253
0.1204	0.041	0.1204	0.0383	0.1204	0.0367	0.1204	0.0353	0.1204	0.034	0.1204	0.0316	0.1204	0.0287
0.1262	0.046	0.1262	0.0427	0.1262	0.0407	0.1262	0.0389	0.1262	0.0372	0.1262	0.0344	0.1262	0.0312
0.1322	0.0489	0.1322	0.0442	0.1322	0.0421	0.1322	0.0403	0.1322	0.0385	0.1322	0.0356	0.1322	0.0321
0.1385	0.0518	0.1385	0.0463	0.1385	0.0431	0.1385	0.0403	0.1385	0.0385	0.1385	0.0356	0.1385	0.0321
0.1451	0.0518	0.1451	0.0463	0.1451	0.0431	0.1451	0.0403	0.1451	0.0385	0.1451	0.0356	0.1451	0.0321
0.152	0.0518	0.152	0.0463	0.152	0.0431	0.152	0.0403	0.152	0.0385	0.152	0.0356	0.152	0.0321
0.1592	0.0518	0.1592	0.0463	0.1592	0.0431	0.1592	0.0403	0.1592	0.0385	0.1592	0.0356	0.1592	0.0325
0.1668	0.0518	0.1668	0.0463	0.1668	0.0431	0.1668	0.0403	0.1668	0.0384	0.1668	0.0362	0.1668	0.0352
0.1748	0.0518	0.1748	0.0463	0.1748	0.0431	0.1748	0.041	0.1748	0.0404	0.1748	0.0394	0.1748	0.0379
0.1831	0.0518	0.1831	0.0463	0.1831	0.0455	0.1831	0.0447	0.1831	0.044	0.1831	0.0426	0.1831	0.0406
0.1918	0.0522	0.1918	0.0505	0.1918	0.0496	0.1918	0.0486	0.1918	0.0476	0.1918	0.0458	0.1918	0.0437
0.2009	0.057	0.2009	0.0549	0.2009	0.0536	0.2009	0.0525	0.2009	0.0514	0.2009	0.0497	0.2009	0.0474
0.2105	0.0707	0.2105	0.06	0.2105	0.0586	0.2105	0.0574	0.2105	0.0562	0.2105	0.054	0.2105	0.0516
0.2205	0.0909	0.2205	0.0714	0.2205	0.0643	0.2205	0.0624	0.2205	0.061	0.2205	0.0586	0.2205	0.0558
0.231	0.1079	0.231	0.0907	0.231	0.0814	0.231	0.0735	0.231	0.0674	0.231	0.0631	0.231	0.0595
0.242	0.1196	0.242	0.0993	0.242	0.0884	0.242	0.0793	0.242	0.0715	0.242	0.0667	0.242	0.0622
0.2535	0.1204	0.2535	0.0993	0.2535	0.0884	0.2535	0.0797	0.2535	0.0755	0.2535	0.0695	0.2535	0.0659
0.2656	0.1204	0.2656	0.0993	0.2656	0.0924	0.2656	0.0881	0.2656	0.0841	0.2656	0.0771	0.2656	0.0687
0.2783	0.1255	0.2783	0.1097	0.2783	0.1009	0.2783	0.095	0.2783	0.0907	0.2783	0.0835	0.2783	0.0755
0.2915	0.1425	0.2915	0.1248	0.2915	0.1148	0.2915	0.106	0.2915	0.0982	0.2915	0.0888	0.2915	0.0813
0.3054	0.1425	0.3054	0.1248	0.3054	0.1152	0.3054	0.1069	0.3054	0.0996	0.3054	0.0909	0.3054	0.0841
0.3199	0.1425	0.3199	0.1248	0.3199	0.1152	0.3199	0.1069	0.3199	0.0996	0.3199	0.0909	0.3199	0.0846
0.3352	0.1711	0.3352	0.1346	0.3352	0.1186	0.3352	0.1069	0.3352	0.0996	0.3352	0.0909	0.3352	0.0846
0.3511	0.2173	0.3511	0.163	0.3511	0.137	0.3511	0.117	0.3511	0.1079	0.3511	0.0933	0.3511	0.0846
0.3678	0.2401	0.3678	0.1757	0.3678	0.1531	0.3678	0.1395	0.3678	0.1276	0.3678	0.108	0.3678	0.0887

0.3853	0.2401	0.3853	0.1803	0.3853	0.1622	0.3853	0.1467	0.3853	0.1335	0.3853	0.1124	0.3853	0.0952
0.4037	0.2401	0.4037	0.1853	0.4037	0.1651	0.4037	0.1483	0.4037	0.1343	0.4037	0.1165	0.4037	0.0996
0.4229	0.2401	0.4229	0.1853	0.4229	0.1651	0.4229	0.1497	0.4229	0.1382	0.4229	0.1221	0.4229	0.1054
0.4431	0.2696	0.4431	0.1872	0.4431	0.1712	0.4431	0.1571	0.4431	0.1447	0.4431	0.1242	0.4431	0.1054
0.4642	0.2696	0.4642	0.1963	0.4642	0.179	0.4642	0.1637	0.4642	0.1503	0.4642	0.1279	0.4642	0.1174
0.4863	0.2696	0.4863	0.2048	0.4863	0.1795	0.4863	0.1637	0.4863	0.1503	0.4863	0.1396	0.4863	0.1334
0.5094	0.3933	0.5094	0.2804	0.5094	0.2339	0.5094	0.2007	0.5094	0.1759	0.5094	0.1597	0.5094	0.1486
0.5337	0.498	0.5337	0.3467	0.5337	0.2831	0.5337	0.2394	0.5337	0.2126	0.5337	0.1766	0.5337	0.1593
0.5591	0.498	0.5591	0.3467	0.5591	0.2831	0.5591	0.2394	0.5591	0.2172	0.5591	0.1895	0.5591	0.1611
0.5857	0.498	0.5857	0.3467	0.5857	0.2831	0.5857	0.2394	0.5857	0.2172	0.5857	0.1895	0.5857	0.168
0.6136	0.498	0.6136	0.3467	0.6136	0.2855	0.6136	0.2597	0.6136	0.2392	0.6136	0.2082	0.6136	0.177
0.6428	0.5118	0.6428	0.3731	0.6428	0.3183	0.6428	0.2805	0.6428	0.2523	0.6428	0.2127	0.6428	0.177
0.6734	0.5118	0.6734	0.3731	0.6734	0.3247	0.6734	0.2958	0.6734	0.2722	0.6734	0.2359	0.6734	0.198
0.7055	0.5118	0.7055	0.3731	0.7055	0.3247	0.7055	0.2958	0.7055	0.2722	0.7055	0.2359	0.7055	0.2086
0.7391	0.5118	0.7391	0.3731	0.7391	0.3247	0.7391	0.2958	0.7391	0.2722	0.7391	0.2389	0.7391	0.2175
0.7743	0.5271	0.7743	0.3892	0.7743	0.3374	0.7743	0.3002	0.7743	0.2812	0.7743	0.2528	0.7743	0.2292
0.8111	0.5842	0.8111	0.3905	0.8111	0.3524	0.8111	0.3253	0.8111	0.3077	0.8111	0.2782	0.8111	0.2429
0.8497	0.5842	0.8497	0.4479	0.8497	0.4022	0.8497	0.367	0.8497	0.3388	0.8497	0.2955	0.8497	0.2503
0.8902	0.5842	0.8902	0.4479	0.8902	0.4022	0.8902	0.367	0.8902	0.3388	0.8902	0.2955	0.8902	0.2503
0.9326	0.8993	0.9326	0.6068	0.9326	0.5069	0.9326	0.4394	0.9326	0.3909	0.9326	0.3258	0.9326	0.2677
0.977	0.8993	0.977	0.6068	0.977	0.507	0.977	0.4543	0.977	0.4088	0.977	0.3406	0.977	0.2841
1.0235	0.8993	1.0235	0.6068	1.0235	0.507	1.0235	0.4543	1.0235	0.4088	1.0235	0.3568	1.0235	0.3084
1.0723	0.8993	1.0723	0.6169	1.0723	0.5581	1.0723	0.5126	1.0723	0.4775	1.0723	0.4206	1.0723	0.3593
1.1233	1.1503	1.1233	0.6989	1.1233	0.6146	1.1233	0.567	1.1233	0.5246	1.1233	0.4637	1.1233	0.4009
1.1768	1.1503	1.1768	0.7013	1.1768	0.6177	1.1768	0.5745	1.1768	0.5387	1.1768	0.4887	1.1768	0.4328
1.2328	1.1503	1.2328	0.7602	1.2328	0.676	1.2328	0.6069	1.2328	0.5619	1.2328	0.5151	1.2328	0.4624
1.2916	1.4069	1.2916	0.9112	1.2916	0.7748	1.2916	0.6655	1.2916	0.6075	1.2916	0.5495	1.2916	0.4943
1.353	1.4069	1.353	0.9854	1.353	0.8366	1.353	0.7197	1.353	0.6331	1.353	0.5865	1.353	0.5282
1.4175	1.4069	1.4175	0.9854	1.4175	0.8366	1.4175	0.7197	1.4175	0.6602	1.4175	0.6163	1.4175	0.5576
1.485	1.4069	1.485	0.9854	1.485	0.8366	1.485	0.7197	1.485	0.6898	1.485	0.6458	1.485	0.5873
1.5557	1.4069	1.5557	0.9854	1.5557	0.8366	1.5557	0.7629	1.5557	0.7329	1.5557	0.6815	1.5557	0.6151
1.6298	1.6681	1.6298	1.0205	1.6298	0.8966	1.6298	0.82	1.6298	0.7642	1.6298	0.7076	1.6298	0.6389
1.7074	1.6681	1.7074	1.0205	1.7074	0.9046	1.7074	0.8499	1.7074	0.8016	1.7074	0.7204	1.7074	0.6548
1.7887	2.0604	1.7887	1.1768	1.7887	1.1373	1.7887	0.99	1.7887	0.8859	1.7887	0.7382	1.7887	0.6673
1.8738	2.0604	1.8738	1.1768	1.8738	1.1373	1.8738	0.99	1.8738	0.8859	1.8738	0.7686	1.8738	0.6934
1.963	2.0604	1.963	1.1768	1.963	1.1373	1.963	0.99	1.963	0.8859	1.963	0.7926	1.963	0.7145
2.0565	2.0604	2.0565	1.1768	2.0565	1.1373	2.0565	0.99	2.0565	0.8859	2.0565	0.8132	2.0565	0.7272
2.1544	2.0604	2.1544	1.1768	2.1544	1.1373	2.1544	0.99	2.1544	0.9184	2.1544	0.829	2.1544	0.7272
2.257	1.7622	2.257	1.1768	2.257	1.1373	2.257	0.99	2.257	0.9184	2.257	0.829	2.257	0.7272

2.3645	1.801	2.3645	1.1855	2.3645	1.1373	2.3645	0.99	2.3645	0.9184	2.3645	0.829	2.3645	0.7272
2.4771	1.801	2.4771	1.2722	2.4771	1.1373	2.4771	0.99	2.4771	0.9184	2.4771	0.829	2.4771	0.7436
2.595	1.801	2.595	1.291	2.595	1.1373	2.595	0.99	2.595	0.9184	2.595	0.8354	2.595	0.7711
2.7186	1.801	2.7186	1.291	2.7186	1.1373	2.7186	0.99	2.7186	0.9314	2.7186	0.8739	2.7186	0.802
2.848	1.801	2.848	1.291	2.848	1.1373	2.848	1.0306	2.848	0.9834	2.848	0.9097	2.848	0.8289
2.9836	1.7695	2.9836	1.291	2.9836	1.1373	2.9836	1.0306	2.9836	0.9834	2.9836	0.919	2.9836	0.8422
3.1257	1.7695	3.1257	1.3084	3.1257	1.1422	3.1257	1.0306	3.1257	0.9834	3.1257	0.9212	3.1257	0.8511
3.2745	1.7695	3.2745	1.3427	3.2745	1.2702	3.2745	1.1405	3.2745	1.0295	3.2745	0.9272	3.2745	0.8631
3.4305	1.9605	3.4305	1.3427	3.4305	1.315	3.4305	1.1822	3.4305	1.0726	3.4305	0.9512	3.4305	0.8756
3.5938	2.186	3.5938	1.3427	3.5938	1.315	3.5938	1.1822	3.5938	1.0726	3.5938	0.9875	3.5938	0.9006
3.7649	2.186	3.7649	1.3427	3.7649	1.315	3.7649	1.1822	3.7649	1.0784	3.7649	0.9958	3.7649	0.9115
3.9442	2.186	3.9442	1.3427	3.9442	1.315	3.9442	1.1822	3.9442	1.0784	3.9442	1.0054	3.9442	0.9143
4.132	2.186	4.132	1.3797	4.132	1.315	4.132	1.1822	4.132	1.0784	4.132	1.0098	4.132	0.9215
4.3288	2.186	4.3288	1.3797	4.3288	1.315	4.3288	1.1822	4.3288	1.117	4.3288	1.0287	4.3288	0.9239
4.5349	2.186	4.5349	1.4477	4.5349	1.3442	4.5349	1.3252	4.5349	1.2251	4.5349	1.0703	4.5349	0.9239
4.7508	2.186	4.7508	1.4477	4.7508	1.3442	4.7508	1.3252	4.7508	1.2251	4.7508	1.0703	4.7508	0.9239
4.977	2.186	4.977	1.4477	4.977	1.3442	4.977	1.3252	4.977	1.2251	4.977	1.0703	4.977	0.9239
5.214	2.186	5.214	1.4477	5.214	1.3442	5.214	1.3252	5.214	1.2251	5.214	1.0703	5.214	0.9239
5.4623	2.129	5.4623	1.4477	5.4623	1.3442	5.4623	1.3252	5.4623	1.2251	5.4623	1.0703	5.4623	0.9141
5.7224	2.129	5.7224	1.4477	5.7224	1.3442	5.7224	1.3243	5.7224	1.2019	5.7224	1.0271	5.7224	0.8812
5.9948	2.0602	5.9948	1.2614	5.9948	1.2227	5.9948	1.1692	5.9948	1.1126	5.9948	1.0071	5.9948	0.8812
6.2803	2.0602	6.2803	1.2213	6.2803	1.1509	6.2803	1.0945	6.2803	1.0449	6.2803	0.9577	6.2803	0.8515
6.5793	2.0602	6.5793	1.1878	6.5793	1.0824	6.5793	1.0377	6.5793	0.9937	6.5793	0.9148	6.5793	0.818
6.8926	2.0602	6.8926	1.1162	6.8926	1.0351	6.8926	0.9782	6.8926	0.9346	6.8926	0.8642	6.8926	0.7799
7.2208	2.0602	7.2208	1.107	7.2208	0.9906	7.2208	0.9262	7.2208	0.8836	7.2208	0.813	7.2208	0.7283
7.5646	2.0602	7.5646	1.107	7.5646	0.9906	7.5646	0.9195	7.5646	0.8594	7.5646	0.7912	7.5646	0.7084
7.9248	2.0602	7.9248	1.107	7.9248	0.9536	7.9248	0.8812	7.9248	0.8301	7.9248	0.758	7.9248	0.6785
8.3022	1.7636	8.3022	1.0601	8.3022	0.8626	8.3022	0.7767	8.3022	0.7243	8.3022	0.6848	8.3022	0.6279
8.6975	1.3385	8.6975	0.8395	8.6975	0.7398	8.6975	0.6985	8.6975	0.6715	8.6975	0.6369	8.6975	0.5912
9.1116	1.0611	9.1116	0.798	9.1116	0.7367	9.1116	0.6899	9.1116	0.6522	9.1116	0.5945	9.1116	0.5436
9.5455	1.0611	9.5455	0.7201	9.5455	0.655	9.5455	0.6244	9.5455	0.5998	9.5455	0.5597	9.5455	0.5149
10	0.8759	10	0.8206	10	0.5593	10	0.5358	10	0.516	10	0.493	10	0.4751
10.4762	0.841	10.4762	0.5804	10.4762	0.542	10.4762	0.5187	10.4762	0.5008	10.4762	0.4787	10.4762	0.4612
10.975	0.7327	10.975	0.5804	10.975	0.542	10.975	0.5187	10.975	0.5008	10.975	0.4787	10.975	0.4612
11.4976	0.7327	11.4976	0.5804	11.4976	0.542	11.4976	0.5187	11.4976	0.5008	11.4976	0.4753	11.4976	0.4513
12.045	0.6827	12.045	0.5648	12.045	0.5078	12.045	0.4909	12.045	0.4782	12.045	0.4588	12.045	0.4391
12.6186	0.6827	12.6186	0.5648	12.6186	0.5078	12.6186	0.4736	12.6186	0.4502	12.6186	0.4326	12.6186	0.4147
13.2194	0.6534	13.2194	0.5648	13.2194	0.5078	13.2194	0.4736	13.2194	0.4502	13.2194	0.4326	13.2194	0.414
13.8489	0.6877	13.8489	0.5648	13.8489	0.5078	13.8489	0.4736	13.8489	0.4502	13.8489	0.4326	13.8489	0.414

14.5083	0.6877	14.5083	0.5648	14.5083	0.5078	14.5083	0.4736	14.5083	0.4502	14.5083	0.4326	14.5083	0.414
15.1991	0.6877	15.1991	0.5648	15.1991	0.5078	15.1991	0.4736	15.1991	0.4502	15.1991	0.4326	15.1991	0.414
15.9228	0.7918	15.9228	0.5648	15.9228	0.5078	15.9228	0.4736	15.9228	0.4502	15.9228	0.4326	15.9228	0.414
16.681	0.7918	16.681	0.5648	16.681	0.5078	16.681	0.4736	16.681	0.4502	16.681	0.4326	16.681	0.414
17.4753	0.8433	17.4753	0.5648	17.4753	0.5078	17.4753	0.4736	17.4753	0.4502	17.4753	0.4326	17.4753	0.414
18.3074	0.8433	18.3074	0.5648	18.3074	0.5078	18.3074	0.4736	18.3074	0.4502	18.3074	0.4326	18.3074	0.414
19.1791	0.9548	19.1791	0.5648	19.1791	0.5078	19.1791	0.4778	19.1791	0.4579	19.1791	0.4326	19.1791	0.414
20.0923	0.9548	20.0923	0.5648	20.0923	0.5078	20.0923	0.4778	20.0923	0.4579	20.0923	0.4326	20.0923	0.414
21.049	0.9548	21.049	0.5648	21.049	0.5078	21.049	0.4778	21.049	0.4579	21.049	0.4326	21.049	0.414
22.0513	0.9548	22.0513	0.5648	22.0513	0.5078	22.0513	0.4778	22.0513	0.4579	22.0513	0.4326	22.0513	0.414
23.1013	0.9548	23.1013	0.5648	23.1013	0.5078	23.1013	0.4778	23.1013	0.4579	23.1013	0.4326	23.1013	0.4127
24.2013	0.8433	24.2013	0.5648	24.2013	0.5052	24.2013	0.468	24.2013	0.444	24.2013	0.4282	24.2013	0.4127
25.3536	0.6913	25.3536	0.4652	25.3536	0.4529	25.3536	0.4436	25.3536	0.4358	25.3536	0.4238	25.3536	0.4112
26.5609	0.6913	26.5609	0.4542	26.5609	0.4319	26.5609	0.42	26.5609	0.4138	26.5609	0.4069	26.5609	0.401
27.8256	0.6242	27.8256	0.4234	27.8256	0.4002	27.8256	0.3941	27.8256	0.3925	27.8256	0.3903	27.8256	0.389
29.1505	0.4776	29.1505	0.4074	29.1505	0.4002	29.1505	0.3941	29.1505	0.3925	29.1505	0.3903	29.1505	0.3881
30.5386	0.4776	30.5386	0.3989	30.5386	0.3961	30.5386	0.3941	30.5386	0.3925	30.5386	0.3903	30.5386	0.3881
31.9927	0.4776	31.9927	0.3989	31.9927	0.3961	31.9927	0.3941	31.9927	0.3925	31.9927	0.3903	31.9927	0.3881
33.516	0.4046	33.516	0.3989	33.516	0.3961	33.516	0.3941	33.516	0.3925	33.516	0.3903	33.516	0.3881
35.1119	0.3927	35.1119	0.392	35.1119	0.3914	35.1119	0.3907	35.1119	0.39	35.1119	0.3887	35.1119	0.3871
36.7838	0.3877	36.7838	0.3875	36.7838	0.3873	36.7838	0.3871	36.7838	0.3868	36.7838	0.3862	36.7838	0.3852
38.5353	0.3846	38.5353	0.3845	38.5353	0.3844	38.5353	0.3843	38.5353	0.3842	38.5353	0.3839	38.5353	0.3834
40.3702	0.3824	40.3702	0.3823	40.3702	0.3823	40.3702	0.3822	40.3702	0.3821	40.3702	0.382	40.3702	0.3817
42.2924	0.3807	42.2924	0.3807	42.2924	0.3807	42.2924	0.3806	42.2924	0.3806	42.2924	0.3805	42.2924	0.3803
44.3062	0.3794	44.3062	0.3794	44.3062	0.3793	44.3062	0.3793	44.3062	0.3793	44.3062	0.3792	44.3062	0.3791
46.4159	0.3782	46.4159	0.3782	46.4159	0.3782	46.4159	0.3782	46.4159	0.3782	46.4159	0.3781	46.4159	0.3781
48.626	0.3772	48.626	0.3772	48.626	0.3772	48.626	0.3772	48.626	0.3772	48.626	0.3772	48.626	0.3772
50.9414	0.3762	50.9414	0.3762	50.9414	0.3762	50.9414	0.3762	50.9414	0.3762	50.9414	0.3763	50.9414	0.3763

RPP-WTP Pretreatment Facility ISRS  
Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTWW041.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-SDC-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 41  
 SLAB-WALL JOINT North-South Responses  
 Elevation 54 Ft.  
 Line 30 & B

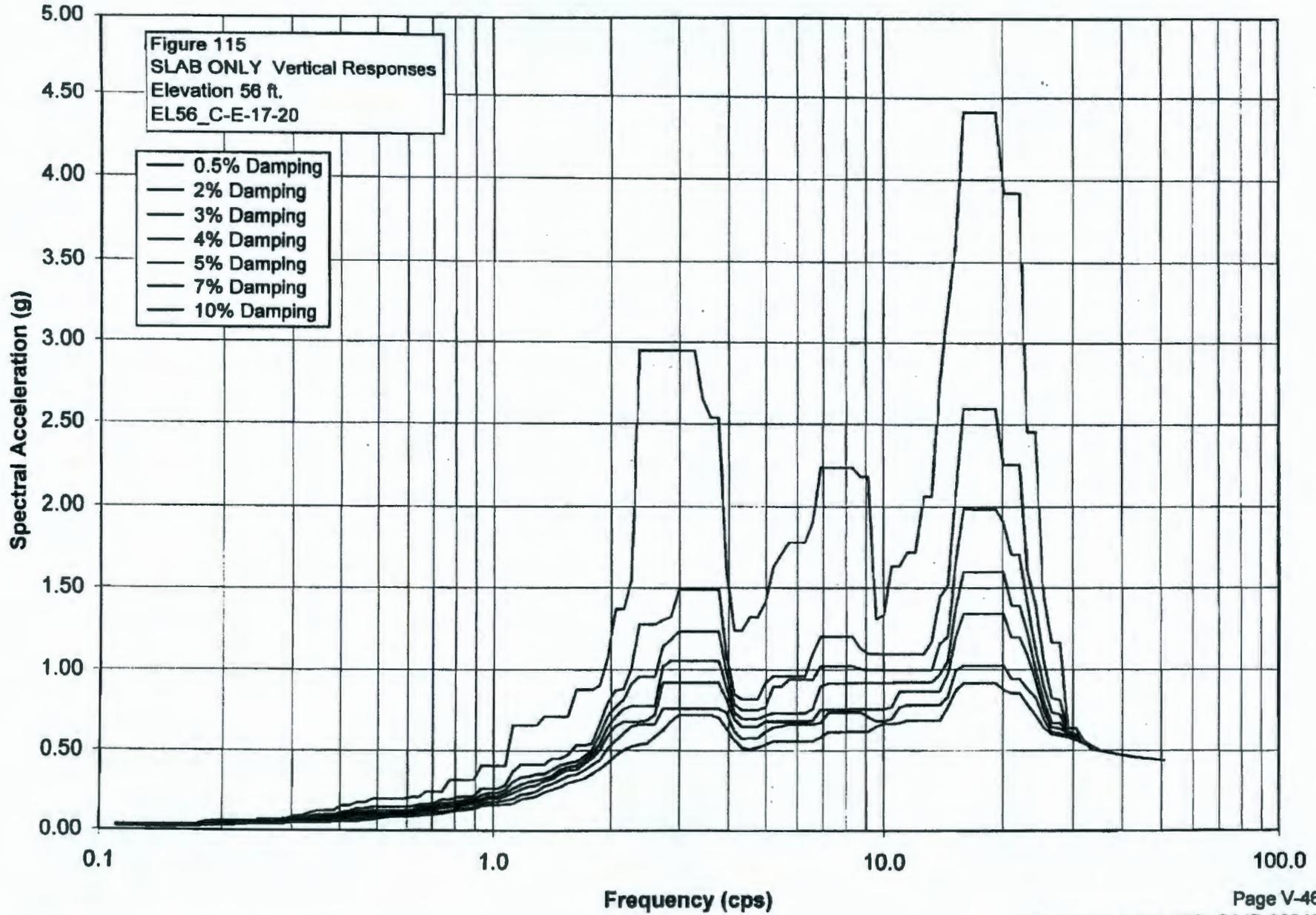
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0457	0.1098	0.0394	0.1098	0.0365	0.1098	0.0344	0.1098	0.0329	0.1098	0.031	0.1098	0.0285
0.115	0.0556	0.115	0.0493	0.115	0.0465	0.115	0.0441	0.115	0.042	0.115	0.0383	0.115	0.0337
0.1204	0.0648	0.1204	0.0582	0.1204	0.0545	0.1204	0.0512	0.1204	0.0481	0.1204	0.0428	0.1204	0.0364
0.1262	0.0719	0.1262	0.0618	0.1262	0.0572	0.1262	0.0533	0.1262	0.0498	0.1262	0.0438	0.1262	0.0381
0.1322	0.0763	0.1322	0.0654	0.1322	0.0603	0.1322	0.0564	0.1322	0.0528	0.1322	0.0469	0.1322	0.0402
0.1385	0.0787	0.1385	0.0673	0.1385	0.0608	0.1385	0.0564	0.1385	0.0528	0.1385	0.0469	0.1385	0.0402
0.1451	0.079	0.1451	0.0676	0.1451	0.0613	0.1451	0.0564	0.1451	0.0528	0.1451	0.0469	0.1451	0.041
0.152	0.079	0.152	0.0676	0.152	0.0613	0.152	0.0568	0.152	0.0538	0.152	0.0486	0.152	0.043
0.1592	0.079	0.1592	0.0676	0.1592	0.0613	0.1592	0.0568	0.1592	0.0538	0.1592	0.0489	0.1592	0.0439
0.1668	0.079	0.1668	0.0676	0.1668	0.0613	0.1668	0.0568	0.1668	0.0538	0.1668	0.0489	0.1668	0.0439
0.1748	0.079	0.1748	0.0676	0.1748	0.0613	0.1748	0.0568	0.1748	0.0538	0.1748	0.0489	0.1748	0.0439
0.1831	0.0788	0.1831	0.0675	0.1831	0.0612	0.1831	0.0568	0.1831	0.0538	0.1831	0.0489	0.1831	0.0439
0.1918	0.0788	0.1918	0.0675	0.1918	0.0612	0.1918	0.0564	0.1918	0.0533	0.1918	0.0489	0.1918	0.0439
0.2009	0.0788	0.2009	0.0675	0.2009	0.0612	0.2009	0.0564	0.2009	0.0533	0.2009	0.0481	0.2009	0.0439
0.2105	0.0736	0.2105	0.0633	0.2105	0.0597	0.2105	0.0564	0.2105	0.0533	0.2105	0.0493	0.2105	0.0476
0.2205	0.0686	0.2205	0.0625	0.2205	0.0589	0.2205	0.0562	0.2205	0.0551	0.2205	0.053	0.2205	0.0514
0.231	0.065	0.231	0.0626	0.231	0.0612	0.231	0.0599	0.231	0.0587	0.231	0.0568	0.231	0.0549
0.242	0.0761	0.242	0.069	0.242	0.0652	0.242	0.0634	0.242	0.0622	0.242	0.0602	0.242	0.0579
0.2535	0.1102	0.2535	0.0918	0.2535	0.0826	0.2535	0.0754	0.2535	0.0696	0.2535	0.063	0.2535	0.0602
0.2656	0.122	0.2656	0.0953	0.2656	0.0828	0.2656	0.0754	0.2656	0.0696	0.2656	0.0651	0.2656	0.0619
0.2783	0.122	0.2783	0.0953	0.2783	0.083	0.2783	0.0782	0.2783	0.0741	0.2783	0.0673	0.2783	0.0627
0.2915	0.122	0.2915	0.1008	0.2915	0.0936	0.2915	0.0877	0.2915	0.0822	0.2915	0.073	0.2915	0.0628
0.3054	0.1365	0.3054	0.1184	0.3054	0.1084	0.3054	0.0997	0.3054	0.0924	0.3054	0.0806	0.3054	0.0685
0.3199	0.1648	0.3199	0.128	0.3199	0.1165	0.3199	0.1067	0.3199	0.0983	0.3199	0.085	0.3199	0.0741
0.3352	0.1873	0.3352	0.1328	0.3352	0.1165	0.3352	0.1067	0.3352	0.0983	0.3352	0.086	0.3352	0.0763
0.3511	0.2172	0.3511	0.164	0.3511	0.1388	0.3511	0.1193	0.3511	0.1086	0.3511	0.0923	0.3511	0.0773
0.3678	0.2172	0.3678	0.164	0.3678	0.1388	0.3678	0.1271	0.3678	0.1171	0.3678	0.1047	0.3678	0.0905

0.3853	0.2172	0.3853	0.164	0.3853	0.1459	0.3853	0.1368	0.3853	0.1287	0.3853	0.115	0.3853	0.0996
0.4037	0.2172	0.4037	0.164	0.4037	0.1463	0.4037	0.1375	0.4037	0.1298	0.4037	0.117	0.4037	0.1029
0.4229	0.2182	0.4229	0.1641	0.4229	0.1463	0.4229	0.1375	0.4229	0.1298	0.4229	0.117	0.4229	0.1029
0.4431	0.3455	0.4431	0.2344	0.4431	0.1916	0.4431	0.1609	0.4431	0.1405	0.4431	0.1208	0.4431	0.1103
0.4642	0.3455	0.4642	0.2344	0.4642	0.1934	0.4642	0.1736	0.4642	0.1584	0.4642	0.1369	0.4642	0.1193
0.4863	0.3455	0.4863	0.2344	0.4863	0.1934	0.4863	0.177	0.4863	0.1649	0.4863	0.1477	0.4863	0.1262
0.5094	0.3455	0.5094	0.2344	0.5094	0.2012	0.5094	0.1877	0.5094	0.1764	0.5094	0.1559	0.5094	0.1315
0.5337	0.3666	0.5337	0.2671	0.5337	0.2308	0.5337	0.2055	0.5337	0.1848	0.5337	0.1559	0.5337	0.1315
0.5591	0.3666	0.5591	0.2772	0.5591	0.2405	0.5591	0.2113	0.5591	0.1897	0.5591	0.1599	0.5591	0.1423
0.5857	0.3666	0.5857	0.2841	0.5857	0.2515	0.5857	0.225	0.5857	0.2033	0.5857	0.1786	0.5857	0.1594
0.6136	0.3666	0.6136	0.2841	0.6136	0.2515	0.6136	0.225	0.6136	0.2046	0.6136	0.1877	0.6136	0.1676
0.6428	0.3774	0.6428	0.2841	0.6428	0.2515	0.6428	0.2274	0.6428	0.2104	0.6428	0.1953	0.6428	0.176
0.6734	0.3774	0.6734	0.2961	0.6734	0.2703	0.6734	0.247	0.6734	0.2315	0.6734	0.2128	0.6734	0.1884
0.7055	0.4413	0.7055	0.3627	0.7055	0.3214	0.7055	0.2868	0.7055	0.2641	0.7055	0.2285	0.7055	0.1969
0.7391	0.5276	0.7391	0.4178	0.7391	0.3661	0.7391	0.3241	0.7391	0.2898	0.7391	0.2385	0.7391	0.2005
0.7743	0.6173	0.7743	0.4646	0.7743	0.394	0.7743	0.3401	0.7743	0.2988	0.7743	0.2409	0.7743	0.2247
0.8111	0.7973	0.8111	0.4704	0.8111	0.394	0.8111	0.3401	0.8111	0.2988	0.8111	0.2664	0.8111	0.2497
0.8497	0.7973	0.8497	0.4704	0.8497	0.394	0.8497	0.3512	0.8497	0.3205	0.8497	0.2921	0.8497	0.2739
0.8902	0.7973	0.8902	0.4704	0.8902	0.4056	0.8902	0.3726	0.8902	0.3463	0.8902	0.3184	0.8902	0.2984
0.9326	1.0399	0.9326	0.6123	0.9326	0.4865	0.9326	0.4159	0.9326	0.3635	0.9326	0.3454	0.9326	0.323
0.977	1.0399	0.977	0.6684	0.977	0.5476	0.977	0.4627	0.977	0.4028	0.977	0.3702	0.977	0.3455
1.0235	1.0399	1.0235	0.6684	1.0235	0.5476	1.0235	0.4627	1.0235	0.4229	1.0235	0.392	1.0235	0.3654
1.0723	1.0399	1.0723	0.6684	1.0723	0.5476	1.0723	0.4928	1.0723	0.4701	1.0723	0.4292	1.0723	0.3824
1.1233	1.1837	1.1233	0.6849	1.1233	0.5729	1.1233	0.5438	1.1233	0.5167	1.1233	0.4691	1.1233	0.4109
1.1768	1.1837	1.1768	0.7158	1.1768	0.6407	1.1768	0.5849	1.1768	0.5523	1.1768	0.4973	1.1768	0.4345
1.2328	1.1837	1.2328	0.7158	1.2328	0.6407	1.2328	0.5873	1.2328	0.5559	1.2328	0.5047	1.2328	0.4483
1.2916	1.3266	1.2916	0.9325	1.2916	0.7812	1.2916	0.6768	1.2916	0.6028	1.2916	0.5047	1.2916	0.4505
1.353	1.4769	1.353	1.0249	1.353	0.8548	1.353	0.7373	1.353	0.6541	1.353	0.5499	1.353	0.4641
1.4175	1.4769	1.4175	1.0249	1.4175	0.8809	1.4175	0.812	1.4175	0.7486	1.4175	0.6428	1.4175	0.5261
1.485	1.4769	1.485	1.0686	1.485	0.9633	1.485	0.8764	1.485	0.8018	1.485	0.6797	1.485	0.552
1.5557	1.7563	1.5557	1.1934	1.5557	0.9931	1.5557	0.8764	1.5557	0.8018	1.5557	0.6797	1.5557	0.5711
1.6298	1.7563	1.6298	1.1934	1.6298	0.9931	1.6298	0.8977	1.6298	0.8327	1.6298	0.7258	1.6298	0.6071
1.7074	1.7563	1.7074	1.2286	1.7074	1.0877	1.7074	0.9847	1.7074	0.9112	1.7074	0.7884	1.7074	0.6473
1.7887	2.2656	1.7887	1.3832	1.7887	1.2124	1.7887	1.0788	1.7887	0.9652	1.7887	0.7963	1.7887	0.6615
1.8738	2.2656	1.8738	1.3832	1.8738	1.2124	1.8738	1.0788	1.8738	0.9755	1.8738	0.808	1.8738	0.7066
1.963	2.2656	1.963	1.5008	1.963	1.214	1.963	1.0788	1.963	0.9755	1.963	0.841	1.963	0.747
2.0565	2.2656	2.0565	1.5008	2.0565	1.214	2.0565	1.0788	2.0565	0.9919	2.0565	0.8969	2.0565	0.7833
2.1544	2.2656	2.1544	1.5008	2.1544	1.214	2.1544	1.1255	2.1544	1.089	2.1544	0.9614	2.1544	0.8327
2.257	2.1036	2.257	1.5008	2.257	1.3434	2.257	1.2512	2.257	1.1692	2.257	1.0266	2.257	0.866

2.3645	2.329	2.3645	1.5215	2.3645	1.4885	2.3645	1.3388	2.3645	1.2186	2.3645	1.0385	2.3645	0.866
2.4771	2.329	2.4771	1.5215	2.4771	1.4885	2.4771	1.3388	2.4771	1.2186	2.4771	1.0385	2.4771	0.866
2.595	2.4067	2.595	1.5215	2.595	1.4885	2.595	1.3388	2.595	1.2186	2.595	1.0385	2.595	0.866
2.7186	2.6498	2.7186	1.5215	2.7186	1.4885	2.7186	1.3388	2.7186	1.2186	2.7186	1.0385	2.7186	0.866
2.848	2.6498	2.848	1.5215	2.848	1.4885	2.848	1.3388	2.848	1.2186	2.848	1.0385	2.848	0.859
2.9836	2.6498	2.9836	1.5215	2.9836	1.4261	2.9836	1.2238	2.9836	1.0738	2.9836	0.9557	2.9836	0.8126
3.1257	2.6498	3.1257	1.5215	3.1257	1.4261	3.1257	1.2238	3.1257	1.0738	3.1257	0.9557	3.1257	0.8126
3.2745	2.6498	3.2745	1.5215	3.2745	1.3039	3.2745	1.1725	3.2745	1.0648	3.2745	0.9547	3.2745	0.7955
3.4305	2.0528	3.4305	1.4038	3.4305	1.2222	3.4305	1.0569	3.4305	0.9788	3.4305	0.8637	3.4305	0.7503
3.5938	2.0528	3.5938	1.4038	3.5938	1.2222	3.5938	1.0518	3.5938	0.9105	3.5938	0.8342	3.5938	0.75
3.7649	1.5608	3.7649	1.1932	3.7649	1.0412	3.7649	0.9413	3.7649	0.8931	3.7649	0.8185	3.7649	0.734
3.9442	1.3287	3.9442	0.9812	3.9442	0.9181	3.9442	0.8966	3.9442	0.8279	3.9442	0.7711	3.9442	0.6991
4.132	1.3641	4.132	0.9812	4.132	0.9181	4.132	0.8966	4.132	0.8279	4.132	0.7296	4.132	0.6579
4.3288	1.3641	4.3288	0.9812	4.3288	0.9181	4.3288	0.8966	4.3288	0.8279	4.3288	0.7296	4.3288	0.6204
4.5349	1.5022	4.5349	0.9812	4.5349	0.9181	4.5349	0.8966	4.5349	0.8279	4.5349	0.7296	4.5349	0.6209
4.7508	1.5022	4.7508	0.9812	4.7508	0.9181	4.7508	0.8966	4.7508	0.8279	4.7508	0.7296	4.7508	0.6209
4.977	1.5022	4.977	0.9812	4.977	0.9181	4.977	0.8966	4.977	0.8279	4.977	0.7296	4.977	0.6209
5.214	1.5022	5.214	0.9812	5.214	0.9181	5.214	0.8966	5.214	0.8279	5.214	0.7296	5.214	0.6209
5.4623	1.5022	5.4623	0.9812	5.4623	0.9181	5.4623	0.8966	5.4623	0.8279	5.4623	0.7296	5.4623	0.6209
5.7224	1.5022	5.7224	0.9812	5.7224	0.9181	5.7224	0.8966	5.7224	0.8219	5.7224	0.708	5.7224	0.5957
5.9948	1.4583	5.9948	0.9812	5.9948	0.9181	5.9948	0.8652	5.9948	0.7895	5.9948	0.6777	5.9948	0.5687
6.2803	1.4583	6.2803	0.9287	6.2803	0.8928	6.2803	0.8015	6.2803	0.735	6.2803	0.6301	6.2803	0.5563
6.5793	1.4036	6.5793	0.9287	6.5793	0.8853	6.5793	0.8015	6.5793	0.735	6.5793	0.6301	6.5793	0.5563
6.8926	1.6746	6.8926	0.9287	6.8926	0.8143	6.8926	0.7332	6.8926	0.6749	6.8926	0.596	6.8926	0.5361
7.2208	1.6746	7.2208	0.9287	7.2208	0.7566	7.2208	0.7053	7.2208	0.664	7.2208	0.5957	7.2208	0.5178
7.5646	1.6746	7.5646	0.9287	7.5646	0.7566	7.5646	0.7053	7.5646	0.664	7.5646	0.5957	7.5646	0.5164
7.9248	1.6746	7.9248	0.9287	7.9248	0.7566	7.9248	0.7053	7.9248	0.664	7.9248	0.5957	7.9248	0.5164
8.3022	1.6746	8.3022	0.9287	8.3022	0.7566	8.3022	0.7053	8.3022	0.664	8.3022	0.5957	8.3022	0.5164
8.6975	1.4729	8.6975	0.821	8.6975	0.7324	8.6975	0.6697	8.6975	0.6267	8.6975	0.5594	8.6975	0.4859
9.1116	1.274	9.1116	0.7622	9.1116	0.6797	9.1116	0.6114	9.1116	0.568	9.1116	0.5151	9.1116	0.4639
9.5455	1.274	9.5455	0.6572	9.5455	0.5678	9.5455	0.5223	9.5455	0.4931	9.5455	0.4644	9.5455	0.4479
10	0.8156	10	0.8076	10	0.55	10	0.5087	10	0.4868	10	0.4561	10	0.4359
10.4762	0.6827	10.4762	0.5301	10.4762	0.4834	10.4762	0.468	10.4762	0.459	10.4762	0.443	10.4762	0.4225
10.975	0.6827	10.975	0.4925	10.975	0.4664	10.975	0.4557	10.975	0.4481	10.975	0.4376	10.975	0.4225
11.4976	0.8119	11.4976	0.4925	11.4976	0.4664	11.4976	0.4557	11.4976	0.4481	11.4976	0.4355	11.4976	0.4198
12.045	0.8119	12.045	0.4659	12.045	0.4529	12.045	0.4449	12.045	0.4385	12.045	0.4273	12.045	0.413
12.6186	0.8119	12.6186	0.451	12.6186	0.44	12.6186	0.4324	12.6186	0.4264	12.6186	0.4167	12.6186	0.404
13.2194	0.8119	13.2194	0.434	13.2194	0.4222	13.2194	0.4153	13.2194	0.4113	13.2194	0.4038	13.2194	0.393
13.8489	0.5034	13.8489	0.4195	13.8489	0.41	13.8489	0.4038	13.8489	0.3987	13.8489	0.3908	13.8489	0.3809

14.5083	0.5034	14.5083	0.4084	14.5083	0.3993	14.5083	0.3934	14.5083	0.3886	14.5083	0.3804	14.5083	0.3698
15.1991	0.5034	15.1991	0.3967	15.1991	0.3816	15.1991	0.3781	15.1991	0.3753	15.1991	0.3694	15.1991	0.3607
15.9228	0.5283	15.9228	0.3784	15.9228	0.3722	15.9228	0.3691	15.9228	0.3658	15.9228	0.3609	15.9228	0.3552
16.681	0.5283	16.681	0.3784	16.681	0.3648	16.681	0.3604	16.681	0.3576	16.681	0.3537	16.681	0.3491
17.4753	0.5283	17.4753	0.3784	17.4753	0.3631	17.4753	0.354	17.4753	0.3481	17.4753	0.3465	17.4753	0.3438
18.3074	0.5283	18.3074	0.3784	18.3074	0.3631	18.3074	0.354	18.3074	0.3481	18.3074	0.3441	18.3074	0.3401
19.1791	0.5283	19.1791	0.3784	19.1791	0.3631	19.1791	0.354	19.1791	0.3481	19.1791	0.3413	19.1791	0.3359
20.0923	0.4604	20.0923	0.3424	20.0923	0.335	20.0923	0.3322	20.0923	0.3302	20.0923	0.3311	20.0923	0.3297
21.049	0.4604	21.049	0.3424	21.049	0.335	21.049	0.3322	21.049	0.3302	21.049	0.3273	21.049	0.3249
22.0513	0.4108	22.0513	0.3424	22.0513	0.3327	22.0513	0.3298	22.0513	0.3273	22.0513	0.3236	22.0513	0.3204
23.1013	0.4056	23.1013	0.3361	23.1013	0.3298	23.1013	0.3258	23.1013	0.3231	23.1013	0.3195	23.1013	0.3161
24.2013	0.4419	24.2013	0.3316	24.2013	0.317	24.2013	0.3156	24.2013	0.3151	24.2013	0.3135	24.2013	0.3113
25.3536	0.4419	25.3536	0.3316	25.3536	0.317	25.3536	0.3143	25.3536	0.3125	25.3536	0.3096	25.3536	0.3071
26.5609	0.4419	26.5609	0.3316	26.5609	0.317	26.5609	0.31	26.5609	0.3069	26.5609	0.3043	26.5609	0.3027
27.8256	0.4419	27.8256	0.3238	27.8256	0.3108	27.8256	0.3024	27.8256	0.2977	27.8256	0.2969	27.8256	0.298
29.1505	0.4419	29.1505	0.3238	29.1505	0.3108	29.1505	0.3024	29.1505	0.2977	29.1505	0.2963	29.1505	0.2958
30.5386	0.3862	30.5386	0.3077	30.5386	0.3004	30.5386	0.298	30.5386	0.2963	30.5386	0.2943	30.5386	0.2939
31.9927	0.3588	31.9927	0.3077	31.9927	0.3004	31.9927	0.298	31.9927	0.2963	31.9927	0.2943	31.9927	0.2928
33.516	0.3151	33.516	0.3045	33.516	0.3004	33.516	0.298	33.516	0.2963	33.516	0.2943	33.516	0.2928
35.1119	0.2975	35.1119	0.2967	35.1119	0.296	35.1119	0.2953	35.1119	0.2945	35.1119	0.2932	35.1119	0.2918
36.7838	0.2918	36.7838	0.2916	36.7838	0.2915	36.7838	0.2913	36.7838	0.2911	36.7838	0.2906	36.7838	0.2898
38.5353	0.2884	38.5353	0.2884	38.5353	0.2884	38.5353	0.2884	38.5353	0.2883	38.5353	0.2881	38.5353	0.2878
40.3702	0.286	40.3702	0.2861	40.3702	0.2862	40.3702	0.2862	40.3702	0.2861	40.3702	0.2861	40.3702	0.286
42.2924	0.2843	42.2924	0.2843	42.2924	0.2844	42.2924	0.2844	42.2924	0.2844	42.2924	0.2844	42.2924	0.2843
44.3062	0.2828	44.3062	0.2828	44.3062	0.2829	44.3062	0.2829	44.3062	0.2829	44.3062	0.2829	44.3062	0.2829
46.4159	0.2816	46.4159	0.2816	46.4159	0.2816	46.4159	0.2816	46.4159	0.2816	46.4159	0.2816	46.4159	0.2817
48.626	0.2804	48.626	0.2804	48.626	0.2804	48.626	0.2804	48.626	0.2804	48.626	0.2805	48.626	0.2805
50.9414	0.2794	50.9414	0.2794	50.9414	0.2794	50.9414	0.2794	50.9414	0.2794	50.9414	0.2794	50.9414	0.2795

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTWW115.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 115  
 SLAB ONLY Vertical Responses  
 Elevation 56 ft.  
 EL56\_C-E-17-20

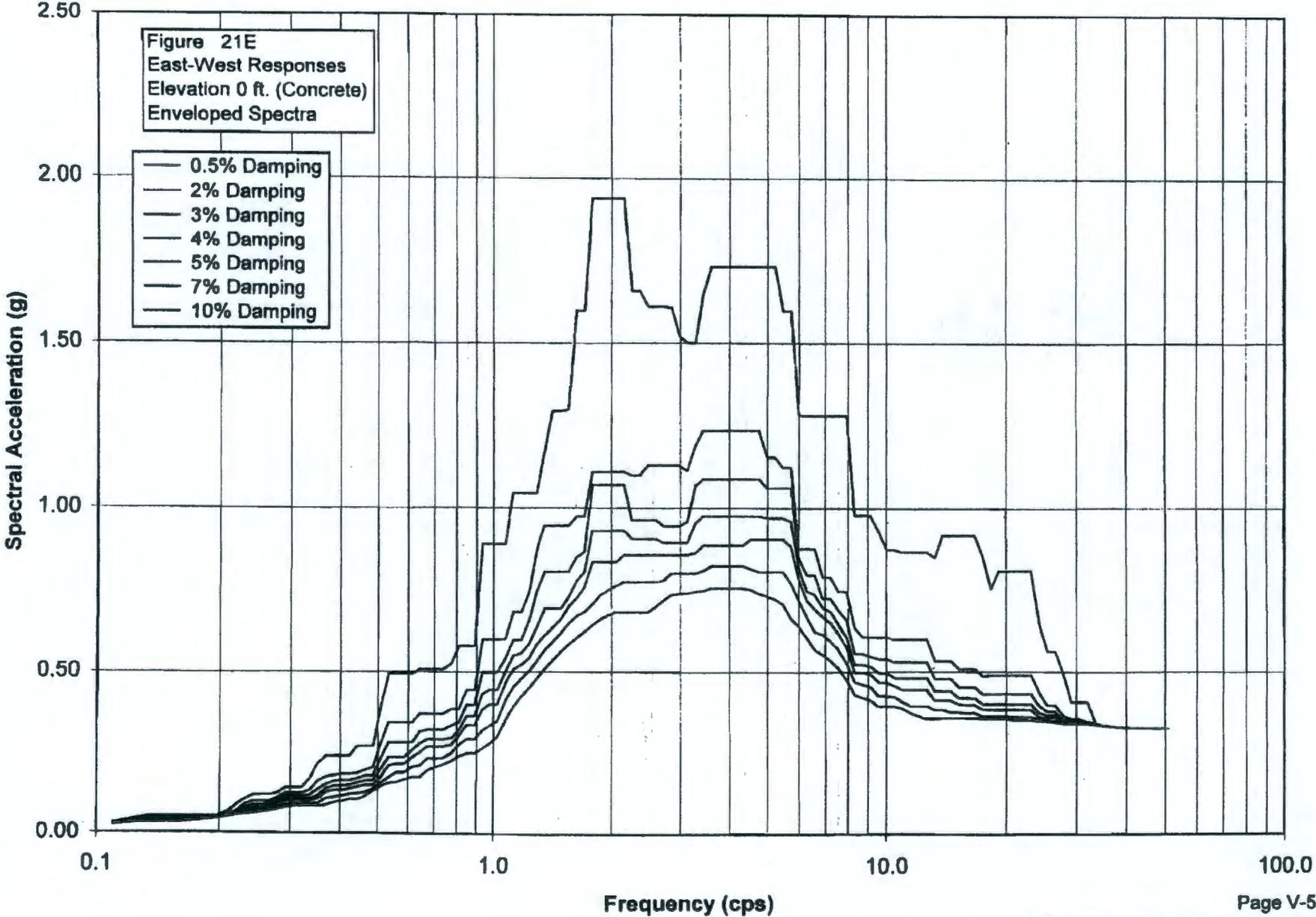
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0329	0.1098	0.0295	0.1098	0.0275	0.1098	0.0264	0.1098	0.0255	0.1098	0.0237	0.1098	0.0217
0.115	0.0347	0.115	0.0311	0.115	0.029	0.115	0.0271	0.115	0.0257	0.115	0.0239	0.115	0.022
0.1204	0.0348	0.1204	0.0312	0.1204	0.0291	0.1204	0.0273	0.1204	0.0257	0.1204	0.0239	0.1204	0.022
0.1262	0.0349	0.1262	0.0312	0.1262	0.0291	0.1262	0.0273	0.1262	0.0257	0.1262	0.0239	0.1262	0.022
0.1322	0.0349	0.1322	0.0312	0.1322	0.0291	0.1322	0.0273	0.1322	0.0257	0.1322	0.0239	0.1322	0.022
0.1385	0.0349	0.1385	0.0312	0.1385	0.0291	0.1385	0.0273	0.1385	0.0259	0.1385	0.0242	0.1385	0.0222
0.1451	0.0349	0.1451	0.0312	0.1451	0.0291	0.1451	0.0273	0.1451	0.0259	0.1451	0.0242	0.1451	0.0222
0.152	0.0349	0.152	0.0312	0.152	0.0291	0.152	0.0273	0.152	0.0263	0.152	0.025	0.152	0.0236
0.1592	0.0349	0.1592	0.0312	0.1592	0.0291	0.1592	0.0283	0.1592	0.0276	0.1592	0.0264	0.1592	0.0248
0.1668	0.0349	0.1668	0.0312	0.1668	0.0298	0.1668	0.029	0.1668	0.0283	0.1668	0.027	0.1668	0.0253
0.1748	0.0423	0.1748	0.0358	0.1748	0.0324	0.1748	0.0296	0.1748	0.0283	0.1748	0.027	0.1748	0.0258
0.1831	0.0535	0.1831	0.0445	0.1831	0.0398	0.1831	0.0358	0.1831	0.0324	0.1831	0.0273	0.1831	0.0261
0.1918	0.0577	0.1918	0.0478	0.1918	0.0424	0.1918	0.038	0.1918	0.0347	0.1918	0.0317	0.1918	0.0285
0.2009	0.0577	0.2009	0.0478	0.2009	0.0424	0.2009	0.0391	0.2009	0.0372	0.2009	0.034	0.2009	0.0301
0.2105	0.0577	0.2105	0.0478	0.2105	0.0424	0.2105	0.0393	0.2105	0.0376	0.2105	0.0347	0.2105	0.0325
0.2205	0.0577	0.2205	0.0478	0.2205	0.0432	0.2205	0.0417	0.2205	0.0402	0.2205	0.0379	0.2205	0.0351
0.231	0.0579	0.231	0.0494	0.231	0.0465	0.231	0.044	0.231	0.0424	0.231	0.0396	0.231	0.036
0.242	0.0625	0.242	0.0555	0.242	0.0514	0.242	0.0476	0.242	0.0443	0.242	0.0396	0.242	0.036
0.2535	0.0713	0.2535	0.0623	0.2535	0.0573	0.2535	0.0531	0.2535	0.0496	0.2535	0.044	0.2535	0.0386
0.2656	0.0713	0.2656	0.0623	0.2656	0.0573	0.2656	0.0531	0.2656	0.0496	0.2656	0.044	0.2656	0.0386
0.2783	0.0713	0.2783	0.0623	0.2783	0.0573	0.2783	0.0531	0.2783	0.0496	0.2783	0.044	0.2783	0.0395
0.2915	0.0743	0.2915	0.0666	0.2915	0.0623	0.2915	0.0586	0.2915	0.0556	0.2915	0.0504	0.2915	0.0443
0.3054	0.0876	0.3054	0.0757	0.3054	0.0694	0.3054	0.0643	0.3054	0.0605	0.3054	0.0541	0.3054	0.0472
0.3199	0.0921	0.3199	0.0797	0.3199	0.0728	0.3199	0.067	0.3199	0.0619	0.3199	0.0541	0.3199	0.0472
0.3352	0.1104	0.3352	0.0888	0.3352	0.0785	0.3352	0.0706	0.3352	0.0644	0.3352	0.0557	0.3352	0.0481
0.3511	0.1253	0.3511	0.0955	0.3511	0.0827	0.3511	0.0727	0.3511	0.0669	0.3511	0.0584	0.3511	0.05
0.3678	0.1253	0.3678	0.0955	0.3678	0.085	0.3678	0.0776	0.3678	0.0713	0.3678	0.0613	0.3678	0.051

0.3853	0.1253	0.3853	0.0958	0.3853	0.0881	0.3853	0.081	0.3853	0.0755	0.3853	0.0658	0.3853	0.055
0.4037	0.155	0.4037	0.1125	0.4037	0.0976	0.4037	0.086	0.4037	0.0768	0.4037	0.0658	0.4037	0.055
0.4229	0.155	0.4229	0.1189	0.4229	0.1036	0.4229	0.0914	0.4229	0.0814	0.4229	0.0672	0.4229	0.055
0.4431	0.1769	0.4431	0.1356	0.4431	0.1158	0.4431	0.1003	0.4431	0.0882	0.4431	0.0706	0.4431	0.059
0.4642	0.1769	0.4642	0.1356	0.4642	0.1158	0.4642	0.1003	0.4642	0.0882	0.4642	0.0737	0.4642	0.0628
0.4863	0.1983	0.4863	0.1471	0.4863	0.1254	0.4863	0.1095	0.4863	0.0976	0.4863	0.0812	0.4863	0.0672
0.5094	0.1983	0.5094	0.1471	0.5094	0.1254	0.5094	0.1095	0.5094	0.0976	0.5094	0.0855	0.5094	0.0744
0.5337	0.1983	0.5337	0.1471	0.5337	0.1254	0.5337	0.1112	0.5337	0.1045	0.5337	0.0939	0.5337	0.082
0.5591	0.1983	0.5591	0.1471	0.5591	0.1254	0.5591	0.1112	0.5591	0.1045	0.5591	0.0956	0.5591	0.0843
0.5857	0.1998	0.5857	0.1485	0.5857	0.1267	0.5857	0.1112	0.5857	0.1048	0.5857	0.0957	0.5857	0.0843
0.6136	0.2101	0.6136	0.1485	0.6136	0.1267	0.6136	0.1136	0.6136	0.1052	0.6136	0.0957	0.6136	0.0843
0.6428	0.2101	0.6428	0.1594	0.6428	0.1441	0.6428	0.1316	0.6428	0.1212	0.6428	0.1053	0.6428	0.089
0.6734	0.2434	0.6734	0.1649	0.6734	0.1494	0.6734	0.1384	0.6734	0.1287	0.6734	0.1125	0.6734	0.0946
0.7055	0.2434	0.7055	0.17	0.7055	0.1494	0.7055	0.1384	0.7055	0.1287	0.7055	0.1128	0.7055	0.0953
0.7391	0.2434	0.7391	0.1945	0.7391	0.1728	0.7391	0.1548	0.7391	0.1398	0.7391	0.1172	0.7391	0.1021
0.7743	0.3189	0.7743	0.1945	0.7743	0.173	0.7743	0.1583	0.7743	0.1458	0.7743	0.1255	0.7743	0.1139
0.8111	0.3189	0.8111	0.2109	0.8111	0.1831	0.8111	0.1637	0.8111	0.1515	0.8111	0.1361	0.8111	0.1235
0.8497	0.3189	0.8497	0.2109	0.8497	0.1901	0.8497	0.1736	0.8497	0.1596	0.8497	0.1394	0.8497	0.1267
0.8902	0.3189	0.8902	0.2149	0.8902	0.1954	0.8902	0.1792	0.8902	0.1656	0.8902	0.1442	0.8902	0.1342
0.9326	0.4062	0.9326	0.2639	0.9326	0.2222	0.9326	0.1981	0.9326	0.183	0.9326	0.1653	0.9326	0.1501
0.977	0.4062	0.977	0.2639	0.977	0.2359	0.977	0.2171	0.977	0.2018	0.977	0.1798	0.977	0.1597
1.0235	0.4062	1.0235	0.2639	1.0235	0.2359	1.0235	0.2171	1.0235	0.2018	1.0235	0.1805	1.0235	0.1597
1.0723	0.4062	1.0723	0.2656	1.0723	0.2573	1.0723	0.2344	1.0723	0.2163	1.0723	0.1897	1.0723	0.1641
1.1233	0.6546	1.1233	0.3729	1.1233	0.3062	1.1233	0.2648	1.1233	0.2359	1.1233	0.1983	1.1233	0.1679
1.1768	0.6546	1.1768	0.4139	1.1768	0.3354	1.1768	0.2882	1.1768	0.2598	1.1768	0.2262	1.1768	0.1952
1.2328	0.6546	1.2328	0.4139	1.2328	0.342	1.2328	0.3066	1.2328	0.2769	1.2328	0.2314	1.2328	0.2051
1.2916	0.6546	1.2916	0.4139	1.2916	0.3557	1.2916	0.3169	1.2916	0.2849	1.2916	0.2463	1.2916	0.2148
1.353	0.7114	1.353	0.4139	1.353	0.3557	1.353	0.3288	1.353	0.3096	1.353	0.2772	1.353	0.2397
1.4175	0.7114	1.4175	0.451	1.4175	0.3821	1.4175	0.3434	1.4175	0.3251	1.4175	0.2931	1.4175	0.2567
1.485	0.7114	1.485	0.451	1.485	0.409	1.485	0.3828	1.485	0.3591	1.485	0.3192	1.485	0.2738
1.5557	0.7114	1.5557	0.4768	1.5557	0.4231	1.5557	0.4003	1.5557	0.3802	1.5557	0.3446	1.5557	0.3
1.6298	0.8771	1.6298	0.5303	1.6298	0.433	1.6298	0.407	1.6298	0.3829	1.6298	0.3538	1.6298	0.3149
1.7074	0.8771	1.7074	0.5303	1.7074	0.4631	1.7074	0.4398	1.7074	0.4182	1.7074	0.3794	1.7074	0.3287
1.7887	0.8771	1.7887	0.5415	1.7887	0.5002	1.7887	0.4765	1.7887	0.4537	1.7887	0.4108	1.7887	0.3573
1.8738	0.9037	1.8738	0.663	1.8738	0.5967	1.8738	0.5392	1.8738	0.4998	1.8738	0.4412	1.8738	0.3872
1.963	1.0756	1.963	0.7961	1.963	0.7133	1.963	0.6453	1.963	0.589	1.963	0.5131	1.963	0.4247
2.0565	1.3711	2.0565	0.8733	2.0565	0.772	2.0565	0.7084	2.0565	0.6513	2.0565	0.5578	2.0565	0.4693
2.1544	1.3711	2.1544	0.8811	2.1544	0.8161	2.1544	0.7568	2.1544	0.6775	2.1544	0.6051	2.1544	0.503
2.257	1.5546	2.257	1.0086	2.257	0.9138	2.257	0.7768	2.257	0.6775	2.257	0.6481	2.257	0.524

2.3645	2.9466	2.3645	1.2778	2.3645	0.9571	2.3645	0.7768	2.3645	0.6775	2.3645	0.6607	2.3645	0.5351
2.4771	2.9466	2.4771	1.2778	2.4771	0.9571	2.4771	0.7768	2.4771	0.6869	2.4771	0.6807	2.4771	0.5397
2.595	2.9466	2.595	1.2778	2.595	0.9571	2.595	0.7792	2.595	0.7236	2.595	0.6807	2.595	0.5851
2.7186	2.9466	2.7186	1.3059	2.7186	1.1457	2.7186	1.0217	2.7186	0.9201	2.7186	0.7599	2.7186	0.6218
2.848	2.9466	2.848	1.323	2.848	1.1833	2.848	1.0545	2.848	0.9207	2.848	0.7599	2.848	0.6777
2.9836	2.9466	2.9836	1.489	2.9836	1.2361	2.9836	1.0545	2.9836	0.9207	2.9836	0.7599	2.9836	0.7194
3.1257	2.9466	3.1257	1.489	3.1257	1.2361	3.1257	1.0545	3.1257	0.9207	3.1257	0.7599	3.1257	0.7194
3.2745	2.9466	3.2745	1.489	3.2745	1.2361	3.2745	1.0545	3.2745	0.9207	3.2745	0.7599	3.2745	0.7194
3.4305	2.6509	3.4305	1.489	3.4305	1.2361	3.4305	1.0545	3.4305	0.9207	3.4305	0.7599	3.4305	0.7194
3.5938	2.5408	3.5938	1.489	3.5938	1.2361	3.5938	1.0545	3.5938	0.9207	3.5938	0.7599	3.5938	0.7194
3.7649	2.5408	3.7649	1.489	3.7649	1.2361	3.7649	1.0545	3.7649	0.9207	3.7649	0.7599	3.7649	0.704
3.9442	1.6105	3.9442	1.0858	3.9442	0.9858	3.9442	0.8969	3.9442	0.8216	3.9442	0.7368	3.9442	0.6389
4.132	1.2409	4.132	0.8498	4.132	0.7883	4.132	0.7373	4.132	0.6921	4.132	0.6195	4.132	0.5637
4.3288	1.2409	4.3288	0.8174	4.3288	0.7508	4.3288	0.6953	4.3288	0.6474	4.3288	0.5705	4.3288	0.5162
4.5349	1.322	4.5349	0.8174	4.5349	0.7508	4.5349	0.6953	4.5349	0.6474	4.5349	0.5762	4.5349	0.5063
4.7508	1.322	4.7508	0.8174	4.7508	0.7508	4.7508	0.6953	4.7508	0.6474	4.7508	0.5763	4.7508	0.5172
4.977	1.4164	4.977	0.9195	4.977	0.7709	4.977	0.7175	4.977	0.6786	4.977	0.6141	4.977	0.5348
5.214	1.6309	5.214	0.9611	5.214	0.8966	5.214	0.7317	5.214	0.6786	5.214	0.6427	5.214	0.555
5.4623	1.7077	5.4623	0.9611	5.4623	0.8966	5.4623	0.7317	5.4623	0.6786	5.4623	0.6491	5.4623	0.555
5.7224	1.7802	5.7224	0.9611	5.7224	0.9394	5.7224	0.7317	5.7224	0.6786	5.7224	0.6618	5.7224	0.555
5.9948	1.7802	5.9948	0.9611	5.9948	0.9394	5.9948	0.7317	5.9948	0.6786	5.9948	0.6618	5.9948	0.555
6.2803	1.7802	6.2803	0.9611	6.2803	0.9394	6.2803	0.7317	6.2803	0.6786	6.2803	0.6618	6.2803	0.555
6.5793	1.9049	6.5793	1.0978	6.5793	0.9394	6.5793	0.7588	6.5793	0.6857	6.5793	0.6618	6.5793	0.555
6.8926	2.2369	6.8926	1.2019	6.8926	1.0214	6.8926	0.9	6.8926	0.7551	6.8926	0.6724	6.8926	0.581
7.2208	2.2369	7.2208	1.2019	7.2208	1.0214	7.2208	0.9172	7.2208	0.7551	7.2208	0.7362	7.2208	0.6129
7.5646	2.2369	7.5646	1.2019	7.5646	1.0214	7.5646	0.9172	7.5646	0.7551	7.5646	0.7362	7.5646	0.6129
7.9248	2.2369	7.9248	1.2019	7.9248	1.0214	7.9248	0.9172	7.9248	0.7551	7.9248	0.7362	7.9248	0.6129
8.3022	2.2369	8.3022	1.2019	8.3022	1.0214	8.3022	0.9172	8.3022	0.7551	8.3022	0.7362	8.3022	0.6129
8.6975	2.1808	8.6975	1.1297	8.6975	1.0044	8.6975	0.9172	8.6975	0.7551	8.6975	0.7362	8.6975	0.6129
9.1116	2.1808	9.1116	1.0994	9.1116	0.9961	9.1116	0.9172	9.1116	0.7551	9.1116	0.7046	9.1116	0.6129
9.5455	1.3081	9.5455	1.097	9.5455	0.9961	9.5455	0.9172	9.5455	0.7551	9.5455	0.68	9.5455	0.6459
10	1.3354	10	1.097	10	0.9961	10	0.9172	10	0.7551	10	0.68	10	0.6626
10.4762	1.6346	10.4762	1.097	10.4762	0.9961	10.4762	0.9172	10.4762	0.7886	10.4762	0.6957	10.4762	0.6626
10.975	1.6346	10.975	1.097	10.975	0.9961	10.975	0.9233	10.975	0.863	10.975	0.768	10.975	0.6671
11.4976	1.7214	11.4976	1.097	11.4976	0.9961	11.4976	0.9233	11.4976	0.8666	11.4976	0.7814	11.4976	0.6841
12.045	1.7214	12.045	1.097	12.045	0.9961	12.045	0.9233	12.045	0.8666	12.045	0.7814	12.045	0.6841
12.6186	2.0632	12.6186	1.097	12.6186	0.9961	12.6186	0.9233	12.6186	0.8666	12.6186	0.7814	12.6186	0.6841
13.2194	2.0632	13.2194	1.1707	13.2194	0.9961	13.2194	0.9233	13.2194	0.8666	13.2194	0.7814	13.2194	0.6841
13.8489	2.7414	13.8489	1.4457	13.8489	1.1557	13.8489	0.9683	13.8489	0.8666	13.8489	0.7814	13.8489	0.6841

14.5083	3.2128	14.5083	1.5157	14.5083	1.2027	14.5083	1.053	14.5083	0.9721	14.5083	0.8336	14.5083	0.7686
15.1991	3.6191	15.1991	2.0698	15.1991	1.6478	15.1991	1.3781	15.1991	1.196	15.1991	0.9925	15.1991	0.8703
15.9228	4.4132	15.9228	2.5964	15.9228	1.9869	15.9228	1.6011	15.9228	1.342	15.9228	1.0241	15.9228	0.9156
16.681	4.4132	16.681	2.5964	16.681	1.9869	16.681	1.6011	16.681	1.342	16.681	1.0241	16.681	0.9156
17.4753	4.4132	17.4753	2.5964	17.4753	1.9869	17.4753	1.6011	17.4753	1.342	17.4753	1.0241	17.4753	0.9156
18.3074	4.4132	18.3074	2.5964	18.3074	1.9869	18.3074	1.6011	18.3074	1.342	18.3074	1.0241	18.3074	0.9156
19.1791	4.4132	19.1791	2.5964	19.1791	1.9869	19.1791	1.6011	19.1791	1.342	19.1791	1.0241	19.1791	0.9156
20.0923	3.9224	20.0923	2.2551	20.0923	1.905	20.0923	1.6011	20.0923	1.342	20.0923	1.0241	20.0923	0.8746
21.049	3.9224	21.049	2.2551	21.049	1.7069	21.049	1.3911	21.049	1.196	21.049	0.9421	21.049	0.8556
22.0513	3.9224	22.0513	2.2551	22.0513	1.7069	22.0513	1.3911	22.0513	1.196	22.0513	0.9421	22.0513	0.8556
23.1013	2.4554	23.1013	1.6083	23.1013	1.3984	23.1013	1.2275	23.1013	1.0867	23.1013	0.8799	23.1013	0.7832
24.2013	2.4554	24.2013	1.3888	24.2013	1.1176	24.2013	0.9951	24.2013	0.9307	24.2013	0.826	24.2013	0.7129
25.3536	1.443	25.3536	1.0506	25.3536	0.8967	25.3536	0.8057	25.3536	0.7474	25.3536	0.6928	25.3536	0.6385
26.5609	1.1643	26.5609	0.8247	26.5609	0.7362	26.5609	0.6696	26.5609	0.6425	26.5609	0.6098	26.5609	0.5997
27.8256	1.1643	27.8256	0.8126	27.8256	0.7222	27.8256	0.6696	27.8256	0.6345	27.8256	0.6043	27.8256	0.5905
29.1505	0.6352	29.1505	0.6165	29.1505	0.6144	29.1505	0.6094	29.1505	0.6035	29.1505	0.5919	29.1505	0.5777
30.5386	0.6352	30.5386	0.5981	30.5386	0.5888	30.5386	0.5826	30.5386	0.5777	30.5386	0.5696	30.5386	0.5593
31.9927	0.5514	31.9927	0.556	31.9927	0.5544	31.9927	0.5521	31.9927	0.5498	31.9927	0.5454	31.9927	0.539
33.516	0.5022	33.516	0.5192	33.516	0.5227	33.516	0.5236	33.516	0.5235	33.516	0.5222	33.516	0.5194
35.1119	0.4958	35.1119	0.4981	35.1119	0.4996	35.1119	0.5007	35.1119	0.5016	35.1119	0.5026	35.1119	0.5024
36.7838	0.4859	36.7838	0.4867	36.7838	0.4873	36.7838	0.4878	36.7838	0.4882	36.7838	0.4888	36.7838	0.4891
38.5353	0.4766	38.5353	0.4771	38.5353	0.4774	38.5353	0.4777	38.5353	0.4779	38.5353	0.4783	38.5353	0.4785
40.3702	0.4685	40.3702	0.4688	40.3702	0.469	40.3702	0.4691	40.3702	0.4693	40.3702	0.4695	40.3702	0.4697
42.2924	0.4613	42.2924	0.4615	42.2924	0.4616	42.2924	0.4617	42.2924	0.4618	42.2924	0.462	42.2924	0.4622
44.3062	0.4548	44.3062	0.455	44.3062	0.455	44.3062	0.4551	44.3062	0.4552	44.3062	0.4554	44.3062	0.4555
46.4159	0.449	46.4159	0.4491	46.4159	0.4491	46.4159	0.4492	46.4159	0.4493	46.4159	0.4494	46.4159	0.4496
48.626	0.4436	48.626	0.4437	48.626	0.4437	48.626	0.4438	48.626	0.4438	48.626	0.4439	48.626	0.4442
50.9414	0.4386	50.9414	0.4386	50.9414	0.4386	50.9414	0.4387	50.9414	0.4387	50.9414	0.4388	50.9414	0.4391

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTEE021.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 21E  
 East-West Responses  
 Elevation 0 ft. (Concrete)  
 Enveloped Spectra

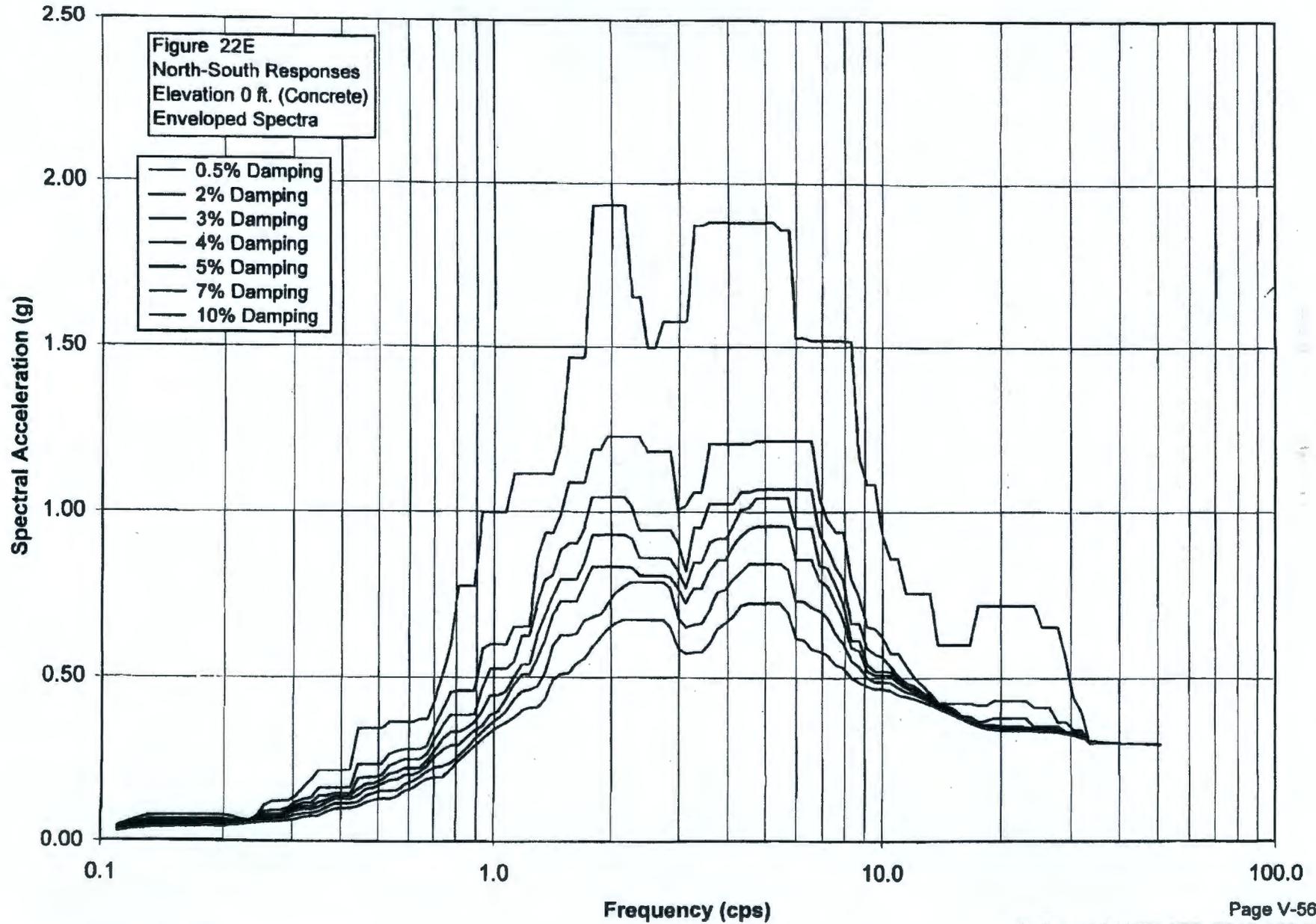
Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0314	0.1098	0.0288	0.1098	0.0275	0.1098	0.0267	0.1098	0.026	0.1098	0.0247	0.1098	0.0231
0.115	0.0358	0.115	0.033	0.115	0.0314	0.115	0.03	0.115	0.0289	0.115	0.0274	0.115	0.0254
0.1204	0.041	0.1204	0.0382	0.1204	0.0366	0.1204	0.0352	0.1204	0.0339	0.1204	0.0316	0.1204	0.0287
0.1262	0.0459	0.1262	0.0426	0.1262	0.0407	0.1262	0.0389	0.1262	0.0373	0.1262	0.0344	0.1262	0.0311
0.1322	0.0488	0.1322	0.0442	0.1322	0.0421	0.1322	0.0402	0.1322	0.0385	0.1322	0.0355	0.1322	0.032
0.1385	0.0518	0.1385	0.0463	0.1385	0.0431	0.1385	0.0402	0.1385	0.0385	0.1385	0.0355	0.1385	0.032
0.1451	0.0518	0.1451	0.0463	0.1451	0.0431	0.1451	0.0402	0.1451	0.0385	0.1451	0.0355	0.1451	0.032
0.152	0.0518	0.152	0.0463	0.152	0.0431	0.152	0.0402	0.152	0.0385	0.152	0.0355	0.152	0.032
0.1592	0.0518	0.1592	0.0463	0.1592	0.0431	0.1592	0.0402	0.1592	0.0385	0.1592	0.0355	0.1592	0.0322
0.1668	0.0518	0.1668	0.0463	0.1668	0.0431	0.1668	0.0402	0.1668	0.0385	0.1668	0.036	0.1668	0.0348
0.1748	0.0518	0.1748	0.0463	0.1748	0.0431	0.1748	0.041	0.1748	0.0403	0.1748	0.0392	0.1748	0.0375
0.1831	0.0518	0.1831	0.0463	0.1831	0.0454	0.1831	0.0446	0.1831	0.0438	0.1831	0.0424	0.1831	0.0402
0.1918	0.0521	0.1918	0.0504	0.1918	0.0484	0.1918	0.0484	0.1918	0.0474	0.1918	0.0455	0.1918	0.0434
0.2009	0.0569	0.2009	0.0549	0.2009	0.0536	0.2009	0.0524	0.2009	0.0513	0.2009	0.0494	0.2009	0.0471
0.2105	0.0707	0.2105	0.06	0.2105	0.0585	0.2105	0.0572	0.2105	0.056	0.2105	0.0538	0.2105	0.0513
0.2205	0.0909	0.2205	0.0714	0.2205	0.0642	0.2205	0.0623	0.2205	0.0608	0.2205	0.0584	0.2205	0.0554
0.231	0.1078	0.231	0.0906	0.231	0.0813	0.231	0.0735	0.231	0.0671	0.231	0.0628	0.231	0.0589
0.242	0.1194	0.242	0.0991	0.242	0.0883	0.242	0.0792	0.242	0.0715	0.242	0.0663	0.242	0.0617
0.2535	0.12	0.2535	0.0991	0.2535	0.0883	0.2535	0.0798	0.2535	0.0755	0.2535	0.069	0.2535	0.0654
0.2656	0.12	0.2656	0.0991	0.2656	0.0922	0.2656	0.0879	0.2656	0.084	0.2656	0.077	0.2656	0.0688
0.2783	0.1252	0.2783	0.1094	0.2783	0.1006	0.2783	0.095	0.2783	0.0907	0.2783	0.0832	0.2783	0.0751
0.2915	0.1421	0.2915	0.1244	0.2915	0.1145	0.2915	0.1057	0.2915	0.0979	0.2915	0.0883	0.2915	0.0805
0.3054	0.1421	0.3054	0.1244	0.3054	0.115	0.3054	0.1067	0.3054	0.0994	0.3054	0.0903	0.3054	0.0832
0.3199	0.1421	0.3199	0.1244	0.3199	0.115	0.3199	0.1067	0.3199	0.0994	0.3199	0.0903	0.3199	0.0837
0.3352	0.1707	0.3352	0.1342	0.3352	0.1178	0.3352	0.1067	0.3352	0.0994	0.3352	0.0903	0.3352	0.0837
0.3511	0.2169	0.3511	0.1627	0.3511	0.1366	0.3511	0.1165	0.3511	0.107	0.3511	0.0923	0.3511	0.0837
0.3678	0.2396	0.3678	0.1754	0.3678	0.1523	0.3678	0.1388	0.3678	0.1269	0.3678	0.1074	0.3678	0.0882

0.3853	0.2396	0.3853	0.1799	0.3853	0.1618	0.3853	0.1463	0.3853	0.1331	0.3853	0.112	0.3853	0.0944
0.4037	0.2396	0.4037	0.1842	0.4037	0.164	0.4037	0.1472	0.4037	0.1332	0.4037	0.1155	0.4037	0.0992
0.4229	0.2396	0.4229	0.1842	0.4229	0.164	0.4229	0.1495	0.4229	0.1381	0.4229	0.1214	0.4229	0.1046
0.4431	0.2688	0.4431	0.1868	0.4431	0.1709	0.4431	0.1588	0.4431	0.1442	0.4431	0.1234	0.4431	0.1046
0.4642	0.2688	0.4642	0.1954	0.4642	0.1781	0.4642	0.1629	0.4642	0.1495	0.4642	0.1272	0.4642	0.1151
0.4863	0.2688	0.4863	0.2037	0.4863	0.1784	0.4863	0.1629	0.4863	0.1495	0.4863	0.1378	0.4863	0.1308
0.5094	0.3911	0.5094	0.2791	0.5094	0.2331	0.5094	0.2001	0.5094	0.1754	0.5094	0.1572	0.5094	0.1456
0.5337	0.4951	0.5337	0.3445	0.5337	0.2811	0.5337	0.237	0.5337	0.2102	0.5337	0.174	0.5337	0.1562
0.5591	0.4951	0.5591	0.3445	0.5591	0.2811	0.5591	0.237	0.5591	0.2161	0.5591	0.1886	0.5591	0.1586
0.5857	0.4951	0.5857	0.3445	0.5857	0.2811	0.5857	0.237	0.5857	0.2161	0.5857	0.1886	0.5857	0.1672
0.6136	0.4951	0.6136	0.3445	0.6136	0.2835	0.6136	0.2579	0.6136	0.2376	0.6136	0.2068	0.6136	0.1755
0.6428	0.5081	0.6428	0.3704	0.6428	0.3158	0.6428	0.2788	0.6428	0.2506	0.6428	0.2109	0.6428	0.1755
0.6734	0.5081	0.6734	0.3704	0.6734	0.3214	0.6734	0.2929	0.6734	0.2694	0.6734	0.2332	0.6734	0.1958
0.7055	0.5081	0.7055	0.3704	0.7055	0.3214	0.7055	0.2929	0.7055	0.2694	0.7055	0.2332	0.7055	0.2068
0.7391	0.5081	0.7391	0.3704	0.7391	0.3214	0.7391	0.2929	0.7391	0.2694	0.7391	0.2359	0.7391	0.2145
0.7743	0.5246	0.7743	0.3867	0.7743	0.3352	0.7743	0.2967	0.7743	0.2757	0.7743	0.2494	0.7743	0.2264
0.8111	0.5776	0.8111	0.3867	0.8111	0.3456	0.8111	0.3215	0.8111	0.3045	0.8111	0.2755	0.8111	0.2408
0.8497	0.5776	0.8497	0.444	0.8497	0.3988	0.8497	0.3642	0.8497	0.3363	0.8497	0.2936	0.8497	0.2491
0.8902	0.5776	0.8902	0.444	0.8902	0.3988	0.8902	0.3642	0.8902	0.3363	0.8902	0.2936	0.8902	0.2491
0.9326	0.8877	0.9326	0.5975	0.9326	0.4991	0.9326	0.4325	0.9326	0.3845	0.9326	0.3203	0.9326	0.2634
0.977	0.8877	0.977	0.5975	0.977	0.4991	0.977	0.4459	0.977	0.4011	0.977	0.3342	0.977	0.2792
1.0235	0.8877	1.0235	0.5975	1.0235	0.4991	1.0235	0.4459	1.0235	0.4011	1.0235	0.3491	1.0235	0.3012
1.0723	0.8877	1.0723	0.6	1.0723	0.5421	1.0723	0.5019	1.0723	0.4672	1.0723	0.4115	1.0723	0.3515
1.1233	1.0439	1.1233	0.6796	1.1233	0.5961	1.1233	0.5493	1.1233	0.5076	1.1233	0.454	1.1233	0.393
1.1768	1.0439	1.1768	0.6796	1.1768	0.5966	1.1768	0.5564	1.1768	0.5218	1.1768	0.4787	1.1768	0.424
1.2328	1.0439	1.2328	0.7363	1.2328	0.6543	1.2328	0.5857	1.2328	0.5418	1.2328	0.503	1.2328	0.452
1.2916	1.0439	1.2916	0.8733	1.2916	0.7423	1.2916	0.6374	1.2916	0.5853	1.2916	0.5346	1.2916	0.4807
1.353	1.1657	1.353	0.9454	1.353	0.8025	1.353	0.6903	1.353	0.6111	1.353	0.5663	1.353	0.5097
1.4175	1.2899	1.4175	0.9454	1.4175	0.8025	1.4175	0.6903	1.4175	0.6337	1.4175	0.5919	1.4175	0.5357
1.485	1.2899	1.485	0.9454	1.485	0.8025	1.485	0.6903	1.485	0.6584	1.485	0.617	1.485	0.5609
1.5557	1.2845	1.5557	0.9454	1.5557	0.8025	1.5557	0.7243	1.5557	0.696	1.5557	0.6469	1.5557	0.584
1.6298	1.5963	1.6298	0.9746	1.6298	0.8489	1.6298	0.7751	1.6298	0.7218	1.6298	0.6683	1.6298	0.604
1.7074	1.5963	1.7074	0.9746	1.7074	0.8847	1.7074	0.8015	1.7074	0.7551	1.7074	0.6813	1.7074	0.6228
1.7887	1.939	1.7887	1.1073	1.7887	1.0689	1.7887	0.93	1.7887	0.8319	1.7887	0.7035	1.7887	0.6419
1.8738	1.939	1.8738	1.1073	1.8738	1.0689	1.8738	0.93	1.8738	0.8319	1.8738	0.7304	1.8738	0.6589
1.963	1.939	1.963	1.1073	1.963	1.0689	1.963	0.93	1.963	0.8319	1.963	0.7451	1.963	0.671
2.0565	1.939	2.0565	1.1073	2.0565	1.0689	2.0565	0.93	2.0565	0.8319	2.0565	0.7593	2.0565	0.6798
2.1544	1.939	2.1544	1.1073	2.1544	1.0689	2.1544	0.93	2.1544	0.8543	2.1544	0.771	2.1544	0.6798
2.257	1.6562	2.257	1.0974	2.257	0.9634	2.257	0.9048	2.257	0.8543	2.257	0.771	2.257	0.6798

2.3645	1.6562	2.3645	1.0974	2.3645	0.9634	2.3645	0.9048	2.3645	0.8543	2.3645	0.771	2.3645	0.6798
2.4771	1.6073	2.4771	1.127	2.4771	0.9634	2.4771	0.9048	2.4771	0.8543	2.4771	0.771	2.4771	0.6798
2.595	1.6073	2.595	1.127	2.595	0.9634	2.595	0.9048	2.595	0.8543	2.595	0.771	2.595	0.6948
2.7186	1.6073	2.7186	1.127	2.7186	0.944	2.7186	0.8929	2.7186	0.8559	2.7186	0.775	2.7186	0.7152
2.848	1.6038	2.848	1.127	2.848	0.944	2.848	0.8929	2.848	0.8559	2.848	0.7972	2.848	0.7309
2.9836	1.5188	2.9836	1.127	2.9836	0.944	2.9836	0.8929	2.9836	0.8559	2.9836	0.7972	2.9836	0.7343
3.1257	1.4997	3.1257	1.1106	3.1257	0.9584	3.1257	0.8929	3.1257	0.8559	3.1257	0.7972	3.1257	0.7358
3.2745	1.4997	3.2745	1.1862	3.2745	1.0659	3.2745	0.9529	3.2745	0.8616	3.2745	0.7972	3.2745	0.7415
3.4305	1.6477	3.4305	1.2303	3.4305	1.0871	3.4305	0.9756	3.4305	0.8845	3.4305	0.8056	3.4305	0.7439
3.5938	1.729	3.5938	1.2303	3.5938	1.0871	3.5938	0.9756	3.5938	0.8845	3.5938	0.8201	3.5938	0.7521
3.7649	1.729	3.7649	1.2303	3.7649	1.0871	3.7649	0.9756	3.7649	0.8845	3.7649	0.8201	3.7649	0.7521
3.9442	1.729	3.9442	1.2303	3.9442	1.0871	3.9442	0.9756	3.9442	0.8845	3.9442	0.8201	3.9442	0.7521
4.132	1.729	4.132	1.2303	4.132	1.0871	4.132	0.9756	4.132	0.8845	4.132	0.8201	4.132	0.7521
4.3288	1.729	4.3288	1.2303	4.3288	1.0871	4.3288	0.9756	4.3288	0.8845	4.3288	0.8201	4.3288	0.7521
4.5349	1.729	4.5349	1.2303	4.5349	1.0871	4.5349	0.9756	4.5349	0.9034	4.5349	0.8114	4.5349	0.7477
4.7508	1.729	4.7508	1.2303	4.7508	1.0871	4.7508	0.9756	4.7508	0.9034	4.7508	0.8028	4.7508	0.7348
4.977	1.729	4.977	1.1517	4.977	1.0607	4.977	0.9698	4.977	0.9034	4.977	0.8028	4.977	0.7272
5.214	1.729	5.214	1.1517	5.214	1.0607	5.214	0.9698	5.214	0.9034	5.214	0.8028	5.214	0.7183
5.4623	1.5947	5.4623	1.1214	5.4623	1.0607	5.4623	0.9698	5.4623	0.9034	5.4623	0.8028	5.4623	0.7033
5.7224	1.5947	5.7224	1.1214	5.7224	1.0607	5.7224	0.9582	5.7224	0.8798	5.7224	0.767	5.7224	0.6597
5.9948	1.2803	5.9948	0.8736	5.9948	0.8444	5.9948	0.8127	5.9948	0.7784	5.9948	0.714	5.9948	0.6374
6.2803	1.2768	6.2803	0.8736	6.2803	0.7928	6.2803	0.744	6.2803	0.7149	6.2803	0.6643	6.2803	0.6028
6.5793	1.2768	6.5793	0.8736	6.5793	0.7928	6.5793	0.7329	6.5793	0.6884	6.5793	0.6225	6.5793	0.5669
6.8926	1.2768	6.8926	0.7867	6.8926	0.7205	6.8926	0.6929	6.8926	0.6658	6.8926	0.6141	6.8926	0.5521
7.2208	1.2768	7.2208	0.7867	7.2208	0.7205	7.2208	0.6813	7.2208	0.6481	7.2208	0.5934	7.2208	0.5329
7.5646	1.2768	7.5646	0.7419	7.5646	0.6843	7.5646	0.6433	7.5646	0.6156	7.5646	0.566	7.5646	0.5094
7.9248	1.2768	7.9248	0.7419	7.9248	0.6556	7.9248	0.6053	7.9248	0.5726	7.9248	0.5246	7.9248	0.474
8.3022	0.9787	8.3022	0.6352	8.3022	0.5554	8.3022	0.5224	8.3022	0.4986	8.3022	0.4686	8.3022	0.4312
8.6975	0.9787	8.6975	0.6069	8.6975	0.5554	8.6975	0.5224	8.6975	0.4986	8.6975	0.4615	8.6975	0.4198
9.1116	0.9787	9.1116	0.6069	9.1116	0.5468	9.1116	0.5167	9.1116	0.4921	9.1116	0.4537	9.1116	0.4127
9.5455	0.9302	9.5455	0.6061	9.5455	0.5391	9.5455	0.4962	9.5455	0.4665	9.5455	0.4253	9.5455	0.3942
10	0.8724	10	0.6061	10	0.5391	10	0.4962	10	0.4665	10	0.4253	10	0.3942
10.4762	0.8724	10.4762	0.5988	10.4762	0.5299	10.4762	0.481	10.4762	0.4557	10.4762	0.4227	10.4762	0.3942
10.975	0.8656	10.975	0.5988	10.975	0.5299	10.975	0.481	10.975	0.4447	10.975	0.4087	10.975	0.3874
11.4976	0.8656	11.4976	0.5988	11.4976	0.5299	11.4976	0.481	11.4976	0.4447	11.4976	0.3958	11.4976	0.3728
12.045	0.8656	12.045	0.5988	12.045	0.5299	12.045	0.481	12.045	0.4447	12.045	0.3958	12.045	0.3646
12.6186	0.8656	12.6186	0.5988	12.6186	0.5299	12.6186	0.481	12.6186	0.4447	12.6186	0.3958	12.6186	0.3544
13.2194	0.849	13.2194	0.5326	13.2194	0.4782	13.2194	0.4405	13.2194	0.4121	13.2194	0.3831	13.2194	0.3547
13.8489	0.917	13.8489	0.5326	13.8489	0.4782	13.8489	0.4405	13.8489	0.4121	13.8489	0.3831	13.8489	0.3575

14.5083	0.917	14.5083	0.5326	14.5083	0.4782	14.5083	0.4405	14.5083	0.4121	14.5083	0.3745	14.5083	0.3575
15.1991	0.917	15.1991	0.5078	15.1991	0.4515	15.1991	0.4192	15.1991	0.401	15.1991	0.3745	15.1991	0.3575
15.9228	0.917	15.9228	0.5078	15.9228	0.4515	15.9228	0.4192	15.9228	0.3981	15.9228	0.3729	15.9228	0.3575
16.681	0.917	16.681	0.5078	16.681	0.4515	16.681	0.4192	16.681	0.3981	16.681	0.3729	16.681	0.3575
17.4753	0.849	17.4753	0.4854	17.4753	0.4308	17.4753	0.4015	17.4753	0.3828	17.4753	0.3623	17.4753	0.3546
18.3074	0.7497	18.3074	0.489	18.3074	0.4321	18.3074	0.4015	18.3074	0.3828	18.3074	0.3623	18.3074	0.3546
19.1791	0.8055	19.1791	0.489	19.1791	0.4321	19.1791	0.4015	19.1791	0.3828	19.1791	0.3623	19.1791	0.3546
20.0923	0.8055	20.0923	0.489	20.0923	0.4321	20.0923	0.4015	20.0923	0.3828	20.0923	0.3623	20.0923	0.3546
21.049	0.8055	21.049	0.489	21.049	0.4321	21.049	0.4015	21.049	0.3828	21.049	0.3607	21.049	0.3508
22.0513	0.8055	22.0513	0.489	22.0513	0.4321	22.0513	0.4015	22.0513	0.3828	22.0513	0.3607	22.0513	0.3504
23.1013	0.8055	23.1013	0.489	23.1013	0.4321	23.1013	0.4015	23.1013	0.3828	23.1013	0.3607	23.1013	0.3504
24.2013	0.6472	24.2013	0.4363	24.2013	0.3973	24.2013	0.3743	24.2013	0.3617	24.2013	0.3546	24.2013	0.3479
25.3536	0.5613	25.3536	0.3979	25.3536	0.3777	25.3536	0.3663	25.3536	0.3586	25.3536	0.3522	25.3536	0.3477
26.5609	0.5613	26.5609	0.3979	26.5609	0.3777	26.5609	0.3663	26.5609	0.3586	26.5609	0.3491	26.5609	0.3452
27.8256	0.4901	27.8256	0.3647	27.8256	0.3523	27.8256	0.3488	27.8256	0.3467	27.8256	0.3435	27.8256	0.3406
29.1505	0.4073	29.1505	0.3548	29.1505	0.3518	29.1505	0.3488	29.1505	0.3467	29.1505	0.3435	29.1505	0.3402
30.5386	0.4073	30.5386	0.3548	30.5386	0.3518	30.5386	0.3488	30.5386	0.3467	30.5386	0.3435	30.5386	0.3402
31.9927	0.4073	31.9927	0.3465	31.9927	0.345	31.9927	0.3447	31.9927	0.3438	31.9927	0.3417	31.9927	0.3392
33.516	0.3423	33.516	0.3426	33.516	0.3419	33.516	0.341	33.516	0.3401	33.516	0.3386	33.516	0.3369
35.1119	0.3337	35.1119	0.3344	35.1119	0.3347	35.1119	0.3349	35.1119	0.3349	35.1119	0.3348	35.1119	0.3343
36.7838	0.3313	36.7838	0.3316	36.7838	0.3318	36.7838	0.3319	36.7838	0.332	36.7838	0.3321	36.7838	0.332
38.5353	0.3298	38.5353	0.3299	38.5353	0.33	38.5353	0.3301	38.5353	0.3302	38.5353	0.3303	38.5353	0.3303
40.3702	0.3286	40.3702	0.3287	40.3702	0.3288	40.3702	0.3289	40.3702	0.3289	40.3702	0.329	40.3702	0.3291
42.2924	0.3277	42.2924	0.3278	42.2924	0.3278	42.2924	0.3279	42.2924	0.3279	42.2924	0.328	42.2924	0.328
44.3062	0.327	44.3062	0.327	44.3062	0.3271	44.3062	0.3271	44.3062	0.3271	44.3062	0.3271	44.3062	0.3272
46.4159	0.3263	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3264	46.4159	0.3265
48.626	0.3257	48.626	0.3257	48.626	0.3257	48.626	0.3257	48.626	0.3258	48.626	0.3258	48.626	0.3258
50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252	50.9414	0.3252

**RPP-WTP Pretreatment Facility ISRS**  
**Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B**



S\_PTEE022.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-SOC-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 22E  
 North-South Responses  
 Elevation 0 ft. (Concrete)  
 Enveloped Spectra

Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0456	0.1098	0.0394	0.1098	0.0365	0.1098	0.0343	0.1098	0.0327	0.1098	0.0306	0.1098	0.0281
0.115	0.0555	0.115	0.0492	0.115	0.0464	0.115	0.0438	0.115	0.0417	0.115	0.038	0.115	0.0333
0.1204	0.0647	0.1204	0.058	0.1204	0.0543	0.1204	0.0509	0.1204	0.0479	0.1204	0.0425	0.1204	0.0361
0.1262	0.0719	0.1262	0.0618	0.1262	0.0571	0.1262	0.0533	0.1262	0.0498	0.1262	0.0438	0.1262	0.0378
0.1322	0.0762	0.1322	0.0652	0.1322	0.06	0.1322	0.0561	0.1322	0.0525	0.1322	0.0466	0.1322	0.0398
0.1385	0.0785	0.1385	0.0671	0.1385	0.0608	0.1385	0.0561	0.1385	0.0525	0.1385	0.0466	0.1385	0.0398
0.1451	0.0789	0.1451	0.0676	0.1451	0.0613	0.1451	0.0561	0.1451	0.0525	0.1451	0.0468	0.1451	0.0407
0.152	0.0789	0.152	0.0676	0.152	0.0613	0.152	0.0564	0.152	0.0534	0.152	0.0482	0.152	0.0428
0.1592	0.0789	0.1592	0.0676	0.1592	0.0613	0.1592	0.0564	0.1592	0.0534	0.1592	0.0482	0.1592	0.0438
0.1668	0.0789	0.1668	0.0676	0.1668	0.0613	0.1668	0.0564	0.1668	0.0534	0.1668	0.0482	0.1668	0.0438
0.1748	0.0789	0.1748	0.0676	0.1748	0.0613	0.1748	0.0564	0.1748	0.0534	0.1748	0.0482	0.1748	0.0438
0.1831	0.0789	0.1831	0.0676	0.1831	0.0613	0.1831	0.0564	0.1831	0.0534	0.1831	0.0482	0.1831	0.0438
0.1918	0.0789	0.1918	0.0676	0.1918	0.0613	0.1918	0.0562	0.1918	0.0532	0.1918	0.0482	0.1918	0.0438
0.2009	0.0789	0.2009	0.0676	0.2009	0.0613	0.2009	0.0562	0.2009	0.0532	0.2009	0.0482	0.2009	0.0438
0.2105	0.0735	0.2105	0.0632	0.2105	0.0596	0.2105	0.0562	0.2105	0.0532	0.2105	0.049	0.2105	0.0468
0.2205	0.0683	0.2205	0.0622	0.2205	0.0587	0.2205	0.0559	0.2205	0.0547	0.2205	0.0527	0.2205	0.0501
0.231	0.0647	0.231	0.0623	0.231	0.0609	0.231	0.0595	0.231	0.0583	0.231	0.056	0.231	0.0536
0.242	0.0759	0.242	0.0665	0.242	0.0647	0.242	0.0627	0.242	0.0614	0.242	0.0591	0.242	0.0565
0.2535	0.1097	0.2535	0.0915	0.2535	0.0824	0.2535	0.075	0.2535	0.0693	0.2535	0.0619	0.2535	0.059
0.2656	0.1215	0.2656	0.0949	0.2656	0.0825	0.2656	0.075	0.2656	0.0693	0.2656	0.0641	0.2656	0.0608
0.2783	0.1215	0.2783	0.0949	0.2783	0.0825	0.2783	0.0776	0.2783	0.0734	0.2783	0.0668	0.2783	0.0617
0.2915	0.1215	0.2915	0.1003	0.2915	0.0935	0.2915	0.0874	0.2915	0.0821	0.2915	0.073	0.2915	0.063
0.3054	0.1359	0.3054	0.1179	0.3054	0.1078	0.3054	0.099	0.3054	0.0914	0.3054	0.0795	0.3054	0.0673
0.3199	0.1641	0.3199	0.1267	0.3199	0.1153	0.3199	0.1055	0.3199	0.0971	0.3199	0.0837	0.3199	0.0734
0.3352	0.1864	0.3352	0.1319	0.3352	0.1153	0.3352	0.1055	0.3352	0.0971	0.3352	0.0859	0.3352	0.0764
0.3511	0.2152	0.3511	0.1625	0.3511	0.1375	0.3511	0.1183	0.3511	0.1047	0.3511	0.0907	0.3511	0.0787
0.3678	0.2152	0.3678	0.1625	0.3678	0.1375	0.3678	0.1252	0.3678	0.1165	0.3678	0.1042	0.3678	0.09

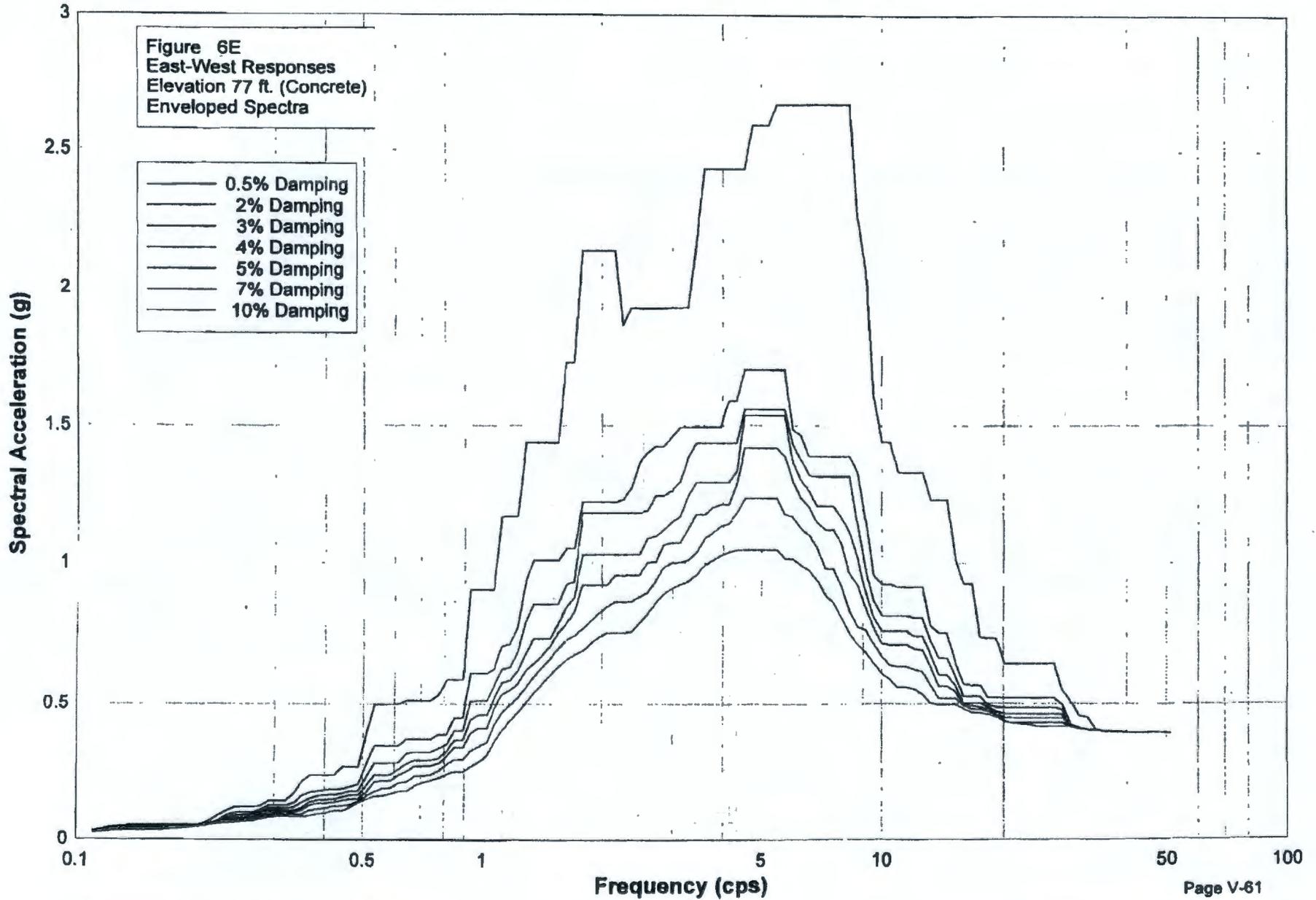
0.3853	0.2152	0.3853	0.1625	0.3853	0.1446	0.3853	0.1356	0.3853	0.1276	0.3853	0.1141	0.3853	0.0986
0.4037	0.2152	0.4037	0.1625	0.4037	0.1446	0.4037	0.1356	0.4037	0.1276	0.4037	0.1144	0.4037	0.1004
0.4229	0.2173	0.4229	0.1637	0.4229	0.1446	0.4229	0.1356	0.4229	0.1276	0.4229	0.1144	0.4229	0.1004
0.4431	0.3427	0.4431	0.2324	0.4431	0.1901	0.4431	0.1598	0.4431	0.1385	0.4431	0.119	0.4431	0.1089
0.4642	0.3427	0.4642	0.2324	0.4642	0.1921	0.4642	0.1724	0.4642	0.1573	0.4642	0.1361	0.4642	0.116
0.4863	0.3427	0.4863	0.2324	0.4863	0.1921	0.4863	0.1743	0.4863	0.1618	0.4863	0.1447	0.4863	0.1236
0.5094	0.3427	0.5094	0.2324	0.5094	0.1991	0.5094	0.1846	0.5094	0.1731	0.5094	0.1523	0.5094	0.1278
0.5337	0.3621	0.5337	0.2851	0.5337	0.229	0.5337	0.204	0.5337	0.1835	0.5337	0.1525	0.5337	0.1278
0.5591	0.3621	0.5591	0.2742	0.5591	0.238	0.5591	0.2093	0.5591	0.1883	0.5591	0.1551	0.5591	0.1354
0.5857	0.3621	0.5857	0.2805	0.5857	0.2483	0.5857	0.222	0.5857	0.2005	0.5857	0.1718	0.5857	0.1526
0.6136	0.3621	0.6136	0.2805	0.6136	0.2483	0.6136	0.222	0.6136	0.2017	0.6136	0.1821	0.6136	0.1622
0.6428	0.3715	0.6428	0.2805	0.6428	0.2483	0.6428	0.2235	0.6428	0.2108	0.6428	0.195	0.6428	0.1766
0.6734	0.3715	0.6734	0.2916	0.6734	0.2663	0.6734	0.2436	0.6734	0.2289	0.6734	0.2117	0.6734	0.1883
0.7055	0.4317	0.7055	0.3543	0.7055	0.3133	0.7055	0.279	0.7055	0.2589	0.7055	0.2257	0.7055	0.1944
0.7391	0.5134	0.7391	0.4029	0.7391	0.3524	0.7391	0.3115	0.7391	0.278	0.7391	0.2284	0.7391	0.1944
0.7743	0.6023	0.7743	0.4541	0.7743	0.3853	0.7743	0.3333	0.7743	0.2932	0.7743	0.2375	0.7743	0.2188
0.8111	0.7736	0.8111	0.4591	0.8111	0.3853	0.8111	0.3333	0.8111	0.2932	0.8111	0.2586	0.8111	0.2434
0.8497	0.7736	0.8497	0.4591	0.8497	0.3853	0.8497	0.3451	0.8497	0.3155	0.8497	0.2842	0.8497	0.2671
0.8902	0.7736	0.8902	0.4591	0.8902	0.388	0.8902	0.3627	0.8902	0.3375	0.8902	0.3097	0.8902	0.2901
0.9326	0.9974	0.9326	0.5856	0.9326	0.4664	0.9326	0.3986	0.9326	0.3523	0.9326	0.3345	0.9326	0.3123
0.977	0.9974	0.977	0.6002	0.977	0.5269	0.977	0.4456	0.977	0.3864	0.977	0.3568	0.977	0.3322
1.0235	0.9974	1.0235	0.6002	1.0235	0.5269	1.0235	0.4456	1.0235	0.3983	1.0235	0.375	1.0235	0.3489
1.0723	0.9974	1.0723	0.6002	1.0723	0.5269	1.0723	0.4578	1.0723	0.4362	1.0723	0.3969	1.0723	0.362
1.1233	1.1138	1.1233	0.6522	1.1233	0.5496	1.1233	0.5028	1.1233	0.4775	1.1233	0.432	1.1233	0.3768
1.1768	1.1138	1.1768	0.6522	1.1768	0.6238	1.1768	0.5399	1.1768	0.5091	1.1768	0.4574	1.1768	0.3984
1.2328	1.1138	1.2328	0.6522	1.2328	0.6238	1.2328	0.5399	1.2328	0.5091	1.2328	0.4606	1.2328	0.4063
1.2916	1.1138	1.2916	0.6628	1.2916	0.7232	1.2916	0.6287	1.2916	0.5604	1.2916	0.4712	1.2916	0.4074
1.353	1.1138	1.353	0.9365	1.353	0.794	1.353	0.6869	1.353	0.6112	1.353	0.5144	1.353	0.4326
1.4175	1.1138	1.4175	0.9365	1.4175	0.8087	1.4175	0.7456	1.4175	0.6895	1.4175	0.5953	1.4175	0.4819
1.485	1.2052	1.485	0.988	1.485	0.8866	1.485	0.7958	1.485	0.7285	1.485	0.6264	1.485	0.511
1.5557	1.4673	1.5557	1.0882	1.5557	0.9041	1.5557	0.7958	1.5557	0.7285	1.5557	0.6264	1.5557	0.5133
1.6298	1.4673	1.6298	1.0882	1.6298	0.9041	1.6298	0.7958	1.6298	0.7285	1.6298	0.6315	1.6298	0.5443
1.7074	1.4673	1.7074	1.0882	1.7074	0.9509	1.7074	0.8485	1.7074	0.7818	1.7074	0.6721	1.7074	0.5582
1.7887	1.9337	1.7887	1.1866	1.7887	1.0454	1.7887	0.9314	1.7887	0.8343	1.7887	0.6827	1.7887	0.5914
1.8738	1.9337	1.8738	1.1866	1.8738	1.0454	1.8738	0.9314	1.8738	0.8343	1.8738	0.6909	1.8738	0.6195
1.963	1.9337	1.963	1.2264	1.963	1.0454	1.963	0.9314	1.963	0.8343	1.963	0.7213	1.963	0.6444
2.0565	1.9337	2.0565	1.2264	2.0565	1.0454	2.0565	0.9314	2.0565	0.8343	2.0565	0.7554	2.0565	0.6649
2.1544	1.9337	2.1544	1.2264	2.1544	1.0454	2.1544	0.9314	2.1544	0.8343	2.1544	0.7745	2.1544	0.6753
2.257	1.6526	2.257	1.2264	2.257	1.0189	2.257	0.9197	2.257	0.8328	2.257	0.7876	2.257	0.6753

2.3645	1.8526	2.3645	1.2264	2.3645	0.946	2.3645	0.8625	2.3645	0.8087	2.3645	0.7876	2.3645	0.6753
2.4771	1.4968	2.4771	1.1813	2.4771	0.946	2.4771	0.8625	2.4771	0.8087	2.4771	0.7876	2.4771	0.6753
2.595	1.4968	2.595	1.1813	2.595	0.946	2.595	0.8625	2.595	0.8087	2.595	0.7876	2.595	0.6753
2.7186	1.5785	2.7186	1.1813	2.7186	0.946	2.7186	0.8625	2.7186	0.8087	2.7186	0.7876	2.7186	0.6751
2.848	1.5785	2.848	1.1813	2.848	0.946	2.848	0.859	2.848	0.8042	2.848	0.771	2.848	0.6514
2.9836	1.5785	2.9836	1.0072	2.9836	0.9027	2.9836	0.8216	2.9836	0.7681	2.9836	0.6806	2.9836	0.5889
3.1257	1.5785	3.1257	1.0196	3.1257	0.8195	3.1257	0.7692	3.1257	0.7236	3.1257	0.652	3.1257	0.5735
3.2745	1.8712	3.2745	1.0587	3.2745	0.9525	3.2745	0.8466	3.2745	0.7681	3.2745	0.6591	3.2745	0.5771
3.4305	1.8712	3.4305	1.0587	3.4305	0.9525	3.4305	0.8466	3.4305	0.7681	3.4305	0.6638	3.4305	0.5771
3.5938	1.8819	3.5938	1.2042	3.5938	1.0249	3.5938	0.908	3.5938	0.8231	3.5938	0.7044	3.5938	0.6039
3.7649	1.8819	3.7649	1.2042	3.7649	1.0249	3.7649	0.9193	3.7649	0.8542	3.7649	0.7564	3.7649	0.6471
3.9442	1.8819	3.9442	1.2042	3.9442	1.0249	3.9442	0.9193	3.9442	0.8542	3.9442	0.765	3.9442	0.665
4.132	1.8819	4.132	1.2042	4.132	1.0249	4.132	0.9584	4.132	0.8998	4.132	0.7958	4.132	0.6849
4.3288	1.8819	4.3288	1.2042	4.3288	1.0595	4.3288	1.0049	4.3288	0.9286	4.3288	0.8184	4.3288	0.7174
4.5349	1.8819	4.5349	1.2042	4.5349	1.0595	4.5349	1.013	4.5349	0.9482	4.5349	0.8437	4.5349	0.7242
4.7508	1.8819	4.7508	1.2133	4.7508	1.0676	4.7508	1.0414	4.7508	0.9565	4.7508	0.8437	4.7508	0.7242
4.977	1.8819	4.977	1.2133	4.977	1.0676	4.977	1.0414	4.977	0.9565	4.977	0.8437	4.977	0.7242
5.214	1.8819	5.214	1.2133	5.214	1.0676	5.214	1.0414	5.214	0.9565	5.214	0.8437	5.214	0.7242
5.4623	1.8588	5.4623	1.2133	5.4623	1.0676	5.4623	1.0414	5.4623	0.9565	5.4623	0.8437	5.4623	0.7242
5.7224	1.8588	5.7224	1.2133	5.7224	1.0676	5.7224	1.0414	5.7224	0.9565	5.7224	0.8263	5.7224	0.6943
5.9948	1.5279	5.9948	1.2133	5.9948	1.0676	5.9948	0.9501	5.9948	0.856	5.9948	0.731	5.9948	0.6191
6.2803	1.5279	6.2803	1.2133	6.2803	1.0676	6.2803	0.9501	6.2803	0.856	6.2803	0.7293	6.2803	0.6134
6.5793	1.5193	6.5793	1.2133	6.5793	1.0676	6.5793	0.9501	6.5793	0.856	6.5793	0.7136	6.5793	0.5858
6.8926	1.5193	6.8926	1.0422	6.8926	0.9338	6.8926	0.8392	6.8926	0.7938	6.8926	0.7012	6.8926	0.5804
7.2208	1.5193	7.2208	0.9784	7.2208	0.8888	7.2208	0.8319	7.2208	0.7768	7.2208	0.6808	7.2208	0.5679
7.5646	1.5193	7.5646	0.9407	7.5646	0.834	7.5646	0.7806	7.5646	0.727	7.5646	0.6328	7.5646	0.5403
7.9248	1.5193	7.9248	0.9407	7.9248	0.7957	7.9248	0.7221	7.9248	0.672	7.9248	0.6025	7.9248	0.5313
8.3022	1.5143	8.3022	0.7983	8.3022	0.662	8.3022	0.6131	8.3022	0.5906	8.3022	0.5511	8.3022	0.5
8.6975	1.1566	8.6975	0.7425	8.6975	0.662	8.6975	0.6116	8.6975	0.5792	8.6975	0.5323	8.6975	0.4853
9.1116	1.082	9.1116	0.8528	9.1116	0.5886	9.1116	0.5397	9.1116	0.5209	9.1116	0.5008	9.1116	0.4735
9.5455	1.082	9.5455	0.6477	9.5455	0.5702	9.5455	0.5208	9.5455	0.5082	9.5455	0.4873	9.5455	0.4651
10	0.9286	10	0.6224	10	0.5625	10	0.5208	10	0.5082	10	0.4873	10	0.4651
10.4762	0.8591	10.4762	0.5732	10.4762	0.5348	10.4762	0.5193	10.4762	0.5065	10.4762	0.4855	10.4762	0.4609
10.975	0.8591	10.975	0.5732	10.975	0.5049	10.975	0.496	10.975	0.4867	10.975	0.4693	10.975	0.4468
11.4976	0.7544	11.4976	0.5377	11.4976	0.4857	11.4976	0.4755	11.4976	0.4693	11.4976	0.4577	11.4976	0.4423
12.045	0.7544	12.045	0.5026	12.045	0.4753	12.045	0.4651	12.045	0.4586	12.045	0.4489	12.045	0.436
12.6186	0.7544	12.6186	0.4796	12.6186	0.4572	12.6186	0.4527	12.6186	0.4481	12.6186	0.4393	12.6186	0.4274
13.2194	0.7544	13.2194	0.4531	13.2194	0.4433	13.2194	0.4378	13.2194	0.4336	13.2194	0.4263	13.2194	0.4166
13.8489	0.5993	13.8489	0.4219	13.8489	0.4173	13.8489	0.4169	13.8489	0.4158	13.8489	0.412	13.8489	0.4049

14.5083	0.5993	14.5083	0.4219	14.5083	0.4147	14.5083	0.4103	14.5083	0.4068	14.5083	0.4011	14.5083	0.394
15.1991	0.5993	15.1991	0.4219	15.1991	0.4024	15.1991	0.3966	15.1991	0.393	15.1991	0.3882	15.1991	0.3825
15.9228	0.5993	15.9228	0.4213	15.9228	0.3823	15.9228	0.3773	15.9228	0.3774	15.9228	0.3753	15.9228	0.3712
16.681	0.5993	16.681	0.4213	16.681	0.3807	16.681	0.3694	16.681	0.366	16.681	0.3635	16.681	0.3605
17.4753	0.7174	17.4753	0.416	17.4753	0.3644	17.4753	0.3552	17.4753	0.3513	17.4753	0.352	17.4753	0.3511
18.3074	0.7174	18.3074	0.416	18.3074	0.3686	18.3074	0.3552	18.3074	0.35	18.3074	0.3471	18.3074	0.3445
19.1791	0.7174	19.1791	0.4309	19.1791	0.3767	19.1791	0.3552	19.1791	0.35	19.1791	0.3449	19.1791	0.3419
20.0923	0.7174	20.0923	0.4309	20.0923	0.3767	20.0923	0.3517	20.0923	0.3445	20.0923	0.3407	20.0923	0.3381
21.049	0.7174	21.049	0.4309	21.049	0.3767	21.049	0.3517	21.049	0.3445	21.049	0.3407	21.049	0.3371
22.0513	0.7174	22.0513	0.4309	22.0513	0.3767	22.0513	0.3517	22.0513	0.3445	22.0513	0.3407	22.0513	0.3371
23.1013	0.7174	23.1013	0.4309	23.1013	0.3767	23.1013	0.3479	23.1013	0.3445	23.1013	0.3407	23.1013	0.3371
24.2013	0.7174	24.2013	0.4105	24.2013	0.3521	24.2013	0.3479	24.2013	0.3445	24.2013	0.3407	24.2013	0.3371
25.3536	0.6529	25.3536	0.4105	25.3536	0.3521	25.3536	0.3479	25.3536	0.3445	25.3536	0.3396	25.3536	0.3356
26.5609	0.6529	26.5609	0.4105	26.5609	0.3521	26.5609	0.3479	26.5609	0.3445	26.5609	0.3396	26.5609	0.3356
27.8256	0.6529	27.8256	0.3657	27.8256	0.3521	27.8256	0.3479	27.8256	0.3445	27.8256	0.3393	27.8256	0.334
29.1505	0.5526	29.1505	0.3657	29.1505	0.3374	29.1505	0.335	29.1505	0.3348	29.1505	0.3331	29.1505	0.3297
30.5386	0.4393	30.5386	0.3422	30.5386	0.3374	30.5386	0.3348	30.5386	0.3325	30.5386	0.3287	30.5386	0.3247
31.9927	0.3966	31.9927	0.3422	31.9927	0.3313	31.9927	0.326	31.9927	0.323	31.9927	0.3199	31.9927	0.3178
33.516	0.3014	33.516	0.3015	33.516	0.3016	33.516	0.3036	33.516	0.306	33.516	0.3088	33.516	0.3105
35.1119	0.3014	35.1119	0.3015	35.1119	0.3016	35.1119	0.3019	35.1119	0.3025	35.1119	0.3043	35.1119	0.3061
36.7838	0.3014	36.7838	0.3015	36.7838	0.3016	36.7838	0.3019	36.7838	0.3022	36.7838	0.3029	36.7838	0.3039
38.5353	0.3014	38.5353	0.3015	38.5353	0.3016	38.5353	0.3017	38.5353	0.3018	38.5353	0.3021	38.5353	0.3027
40.3702	0.301	40.3702	0.301	40.3702	0.3011	40.3702	0.3011	40.3702	0.3012	40.3702	0.3014	40.3702	0.3016
42.2924	0.3004	42.2924	0.3004	42.2924	0.3004	42.2924	0.3004	42.2924	0.3005	42.2924	0.3006	42.2924	0.3007
44.3062	0.2996	44.3062	0.2997	44.3062	0.2997	44.3062	0.2997	44.3062	0.2997	44.3062	0.2998	44.3062	0.2999
46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.2989	46.4159	0.299	46.4159	0.2991
48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2982	48.626	0.2983
50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975	50.9414	0.2975

# RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTEE006.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 6E  
 East-West Responses  
 Elevation 77 ft. (Concrete)  
 Enveloped Spectra

Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0314	0.1098	0.0289	0.1098	0.0276	0.1098	0.0269	0.1098	0.0262	0.1098	0.0249	0.1098	0.0233
0.115	0.0359	0.115	0.0331	0.115	0.0316	0.115	0.0302	0.115	0.0291	0.115	0.0276	0.115	0.0255
0.1204	0.0411	0.1204	0.0383	0.1204	0.0368	0.1204	0.0354	0.1204	0.0341	0.1204	0.0317	0.1204	0.0288
0.1262	0.046	0.1262	0.0427	0.1262	0.0408	0.1262	0.039	0.1262	0.0373	0.1262	0.0344	0.1262	0.0313
0.1322	0.0489	0.1322	0.0443	0.1322	0.0422	0.1322	0.0403	0.1322	0.0386	0.1322	0.0357	0.1322	0.0323
0.1385	0.0518	0.1385	0.0463	0.1385	0.0431	0.1385	0.0403	0.1385	0.0386	0.1385	0.0357	0.1385	0.0323
0.1451	0.0518	0.1451	0.0463	0.1451	0.0431	0.1451	0.0403	0.1451	0.0386	0.1451	0.0357	0.1451	0.0323
0.152	0.0518	0.152	0.0463	0.152	0.0431	0.152	0.0403	0.152	0.0386	0.152	0.0357	0.152	0.0323
0.1592	0.0518	0.1592	0.0463	0.1592	0.0431	0.1592	0.0403	0.1592	0.0386	0.1592	0.0357	0.1592	0.0326
0.1668	0.0519	0.1668	0.0463	0.1668	0.0431	0.1668	0.0403	0.1668	0.0386	0.1668	0.0364	0.1668	0.0354
0.1748	0.0519	0.1748	0.0463	0.1748	0.0431	0.1748	0.041	0.1748	0.0405	0.1748	0.0396	0.1748	0.0381
0.1831	0.0519	0.1831	0.0463	0.1831	0.0455	0.1831	0.0448	0.1831	0.0441	0.1831	0.0428	0.1831	0.0408
0.1918	0.0522	0.1918	0.0506	0.1918	0.0496	0.1918	0.0487	0.1918	0.0478	0.1918	0.046	0.1918	0.0439
0.2009	0.057	0.2009	0.055	0.2009	0.0537	0.2009	0.0526	0.2009	0.0515	0.2009	0.0498	0.2009	0.0476
0.2105	0.0708	0.2105	0.0602	0.2105	0.0587	0.2105	0.0575	0.2105	0.0563	0.2105	0.0542	0.2105	0.052
0.2205	0.091	0.2205	0.0715	0.2205	0.0644	0.2205	0.0626	0.2205	0.0612	0.2205	0.0588	0.2205	0.0562
0.231	0.1081	0.231	0.0909	0.231	0.0815	0.231	0.0736	0.231	0.0676	0.231	0.0634	0.231	0.0598
0.242	0.1197	0.242	0.0994	0.242	0.0885	0.242	0.0794	0.242	0.0717	0.242	0.0669	0.242	0.0625
0.2535	0.1207	0.2535	0.0995	0.2535	0.0885	0.2535	0.0797	0.2535	0.0756	0.2535	0.0698	0.2535	0.0663
0.2656	0.1207	0.2656	0.0995	0.2656	0.0825	0.2656	0.0882	0.2656	0.0843	0.2656	0.0772	0.2656	0.0689
0.2783	0.1257	0.2783	0.1098	0.2783	0.101	0.2783	0.095	0.2783	0.0907	0.2783	0.0838	0.2783	0.0759
0.2915	0.1427	0.2915	0.125	0.2915	0.115	0.2915	0.1062	0.2915	0.0983	0.2915	0.0891	0.2915	0.0818
0.3054	0.1427	0.3054	0.125	0.3054	0.1154	0.3054	0.1071	0.3054	0.0997	0.3054	0.0914	0.3054	0.0848
0.3199	0.1427	0.3199	0.125	0.3199	0.1154	0.3199	0.1071	0.3199	0.0997	0.3199	0.0914	0.3199	0.0852
0.3352	0.1714	0.3352	0.1351	0.3352	0.1191	0.3352	0.1071	0.3352	0.0997	0.3352	0.0914	0.3352	0.0852
0.3511	0.2178	0.3511	0.1633	0.3511	0.1372	0.3511	0.1174	0.3511	0.1084	0.3511	0.0938	0.3511	0.0852
0.3678	0.2403	0.3678	0.176	0.3678	0.1535	0.3678	0.1399	0.3678	0.128	0.3678	0.1083	0.3678	0.0892

0.3853	0.2403	0.3853	0.1806	0.3853	0.1625	0.3853	0.147	0.3853	0.1338	0.3853	0.1128	0.3853	0.0957
0.4037	0.2403	0.4037	0.1859	0.4037	0.1657	0.4037	0.149	0.4037	0.135	0.4037	0.1171	0.4037	0.0998
0.4229	0.2403	0.4229	0.1859	0.4229	0.1657	0.4229	0.1499	0.4229	0.1384	0.4229	0.1225	0.4229	0.1059
0.4431	0.2701	0.4431	0.1875	0.4431	0.1716	0.4431	0.1575	0.4431	0.145	0.4431	0.1247	0.4431	0.1059
0.4642	0.2701	0.4642	0.1968	0.4642	0.1795	0.4642	0.1641	0.4642	0.1507	0.4642	0.1283	0.4642	0.1192
0.4863	0.2701	0.4863	0.2056	0.4863	0.1804	0.4863	0.1641	0.4863	0.1507	0.4863	0.1412	0.4863	0.1353
0.5094	0.3947	0.5094	0.2813	0.5094	0.2346	0.5094	0.2012	0.5094	0.1765	0.5094	0.1614	0.5094	0.1505
0.5337	0.4997	0.5337	0.3481	0.5337	0.2843	0.5337	0.2411	0.5337	0.2145	0.5337	0.1783	0.5337	0.161
0.5591	0.4997	0.5591	0.3481	0.5591	0.2843	0.5591	0.2411	0.5591	0.2181	0.5591	0.1904	0.5591	0.1626
0.5857	0.4997	0.5857	0.3481	0.5857	0.2843	0.5857	0.2411	0.5857	0.2181	0.5857	0.1904	0.5857	0.1691
0.6136	0.4997	0.6136	0.3481	0.6136	0.287	0.6136	0.2611	0.6136	0.2405	0.6136	0.2095	0.6136	0.1783
0.6428	0.5129	0.6428	0.3748	0.6428	0.3198	0.6428	0.2818	0.6428	0.2536	0.6428	0.214	0.6428	0.1783
0.6734	0.5129	0.6734	0.3748	0.6734	0.3264	0.6734	0.2974	0.6734	0.2737	0.6734	0.2372	0.6734	0.1992
0.7055	0.5129	0.7055	0.3748	0.7055	0.3264	0.7055	0.2974	0.7055	0.2737	0.7055	0.2372	0.7055	0.2098
0.7391	0.5129	0.7391	0.3748	0.7391	0.3264	0.7391	0.2974	0.7391	0.2737	0.7391	0.2407	0.7391	0.2193
0.7743	0.5335	0.7743	0.3916	0.7743	0.3391	0.7743	0.3039	0.7743	0.2849	0.7743	0.2555	0.7743	0.2308
0.8111	0.5884	0.8111	0.3927	0.8111	0.3541	0.8111	0.3276	0.8111	0.3099	0.8111	0.2801	0.8111	0.2444
0.8497	0.5884	0.8497	0.4507	0.8497	0.4046	0.8497	0.3692	0.8497	0.3408	0.8497	0.2971	0.8497	0.2516
0.8902	0.5884	0.8902	0.4507	0.8902	0.4046	0.8902	0.3692	0.8902	0.3408	0.8902	0.2971	0.8902	0.2516
0.9326	0.907	0.9326	0.6127	0.9326	0.5121	0.9326	0.4441	0.9326	0.3953	0.9326	0.3297	0.9326	0.2714
0.977	0.907	0.977	0.6127	0.977	0.5136	0.977	0.4604	0.977	0.4144	0.977	0.3455	0.977	0.2883
1.0235	0.907	1.0235	0.6127	1.0235	0.5136	1.0235	0.4604	1.0235	0.4144	1.0235	0.3621	1.0235	0.3137
1.0723	0.907	1.0723	0.6274	1.0723	0.5678	1.0723	0.5191	1.0723	0.4836	1.0723	0.4261	1.0723	0.3634
1.1233	1.168	1.1233	0.7103	1.1233	0.6256	1.1233	0.5775	1.1233	0.5347	1.1233	0.4691	1.1233	0.4056
1.1768	1.168	1.1768	0.7159	1.1768	0.6311	1.1768	0.5847	1.1768	0.5488	1.1768	0.4951	1.1768	0.4381
1.2328	1.168	1.2328	0.7742	1.2328	0.6868	1.2328	0.6188	1.2328	0.5733	1.2328	0.5223	1.2328	0.4691
1.2916	1.4394	1.2916	0.933	1.2916	0.7935	1.2916	0.6819	1.2916	0.6203	1.2916	0.5595	1.2916	0.5037
1.353	1.4394	1.353	1.0107	1.353	0.8561	1.353	0.7366	1.353	0.6465	1.353	0.5986	1.353	0.539
1.4175	1.4394	1.4175	1.0107	1.4175	0.8561	1.4175	0.7366	1.4175	0.676	1.4175	0.6312	1.4175	0.5715
1.485	1.4394	1.485	1.0107	1.485	0.8561	1.485	0.7366	1.485	0.7092	1.485	0.664	1.485	0.6039
1.5557	1.4394	1.5557	1.0107	1.5557	0.8561	1.5557	0.7866	1.5557	0.7557	1.5557	0.7023	1.5557	0.634
1.6298	1.7292	1.6298	1.0521	1.6298	0.9256	1.6298	0.8473	1.6298	0.7898	1.6298	0.7315	1.6298	0.6605
1.7074	1.7292	1.7074	1.0521	1.7074	0.9348	1.7074	0.879	1.7074	0.8295	1.7074	0.748	1.7074	0.6783
1.7887	2.1395	1.7887	1.2235	1.7887	1.1827	1.7887	1.0302	1.7887	0.9224	1.7887	0.7696	1.7887	0.6918
1.8738	2.1395	1.8738	1.2235	1.8738	1.1827	1.8738	1.0302	1.8738	0.9224	1.8738	0.7958	1.8738	0.7181
1.963	2.1395	1.963	1.2235	1.963	1.1827	1.963	1.0302	1.963	0.9224	1.963	0.8233	1.963	0.7412
2.0565	2.1395	2.0565	1.2235	2.0565	1.1827	2.0565	1.0302	2.0565	0.9224	2.0565	0.8464	2.0565	0.7562
2.1544	2.1395	2.1544	1.2235	2.1544	1.1827	2.1544	1.0302	2.1544	0.956	2.1544	0.8634	2.1544	0.7566
2.257	1.8655	2.257	1.2311	2.257	1.1827	2.257	1.0302	2.257	0.956	2.257	0.8634	2.257	0.7566

2.3645	1.9283	2.3645	1.2725	2.3645	1.1827	2.3645	1.0302	2.3645	0.956	2.3645	0.8634	2.3645	0.7574
2.4771	1.9283	2.4771	1.3663	2.4771	1.1827	2.4771	1.0302	2.4771	0.9561	2.4771	0.8798	2.4771	0.7883
2.595	1.9283	2.595	1.4031	2.595	1.1893	2.595	1.0882	2.595	1.002	2.595	0.8969	2.595	0.8218
2.7186	1.9283	2.7186	1.426	2.7186	1.244	2.7186	1.0965	2.7186	1.003	2.7186	0.9367	2.7186	0.8593
2.848	1.9283	2.848	1.426	2.848	1.244	2.848	1.12	2.848	1.0657	2.848	0.9822	2.848	0.8917
2.9836	1.9305	2.9836	1.4595	2.9836	1.2631	2.9836	1.1486	2.9836	1.0724	2.9836	1.0006	2.9836	0.9093
3.1257	1.9305	3.1257	1.4936	3.1257	1.2982	3.1257	1.1662	3.1257	1.0724	3.1257	1.0031	3.1257	0.9247
3.2745	1.9305	3.2745	1.4936	3.2745	1.3839	3.2745	1.2443	3.2745	1.1253	3.2745	1.0094	3.2745	0.9364
3.4305	2.1639	3.4305	1.4936	3.4305	1.438	3.4305	1.2942	3.4305	1.1756	3.4305	1.0379	3.4305	0.9574
3.5938	2.4397	3.5938	1.4936	3.5938	1.438	3.5938	1.2942	3.5938	1.1756	3.5938	1.0872	3.5938	0.9915
3.7649	2.4397	3.7649	1.4936	3.7649	1.438	3.7649	1.2942	3.7649	1.2011	3.7649	1.1103	3.7649	1.01
3.9442	2.4397	3.9442	1.4936	3.9442	1.438	3.9442	1.2942	3.9442	1.2125	3.9442	1.1322	3.9442	1.027
4.132	2.4397	4.132	1.5905	4.132	1.438	4.132	1.2942	4.132	1.2129	4.132	1.1433	4.132	1.0403
4.3288	2.4397	4.3288	1.5905	4.3288	1.438	4.3288	1.3377	4.3288	1.2864	4.3288	1.1828	4.3288	1.0466
4.5349	2.4397	4.5349	1.7034	4.5349	1.5598	4.5349	1.5366	4.5349	1.4195	4.5349	1.2359	4.5349	1.0471
4.7508	2.5935	4.7508	1.7034	4.7508	1.5598	4.7508	1.5369	4.7508	1.4195	4.7508	1.2359	4.7508	1.0471
4.977	2.5935	4.977	1.7034	4.977	1.5598	4.977	1.5369	4.977	1.4195	4.977	1.2359	4.977	1.0471
5.214	2.5935	5.214	1.7034	5.214	1.5598	5.214	1.5369	5.214	1.4195	5.214	1.2359	5.214	1.0471
5.4623	2.6705	5.4623	1.7034	5.4623	1.5598	5.4623	1.5369	5.4623	1.4195	5.4623	1.2359	5.4623	1.0471
5.7224	2.6705	5.7224	1.7034	5.7224	1.5598	5.7224	1.5369	5.7224	1.3894	5.7224	1.1786	5.7224	1.0148
5.9948	2.6705	5.9948	1.4863	5.9948	1.4339	5.9948	1.3671	5.9948	1.298	5.9948	1.1683	5.9948	1.0148
6.2803	2.6705	6.2803	1.4665	6.2803	1.3756	6.2803	1.3021	6.2803	1.2378	6.2803	1.1263	6.2803	0.9924
6.5793	2.6705	6.5793	1.3892	6.5793	1.3198	6.5793	1.2621	6.5793	1.2047	6.5793	1.1014	6.5793	0.9743
6.8926	2.6721	6.8926	1.3892	6.8926	1.3154	6.8926	1.2076	6.8926	1.1475	6.8926	1.0524	6.8926	0.9402
7.2208	2.6721	7.2208	1.3892	7.2208	1.3154	7.2208	1.2076	7.2208	1.1212	7.2208	0.9816	7.2208	0.8881
7.5646	2.6721	7.5646	1.3892	7.5646	1.3154	7.5646	1.2076	7.5646	1.1212	7.5646	0.9805	7.5646	0.8604
7.9248	2.6721	7.9248	1.3892	7.9248	1.3154	7.9248	1.1669	7.9248	1.0689	7.9248	0.9186	7.9248	0.8095
8.3022	2.6721	8.3022	1.3892	8.3022	1.3154	8.3022	1.1119	8.3022	0.965	8.3022	0.8323	8.3022	0.7581
8.6975	2.2773	8.6975	1.329	8.6975	1.1414	8.6975	1.0201	8.6975	0.9238	8.6975	0.7781	8.6975	0.7165
9.1116	2.0653	9.1116	1.1587	9.1116	0.9831	9.1116	0.8993	9.1116	0.8446	9.1116	0.7675	9.1116	0.6862
9.5455	1.6085	9.5455	0.9584	9.5455	0.8663	9.5455	0.8096	9.5455	0.7738	9.5455	0.7154	9.5455	0.6462
10	1.4427	10	0.927	10	0.817	10	0.7614	10	0.7184	10	0.6701	10	0.6104
10.4762	1.4427	10.4762	0.927	10.4762	0.8156	10.4762	0.7614	10.4762	0.7132	10.4762	0.6399	10.4762	0.5871
10.975	1.3323	10.975	0.9176	10.975	0.8156	10.975	0.7614	10.975	0.7132	10.975	0.6348	10.975	0.5606
11.4976	1.3323	11.4976	0.9176	11.4976	0.8156	11.4976	0.7614	11.4976	0.7132	11.4976	0.6348	11.4976	0.5606
12.045	1.3323	12.045	0.9176	12.045	0.8073	12.045	0.7448	12.045	0.6972	12.045	0.6244	12.045	0.5528
12.6186	1.3323	12.6186	0.9176	12.6186	0.8073	12.6186	0.7441	12.6186	0.6935	12.6186	0.6159	12.6186	0.5346
13.2194	1.2305	13.2194	0.7787	13.2194	0.7246	13.2194	0.6739	13.2194	0.6308	13.2194	0.5648	13.2194	0.5011
13.8489	1.2305	13.8489	0.7544	13.8489	0.6632	13.8489	0.604	13.8489	0.5635	13.8489	0.5187	13.8489	0.4957

14.5083	1.2305	14.5083	0.7544	14.5083	0.6629	14.5083	0.6028	14.5083	0.5635	14.5083	0.5187	14.5083	0.4957
15.1991	1.012	15.1991	0.6452	15.1991	0.5972	15.1991	0.5643	15.1991	0.5417	15.1991	0.5187	15.1991	0.4952
15.9228	0.9276	15.9228	0.5712	15.9228	0.5274	15.9228	0.5028	15.9228	0.4971	15.9228	0.492	15.9228	0.4805
16.681	0.9276	16.681	0.5663	16.681	0.5274	16.681	0.5028	16.681	0.4912	16.681	0.4789	16.681	0.4675
17.4753	0.741	17.4753	0.5663	17.4753	0.5274	17.4753	0.5028	17.4753	0.4855	17.4753	0.4775	17.4753	0.4665
18.3074	0.7343	18.3074	0.5209	18.3074	0.4936	18.3074	0.4851	18.3074	0.4791	18.3074	0.4702	18.3074	0.4597
19.1791	0.7343	19.1791	0.5209	19.1791	0.4849	19.1791	0.4691	19.1791	0.4628	19.1791	0.4548	19.1791	0.4475
20.0923	0.6437	20.0923	0.5209	20.0923	0.4849	20.0923	0.4624	20.0923	0.4471	20.0923	0.4361	20.0923	0.433
21.049	0.6437	21.049	0.5209	21.049	0.4849	21.049	0.4624	21.049	0.4471	21.049	0.4307	21.049	0.429
22.0513	0.6443	22.0513	0.5209	22.0513	0.4849	22.0513	0.4624	22.0513	0.4471	22.0513	0.4304	22.0513	0.4267
23.1013	0.6443	23.1013	0.5209	23.1013	0.4849	23.1013	0.4624	23.1013	0.4471	23.1013	0.4311	23.1013	0.424
24.2013	0.6443	24.2013	0.5209	24.2013	0.4849	24.2013	0.4624	24.2013	0.4471	24.2013	0.4311	24.2013	0.4187
25.3536	0.6443	25.3536	0.5209	25.3536	0.4849	25.3536	0.4624	25.3536	0.4471	25.3536	0.4311	25.3536	0.4187
26.5609	0.6443	26.5609	0.5209	26.5609	0.4849	26.5609	0.4624	26.5609	0.4471	26.5609	0.4311	26.5609	0.4187
27.8256	0.55	27.8256	0.495	27.8256	0.4759	27.8256	0.4595	27.8256	0.4471	27.8256	0.4311	27.8256	0.4187
29.1505	0.5074	29.1505	0.4252	29.1505	0.4162	29.1505	0.4191	29.1505	0.4198	29.1505	0.4188	29.1505	0.4152
30.5386	0.4557	30.5386	0.4135	30.5386	0.4124	30.5386	0.412	30.5386	0.4115	30.5386	0.4105	30.5386	0.4099
31.9927	0.4496	31.9927	0.4062	31.9927	0.4055	31.9927	0.4055	31.9927	0.4061	31.9927	0.4066	31.9927	0.4065
33.516	0.407	33.516	0.4062	33.516	0.4055	33.516	0.4051	33.516	0.4048	33.516	0.4045	33.516	0.4043
35.1119	0.4017	35.1119	0.4021	35.1119	0.4022	35.1119	0.4024	35.1119	0.4024	35.1119	0.4025	35.1119	0.4024
36.7838	0.4001	36.7838	0.4003	36.7838	0.4005	36.7838	0.4008	36.7838	0.4007	36.7838	0.4008	36.7838	0.401
38.5353	0.3991	38.5353	0.3993	38.5353	0.3994	38.5353	0.3995	38.5353	0.3995	38.5353	0.3997	38.5353	0.3998
40.3702	0.3984	40.3702	0.3985	40.3702	0.3986	40.3702	0.3987	40.3702	0.3987	40.3702	0.3988	40.3702	0.3989
42.2924	0.3979	42.2924	0.3979	42.2924	0.398	42.2924	0.398	42.2924	0.3981	42.2924	0.3981	42.2924	0.3982
44.3062	0.3974	44.3062	0.3974	44.3062	0.3975	44.3062	0.3975	44.3062	0.3975	44.3062	0.3976	44.3062	0.3976
46.4159	0.397	46.4159	0.397	46.4159	0.397	46.4159	0.397	46.4159	0.397	46.4159	0.3971	46.4159	0.3971
48.626	0.3966	48.626	0.3966	48.626	0.3966	48.626	0.3966	48.626	0.3966	48.626	0.3966	48.626	0.3967
50.9414	0.3962	50.9414	0.3962	50.9414	0.3962	50.9414	0.3962	50.9414	0.3962	50.9414	0.3962	50.9414	0.3963

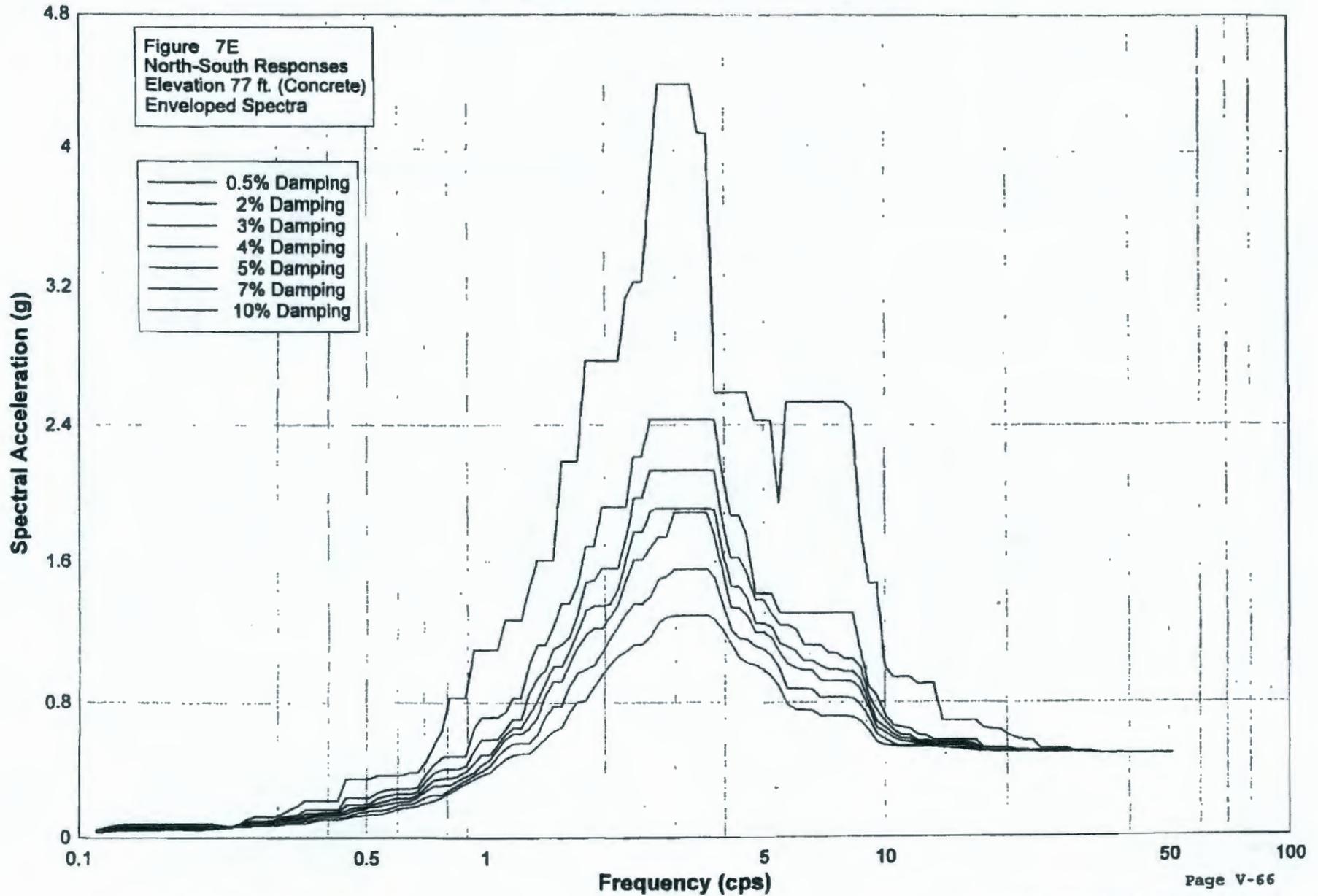
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 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 7E  
 North-South Responses  
 Elevation 77 ft. (Concrete)  
 Enveloped Spectra

Damping	0.50%	Damping	2%	Damping	3%	Damping	4%	Damping	5%	Damping	7%	Damping	10%
Freq.	Accel.												
0.1098	0.0457	0.1098	0.0394	0.1098	0.0368	0.1098	0.0346	0.1098	0.0333	0.1098	0.0314	0.1098	0.029
0.115	0.0556	0.115	0.0495	0.115	0.0468	0.115	0.0445	0.115	0.0424	0.115	0.0387	0.115	0.0341
0.1204	0.065	0.1204	0.0585	0.1204	0.0548	0.1204	0.0514	0.1204	0.0484	0.1204	0.0431	0.1204	0.0368
0.1262	0.072	0.1262	0.0619	0.1262	0.0573	0.1262	0.0534	0.1262	0.0499	0.1262	0.044	0.1262	0.0387
0.1322	0.0763	0.1322	0.0654	0.1322	0.0606	0.1322	0.0566	0.1322	0.0532	0.1322	0.0474	0.1322	0.0408
0.1385	0.0787	0.1385	0.0673	0.1385	0.0609	0.1385	0.0566	0.1385	0.0532	0.1385	0.0474	0.1385	0.0408
0.1451	0.0789	0.1451	0.0676	0.1451	0.0613	0.1451	0.0566	0.1451	0.0532	0.1451	0.0474	0.1451	0.0414
0.152	0.0789	0.152	0.0676	0.152	0.0613	0.152	0.0569	0.152	0.054	0.152	0.049	0.152	0.0438
0.1592	0.0789	0.1592	0.0676	0.1592	0.0613	0.1592	0.0569	0.1592	0.054	0.1592	0.0495	0.1592	0.0446
0.1668	0.0792	0.1668	0.0677	0.1668	0.0613	0.1668	0.0569	0.1668	0.054	0.1668	0.0495	0.1668	0.0446
0.1748	0.0794	0.1748	0.068	0.1748	0.0616	0.1748	0.0569	0.1748	0.054	0.1748	0.0495	0.1748	0.0446
0.1831	0.0794	0.1831	0.068	0.1831	0.0616	0.1831	0.0569	0.1831	0.054	0.1831	0.0495	0.1831	0.0446
0.1918	0.0794	0.1918	0.068	0.1918	0.0616	0.1918	0.0568	0.1918	0.0539	0.1918	0.0495	0.1918	0.0446
0.2009	0.0794	0.2009	0.068	0.2009	0.0616	0.2009	0.0568	0.2009	0.0537	0.2009	0.0487	0.2009	0.0448
0.2105	0.0744	0.2105	0.0638	0.2105	0.0601	0.2105	0.0568	0.2105	0.0537	0.2105	0.0501	0.2105	0.0489
0.2205	0.0694	0.2205	0.0633	0.2205	0.0597	0.2205	0.0567	0.2205	0.0557	0.2205	0.0543	0.2205	0.0527
0.231	0.0656	0.231	0.0633	0.231	0.062	0.231	0.0608	0.231	0.0598	0.231	0.0581	0.231	0.0561
0.242	0.0768	0.242	0.0695	0.242	0.0657	0.242	0.0645	0.242	0.0633	0.242	0.0614	0.242	0.059
0.2535	0.1108	0.2535	0.0924	0.2535	0.0831	0.2535	0.0756	0.2535	0.0697	0.2535	0.064	0.2535	0.0613
0.2656	0.1224	0.2656	0.0958	0.2656	0.0833	0.2656	0.0756	0.2656	0.0697	0.2656	0.066	0.2656	0.0628
0.2783	0.1224	0.2783	0.0958	0.2783	0.0843	0.2783	0.0796	0.2783	0.0755	0.2783	0.0686	0.2783	0.0634
0.2915	0.1224	0.2915	0.1016	0.2915	0.0946	0.2915	0.0884	0.2915	0.0829	0.2915	0.0737	0.2915	0.0659
0.3054	0.1376	0.3054	0.1198	0.3054	0.1099	0.3054	0.1013	0.3054	0.0938	0.3054	0.0818	0.3054	0.0736
0.3199	0.1656	0.3199	0.1295	0.3199	0.118	0.3199	0.1082	0.3199	0.0997	0.3199	0.0864	0.3199	0.0788
0.3352	0.1885	0.3352	0.1345	0.3352	0.118	0.3352	0.1082	0.3352	0.0997	0.3352	0.0888	0.3352	0.0799
0.3511	0.2195	0.3511	0.1658	0.3511	0.1404	0.3511	0.121	0.3511	0.1094	0.3511	0.0947	0.3511	0.0799
0.3678	0.2195	0.3678	0.1658	0.3678	0.1411	0.3678	0.1297	0.3678	0.1197	0.3678	0.1054	0.3678	0.0927

# RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



0.3853	0.2195	0.3853	0.1658	0.3853	0.1482	0.3853	0.1392	0.3853	0.1313	0.3853	0.1182	0.3853	0.1037
0.4037	0.2195	0.4037	0.1658	0.4037	0.1497	0.4037	0.141	0.4037	0.1333	0.4037	0.1207	0.4037	0.1067
0.4229	0.2197	0.4229	0.1658	0.4229	0.1497	0.4229	0.141	0.4229	0.1333	0.4229	0.1207	0.4229	0.1067
0.4431	0.3492	0.4431	0.237	0.4431	0.1936	0.4431	0.1625	0.4431	0.1433	0.4431	0.123	0.4431	0.1141
0.4642	0.3492	0.4642	0.237	0.4642	0.1965	0.4642	0.1766	0.4642	0.1607	0.4642	0.14	0.4642	0.1239
0.4863	0.3492	0.4863	0.237	0.4863	0.1965	0.4863	0.1797	0.4863	0.1687	0.4863	0.1514	0.4863	0.1297
0.5094	0.3492	0.5094	0.237	0.5094	0.2038	0.5094	0.1919	0.5094	0.1804	0.5094	0.1599	0.5094	0.1356
0.5337	0.3728	0.5337	0.2709	0.5337	0.2336	0.5337	0.2071	0.5337	0.1861	0.5337	0.1599	0.5337	0.1356
0.5591	0.3728	0.5591	0.2844	0.5591	0.2472	0.5591	0.2178	0.5591	0.1969	0.5591	0.1672	0.5591	0.1469
0.5857	0.3728	0.5857	0.291	0.5857	0.2581	0.5857	0.2314	0.5857	0.2095	0.5857	0.1839	0.5857	0.1647
0.6136	0.3728	0.6136	0.291	0.6136	0.2581	0.6136	0.2314	0.6136	0.211	0.6136	0.1935	0.6136	0.1734
0.6428	0.3892	0.6428	0.291	0.6428	0.2581	0.6428	0.2341	0.6428	0.2164	0.6428	0.198	0.6428	0.1784
0.6734	0.3892	0.6734	0.3002	0.6734	0.2736	0.6734	0.253	0.6734	0.2391	0.6734	0.2147	0.6734	0.1893
0.7055	0.4568	0.7055	0.3773	0.7055	0.3354	0.7055	0.3005	0.7055	0.2769	0.7055	0.2399	0.7055	0.2062
0.7391	0.5468	0.7391	0.437	0.7391	0.3838	0.7391	0.3407	0.7391	0.3056	0.7391	0.2529	0.7391	0.2172
0.7743	0.6403	0.7743	0.4827	0.7743	0.4094	0.7743	0.3537	0.7743	0.3106	0.7743	0.254	0.7743	0.239
0.8111	0.831	0.8111	0.4886	0.8111	0.4094	0.8111	0.3537	0.8111	0.3106	0.8111	0.2831	0.8111	0.2657
0.8497	0.831	0.8497	0.4886	0.8497	0.4094	0.8497	0.3657	0.8497	0.3378	0.8497	0.3109	0.8497	0.2933
0.8902	0.831	0.8902	0.4886	0.8902	0.4288	0.8902	0.3942	0.8902	0.3631	0.8902	0.3404	0.8902	0.3207
0.9326	1.1005	0.9326	0.6506	0.9326	0.519	0.9326	0.4449	0.9326	0.3898	0.9326	0.3703	0.9326	0.3469
0.977	1.1005	0.977	0.7147	0.977	0.5864	0.977	0.4962	0.977	0.4337	0.977	0.3972	0.977	0.3706
1.0235	1.1005	1.0235	0.7147	1.0235	0.5864	1.0235	0.4962	1.0235	0.4691	1.0235	0.4309	1.0235	0.3909
1.0723	1.1005	1.0723	0.7147	1.0723	0.5864	1.0723	0.5524	1.0723	0.5282	1.0723	0.4852	1.0723	0.4308
1.1233	1.2677	1.1233	0.7412	1.1233	0.6432	1.1233	0.6123	1.1233	0.5832	1.1233	0.5321	1.1233	0.4696
1.1768	1.2677	1.1768	0.8293	1.1768	0.7065	1.1768	0.6555	1.1768	0.62	1.1768	0.5613	1.1768	0.4934
1.2328	1.2677	1.2328	0.8293	1.2328	0.7065	1.2328	0.6555	1.2328	0.62	1.2328	0.5639	1.2328	0.5024
1.2916	1.4479	1.2916	1.0168	1.2916	0.8501	1.2916	0.7366	1.2916	0.6556	1.2916	0.5639	1.2916	0.5055
1.353	1.6058	1.353	1.1275	1.353	0.9398	1.353	0.8103	1.353	0.7197	1.353	0.6176	1.353	0.5488
1.4175	1.6058	1.4175	1.1275	1.4175	0.9845	1.4175	0.9078	1.4175	0.8382	1.4175	0.7198	1.4175	0.5908
1.485	1.6058	1.485	1.2335	1.485	1.1052	1.485	1.0054	1.485	0.9202	1.485	0.7812	1.485	0.6369
1.5557	2.1846	1.5557	1.3621	1.5557	1.1315	1.5557	1.0054	1.5557	0.9202	1.5557	0.7812	1.5557	0.6625
1.6298	2.1846	1.6298	1.3621	1.6298	1.1769	1.6298	1.0959	1.6298	1.0225	1.6298	0.8962	1.6298	0.7518
1.7074	2.1846	1.7074	1.4719	1.7074	1.3054	1.7074	1.2055	1.7074	1.1171	1.7074	0.9707	1.7074	0.8071
1.7887	2.7802	1.7887	1.6856	1.7887	1.4812	1.7887	1.3211	1.7887	1.1842	1.7887	0.9918	1.7887	0.8152
1.8738	2.7802	1.8738	1.6856	1.8738	1.4926	1.8738	1.3481	1.8738	1.2212	1.8738	1.0136	1.8738	0.8884
1.963	2.7802	1.963	1.9172	1.963	1.5603	1.963	1.3481	1.963	1.2212	1.963	1.0811	1.963	0.9548
2.0565	2.7802	2.0565	1.9172	2.0565	1.5603	2.0565	1.3571	2.0565	1.2669	2.0565	1.1624	2.0565	1.0171
2.1544	2.7802	2.1544	1.9172	2.1544	1.5603	2.1544	1.4424	2.1544	1.3536	2.1544	1.2355	2.1544	1.0641
2.257	3.1449	2.257	1.9172	2.257	1.7334	2.257	1.6089	2.257	1.4947	2.257	1.309	2.257	1.0916

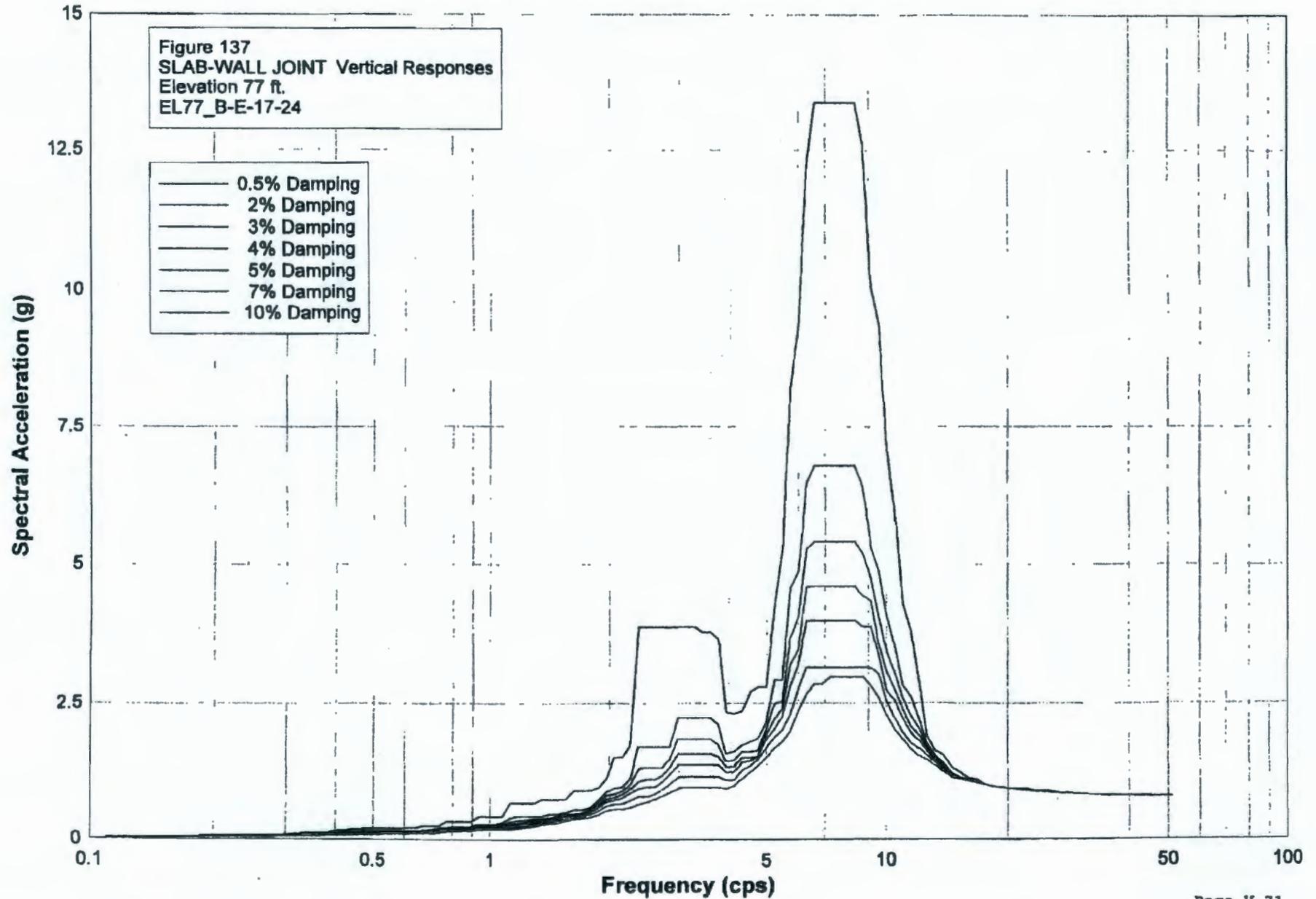
2.3645	3.2327	2.3645	2.2136	2.3645	1.968	2.3645	1.7697	2.3645	1.6071	2.3645	1.3579	2.3645	1.1296
2.4771	3.2327	2.4771	2.2136	2.4771	1.968	2.4771	1.7697	2.4771	1.6071	2.4771	1.3579	2.4771	1.1301
2.595	3.7738	2.595	2.4327	2.595	2.131	2.595	1.8936	2.595	1.6778	2.595	1.3976	2.595	1.1754
2.7186	4.3838	2.7186	2.4327	2.7186	2.131	2.7186	1.9075	2.7186	1.7384	2.7186	1.4956	2.7186	1.2512
2.848	4.3838	2.848	2.4327	2.848	2.131	2.848	1.9075	2.848	1.7384	2.848	1.5139	2.848	1.2815
2.9836	4.3838	2.9836	2.4327	2.9836	2.131	2.9836	1.9075	2.9836	1.8855	2.9836	1.5536	2.9836	1.2917
3.1257	4.3838	3.1257	2.4327	3.1257	2.131	3.1257	1.9075	3.1257	1.8855	3.1257	1.5536	3.1257	1.2917
3.2745	4.3838	3.2745	2.4327	3.2745	2.131	3.2745	1.9075	3.2745	1.8855	3.2745	1.5536	3.2745	1.2917
3.4305	4.1005	3.4305	2.4327	3.4305	2.131	3.4305	1.9075	3.4305	1.8855	3.4305	1.5536	3.4305	1.2917
3.5938	4.1005	3.5938	2.4327	3.5938	2.131	3.5938	1.9075	3.5938	1.8855	3.5938	1.5536	3.5938	1.2917
3.7649	2.5959	3.7649	2.4327	3.7649	2.131	3.7649	1.9042	3.7649	1.7489	3.7649	1.5021	3.7649	1.265
3.9442	2.5959	3.9442	2.121	3.9442	1.8355	3.9442	1.6598	3.9442	1.5405	3.9442	1.3563	3.9442	1.2103
4.132	2.5959	4.132	1.8694	4.132	1.6226	4.132	1.4573	4.132	1.3351	4.132	1.2096	4.132	1.1326
4.3288	2.5959	4.3288	1.8694	4.3288	1.6226	4.3288	1.4573	4.3288	1.3351	4.3288	1.162	4.3288	1.0536
4.5349	2.5959	4.5349	1.7534	4.5349	1.5274	4.5349	1.3901	4.5349	1.2878	4.5349	1.1559	4.5349	1.0242
4.7508	2.4293	4.7508	1.4177	4.7508	1.3814	4.7508	1.25	4.7508	1.1959	4.7508	1.1203	4.7508	1.0119
4.977	2.4293	4.977	1.4177	4.977	1.3814	4.977	1.25	4.977	1.1959	4.977	1.1002	4.977	0.9832
5.214	2.4293	5.214	1.4177	5.214	1.3011	5.214	1.2293	5.214	1.1678	5.214	1.0665	5.214	0.9502
5.4623	1.9405	5.4623	1.3108	5.4623	1.2385	5.4623	1.1382	5.4623	1.084	5.4623	0.9911	5.4623	0.8858
5.7224	2.5389	5.7224	1.3108	5.7224	1.2385	5.7224	1.1157	5.7224	1.0195	5.7224	0.8782	5.7224	0.7893
5.9948	2.5389	5.9948	1.3108	5.9948	1.2138	5.9948	1.0915	5.9948	0.996	5.9948	0.8782	5.9948	0.7551
6.2803	2.5389	6.2803	1.3108	6.2803	1.1292	6.2803	1.0403	6.2803	0.9828	6.2803	0.8782	6.2803	0.7551
6.5793	2.5389	6.5793	1.3108	6.5793	1.1292	6.5793	1.0403	6.5793	0.9828	6.5793	0.8776	6.5793	0.7522
6.8926	2.5389	6.8926	1.3108	6.8926	1.1292	6.8926	1.0107	6.8926	0.9301	6.8926	0.8305	6.8926	0.7234
7.2208	2.5389	7.2208	1.3108	7.2208	1.0813	7.2208	0.9868	7.2208	0.9225	7.2208	0.8305	7.2208	0.7231
7.5646	2.5389	7.5646	1.3108	7.5646	1.0813	7.5646	0.9868	7.5646	0.9225	7.5646	0.8305	7.5646	0.7231
7.9248	2.5389	7.9248	1.3108	7.9248	1.0494	7.9248	0.9755	7.9248	0.9203	7.9248	0.8305	7.9248	0.7231
8.3022	2.4941	8.3022	1.3108	8.3022	1.0494	8.3022	0.9755	8.3022	0.9182	8.3022	0.8251	8.3022	0.7169
8.6975	1.8253	8.6975	1.0955	8.6975	0.9976	8.6975	0.9284	8.6975	0.8735	8.6975	0.7863	8.6975	0.6887
9.1116	1.4804	9.1116	0.8931	9.1116	0.8487	9.1116	0.8084	9.1116	0.7724	9.1116	0.7118	9.1116	0.6409
9.5455	1.4804	9.5455	0.8385	9.5455	0.7483	9.5455	0.684	9.5455	0.6476	9.5455	0.612	9.5455	0.5642
10	0.9957	10	0.7233	10	0.685	10	0.6511	10	0.6232	10	0.5792	10	0.5466
10.4762	0.9436	10.4762	0.6652	10.4762	0.6378	10.4762	0.6134	10.4762	0.5916	10.4762	0.5543	10.4762	0.5416
10.975	0.9436	10.975	0.6547	10.975	0.6085	10.975	0.5856	10.975	0.5694	10.975	0.5453	10.975	0.5376
11.4976	0.9436	11.4976	0.648	11.4976	0.6085	11.4976	0.5856	11.4976	0.5658	11.4976	0.5453	11.4976	0.5376
12.045	0.9057	12.045	0.6115	12.045	0.5714	12.045	0.561	12.045	0.5542	12.045	0.5453	12.045	0.5376
12.6186	0.9057	12.6186	0.6023	12.6186	0.5714	12.6186	0.561	12.6186	0.5542	12.6186	0.5453	12.6186	0.5376
13.2194	0.9057	13.2194	0.574	13.2194	0.5614	13.2194	0.5505	13.2194	0.5472	13.2194	0.5416	13.2194	0.5356
13.8489	0.6913	13.8489	0.574	13.8489	0.5614	13.8489	0.5504	13.8489	0.5417	13.8489	0.535	13.8489	0.5308

14.5083	0.6913	14.5083	0.574	14.5083	0.5814	14.5083	0.5504	14.5083	0.5417	14.5083	0.5301	14.5083	0.5264
15.1991	0.6913	15.1991	0.574	15.1991	0.5814	15.1991	0.5504	15.1991	0.5417	15.1991	0.5301	15.1991	0.5234
15.9228	0.6913	15.9228	0.574	15.9228	0.5814	15.9228	0.5504	15.9228	0.5417	15.9228	0.5292	15.9228	0.5181
16.681	0.6913	16.681	0.5725	16.681	0.5477	16.681	0.5365	16.681	0.5284	16.681	0.518	16.681	0.5095
17.4753	0.6486	17.4753	0.5314	17.4753	0.5237	17.4753	0.518	17.4753	0.5141	17.4753	0.5087	17.4753	0.5051
18.3074	0.6404	18.3074	0.5314	18.3074	0.5237	18.3074	0.518	18.3074	0.5141	18.3074	0.5087	18.3074	0.5057
19.1791	0.6404	19.1791	0.5314	19.1791	0.5237	19.1791	0.518	19.1791	0.5141	19.1791	0.5087	19.1791	0.5057
20.0923	0.6104	20.0923	0.5314	20.0923	0.5237	20.0923	0.518	20.0923	0.5141	20.0923	0.5087	20.0923	0.5057
21.049	0.5894	21.049	0.5192	21.049	0.515	21.049	0.5122	21.049	0.5106	21.049	0.5081	21.049	0.5057
22.0513	0.5736	22.0513	0.5155	22.0513	0.5137	22.0513	0.5122	22.0513	0.5106	22.0513	0.5081	22.0513	0.5057
23.1013	0.5736	23.1013	0.5131	23.1013	0.5105	23.1013	0.5085	23.1013	0.507	23.1013	0.5056	23.1013	0.5045
24.2013	0.5233	24.2013	0.5131	24.2013	0.5105	24.2013	0.5085	24.2013	0.507	24.2013	0.505	24.2013	0.5034
25.3536	0.5233	25.3536	0.5131	25.3536	0.5105	25.3536	0.5085	25.3536	0.507	25.3536	0.505	25.3536	0.5034
26.5609	0.5233	26.5609	0.5131	26.5609	0.5105	26.5609	0.5085	26.5609	0.507	26.5609	0.505	26.5609	0.5034
27.8256	0.5233	27.8256	0.5131	27.8256	0.5105	27.8256	0.5085	27.8256	0.507	27.8256	0.505	27.8256	0.5031
29.1505	0.5079	29.1505	0.5031	29.1505	0.5033	29.1505	0.5033	29.1505	0.5031	29.1505	0.5026	29.1505	0.5017
30.5386	0.5079	30.5386	0.5022	30.5386	0.5014	30.5386	0.501	30.5386	0.5008	30.5386	0.5005	30.5386	0.5001
31.9927	0.5079	31.9927	0.5022	31.9927	0.5005	31.9927	0.4997	31.9927	0.4994	31.9927	0.4991	31.9927	0.4988
33.516	0.4972	33.516	0.4972	33.516	0.4974	33.516	0.4975	33.516	0.4976	33.516	0.4976	33.516	0.4975
35.1119	0.4965	35.1119	0.4965	35.1119	0.4965	35.1119	0.4965	35.1119	0.4965	35.1119	0.4965	35.1119	0.4965
36.7838	0.4957	36.7838	0.4957	36.7838	0.4957	36.7838	0.4957	36.7838	0.4957	36.7838	0.4958	36.7838	0.4958
38.5353	0.495	38.5353	0.495	38.5353	0.495	38.5353	0.4951	38.5353	0.4951	38.5353	0.4951	38.5353	0.4951
40.3702	0.4944	40.3702	0.4944	40.3702	0.4945	40.3702	0.4945	40.3702	0.4945	40.3702	0.4945	40.3702	0.4945
42.2924	0.4939	42.2924	0.4939	42.2924	0.4939	42.2924	0.4939	42.2924	0.4939	42.2924	0.494	42.2924	0.494
44.3062	0.4934	44.3062	0.4935	44.3062	0.4935	44.3062	0.4935	44.3062	0.4935	44.3062	0.4935	44.3062	0.4935
46.4159	0.493	46.4159	0.4931	46.4159	0.4931	46.4159	0.4931	46.4159	0.4931	46.4159	0.4931	46.4159	0.4931
48.626	0.4927	48.626	0.4927	48.626	0.4927	48.626	0.4927	48.626	0.4927	48.626	0.4927	48.626	0.4927
50.9414	0.4923	50.9414	0.4923	50.9414	0.4923	50.9414	0.4923	50.9414	0.4923	50.9414	0.4923	50.9414	0.4923

# RPP-WTP Pretreatment Facility ISRS

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System



S\_PTWW137.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 137  
 SLAB-WALL JOINT Vertical Responses  
 Elevation 77 ft.  
 EL77\_B-E-17-24

Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.0329	0.1098	0.0298	0.1098	0.0278	0.1098	0.0268	0.1098	0.0259	0.1098	0.0243	0.1098	0.0227
0.115	0.0347	0.115	0.0312	0.115	0.0291	0.115	0.0273	0.115	0.0261	0.115	0.0247	0.115	0.0232
0.1204	0.0348	0.1204	0.0313	0.1204	0.0293	0.1204	0.0275	0.1204	0.0261	0.1204	0.0247	0.1204	0.0232
0.1262	0.0349	0.1262	0.0313	0.1262	0.0293	0.1262	0.0275	0.1262	0.0281	0.1262	0.0247	0.1262	0.0232
0.1322	0.0349	0.1322	0.0313	0.1322	0.0293	0.1322	0.0275	0.1322	0.0261	0.1322	0.0247	0.1322	0.0232
0.1385	0.0349	0.1385	0.0313	0.1385	0.0293	0.1385	0.0275	0.1385	0.0262	0.1385	0.0248	0.1385	0.0232
0.1451	0.0349	0.1451	0.0313	0.1451	0.0293	0.1451	0.0275	0.1451	0.0262	0.1451	0.0248	0.1451	0.0235
0.152	0.0349	0.152	0.0313	0.152	0.0293	0.152	0.0278	0.152	0.0271	0.152	0.0258	0.152	0.0246
0.1592	0.0349	0.1592	0.0313	0.1592	0.0295	0.1592	0.0288	0.1592	0.0282	0.1592	0.0271	0.1592	0.0258
0.1668	0.0349	0.1668	0.0313	0.1668	0.0302	0.1668	0.0294	0.1668	0.0288	0.1668	0.0277	0.1668	0.0266
0.1748	0.0423	0.1748	0.0358	0.1748	0.0324	0.1748	0.0297	0.1748	0.0288	0.1748	0.0279	0.1748	0.0269
0.1831	0.0536	0.1831	0.0446	0.1831	0.0399	0.1831	0.0359	0.1831	0.0325	0.1831	0.0284	0.1831	0.0269
0.1918	0.0578	0.1918	0.0479	0.1918	0.0426	0.1918	0.0381	0.1918	0.0354	0.1918	0.0331	0.1918	0.0306
0.2009	0.0578	0.2009	0.0479	0.2009	0.0426	0.2009	0.0399	0.2009	0.0383	0.2009	0.0356	0.2009	0.0325
0.2105	0.0578	0.2105	0.0479	0.2105	0.0426	0.2105	0.0401	0.2105	0.0385	0.2105	0.0358	0.2105	0.0336
0.2205	0.0578	0.2205	0.0479	0.2205	0.0438	0.2205	0.0425	0.2205	0.0412	0.2205	0.0389	0.2205	0.036
0.231	0.0582	0.231	0.0496	0.231	0.0468	0.231	0.0447	0.231	0.0432	0.231	0.0403	0.231	0.0368
0.242	0.0628	0.242	0.0559	0.242	0.0518	0.242	0.0483	0.242	0.0457	0.242	0.0415	0.242	0.0383
0.2535	0.0718	0.2535	0.0628	0.2535	0.0583	0.2535	0.0547	0.2535	0.0515	0.2535	0.0468	0.2535	0.0422
0.2656	0.0718	0.2656	0.0628	0.2656	0.0583	0.2656	0.0547	0.2656	0.0515	0.2656	0.0468	0.2656	0.0422
0.2783	0.0718	0.2783	0.0628	0.2783	0.0583	0.2783	0.0547	0.2783	0.0515	0.2783	0.0468	0.2783	0.0422
0.2915	0.0751	0.2915	0.0675	0.2915	0.0638	0.2915	0.0605	0.2915	0.0576	0.2915	0.0527	0.2915	0.0473
0.3054	0.0882	0.3054	0.0765	0.3054	0.0701	0.3054	0.0658	0.3054	0.0621	0.3054	0.0561	0.3054	0.0493
0.3199	0.0922	0.3199	0.0798	0.3199	0.0729	0.3199	0.067	0.3199	0.0621	0.3199	0.0561	0.3199	0.0493
0.3352	0.1108	0.3352	0.0902	0.3352	0.0805	0.3352	0.0732	0.3352	0.0674	0.3352	0.0595	0.3352	0.0526
0.3511	0.1266	0.3511	0.096	0.3511	0.0832	0.3511	0.0743	0.3511	0.0692	0.3511	0.0614	0.3511	0.0542
0.3678	0.1266	0.3678	0.096	0.3678	0.0851	0.3678	0.078	0.3678	0.072	0.3678	0.0628	0.3678	0.0542

0.3853	0.1266	0.3853	0.0968	0.3853	0.0891	0.3853	0.0825	0.3853	0.0771	0.3853	0.0679	0.3853	0.0575
0.4037	0.1556	0.4037	0.1128	0.4037	0.0977	0.4037	0.0882	0.4037	0.0772	0.4037	0.0679	0.4037	0.0575
0.4229	0.1556	0.4229	0.1198	0.4229	0.1048	0.4229	0.0928	0.4229	0.0831	0.4229	0.0687	0.4229	0.0575
0.4431	0.1788	0.4431	0.1373	0.4431	0.1175	0.4431	0.1021	0.4431	0.09	0.4431	0.0727	0.4431	0.062
0.4642	0.1788	0.4642	0.1373	0.4642	0.1175	0.4642	0.1021	0.4642	0.0924	0.4642	0.0797	0.4642	0.0684
0.4863	0.1989	0.4863	0.1478	0.4863	0.1261	0.4863	0.1102	0.4863	0.0981	0.4863	0.0811	0.4863	0.0718
0.5094	0.1989	0.5094	0.1478	0.5094	0.1261	0.5094	0.1102	0.5094	0.0999	0.5094	0.0883	0.5094	0.0755
0.5337	0.1989	0.5337	0.1478	0.5337	0.1261	0.5337	0.1123	0.5337	0.1057	0.5337	0.0955	0.5337	0.0848
0.5591	0.1989	0.5591	0.1478	0.5591	0.1261	0.5591	0.1123	0.5591	0.107	0.5591	0.0991	0.5591	0.0891
0.5857	0.1996	0.5857	0.1489	0.5857	0.1273	0.5857	0.1124	0.5857	0.1076	0.5857	0.0992	0.5857	0.0891
0.6136	0.2118	0.6136	0.1492	0.6136	0.1284	0.6136	0.1155	0.6136	0.1076	0.6136	0.0992	0.6136	0.0891
0.6428	0.2118	0.6428	0.1607	0.6428	0.1455	0.6428	0.1342	0.6428	0.1253	0.6428	0.1121	0.6428	0.1004
0.6734	0.2447	0.6734	0.168	0.6734	0.1558	0.6734	0.1454	0.6734	0.1366	0.6734	0.1223	0.6734	0.1071
0.7055	0.2447	0.7055	0.1758	0.7055	0.1558	0.7055	0.1454	0.7055	0.1366	0.7055	0.1223	0.7055	0.1071
0.7391	0.2447	0.7391	0.2046	0.7391	0.1828	0.7391	0.165	0.7391	0.1501	0.7391	0.1276	0.7391	0.1108
0.7743	0.3235	0.7743	0.2046	0.7743	0.1828	0.7743	0.1668	0.7743	0.1542	0.7743	0.1338	0.7743	0.1258
0.8111	0.3235	0.8111	0.2226	0.8111	0.1927	0.8111	0.1741	0.8111	0.162	0.8111	0.148	0.8111	0.1388
0.8497	0.3235	0.8497	0.2226	0.8497	0.1989	0.8497	0.1825	0.8497	0.1686	0.8497	0.148	0.8497	0.144
0.8902	0.3235	0.8902	0.2226	0.8902	0.1989	0.8902	0.1825	0.8902	0.1686	0.8902	0.1499	0.8902	0.1536
0.9326	0.4162	0.9326	0.2704	0.9326	0.2331	0.9326	0.2122	0.9326	0.1988	0.9326	0.1834	0.9326	0.1717
0.977	0.4162	0.977	0.2758	0.977	0.2548	0.977	0.2364	0.977	0.2215	0.977	0.2006	0.977	0.1822
1.0235	0.4162	1.0235	0.2758	1.0235	0.2548	1.0235	0.2364	1.0235	0.2215	1.0235	0.2006	1.0235	0.1822
1.0723	0.4162	1.0723	0.3054	1.0723	0.276	1.0723	0.2529	1.0723	0.2346	1.0723	0.2077	1.0723	0.1835
1.1233	0.6808	1.1233	0.3906	1.1233	0.3224	1.1233	0.2796	1.1233	0.25	1.1233	0.2121	1.1233	0.1835
1.1768	0.6808	1.1768	0.4285	1.1768	0.3494	1.1768	0.3004	1.1768	0.2678	1.1768	0.2326	1.1768	0.2022
1.2328	0.6808	1.2328	0.4285	1.2328	0.362	1.2328	0.3249	1.2328	0.2939	1.2328	0.2462	1.2328	0.2197
1.2916	0.6808	1.2916	0.4285	1.2916	0.3787	1.2916	0.3361	1.2916	0.3025	1.2916	0.2706	1.2916	0.238
1.353	0.7474	1.353	0.4307	1.353	0.3822	1.353	0.3605	1.353	0.3408	1.353	0.3074	1.353	0.2695
1.4175	0.7474	1.4175	0.4745	1.4175	0.399	1.4175	0.3783	1.4175	0.3595	1.4175	0.327	1.4175	0.2904
1.485	0.7474	1.485	0.4745	1.485	0.4308	1.485	0.4027	1.485	0.3776	1.485	0.3367	1.485	0.2965
1.5557	0.7474	1.5557	0.4917	1.5557	0.4567	1.5557	0.4327	1.5557	0.4106	1.5557	0.3746	1.5557	0.3318
1.6298	0.8991	1.6298	0.5424	1.6298	0.4596	1.6298	0.4435	1.6298	0.4278	1.6298	0.3983	1.6298	0.362
1.7074	0.8991	1.7074	0.5424	1.7074	0.4907	1.7074	0.4675	1.7074	0.4447	1.7074	0.4175	1.7074	0.3835
1.7887	0.8991	1.7887	0.5865	1.7887	0.5461	1.7887	0.5203	1.7887	0.498	1.7887	0.4559	1.7887	0.4044
1.8738	0.9445	1.8738	0.7195	1.8738	0.6654	1.8738	0.6223	1.8738	0.5827	1.8738	0.5201	1.8738	0.4509
1.963	1.1123	1.963	0.8748	1.963	0.8034	1.963	0.7426	1.963	0.691	1.963	0.6109	1.963	0.5227
2.0565	1.5088	2.0565	0.933	2.0565	0.8293	2.0565	0.7716	2.0565	0.7237	2.0565	0.645	2.0565	0.5543
2.1544	1.5088	2.1544	0.961	2.1544	0.8884	2.1544	0.8244	2.1544	0.7852	2.1544	0.6607	2.1544	0.5543
2.257	1.7236	2.257	1.1268	2.257	1.013	2.257	0.9252	2.257	0.849	2.257	0.7236	2.257	0.59

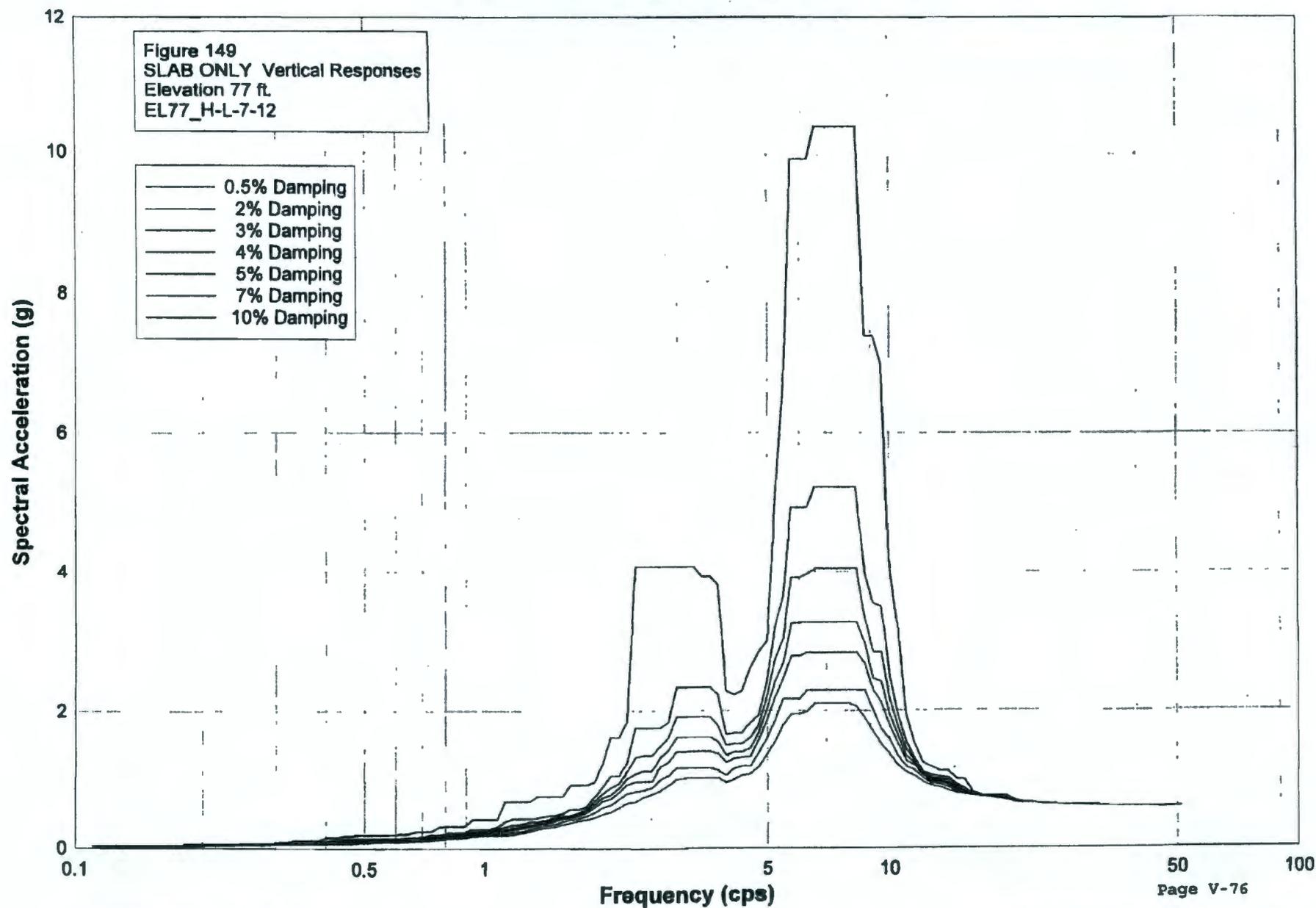
2.3645	3.866	2.3645	1.6971	2.3645	1.2916	2.3645	1.0575	2.3645	0.9248	2.3645	0.7851	2.3645	0.6424
2.4771	3.866	2.4771	1.6971	2.4771	1.3169	2.4771	1.1038	2.4771	0.9563	2.4771	0.7851	2.4771	0.6887
2.595	3.866	2.595	1.6971	2.595	1.3169	2.595	1.1038	2.595	0.9563	2.595	0.8262	2.595	0.7426
2.7186	3.866	2.7186	1.6971	2.7186	1.3169	2.7186	1.1727	2.7186	1.0567	2.7186	0.9171	2.7186	0.7945
2.848	3.866	2.848	1.6971	2.848	1.4804	2.848	1.3327	2.848	1.206	2.848	1.018	2.848	0.8669
2.9836	3.866	2.9836	2.2406	2.9836	1.8408	2.9836	1.5625	2.9836	1.3591	2.9836	1.1387	2.9836	0.928
3.1257	3.866	3.1257	2.2406	3.1257	1.8408	3.1257	1.5625	3.1257	1.3591	3.1257	1.143	3.1257	0.9493
3.2745	3.866	3.2745	2.2406	3.2745	1.8408	3.2745	1.5625	3.2745	1.3591	3.2745	1.143	3.2745	0.9493
3.4305	3.7694	3.4305	2.2406	3.4305	1.8408	3.4305	1.5625	3.4305	1.3591	3.4305	1.143	3.4305	0.9493
3.5938	3.7694	3.5938	2.2406	3.5938	1.8408	3.5938	1.5625	3.5938	1.3591	3.5938	1.143	3.5938	0.9493
3.7649	3.6368	3.7649	2.1031	3.7649	1.7293	3.7649	1.5178	3.7649	1.3536	3.7649	1.143	3.7649	0.9493
3.9442	2.3406	3.9442	1.5628	3.9442	1.4278	3.9442	1.3158	3.9442	1.2252	3.9442	1.0832	3.9442	0.9243
4.132	2.3105	4.132	1.6043	4.132	1.4457	4.132	1.33	4.132	1.2348	4.132	1.0881	4.132	0.9795
4.3288	2.3606	4.3288	1.7203	4.3288	1.5989	4.3288	1.4967	4.3288	1.4076	4.3288	1.2637	4.3288	1.1134
4.5349	2.7028	4.5349	1.7884	4.5349	1.5989	4.5349	1.4967	4.5349	1.4341	4.5349	1.3413	4.5349	1.2294
4.7508	2.7941	4.7508	1.8475	4.7508	1.626	4.7508	1.5163	4.7508	1.5039	4.7508	1.4543	4.7508	1.3491
4.977	2.7941	4.977	2.1563	4.977	2.0226	4.977	1.9141	4.977	1.822	4.977	1.6659	4.977	1.4987
5.214	4.219	5.214	2.9143	5.214	2.4943	5.214	2.205	5.214	2.0309	5.214	1.8627	5.214	1.6667
5.4623	5.2918	5.4623	2.9192	5.4623	2.5485	5.4623	2.4104	5.4623	2.2607	5.4623	2.0112	5.4623	1.7876
5.7224	8.1324	5.7224	4.5631	5.7224	3.6583	5.7224	3.1823	5.7224	2.8095	5.7224	2.2869	5.7224	1.9827
5.9948	9.3796	5.9948	4.8676	5.9948	4.0343	5.9948	3.4641	5.9948	3.179	5.9948	2.7514	5.9948	2.3427
6.2803	12.1837	6.2803	6.4303	6.2803	5.2789	6.2803	4.5801	6.2803	3.9709	6.2803	3.1363	6.2803	2.6609
6.5793	13.368	6.5793	6.7759	6.5793	5.4003	6.5793	4.5998	6.5793	3.9709	6.5793	3.1363	6.5793	2.8505
6.8926	13.368	6.8926	6.7759	6.8926	5.4003	6.8926	4.5998	6.8926	3.9709	6.8926	3.1363	6.8926	2.8505
7.2208	13.368	7.2208	6.7759	7.2208	5.4003	7.2208	4.5998	7.2208	3.9709	7.2208	3.1363	7.2208	2.9722
7.5646	13.368	7.5646	6.7759	7.5646	5.4003	7.5646	4.5998	7.5646	3.9709	7.5646	3.1363	7.5646	2.9722
7.9248	13.368	7.9248	6.7759	7.9248	5.4003	7.9248	4.5998	7.9248	3.9709	7.9248	3.1363	7.9248	2.9722
8.3022	13.368	8.3022	6.7759	8.3022	5.4003	8.3022	4.5998	8.3022	3.9709	8.3022	3.1363	8.3022	2.9722
8.6975	12.5927	8.6975	6.4217	8.6975	5.1938	8.6975	4.425	8.6975	3.8585	8.6975	3.1363	8.6975	2.9722
9.1116	10.032	9.1116	5.2958	9.1116	4.7479	9.1116	4.3324	9.1116	3.8585	9.1116	3.1278	9.1116	2.8105
9.5455	9.3441	9.5455	4.8678	9.5455	4.0343	9.5455	3.5395	9.5455	3.3508	9.5455	3.014	9.5455	2.5933
10	7.1545	10	4.045	10	3.4174	10	3.0579	10	2.7208	10	2.5271	10	2.2822
10.4782	5.9747	10.4782	3.5047	10.4782	3.0327	10.4782	2.7438	10.4782	2.5427	10.4782	2.2327	10.4782	2.0169
10.975	4.2808	10.975	2.8111	10.975	2.5879	10.975	2.3944	10.975	2.2183	10.975	1.958	10.975	1.8268
11.4976	3.7662	11.4976	2.6092	11.4976	2.2639	11.4976	2.0699	11.4976	1.9469	11.4976	1.7588	11.4976	1.648
12.045	2.8902	12.045	2.215	12.045	2.0392	12.045	1.9048	12.045	1.8023	12.045	1.6549	12.045	1.5218
12.6186	1.8788	12.6186	1.7416	12.6186	1.6839	12.6186	1.6394	12.6186	1.6018	12.6186	1.5334	12.6186	1.4443
13.2194	1.6128	13.2194	1.5184	13.2194	1.4878	13.2194	1.4617	13.2194	1.4374	13.2194	1.393	13.2194	1.3351
13.8489	1.5359	13.8489	1.3774	13.8489	1.3281	13.8489	1.2932	13.8489	1.2655	13.8489	1.2404	13.8489	1.2179

14.5083	1.3107	14.5083	1.2007	14.5083	1.1687	14.5083	1.1419	14.5083	1.121	14.5083	1.1308	14.5083	1.1366
15.1991	1.2196	15.1991	1.1295	15.1991	1.1116	15.1991	1.1016	15.1991	1.0957	15.1991	1.0862	15.1991	1.09
15.9228	1.1205	15.9228	1.1	15.9228	1.0915	15.9228	1.0833	15.9228	1.0757	15.9228	1.0631	15.9228	1.0579
16.681	1.0927	16.681	1.0685	16.681	1.058	16.681	1.0504	16.681	1.0446	16.681	1.0363	16.681	1.0281
17.4753	1.0023	17.4753	1.0048	17.4753	1.0053	17.4753	1.0048	17.4753	1.0038	17.4753	1.0012	17.4753	0.9968
18.3074	0.961	18.3074	0.9671	18.3074	0.9887	18.3074	0.9693	18.3074	0.9695	18.3074	0.969	18.3074	0.9673
19.1791	0.9518	19.1791	0.9477	19.1791	0.9463	19.1791	0.9455	19.1791	0.9448	19.1791	0.9436	19.1791	0.9415
20.0923	0.9305	20.0923	0.9309	20.0923	0.9296	20.0923	0.9286	20.0923	0.9278	20.0923	0.9263	20.0923	0.9238
21.049	0.9233	21.049	0.9146	21.049	0.9138	21.049	0.9133	21.049	0.9127	21.049	0.9111	21.049	0.9085
22.0513	0.9233	22.0513	0.908	22.0513	0.9049	22.0513	0.9025	22.0513	0.9006	22.0513	0.8977	22.0513	0.8945
23.1013	0.8961	23.1013	0.8852	23.1013	0.8849	23.1013	0.8846	23.1013	0.884	23.1013	0.8827	23.1013	0.8807
24.2013	0.8833	24.2013	0.8727	24.2013	0.8712	24.2013	0.87	24.2013	0.8691	24.2013	0.869	24.2013	0.868
25.3536	0.8713	25.3536	0.8633	25.3536	0.8611	25.3536	0.8595	25.3536	0.8586	25.3536	0.858	25.3536	0.8571
26.5609	0.8529	26.5609	0.8516	26.5609	0.8504	26.5609	0.8496	26.5609	0.8491	26.5609	0.8483	26.5609	0.8474
27.8256	0.838	27.8256	0.8397	27.8256	0.8399	27.8256	0.8398	27.8256	0.8396	27.8256	0.8392	27.8256	0.8385
29.1505	0.8335	29.1505	0.8322	29.1505	0.8319	29.1505	0.8316	29.1505	0.8313	29.1505	0.8309	29.1505	0.8303
30.5386	0.8228	30.5386	0.8232	30.5386	0.8232	30.5386	0.8232	30.5386	0.8232	30.5386	0.8231	30.5386	0.8229
31.9927	0.8147	31.9927	0.8153	31.9927	0.8155	31.9927	0.8158	31.9927	0.8159	31.9927	0.8161	31.9927	0.8162
33.516	0.8095	33.516	0.8097	33.516	0.8098	33.516	0.8099	33.516	0.8101	33.516	0.8102	33.516	0.8104
35.1119	0.8048	35.1119	0.8049	35.1119	0.805	35.1119	0.8051	35.1119	0.8051	35.1119	0.8052	35.1119	0.8054
36.7838	0.8005	36.7838	0.8006	36.7838	0.8007	36.7838	0.8007	36.7838	0.8007	36.7838	0.8008	36.7838	0.8009
38.5353	0.7966	38.5353	0.7967	38.5353	0.7967	38.5353	0.7967	38.5353	0.7968	38.5353	0.7968	38.5353	0.7969
40.3702	0.7931	40.3702	0.7931	40.3702	0.7931	40.3702	0.7931	40.3702	0.7932	40.3702	0.7932	40.3702	0.7933
42.2924	0.7898	42.2924	0.7898	42.2924	0.7898	42.2924	0.7898	42.2924	0.7899	42.2924	0.7899	42.2924	0.79
44.3062	0.7868	44.3062	0.7868	44.3062	0.7868	44.3062	0.7868	44.3062	0.7868	44.3062	0.7869	44.3062	0.787
46.4159	0.7839	46.4159	0.7839	46.4159	0.784	46.4159	0.784	46.4159	0.784	46.4159	0.7841	46.4159	0.7842
48.626	0.7813	48.626	0.7813	48.626	0.7813	48.626	0.7813	48.626	0.7814	48.626	0.7814	48.626	0.7815
50.9414	0.7788	50.9414	0.7788	50.9414	0.7788	50.9414	0.7788	50.9414	0.7789	50.9414	0.7789	50.9414	0.7791

# RPP-WTP Pretreatment Facility ISRS

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B



S\_PTWW149.grf  
 RPP-WTP Pretreatment Facility ISRS  
 Calc No.: 24590-PTF-S0C-S15T-00005, Rev. 0B  
 Frequency (cps)  
 Spectral Acceleration (g)  
 Figure 149  
 SLAB ONLY Vertical Responses  
 Elevation 77 ft.  
 EL77\_H-L-7-12

Damping 0.50%		Damping 2%		Damping 3%		Damping 4%		Damping 5%		Damping 7%		Damping 10%	
Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.	Freq.	Accel.
0.1098	0.033	0.1098	0.0296	0.1098	0.0277	0.1098	0.0266	0.1098	0.0257	0.1098	0.024	0.1098	0.0226
0.115	0.0347	0.115	0.0312	0.115	0.0291	0.115	0.0273	0.115	0.0261	0.115	0.0246	0.115	0.023
0.1204	0.0348	0.1204	0.0313	0.1204	0.0292	0.1204	0.0274	0.1204	0.0261	0.1204	0.0246	0.1204	0.023
0.1262	0.0349	0.1262	0.0313	0.1262	0.0292	0.1262	0.0274	0.1262	0.0261	0.1262	0.0246	0.1262	0.023
0.1322	0.0349	0.1322	0.0313	0.1322	0.0292	0.1322	0.0274	0.1322	0.0261	0.1322	0.0246	0.1322	0.023
0.1385	0.0349	0.1385	0.0313	0.1385	0.0292	0.1385	0.0274	0.1385	0.0261	0.1385	0.0246	0.1385	0.023
0.1451	0.0349	0.1451	0.0313	0.1451	0.0292	0.1451	0.0274	0.1451	0.0261	0.1451	0.0245	0.1451	0.0231
0.152	0.035	0.152	0.0313	0.152	0.0292	0.152	0.0276	0.152	0.0269	0.152	0.0256	0.152	0.0239
0.1592	0.035	0.1592	0.0313	0.1592	0.0292	0.1592	0.0285	0.1592	0.0278	0.1592	0.0265	0.1592	0.0252
0.1668	0.035	0.1668	0.0313	0.1668	0.0299	0.1668	0.0281	0.1668	0.0284	0.1668	0.0273	0.1668	0.026
0.1748	0.0423	0.1748	0.0359	0.1748	0.0325	0.1748	0.0297	0.1748	0.0285	0.1748	0.0275	0.1748	0.0262
0.1831	0.0536	0.1831	0.0446	0.1831	0.0399	0.1831	0.0359	0.1831	0.0325	0.1831	0.0279	0.1831	0.0266
0.1918	0.0578	0.1918	0.0479	0.1918	0.0426	0.1918	0.0382	0.1918	0.0353	0.1918	0.0328	0.1918	0.0303
0.2009	0.0578	0.2009	0.0479	0.2009	0.0426	0.2009	0.0398	0.2009	0.0381	0.2009	0.0353	0.2009	0.032
0.2105	0.0578	0.2105	0.0479	0.2105	0.0426	0.2105	0.0398	0.2105	0.0381	0.2105	0.0361	0.2105	0.0339
0.2205	0.0578	0.2205	0.0479	0.2205	0.044	0.2205	0.0427	0.2205	0.0414	0.2205	0.0391	0.2205	0.0363
0.231	0.0581	0.231	0.0501	0.231	0.0473	0.231	0.0449	0.231	0.0433	0.231	0.0405	0.231	0.0371
0.242	0.0626	0.242	0.0557	0.242	0.0519	0.242	0.0485	0.242	0.0454	0.242	0.0416	0.242	0.0385
0.2535	0.0718	0.2535	0.0633	0.2535	0.0588	0.2535	0.055	0.2535	0.0519	0.2535	0.047	0.2535	0.0422
0.2656	0.0718	0.2656	0.0633	0.2656	0.0588	0.2656	0.055	0.2656	0.0519	0.2656	0.047	0.2656	0.0422
0.2783	0.0718	0.2783	0.0633	0.2783	0.0588	0.2783	0.055	0.2783	0.0519	0.2783	0.047	0.2783	0.0422
0.2915	0.0748	0.2915	0.0674	0.2915	0.0634	0.2915	0.0599	0.2915	0.057	0.2915	0.0521	0.2915	0.0463
0.3054	0.088	0.3054	0.0765	0.3054	0.0702	0.3054	0.0654	0.3054	0.0616	0.3054	0.0554	0.3054	0.0485
0.3199	0.0924	0.3199	0.08	0.3199	0.0733	0.3199	0.0676	0.3199	0.0627	0.3199	0.0554	0.3199	0.0485
0.3352	0.1119	0.3352	0.091	0.3352	0.0811	0.3352	0.0736	0.3352	0.0677	0.3352	0.0594	0.3352	0.0521
0.3511	0.1269	0.3511	0.096	0.3511	0.0832	0.3511	0.0737	0.3511	0.0685	0.3511	0.0607	0.3511	0.0533
0.3678	0.1269	0.3678	0.096	0.3678	0.0854	0.3678	0.0784	0.3678	0.0725	0.3678	0.0632	0.3678	0.0538

0.3853	0.1269	0.3853	0.0967	0.3853	0.0889	0.3853	0.0828	0.3853	0.0774	0.3853	0.068	0.3853	0.0577
0.4037	0.1558	0.4037	0.1134	0.4037	0.0984	0.4037	0.0868	0.4037	0.0777	0.4037	0.068	0.4037	0.0577
0.4229	0.1558	0.4229	0.12	0.4229	0.1048	0.4229	0.0924	0.4229	0.0826	0.4229	0.0685	0.4229	0.0577
0.4431	0.1798	0.4431	0.138	0.4431	0.1181	0.4431	0.1026	0.4431	0.0904	0.4431	0.073	0.4431	0.0635
0.4642	0.1798	0.4642	0.138	0.4642	0.1181	0.4642	0.1026	0.4642	0.0907	0.4642	0.0774	0.4642	0.0671
0.4863	0.1988	0.4863	0.1472	0.4863	0.1254	0.4863	0.1094	0.4863	0.0976	0.4863	0.0828	0.4863	0.0708
0.5094	0.1988	0.5094	0.1472	0.5094	0.1254	0.5094	0.1094	0.5094	0.1005	0.5094	0.0887	0.5094	0.0766
0.5337	0.1988	0.5337	0.1472	0.5337	0.1254	0.5337	0.1132	0.5337	0.1066	0.5337	0.0963	0.5337	0.0852
0.5591	0.1988	0.5591	0.1472	0.5591	0.1254	0.5591	0.1132	0.5591	0.1071	0.5591	0.0989	0.5591	0.0884
0.5857	0.2009	0.5857	0.1489	0.5857	0.127	0.5857	0.1132	0.5857	0.1071	0.5857	0.0989	0.5857	0.0884
0.6136	0.2117	0.6136	0.1492	0.6136	0.1286	0.6136	0.116	0.6136	0.1077	0.6136	0.0989	0.6136	0.0884
0.6428	0.2117	0.6428	0.162	0.6428	0.1468	0.6428	0.1344	0.6428	0.1242	0.6428	0.1094	0.6428	0.0956
0.6734	0.2463	0.6734	0.168	0.6734	0.1527	0.6734	0.1421	0.6734	0.1328	0.6734	0.1174	0.6734	0.101
0.7055	0.2463	0.7055	0.1736	0.7055	0.1527	0.7055	0.1421	0.7055	0.1328	0.7055	0.1175	0.7055	0.1013
0.7391	0.2463	0.7391	0.2014	0.7391	0.1797	0.7391	0.1616	0.7391	0.1463	0.7391	0.1236	0.7391	0.1129
0.7743	0.3234	0.7743	0.2014	0.7743	0.1797	0.7743	0.1646	0.7743	0.1516	0.7743	0.134	0.7743	0.1268
0.8111	0.3234	0.8111	0.2195	0.8111	0.1922	0.8111	0.1747	0.8111	0.1629	0.8111	0.1485	0.8111	0.1372
0.8497	0.3234	0.8497	0.2195	0.8497	0.1962	0.8497	0.1798	0.8497	0.1658	0.8497	0.1485	0.8497	0.1406
0.8902	0.3234	0.8902	0.2211	0.8902	0.201	0.8902	0.1842	0.8902	0.1702	0.8902	0.1486	0.8902	0.1489
0.9326	0.4198	0.9326	0.2792	0.9326	0.2383	0.9326	0.2146	0.9326	0.1992	0.9326	0.1804	0.9326	0.1644
0.977	0.4198	0.977	0.2792	0.977	0.2504	0.977	0.2316	0.977	0.2163	0.977	0.1944	0.977	0.1753
1.0235	0.4198	1.0235	0.2792	1.0235	0.2504	1.0235	0.2316	1.0235	0.2191	1.0235	0.2007	1.0235	0.1804
1.0723	0.4198	1.0723	0.3095	1.0723	0.2808	1.0723	0.2575	1.0723	0.2389	1.0723	0.2132	1.0723	0.189
1.1233	0.6844	1.1233	0.3935	1.1233	0.3182	1.1233	0.2754	1.1233	0.2456	1.1233	0.2132	1.1233	0.189
1.1768	0.6844	1.1768	0.4309	1.1768	0.3458	1.1768	0.3014	1.1768	0.27	1.1768	0.2317	1.1768	0.2005
1.2328	0.6844	1.2328	0.4309	1.2328	0.3555	1.2328	0.3182	1.2328	0.2875	1.2328	0.242	1.2328	0.2184
1.2916	0.6844	1.2916	0.4367	1.2916	0.3871	1.2916	0.3464	1.2916	0.3129	1.2916	0.2714	1.2916	0.2384
1.353	0.7599	1.353	0.4415	1.353	0.3871	1.353	0.362	1.353	0.3421	1.353	0.3087	1.353	0.2704
1.4175	0.7599	1.4175	0.4716	1.4175	0.4059	1.4175	0.3841	1.4175	0.3646	1.4175	0.3316	1.4175	0.2943
1.485	0.7599	1.485	0.4772	1.485	0.4445	1.485	0.416	1.485	0.3917	1.485	0.3508	1.485	0.3069
1.5557	0.7599	1.5557	0.5063	1.5557	0.4753	1.5557	0.4507	1.5557	0.4289	1.5557	0.3928	1.5557	0.3496
1.6298	0.9291	1.6298	0.5737	1.6298	0.4806	1.6298	0.4629	1.6298	0.4471	1.6298	0.4181	1.6298	0.3789
1.7074	0.9291	1.7074	0.5737	1.7074	0.522	1.7074	0.4969	1.7074	0.4744	1.7074	0.4365	1.7074	0.4026
1.7887	0.9291	1.7887	0.6148	1.7887	0.5734	1.7887	0.5478	1.7887	0.5228	1.7887	0.4764	1.7887	0.4212
1.8738	0.9814	1.8738	0.7586	1.8738	0.698	1.8738	0.6464	1.8738	0.6012	1.8738	0.5264	1.8738	0.453
1.963	1.2411	1.963	0.9059	1.963	0.8076	1.963	0.7419	1.963	0.6881	1.963	0.5999	1.963	0.5004
2.0565	1.6176	2.0565	1.0647	2.0565	0.8875	2.0565	0.7869	2.0565	0.723	2.0565	0.6342	2.0565	0.5339
2.1544	1.6176	2.1544	1.0647	2.1544	0.9533	2.1544	0.8819	2.1544	0.8219	2.1544	0.7158	2.1544	0.5935
2.257	1.8429	2.257	1.2512	2.257	1.1235	2.257	1.0205	2.257	0.9348	2.257	0.8052	2.257	0.6626

2.3645	4.0699	2.3645	1.7554	2.3645	1.3289	2.3645	1.0963	2.3645	0.9746	2.3645	0.8303	2.3645	0.6835
2.4771	4.0699	2.4771	1.7554	2.4771	1.3554	2.4771	1.1336	2.4771	0.9787	2.4771	0.8493	2.4771	0.746
2.595	4.0699	2.595	1.7554	2.595	1.3554	2.595	1.1336	2.595	0.9787	2.595	0.8889	2.595	0.7961
2.7186	4.0699	2.7186	1.7554	2.7186	1.4847	2.7186	1.3257	2.7186	1.1963	2.7186	1.0049	2.7186	0.8443
2.848	4.0699	2.848	1.8374	2.848	1.6183	2.848	1.4326	2.848	1.2673	2.848	1.0698	2.848	0.9235
2.9836	4.0699	2.9836	2.3349	2.9836	1.9127	2.9836	1.6189	2.9836	1.412	2.9836	1.1782	2.9836	1.0145
3.1257	4.0699	3.1257	2.3349	3.1257	1.9127	3.1257	1.6189	3.1257	1.412	3.1257	1.1782	3.1257	1.0257
3.2745	4.0699	3.2745	2.3349	3.2745	1.9127	3.2745	1.6189	3.2745	1.412	3.2745	1.1782	3.2745	1.0257
3.4305	3.9252	3.4305	2.3349	3.4305	1.9127	3.4305	1.6189	3.4305	1.412	3.4305	1.1782	3.4305	1.0257
3.5938	3.9252	3.5938	2.3349	3.5938	1.9127	3.5938	1.6189	3.5938	1.412	3.5938	1.1782	3.5938	1.0257
3.7649	3.804	3.7649	2.2244	3.7649	1.7791	3.7649	1.55	3.7649	1.3773	3.7649	1.1417	3.7649	1.0257
3.9442	2.2828	3.9442	1.6635	3.9442	1.4979	3.9442	1.355	3.9442	1.2502	3.9442	1.0633	3.9442	0.9604
4.132	2.2248	4.132	1.685	4.132	1.5218	4.132	1.4035	4.132	1.3092	4.132	1.1637	4.132	1.0062
4.3288	2.288	4.3288	1.685	4.3288	1.5218	4.3288	1.4071	4.3288	1.3287	4.3288	1.2037	4.3288	1.0665
4.5349	2.6268	4.5349	1.8325	4.5349	1.6161	4.5349	1.4583	4.5349	1.3356	4.5349	1.2037	4.5349	1.0858
4.7508	2.8442	4.7508	1.9334	4.7508	1.7955	4.7508	1.6875	4.7508	1.5786	4.7508	1.3925	4.7508	1.1956
4.977	2.9945	4.977	2.4197	4.977	2.1964	4.977	2.0129	4.977	1.8562	4.977	1.6043	4.977	1.3684
5.214	4.8895	5.214	3.196	5.214	2.7298	5.214	2.4134	5.214	2.1805	5.214	1.8538	5.214	1.5482
5.4623	6.643	5.4623	3.6241	5.4623	3.0266	5.4623	2.6787	5.4623	2.4595	5.4623	2.1662	5.4623	1.7974
5.7224	9.9168	5.7224	4.9346	5.7224	3.9171	5.7224	3.2471	5.7224	2.7804	5.7224	2.1672	5.7224	1.9541
5.9948	9.9168	5.9948	4.9346	5.9948	3.9171	5.9948	3.2471	5.9948	2.7804	5.9948	2.1672	5.9948	1.9541
6.2803	9.9168	6.2803	4.9346	6.2803	3.9685	6.2803	3.2662	6.2803	2.8301	6.2803	2.2953	6.2803	1.9935
6.5793	10.3887	6.5793	5.2245	6.5793	4.0457	6.5793	3.2662	6.5793	2.8301	6.5793	2.2953	6.5793	2.1124
6.8926	10.3887	6.8926	5.2245	6.8926	4.0457	6.8926	3.2662	6.8926	2.8301	6.8926	2.2953	6.8926	2.1124
7.2208	10.3887	7.2208	5.2245	7.2208	4.0457	7.2208	3.2662	7.2208	2.8301	7.2208	2.2953	7.2208	2.1124
7.5646	10.3887	7.5646	5.2245	7.5646	4.0457	7.5646	3.2662	7.5646	2.8301	7.5646	2.2953	7.5646	2.1124
7.9248	10.3887	7.9248	5.2245	7.9248	4.0457	7.9248	3.2662	7.9248	2.8301	7.9248	2.2953	7.9248	2.1124
8.3022	10.3887	8.3022	5.2245	8.3022	4.0457	8.3022	3.2662	8.3022	2.8301	8.3022	2.2953	8.3022	2.0603
8.6975	7.3975	8.6975	3.974	8.6975	3.3379	8.6975	2.9621	8.6975	2.6815	8.6975	2.2953	8.6975	1.8954
9.1116	7.3975	9.1116	3.5465	9.1116	2.8359	9.1116	2.4675	9.1116	2.2993	9.1116	2.0155	9.1116	1.7008
9.5455	6.9962	9.5455	3.4966	9.5455	2.8359	9.5455	2.4192	9.5455	2.1154	9.5455	1.729	9.5455	1.5076
10	4.0615	10	2.522	10	2.1855	10	1.9525	10	1.7893	10	1.5795	10	1.3631
10.4762	3.1699	10.4762	1.9404	10.4762	1.776	10.4762	1.6394	10.4762	1.5179	10.4762	1.337	10.4762	1.2021
10.975	1.9474	10.975	1.5482	10.975	1.4306	10.975	1.3319	10.975	1.272	10.975	1.1863	10.975	1.1066
11.4976	1.5165	11.4976	1.3046	11.4976	1.2807	11.4976	1.2422	11.4976	1.2023	11.4976	1.1318	11.4976	1.0488
12.045	1.2489	12.045	1.1132	12.045	1.0935	12.045	1.0811	12.045	1.0607	12.045	1.0187	12.045	0.9603
12.6186	1.1761	12.6186	1.0559	12.6186	1.0122	12.6186	0.9796	12.6186	0.9552	12.6186	0.9329	12.6186	0.8986
13.2194	1.1222	13.2194	1.0329	13.2194	1.0014	13.2194	0.9756	13.2194	0.9532	13.2194	0.9153	13.2194	0.8706
13.8489	1.1222	13.8489	1.0163	13.8489	0.9733	13.8489	0.9402	13.8489	0.9132	13.8489	0.8719	13.8489	0.8283

14.5083	0.9999	14.5083	0.9199	14.5083	0.8835	14.5083	0.8538	14.5083	0.8294	14.5083	0.7998	14.5083	0.7902
15.1991	0.9904	15.1991	0.8457	15.1991	0.8202	15.1991	0.8039	15.1991	0.7915	15.1991	0.7732	15.1991	0.7648
15.9228	0.8007	15.9228	0.7875	15.9228	0.7748	15.9228	0.7634	15.9228	0.7533	15.9228	0.7476	15.9228	0.7458
16.681	0.7564	16.681	0.745	16.681	0.7406	16.681	0.7383	16.681	0.7367	16.681	0.7341	16.681	0.7307
17.4753	0.7396	17.4753	0.7337	17.4753	0.728	17.4753	0.7234	17.4753	0.7236	17.4753	0.7215	17.4753	0.7171
18.3074	0.7396	18.3074	0.7337	18.3074	0.728	18.3074	0.7222	18.3074	0.7173	18.3074	0.7102	18.3074	0.7033
19.1791	0.7396	19.1791	0.7105	19.1791	0.7035	19.1791	0.6983	19.1791	0.6949	19.1791	0.6904	19.1791	0.6864
20.0923	0.6835	20.0923	0.6497	20.0923	0.6558	20.0923	0.6604	20.0923	0.6634	20.0923	0.6669	20.0923	0.6687
21.049	0.6556	21.049	0.6476	21.049	0.6466	21.049	0.6466	21.049	0.6494	21.049	0.6529	21.049	0.6557
22.0513	0.6556	22.0513	0.6476	22.0513	0.6466	22.0513	0.6461	22.0513	0.646	22.0513	0.6462	22.0513	0.647
23.1013	0.6334	23.1013	0.6388	23.1013	0.6393	23.1013	0.6393	23.1013	0.6394	23.1013	0.6395	23.1013	0.6399
24.2013	0.6321	24.2013	0.6316	24.2013	0.6324	24.2013	0.6327	24.2013	0.6329	24.2013	0.6332	24.2013	0.6335
25.3536	0.6321	25.3536	0.6263	25.3536	0.6267	25.3536	0.627	25.3536	0.6273	25.3536	0.6276	25.3536	0.6279
26.5609	0.6191	26.5609	0.6223	26.5609	0.6227	26.5609	0.6229	26.5609	0.6229	26.5609	0.623	26.5609	0.6231
27.8256	0.618	27.8256	0.617	27.8256	0.6181	27.8256	0.6185	27.8256	0.6187	27.8256	0.6189	27.8256	0.6189
29.1505	0.618	29.1505	0.617	29.1505	0.6164	29.1505	0.6159	29.1505	0.6157	29.1505	0.6154	29.1505	0.6151
30.5386	0.612	30.5386	0.612	30.5386	0.612	30.5386	0.6119	30.5386	0.6118	30.5386	0.6117	30.5386	0.6115
31.9927	0.6082	31.9927	0.6083	31.9927	0.6083	31.9927	0.6083	31.9927	0.6082	31.9927	0.6082	31.9927	0.6081
33.516	0.605	33.516	0.6051	33.516	0.6051	33.516	0.6051	33.516	0.6051	33.516	0.6051	33.516	0.605
35.1119	0.6022	35.1119	0.6022	35.1119	0.6022	35.1119	0.6022	35.1119	0.6022	35.1119	0.6022	35.1119	0.6022
36.7838	0.5997	36.7838	0.5997	36.7838	0.5997	36.7838	0.5997	36.7838	0.5997	36.7838	0.5997	36.7838	0.5997
38.5353	0.5974	38.5353	0.5974	38.5353	0.5974	38.5353	0.5974	38.5353	0.5974	38.5353	0.5974	38.5353	0.5974
40.3702	0.5953	40.3702	0.5953	40.3702	0.5953	40.3702	0.5953	40.3702	0.5953	40.3702	0.5953	40.3702	0.5953
42.2924	0.5934	42.2924	0.5934	42.2924	0.5934	42.2924	0.5934	42.2924	0.5934	42.2924	0.5934	42.2924	0.5935
44.3062	0.5917	44.3062	0.5917	44.3062	0.5917	44.3062	0.5917	44.3062	0.5917	44.3062	0.5917	44.3062	0.5917
46.4159	0.5901	46.4159	0.5901	46.4159	0.5901	46.4159	0.5901	46.4159	0.5901	46.4159	0.5901	46.4159	0.5902
48.626	0.5886	48.626	0.5886	48.626	0.5886	48.626	0.5886	48.626	0.5886	48.626	0.5887	48.626	0.5887
50.9414	0.5873	50.9414	0.5873	50.9414	0.5873	50.9414	0.5873	50.9414	0.5873	50.9414	0.5873	50.9414	0.5874

**ATTACHMENT #2**

**BNI TLP Coupled Structural Analysis Draft Report**



**Draft**

**CALCULATION SHEET**

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

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# Draft

# CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 9/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

## 1 Objective

The objective of this analysis is to describe the effects of coupling on the nozzle loads of the TLP (Treated LAW Evaporation Process) arrangement consisting of a separator, pump, reboiler and major connecting piping. Load considered are deadweight, seismic and thermal. Nozzle loads are compared for coupled and uncoupled analysis and anchor movements are compiled. The first three analysis cases were specified in Ref. SCN, Section 8. The remainder evolved as requested by the participants of the study.

### Analysis Cases

Case	Type	Pump Mount	Nozzle Flexibility	Other
8a	Uncoupled	Fixed	No	
8b	Coupled	Free EW & NS	No	
8c	Coupled	Free EW & NS	Yes	
8d	Coupled	Free EW	Yes	
8e	Uncoupled	Fixed	Yes	
8f	Coupled	Free EW	Yes	No Grayloc weights
8g	Coupled	Free EW	Yes	Removed separator top support
8h	Coupled	Free EW	Yes	Pre-RGM spectra
8i	Coupled	Free EW	Yes	NS support at top of 2nd elbow of reboiler discharge line
8j	Coupled	Fixed	Yes	8i plus pump fixed to frame
8k	Coupled	Free EW	Yes	8i plus replacement of separator discharge NS constraint with NS restraint on far end of 2nd elbow from pump inlet line.
8L	Coupled	Fixed	Yes	8k with fixed pump mount
8o	Coupled	Free EW	Yes	8i with 10.5 Kip upward load support on reboiler discharge line to represent a spring can support. Piping and vessels have 131 F temperature instead of 150 F.
8p	Coupled	Gapped	Yes	8i with 1/8" gap at west pump support point. Piping and vessels have 131 F temperature instead of 150 F
8q	Coupled	Gapped	Yes	8p with 1/16" gap instead of 1/8"
8r	Coupled	Gapped	Yes	8q with 1/32" gap.
8s	Coupled	Gapped	Yes	8r with Elev 00' spectra and 10.5 Kip upward load support on reboiler discharge line.

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# CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

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## 2 Inputs

### Design Inputs

Item	Reference
Piping arrangement & properties	Ref SCN, Item 10c. Item includes piping isometrics with restraints, Grayloc fitting locations and weights. NS restraint at reboiler discharge was omitted per Ref. ECO
Piping content	Specific gravity 1.57
Separator model	GTSTRUDL (Ref GTS) model, from analysis of Ref A472
Reboiler model	GTSTRUDL model, from analysis of Ref A402
Pump frame	Fig 2 of Ref A603
Pump arrangement	Ref A647B
Pump weight & cg	Section 3.0 of Ref A603
Design temperatures	Frames 113 F Vessels, piping 150 F Reference 75 F
Seismic inertial loading	Ref SCN Item 10b with ISRS attachments. Damping = 3%.
Seismic drift loading	Drift of Elev 66' relative to Elev 00' is 0.06" EW, 0.23" NS, 0.03" Vertical per Ref. SCN Item 10d.
Material properties	Stainless steel Young's Modulus 28e6 psi Poisson's ratio 0.3 Coeff. Thermal Exp 9.25e-6 F <sup>-1</sup> Density 0.284 lb/in <sup>3</sup>
Nozzle flexibility for separator & reboiler	Vendor supplied. See table below.

### Nozzle Stiffness Components

Component	Vessel: Nozzle:	Separator Dischg	Separator Inlet	Reboiler 24"	Reboiler 18"	Pump All
Axial	lb/in	9.39E+06	4.97E+05	7.78E+05	3.24E+06	1e9
Lateral	lb/in			1.00E+09	1.00E+09	1e9
Torsional	lb/in/rad	4.02E+09	3.27E+09	1.00E+09	1.00E+09	1e12
Outplane-rotational	lb/in/rad	2.15E+09	3.83E+07	9.95E+07	2.54E+08	1e12
Inplane-rotational	lb/in/rad	2.15E+09	2.71E+08	4.74E+08	4.52E+08	1e12

#### Notes

1. Unspecified lateral components set to 1e9. Rotational components given as 1e9 were set to 1e12, because there were flexible values given on the order of 1e9.
2. 24" reboiler data apply to inlet and discharge. 18" nozzle is not connected to piping.
3. Separator and reboiler components provided by vendor. Pump components are rigid per tee data of B31.3.

## 3 Background

Uncoupled analysis typically offers more restraint to thermal expansion than the more complex coupled analysis. Therefore, coupled analysis is expected to have lower nozzle loads.

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Ref: 24590-WTP-3DP-G04B-00049

24590-G04B-F00012 Rev 2

CCN 122811

Ref: 24590-WTP-3DP-G04B-00037

BY: E.O. Weiner  
DATE: 6/15/06SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

## 4 Applicable Codes and Standards

ASME B31.3-2004, ASME Code for Process Piping.

## 5 Methodology

Models for the separator, reboiler, pump and piping were imported into SAP2000, Ref SAP, as separate models and then merged into one model.

### 5.1 Piping Models

Piping models were generated with an Excel VBA routine that takes keypoints and tangent intersections and produces joints and straight frame members representing straight runs and elbows with refinement. The elbows are modeled with 10° segments, and straight runs are limited to 2 ft. The data is imported into SAP2000, and the loadings, materials and sections are input graphically. Each of the five piping runs is a separate model.

Elbow flexibility (a section property) was used with the bending stiffnesses of the straight sections in the elbow and not with the torsional stiffness. The flexibility factor for the 24" OD x 0.375" T long radius elbow for both in-plane and out-of-plane is 16.27 (Ref B31.3 App D).

### 5.2 Vessel and Support Frame Models

The separator and reboiler vessels and their frames were provided as two GTSTRUDL models that were imported to SAP2000. The pump and frame model was developed from scratch.

### 5.3 Merging of the Models

The coupled model was obtained by merger of the individual models achieved by import after consistent positioning controlled by the piping arrangement. Short links between vessels and piping were added with the given nozzle stiffness properties. The merged model is shown below in an extruded view. The separator and reboiler vessels as well as the pump motor are shown as equivalent stick elements. The cross-sectional dimensions are scaled to solid cross sectional area. If they were scaled to radii of gyration, they would overwhelm the rest of the model. The XYZ coordinate triad shown in the figure gives the orientation of the SAP2000 global coordinate system that is used for reporting global results such as anchor movements.

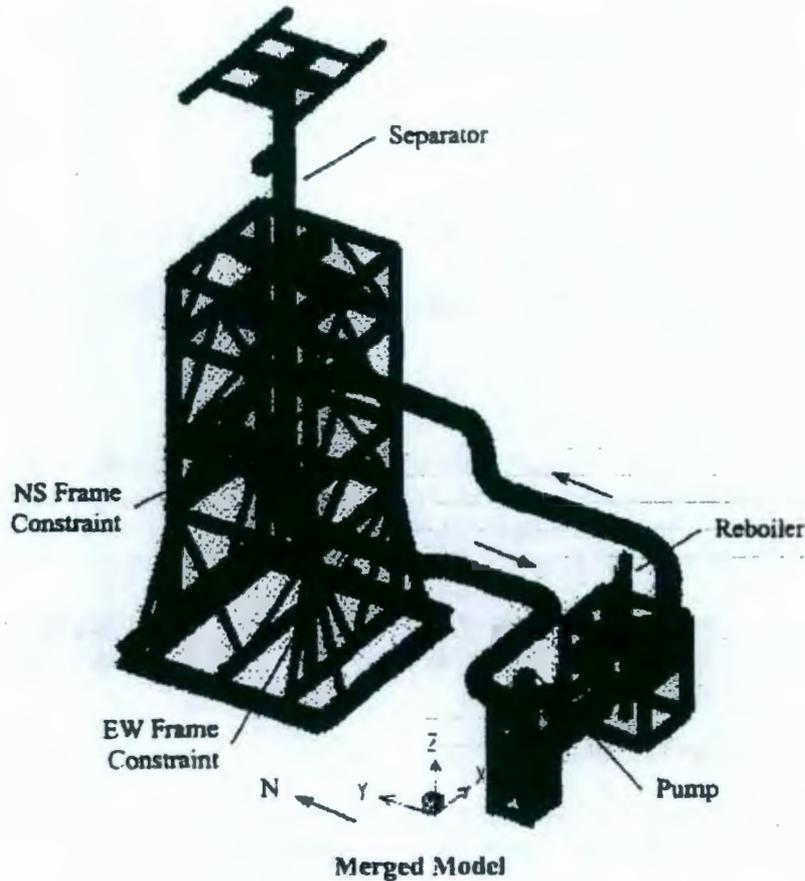
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Two piping constraints to the separator frame are shown. They are not detailed in Ref SCN. For the constraint nearest the discharge nozzle, a weightless X-brace was placed in the north side of the frame to get a joint in line with the desired point of constraint. A TS10x10x5/8 section was then brought to the piping to provide a NS constraint. The choice of member end releases in the X-brace provides the NS support required but does not affect the inplane behavior of the north side of the frame. The EW constraint was implemented by a simple constraint condition to a joint in the center of a nearby EW beam. The frames are supported at their bases. The separator is also supported at the top. The piping restraints (to ground) are shown in the following piping restraint diagram.

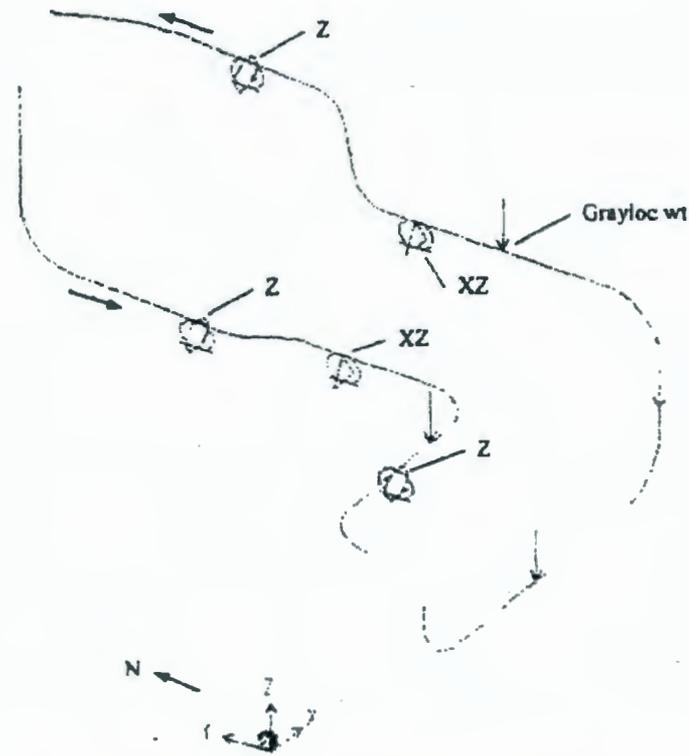
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Piping Restraints and Grayloc Locations (Case 8d)

## 5.4 Seismic Analysis

Seismic data and parameters used in the analysis are as follows.

### Seismic Parameters

Item	Description
Modal Analysis	Load Directed Ritz method
Inertia	From deadweight loading
Ritz Vectors	Linear in each direction: 8 Rotational about each axis: 3
Number of Modes	24
Damping	3%
Frequency Range	3.8 - 71 Hz (Case 8d)
Mass Participation	X = 95%, Y = 97%, Z = 92% (Case 8d)
Seismic Analysis Method	Response Spectrum Analysis
Modal Combination	CQC
Loading Directions	EW = X, NS = Y, Vert = Z
Directional Combination	SRSS.
Drift Combination	SRSS.

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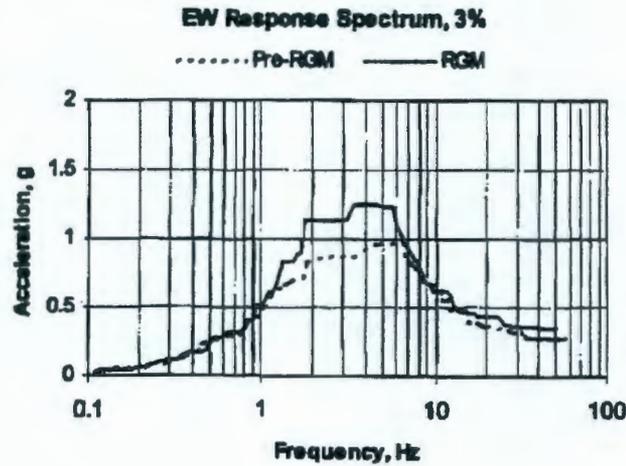
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Enveloped response spectra are shown below. The RGM data is that specified in Item 10b of the SCN, but the spectrum of Fig 407 was omitted in the envelope since there is no piping restraint normal to the wall. The Pre-RGM data precedes this data and corresponds to the same figure numbers in Ref. 00005A.



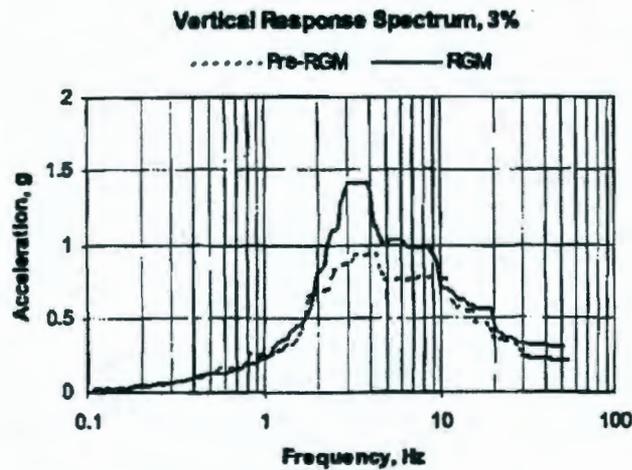
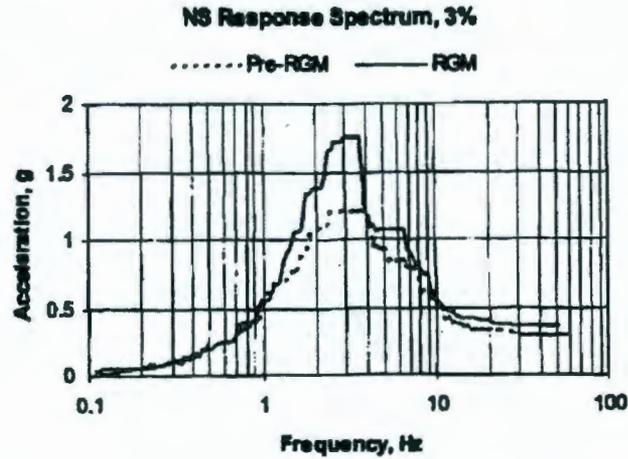
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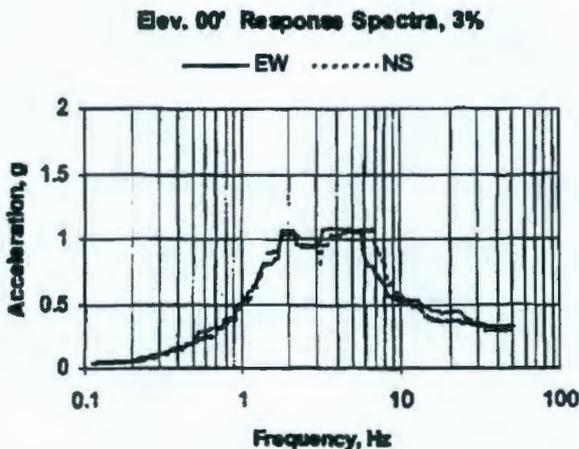
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Case 8s used unenveloped RGM Elev 00 spectra that essentially leave out the Elev 56 effects. The vertical spectrum is the same as before. The horizontal spectra are those of Figures 21E and 22E of Ref. SCN, Item 10.b, and are shown below.

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The static drift solution has the prescribed displacements at the top of the separator and 1/3 of those displacements at the piping restraints.

**5.5 SAP2000 Results Cases**

SAP2000 results cases (analysis cases and combinations) are as follows.

**Results Cases**

Case	Description
D	Deadweight
T	Thermal
MODAL	Modal analysis
RS	Response spectrum analysis
Dr	Drift
E	Seismic = SRSS of Dr and RS

**5.6 Analysis Cases**

Separate models were created for the various analysis cases. Each model is a modification of the merged model that was set up for Case 8d with the RGM spectra. The first three are those of Ref. SCN, and the remainders were subsequently requested by the participants of the study (J. Minichiello, E. Le, E. Ocoma & J. Julyk).

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Analysis Case Modifications

Analysis Case	Parent Case	Model Changes Relative to Parent Case
8a	8e	Relative to the final model of 8e, the nozzle links were assigned stiff properties.
8b	8d	Nozzle links were assigned stiff properties. Pump was set free in the horizontal plane.
8c	8d	Pump was set free in the horizontal plane.
8d		Parent model
8e	8d	Nozzle links were separated from the vessels but retained with the piping, thus isolating the runs between the pump, reboiler and separator. Vessel joints previously connected to the links were left free. Analysis provides anchor movements at these vessel-side joints. The deadweight and thermal movements were input as prescribed displacements on the piping-side joints. The seismic and drift displacements at all piping supports are input as zero. The vessels and frames were deleted to avoid obscuring mass participation of the piping, and the model was reanalyzed.
8f	8d	Removed Grayloc weights. This affects deadweight and seismic inertia.
8dB	8d	Constrained frame bases and top support to single joints for reporting reactions needed to compare with Case 8g.
8g	8dB	Removed separator top support.
8h	8d	Reread spectral functions with pre-RGM data.
8i	8d	Added NS restraint at top of 2nd elbow of reboiler discharge line.
8j	8i	Fixed the pump to the frame.
8k	8i	Replaced separator discharge NS frame constraint with NS ground restraint on far end of 2nd elbow from pump inlet.
8L	8k	Fixed the pump to the frame.
8o	8i	Added 10.5 Kip upward load support on reboiler discharge line between the first and second elbow from the reboiler. This does not affect inertia for seismic loading. Piping and vessels have 131 F temperature instead of 150 F.
8p	8i	Modeled 1/8" gap in EW direction at west pump support point. The gap was modeled by fixing the pump to the frame at this support and introducing a thermal load below reference on the support arm. The gap is the free thermal expansion. A large expansion coefficient was used to avoid swamping temperature contour plots used for checking. Piping and vessels have 131 F temperature instead of 150 F.
8q	8p	Reduced 1/8" gap to 1/16".
8r	8q	Reduced gap to 1/32".
8s	8r	Used Elev 00' spectra and 10.5 Kip upward load support on reboiler discharge line.

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# CALCULATION SHEET

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## 6 Assumptions

Item	Assumption
Pump support	Various cases of pump fixity to the frame were considered, including gaps.
Nozzle stiffness	Vendor provided data, see inputs section
Vessel & frame geometry, dimensions and weights	Base on preliminary data
Piping arrangement	Base on preliminary data
Weights of Grayloc fittings	Base on preliminary data
Piping constraints near separator discharge	Analyst provided. See Section 5.3.
SAP V&V	Dynamics features not included in Ref SAPVV.

## 7 Calculations

All calculations are in the SAP2000 system, Version 10. Verification and validation are reported in Ref SAPVV. It is to be noted that this reference does not cover dynamics features of the program.

## 8 Results and Conclusions

Nozzle loads and anchor movements from the SAP2000 analyses are shown in the following tables.

**Results Tables - Description and Location**

Table	Purpose	Page
Nozzle Loads	List P, V1, V2, T, M2 & M3 nozzle loads	12
Pump Support Gap Closure Loads	Gap compression loadings in west pump support arm indicate closure status	20
Mid-Elbow Loads	List P, V1, V2, T, M2 & M3 mid-elbow loads	21
RGM vs Pre-RGM Nozzle Loads	Compare RGM & Pre-RGM loads	25
Drift Nozzle Loads	Compare drift effects with total seismic	26
Frame Reactions	Show effect of top frame support on separator	28
Nozzle Displacements	List global nozzle displacements	27
Modal Participation	List mass participation of significant modes	34

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SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3	
Case 8a	Pump	Inlet	D	-0.03	0.81	-0.04	-4	-1	55
		Dischg	D	4.27	2.38	0.76	26	-18	25
	Reboiler	Inlet	D	2.38	-3.95	0.76	17	-75	36
		Dischg	D	-0.53	-10.81	0.56	25	8	-275
	Separator	Inlet	D	0.32	-1.01	-0.56	-70	28	39
		Dischg	D	4.87	0.03	0.10	-1	-3	2
	Pump	Inlet	E	1.89	1.27	3.89	9	-109	37
		Dischg	E	1.88	0.62	0.98	13	-21	9
	Reboiler	Inlet	E	2.98	1.73	1.78	12	-43	25
		Dischg	E	7.55	4.30	7.88	473	-159	444
	Separator	Inlet	E	5.39	5.83	15.27	176	-1659	444
		Dischg	E	2.48	1.37	6.19	5	-33	55
	Pump	Inlet	T	-3.41	-2.62	-7.52	124	34	-29
		Dischg	T	-20.81	-70.84	0.51	21	-2	-1918
	Reboiler	Inlet	T	-70.73	-21.27	0.51	21	-46	-1512
		Dischg	T	-1.59	-1.91	5.14	352	-26	9
	Separator	Inlet	T	0.59	-1.00	-5.14	54	559	-84
		Dischg	T	-1.73	3.28	-22.24	16	1288	347
Case 8b	Pump	Inlet	D	0.02	0.64	0.02	2	1	49
		Dischg	D	2.88	-0.02	0.02	0	-8	-29
	Reboiler	Inlet	D	0.00	-5.35	0.02	-5	-3	-95
		Dischg	D	-0.53	-10.89	0.45	21	11	-289
	Separator	Inlet	D	0.28	-0.95	-0.45	-75	15	42
		Dischg	D	4.88	0.02	0.45	-1	-25	1
	Pump	Inlet	E	3.45	2.19	10.04	75	-189	59
		Dischg	E	3.45	15.76	14.51	519	-318	421
	Reboiler	Inlet	E	18.21	4.23	19.59	436	-1968	225
		Dischg	E	11.67	9.72	17.15	1058	-278	704
	Separator	Inlet	E	8.51	9.06	28.16	277	-3010	692
		Dischg	E	5.07	5.53	29.27	110	-1242	544
	Pump	Inlet	T	-1.70	-2.45	-1.91	106	-86	-23
		Dischg	T	-0.15	1.91	-1.70	-19	54	62
	Reboiler	Inlet	T	1.91	-0.14	-1.70	-23	207	-43
		Dischg	T	-1.49	-1.78	4.74	323	-24	9
	Separator	Inlet	T	0.53	-0.96	-4.74	51	512	-82
		Dischg	T	-1.07	0.41	2.57	19	-94	60

Notes: P is axial, positive is tension. V3 is horizontal  
V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
M2 & M3 axes follow V2 and V3.  
M2 has the sign reversed relative to the SAP2000 local system so all systems are right handed.  
M2 reversal reverses the sign of the positive seismic amplitude.

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/08

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3	
Case 8c	Pump	Inlet	D	0.01	0.65	0.00	2	1	50
		Dischg	D	3.35	0.00	0.01	1	-8	-34
	Reboiler	Inlet	D	0.02	-4.88	0.01	-5	-1	-39
		Dischg	D	-0.62	-10.57	0.37	20	13	-247
	Separator	Inlet	D	0.21	-1.03	-0.37	-74	2	17
		Dischg	D	4.87	0.03	0.29	-1	-15	2
	Pump	Inlet	E	8.50	1.94	27.76	96	-285	50
		Dischg	E	5.23	32.66	13.88	1244	-97	880
	Reboiler	Inlet	E	35.39	6.19	22.76	762	-1432	126
		Dischg	E	10.91	12.12	35.48	2404	-298	560
	Separator	Inlet	E	12.58	8.32	11.65	237	-458	388
		Dischg	E	8.00	9.82	27.69	136	-838	834
	Pump	Inlet	T	-1.11	-2.34	-0.80	100	-89	-21
		Dischg	T	-0.10	0.80	-1.11	-81	19	30
	Reboiler	Inlet	T	0.80	-0.09	-1.11	-32	87	-19
		Dischg	T	-0.96	-0.97	1.75	103	0	13
	Separator	Inlet	T	-0.82	-0.24	-1.75	36	69	-13
		Dischg	T	-0.86	0.06	0.64	16	-14	23
Case 8d	Pump	Inlet	D	-0.05	0.65	-0.11	2	2	50
		Dischg	D	3.37	0.11	0.09	6	-6	-31
	Reboiler	Inlet	D	0.14	-4.86	0.09	-2	-6	-39
		Dischg	D	-0.62	-10.57	0.37	20	14	-247
	Separator	Inlet	D	0.21	-1.03	-0.37	-74	2	17
		Dischg	D	4.85	0.06	0.32	-1	-15	5
	Pump	Inlet	E	4.53	1.93	8.57	80	-165	47
		Dischg	E	2.68	15.59	2.21	316	-85	423
	Reboiler	Inlet	E	19.04	3.57	4.39	157	-74	91
		Dischg	E	9.80	10.77	30.61	2074	-254	497
	Separator	Inlet	E	11.03	7.29	10.12	206	-398	339
		Dischg	E	5.22	3.46	23.88	102	-763	325
	Pump	Inlet	T	-2.01	-2.32	-2.75	103	-84	-19
		Dischg	T	0.21	2.75	-0.10	-8	11	82
	Reboiler	Inlet	T	2.75	0.23	-0.10	6	6	-13
		Dischg	T	-0.96	-0.95	1.73	103	1	13
	Separator	Inlet	T	-0.81	-0.24	-1.73	35	69	-14
		Dischg	T	-1.14	0.58	1.15	20	-5	74

Notes: P is axial, positive is tension. V3 is horizontal  
 V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
 M2 & M3 axes follow V2 and V3.  
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 M2 reversal reverses the sign of the positive seismic amplitude.

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3		
Case 8e	Pump	Inlet	D	-0.03	0.81	-0.04	-4	-1	55	
		Dischg	D	3.86	1.30	0.14	11	-3	-2	
	Reboiler	Inlet	D	1.32	-4.37	0.14	4	-7	1	
		Dischg	D	-0.62	-10.66	0.40	18	12	-253	
	Separator	Inlet	D	0.22	-1.08	-0.40	-70	4	16	
		Dischg	D	4.88	0.03	0.06	-1	-2	1	
	Pump	Inlet	E	2.03	1.40	3.95	9	-110	38	
		Dischg	E	2.52	1.24	1.34	24	-31	30	
	Reboiler	Inlet	E	1.85	1.44	1.25	22	-5	12	
		Dischg	E	8.33	7.76	26.89	1837	-233	426	
	Separator	Inlet	E	8.10	6.08	6.62	175	-336	285	
		Dischg	E	2.27	1.27	5.94	6	-19	44	
	Pump	Inlet	T	-3.37	-2.67	-7.31	125	29	-29	
		Dischg	T	-6.66	-38.21	0.12	12	7	-1097	
	Reboiler	Inlet	T	-38.18	-6.85	0.12	12	-4	-263	
		Dischg	T	-0.99	-0.99	1.79	106	1	13	
	Separator	Inlet	T	-0.84	-0.25	-1.79	37	72	-13	
		Dischg	T	-1.69	2.59	-10.31	31	637	273	
	Case 8f	Pump	Inlet	D	-0.06	-0.22	-0.13	0	1	18
			Dischg	D	3.23	0.13	0.08	8	-3	-28
Reboiler		Inlet	D	0.14	-2.05	0.08	0	-5	-18	
		Dischg	D	-0.33	-5.09	0.25	15	5	-132	
Separator		Inlet	D	0.56	-1.32	-0.25	-56	-1	13	
		Dischg	D	4.64	0.11	0.27	-4	-14	7	
Pump		Inlet	E	3.04	1.40	5.10	67	-91	26	
		Dischg	E	2.18	12.57	1.38	200	-89	342	
Reboiler		Inlet	E	15.00	2.66	2.66	96	-51	72	
		Dischg	E	4.74	6.48	18.02	1259	-141	257	
Separator		Inlet	E	8.38	5.03	6.65	127	-253	227	
		Dischg	E	4.00	2.68	21.80	101	-776	246	
Pump		Inlet	T	-2.01	-2.32	-2.75	103	-64	-19	
		Dischg	T	0.21	2.75	-0.10	-6	11	82	
Reboiler		Inlet	T	2.75	0.23	-0.10	6	6	-13	
		Dischg	T	-0.96	-0.95	1.73	103	1	13	
Separator		Inlet	T	-0.81	-0.24	-1.73	35	69	-14	
		Dischg	T	-1.14	0.58	1.15	20	-5	74	

Notes: P is axial, positive is tension. V3 is horizontal  
V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load		Kip P	Kip V2	Kip V3	in-Kip T	in-Kip M2	in-Kip M3
Case 8i	Pump	Inlet	D	-0.05	0.65	-0.11	2	2	50
		Dischg	D	3.37	0.11	0.09	6	-6	-31
	Reboiler	Inlet	D	0.14	-4.86	0.09	-2	-6	-39
		Dischg	D	-0.62	-10.56	0.34	17	14	-247
	Separator	Inlet	D	0.20	-1.03	-0.38	-74	3	18
		Dischg	D	4.85	0.06	0.32	-1	-15	5
	Pump	Inlet	E	4.61	1.65	8.58	80	-167	34
		Dischg	E	2.62	15.60	2.17	318	-83	424
	Reboiler	Inlet	E	19.05	3.52	4.38	157	-63	79
		Dischg	E	8.79	7.06	1.86	112	-101	499
	Separator	Inlet	E	8.33	4.33	1.71	118	-57	163
		Dischg	E	5.33	3.44	24.43	102	-771	323
	Pump	Inlet	T	-2.01	-2.32	-2.75	103	-84	-18
		Dischg	T	0.22	2.75	-0.09	-6	10	82
	Reboiler	Inlet	T	2.75	0.23	-0.09	6	6	-13
		Dischg	T	-0.91	-0.82	1.30	71	4	15
	Separator	Inlet	T	-0.89	-0.16	-1.85	32	75	-10
		Dischg	T	-1.14	0.58	1.18	20	-7	74
Case 8j	Pump	Inlet	D	-0.04	0.65	-0.10	2	1	50
		Dischg	D	3.38	0.16	0.10	8	-6	-30
	Reboiler	Inlet	D	0.18	-4.85	0.10	-1	-6	-38
		Dischg	D	-0.61	-10.56	0.34	17	14	-247
	Separator	Inlet	D	0.20	-1.03	-0.38	-74	3	18
		Dischg	D	4.85	0.05	0.32	-1	-15	4
	Pump	Inlet	E	4.08	1.20	6.81	33	-154	32
		Dischg	E	1.02	5.15	1.74	217	-82	142
	Reboiler	Inlet	E	2.53	1.61	3.43	103	-50	42
		Dischg	E	7.91	6.83	2.15	101	-94	450
	Separator	Inlet	E	7.99	4.06	1.63	108	-58	155
		Dischg	E	5.21	1.83	24.85	102	-776	135
	Pump	Inlet	T	-3.14	-1.84	-5.76	56	-31	-14
		Dischg	T	-2.24	-12.28	0.29	37	14	-321
	Reboiler	Inlet	T	-12.27	-2.30	0.29	28	-2	-86
		Dischg	T	-0.99	-0.91	1.44	79	6	14
	Separator	Inlet	T	-0.91	-0.23	-1.87	37	75	-12
		Dischg	T	-1.39	1.72	1.85	26	4	182

Notes: P is axial, positive is tension. V3 is horizontal  
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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	in-Kip T	in-Kip M2	in-Kip M3		
Case 8k	Pump	Inlet	D	0.01	0.65	-0.09	2	3	50	
		Dischg	D	3.37	0.09	0.11	8	-6	-31	
	Reboiler	Inlet	D	0.12	-4.86	0.11	-1	-8	-39	
		Dischg	D	-0.61	-10.56	0.34	17	14	-247	
	Separator	Inlet	D	0.20	-1.03	-0.38	-75	3	18	
		Dischg	D	4.81	0.06	-0.19	-1	17	5	
	Pump	Inlet	E	2.08	2.14	10.63	94	-120	43	
		Dischg	E	3.20	19.55	2.16	305	-91	531	
	Reboiler	Inlet	E	24.01	4.25	4.49	152	-57	82	
		Dischg	E	8.87	7.19	2.24	114	-104	506	
	Separator	Inlet	E	8.39	4.33	1.73	118	-43	157	
		Dischg	E	3.88	4.15	9.42	102	-938	385	
	Pump	Inlet	T	1.06	-2.19	-2.33	108	22	-9	
		Dischg	T	0.14	2.33	0.61	70	18	71	
	Reboiler	Inlet	T	2.33	0.15	0.61	45	-11	-15	
		Dischg	T	-0.87	-0.80	1.28	70	4	14	
	Separator	Inlet	T	-0.80	-0.18	-1.65	25	64	-12	
		Dischg	T	-4.18	0.60	-12.15	17	1065	74	
	Case 8L	Pump	Inlet	D	0.02	0.65	-0.07	2	3	50
			Dischg	D	3.38	0.15	0.11	9	-6	-30
Reboiler		Inlet	D	0.18	-4.85	0.11	-1	-7	-38	
		Dischg	D	-0.61	-10.56	0.34	17	14	-247	
Separator		Inlet	D	0.20	-1.03	-0.38	-75	3	18	
		Dischg	D	4.81	0.05	-0.18	-1	16	4	
Pump		Inlet	E	2.01	1.88	10.27	35	-134	55	
		Dischg	E	1.08	5.71	1.82	254	-75	158	
Reboiler		Inlet	E	3.62	1.73	3.96	120	-56	42	
		Dischg	E	7.89	6.85	2.45	103	-95	450	
Separator		Inlet	E	8.01	4.03	1.68	107	-45	149	
		Dischg	E	3.84	2.07	8.08	106	-840	117	
Pump		Inlet	T	0.00	-1.55	-5.23	62	60	-5	
		Dischg	T	-2.27	-12.39	0.92	104	20	-324	
Reboiler		Inlet	T	-12.38	-2.33	0.92	61	-18	-68	
		Dischg	T	-0.94	-0.88	1.42	78	6	13	
Separator		Inlet	T	-0.81	-0.25	-1.66	30	64	-15	
		Dischg	T	-4.37	1.73	-13.09	23	1149	180	

Notes: P is axial, positive is tension. V3 is horizontal  
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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	in-Kip T	in-Kip M2	in-Kip M3	
Case 8o	Pump	Inlet	D	-0.10	0.66	-0.25	2	3	50
		Dischg	D	3.82	0.25	0.11	8	-6	-34
	Reboiler	Inlet	D	0.27	-4.41	0.11	-1	-7	12
		Dischg	D	-0.01	-0.49	0.36	-4	-14	12
	Separator	Inlet	D	0.96	-1.81	-0.22	-46	1	6
		Dischg	D	4.83	0.10	0.34	0	-14	9
	Pump	Inlet	E	4.61	1.65	8.58	80	-167	34
		Dischg	E	2.62	15.60	2.17	318	-83	424
	Reboiler	Inlet	E	19.05	3.52	4.38	157	-63	79
		Dischg	E	8.79	7.06	1.86	112	-101	499
	Separator	Inlet	E	8.33	4.33	1.71	118	-57	163
		Dischg	E	5.33	3.44	24.43	102	-771	323
	Pump	Inlet	T	-1.45	-2.62	-2.02	98	-45	-38
		Dischg	T	0.26	2.02	-0.05	-3	12	57
	Reboiler	Inlet	T	2.02	0.27	-0.05	9	5	2
		Dischg	T	-0.71	-0.71	1.09	61	9	-1
	Separator	Inlet	T	-0.32	-0.88	-1.28	43	57	-67
		Dischg	T	0.03	0.29	0.83	24	25	53
Case 8p	Pump	Inlet	D	-0.05	0.65	-0.11	2	2	50
		Dischg	D	3.38	0.15	0.09	6	-6	-30
	Reboiler	Inlet	D	0.17	-4.85	0.09	-2	-6	-38
		Dischg	D	-0.61	-10.56	0.34	17	14	-247
	Separator	Inlet	D	0.20	-1.03	-0.38	-74	3	18
		Dischg	D	4.85	0.06	0.32	-1	-15	5
	Pump	Inlet	E	4.25	1.18	7.20	33	-148	30
		Dischg	E	1.00	4.50	1.99	273	-75	123
	Reboiler	Inlet	E	4.00	1.53	3.98	134	-57	44
		Dischg	E	8.02	6.89	2.09	103	-85	457
	Separator	Inlet	E	8.05	4.08	1.85	109	-58	155
		Dischg	E	5.28	1.90	24.72	101	-778	173
	Pump	Inlet	T	-1.32	-2.74	-1.67	106	-49	-37
		Dischg	T	0.57	3.83	-0.11	-9	11	106
	Reboiler	Inlet	T	3.83	0.59	-0.11	6	6	9
		Dischg	T	-0.70	-0.70	1.08	60	9	-1
	Separator	Inlet	T	-0.32	-0.67	-1.28	42	57	-67
		Dischg	T	0.07	0.15	0.75	24	24	41

Notes: P is axial, positive is tension. V3 is horizontal  
V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
M2 & M3 axes follow V2 and V3.  
M2 has the sign reversed relative to the SAP2000 local system so all systems are right handed.  
M2 reversal reverses the sign of the positive seismic amplitude.

# Draft

# CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

## Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3	
Case 8q	Pump	Inlet	D	-0.05	0.65	-0.11	2	2	50
		Dischg	D	3.38	0.15	0.09	6	-6	-30
	Reboiler	Inlet	D	0.17	-4.85	0.09	-2	-6	-38
		Dischg	D	-0.61	-10.56	0.34	17	14	-247
	Separator	Inlet	D	0.20	-1.03	-0.38	-74	3	18
		Dischg	D	4.85	0.06	0.32	-1	-15	5
	Pump	Inlet	E	4.25	1.18	7.20	33	-148	30
		Dischg	E	1.00	4.50	1.99	273	-75	123
	Reboiler	Inlet	E	4.00	1.53	3.98	134	-57	44
		Dischg	E	8.02	6.89	2.09	103	-95	457
	Separator	Inlet	E	8.05	4.08	1.65	109	-58	155
		Dischg	E	5.28	1.90	24.72	101	-776	173
	Pump	Inlet	T	-1.70	-2.51	-2.66	90	-39	-35
		Dischg	T	-0.26	-1.28	0.05	9	13	-32
	Reboiler	Inlet	T	-1.28	-0.27	0.05	15	3	-9
		Dischg	T	-0.73	-0.73	1.13	63	9	-1
	Separator	Inlet	T	-0.32	-0.69	-1.29	44	57	-68
		Dischg	T	-0.02	0.53	0.98	26	27	78
Case 8r	Pump	Inlet	D	-0.05	0.65	-0.11	2	2	50
		Dischg	D	3.38	0.15	0.09	6	-6	-30
	Reboiler	Inlet	D	0.17	-4.85	0.09	-2	-6	-38
		Dischg	D	-0.61	-10.56	0.34	17	14	-247
	Separator	Inlet	D	0.20	-1.03	-0.38	-74	3	18
		Dischg	D	4.85	0.06	0.32	-1	-15	5
	Pump	Inlet	E	4.25	1.18	7.20	33	-148	30
		Dischg	E	1.00	4.50	1.99	273	-75	123
	Reboiler	Inlet	E	4.00	1.53	3.98	134	-57	44
		Dischg	E	8.02	6.89	2.09	103	-95	457
	Separator	Inlet	E	8.05	4.08	1.65	109	-58	155
		Dischg	E	5.28	1.90	24.72	101	-776	173
	Pump	Inlet	T	-1.89	-2.39	-3.16	82	-34	-35
		Dischg	T	-0.68	-3.84	0.13	18	14	-101
	Reboiler	Inlet	T	-3.83	-0.70	0.13	20	1	-18
		Dischg	T	-0.74	-0.75	1.15	85	10	-2
	Separator	Inlet	T	-0.33	-0.70	-1.29	45	57	-68
		Dischg	T	-0.06	0.72	1.09	27	29	94

Notes: P is axial, positive is tension. V3 is horizontal  
V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
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M2 reversal reverses the sign of the positive seismic amplitude.

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	in-Kip T	in-Kip M2	in-Kip M3	
Case 6s	Pump	Inlet	D	-0.07	0.64	-0.16	4	2	50
		Dischg	D	3.89	0.67	0.10	7	-8	-23
	Reboiler	Inlet	D	0.70	-4.33	0.10	-1	-7	14
		Dischg	D	-0.01	-0.49	0.36	-4	-14	12
	Separator	Inlet	D	0.96	-1.61	-0.22	-45	1	6
		Dischg	D	4.84	0.07	0.32	0	-14	6
	Pump	Inlet	E	4.19	1.17	6.57	32	-143	30
		Dischg	E	0.98	4.30	1.93	255	-70	118
	Reboiler	Inlet	E	3.68	1.50	3.77	125	-54	43
		Dischg	E	7.60	6.79	2.08	98	-91	434
	Separator	Inlet	E	7.77	3.93	1.81	104	-57	152
		Dischg	E	5.24	1.77	24.71	98	-774	163
	Pump	Inlet	T	-1.89	-2.39	-3.16	82	-34	-35
		Dischg	T	-0.68	-3.84	0.13	18	14	-101
	Reboiler	Inlet	T	-3.83	-0.70	0.13	20	1	-18
		Dischg	T	-0.74	-0.75	1.15	65	10	-2
	Separator	Inlet	T	-0.33	-0.70	-1.29	45	57	-68
		Dischg	T	-0.06	0.72	1.09	27	29	94

Notes: P is axial, positive is tension. V3 is horizontal  
V2 has an upward sense, unless P is vertical. Then V2 follows X (east)  
M2 & M3 axes follow V2 and V3.  
M2 has the sign reversed relative to the SAP2000 local system so all systems are right handed.  
M2 reversal reverses the sign of the positive seismic amplitude.

**Draft**

**CALCULATION SHEET**

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 8/15/08

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

**Pump Support Gap Closure Loads**

Case	In Gap	Load	Kip P	Remark
Case 8p	1/8	D	0.04	
		E	8.74	Seismic amplitude
		T	2.16	Tension, gap did not close
Case 8q	1/16	D	0.04	
		E	8.74	Seismic amplitude, exceeds thermal compression and suggests opening during seismic event
		T	-3.94	Compression, gap closed
Case 8r	1/32	D	0.04	
		E	8.74	Seismic amplitude, exceeds thermal compression and suggests opening during seismic event
		T	-6.99	Compression, gap closed
Case 8s	1/32	D	0.51	
		E	8.08	Seismic amplitude, exceeds thermal compression and suggests opening during seismic event
		T	-7.00	Compression, gap closed

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24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Mid-Elbow Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3	
Case 8a	Pump	Inlet	D	-0.05	0.01	-1.74	24	8	1
	Reboiler	Dischg	D	-7.40	6.57	0.56	30	3	-8
	Separator	Dischg	D	0.99	-0.98	-0.03	-2	0	16
	Pump	Inlet	E	2.42	3.28	1.16	8	2	17
	Reboiler	Dischg	E	4.24	7.47	7.83	349	217	288
	Separator	Dischg	E	5.76	4.23	0.34	3	5	40
	Pump	Inlet	T	-7.73	2.91	2.62	96	-39	128
	Reboiler	Dischg	T	-2.48	0.21	5.14	286	-134	42
	Separator	Dischg	T	-3.60	-1.27	-3.28	39	29	79
Case 8b	Pump	Inlet	D	0.03	0.00	-1.57	28	4	-1
	Reboiler	Dischg	D	-7.32	6.49	0.45	28	5	-4
	Separator	Dischg	D	1.04	-0.98	-0.02	-1	0	16
	Pump	Inlet	E	5.53	7.97	2.10	61	28	151
	Reboiler	Dischg	E	8.09	12.45	16.97	794	485	439
	Separator	Dischg	E	11.38	7.85	5.80	75	88	73
	Pump	Inlet	T	-2.55	0.14	2.45	86	-27	118
	Reboiler	Dischg	T	-2.32	0.20	4.74	263	-122	40
	Separator	Dischg	T	-1.83	-0.61	-0.41	28	3	29
Case 8c	Pump	Inlet	D	0.01	0.01	-1.58	26	4	-1
	Reboiler	Dischg	D	-7.29	6.34	0.37	28	5	13
	Separator	Dischg	D	1.02	-0.96	-0.03	-1	0	16
	Pump	Inlet	E	26.06	13.94	1.77	87	38	383
	Reboiler	Dischg	E	11.80	10.80	35.29	1895	975	368
	Separator	Dischg	E	20.84	14.10	9.62	109	171	139
	Pump	Inlet	T	-1.35	-0.23	2.34	62	-24	98
	Reboiler	Dischg	T	-1.36	-0.01	1.75	92	-28	28
	Separator	Dischg	T	-1.34	-0.27	-0.06	24	-1	27
Case 8d	Pump	Inlet	D	-0.11	0.05	-1.58	26	4	1
	Reboiler	Dischg	D	-7.29	6.34	0.37	28	5	13
	Separator	Dischg	D	0.97	-0.99	-0.06	-1	1	17
	Pump	Inlet	E	4.48	7.30	1.80	69	29	116
	Reboiler	Dischg	E	10.34	9.64	30.44	1638	839	326
	Separator	Dischg	E	12.42	8.95	3.79	67	74	71
	Pump	Inlet	T	-3.37	0.52	2.32	85	-26	115
	Reboiler	Dischg	T	-1.35	-0.01	1.73	92	-27	28
	Separator	Dischg	T	-2.12	-0.76	-0.58	28	7	32

Notes Results are at the center of each elbow listed nearest the nozzle listed.  
Forces & moments are in the SAP2000 frame local coordinate system.  
The user-specified local system for elbows have the 2-axis pointing to the center of the elbow run.  
M2 is out-of-plane bending. M3 is in-plane bending. Positive P is tension.

Draft

CALCULATION SHEET

24590-PTF-3PS-MEV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Mid-Elbow Loads

Case	Location	Load	Kp P	Kp V2	Kp V3	in-Kip T	in-Kip M2	in-Kip M3	
Case 8e	Pump	Inlet	D	-0.05	0.01	-1.74	24	8	1
	Reboiler	Dischg	D	-7.35	6.40	0.40	26	6	10
	Separator	Dischg	D	0.98	-0.97	-0.03	-2	1	17
	Pump	Inlet	E	2.52	3.32	1.16	8	2	17
	Reboiler	Dischg	E	8.13	7.80	26.82	1439	756	285
	Separator	Dischg	E	5.78	4.24	0.32	4	6	40
	Pump	Inlet	T	-7.56	2.79	2.87	97	-39	128
	Reboiler	Dischg	T	-1.40	-0.01	1.79	95	-28	28
	Separator	Dischg	T	-3.55	-1.28	-2.59	44	36	77
Case 8f	Pump	Inlet	D	-0.13	0.06	-0.71	12	6	1
	Reboiler	Dischg	D	-3.91	3.39	0.25	17	-1	13
	Separator	Dischg	D	0.81	-0.85	-0.11	-5	2	17
	Pump	Inlet	E	2.96	3.95	1.32	55	25	96
	Reboiler	Dischg	E	6.13	4.79	17.90	995	516	183
	Separator	Dischg	E	8.83	6.56	3.12	65	65	46
	Pump	Inlet	T	-3.37	0.52	2.32	85	-26	115
	Reboiler	Dischg	T	-1.35	-0.01	1.73	92	-27	28
	Separator	Dischg	T	-2.12	-0.76	-0.58	28	7	32
Case 8g	Pump	Inlet	D	-0.11	0.05	-1.58	26	4	1
	Reboiler	Dischg	D	-7.28	6.33	0.34	26	6	13
	Separator	Dischg	D	0.97	-0.99	-0.06	-1	1	17
	Pump	Inlet	E	4.52	7.33	1.57	67	28	117
	Reboiler	Dischg	E	5.89	9.26	1.42	152	25	306
	Separator	Dischg	E	12.75	9.19	3.79	67	74	72
	Pump	Inlet	T	-3.37	0.52	2.32	85	-26	115
	Reboiler	Dischg	T	-1.22	-0.07	1.30	67	-14	26
	Separator	Dischg	T	-2.12	-0.76	-0.58	29	7	32
Case 8j	Pump	Inlet	D	-0.10	0.04	-1.58	26	4	1
	Reboiler	Dischg	D	-7.28	6.33	0.34	26	6	13
	Separator	Dischg	D	0.97	-0.99	-0.05	-1	1	17
	Pump	Inlet	E	4.37	5.85	1.10	30	12	93
	Reboiler	Dischg	E	5.64	8.43	1.70	137	26	276
	Separator	Dischg	E	12.37	8.95	2.41	66	55	67
	Pump	Inlet	T	-6.30	1.85	1.64	47	-7	149
	Reboiler	Dischg	T	-1.34	-0.06	1.44	76	-15	27
	Separator	Dischg	T	-3.02	-1.46	-1.72	34	27	39

Notes Results are at the center of each elbow listed nearest the nozzle listed.  
Forces & moments are in the SAP2000 frame local coordinate system.  
The user-specified local system for elbows have the 2-axis pointing to the center of the elbow run.  
M2 is out-of-plane bending. M3 is in-plane bending. Positive P is tension.

Draft

CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Mid-Elbow Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	In-Kip T	In-Kip M2	In-Kip M3	
Case 8k	Pump	Inlet	D	-0.06	0.07	-1.58	26	4	-1
	Reboiler	Dischg	D	-7.28	6.33	0.34	26	6	13
	Separator	Dischg	D	0.83	-1.05	-0.06	-1	1	19
	Pump	Inlet	E	6.21	7.16	1.99	75	35	163
	Reboiler	Dischg	E	5.96	9.38	1.80	153	26	310
	Separator	Dischg	E	9.55	6.02	4.28	67	83	113
	Pump	Inlet	T	-0.89	2.40	2.19	94	-25	51
	Reboiler	Dischg	T	-1.18	-0.06	1.28	67	-13	25
	Separator	Dischg	T	-11.40	-5.92	-0.60	24	8	159
Case 8L	Pump	Inlet	D	-0.04	0.06	-1.58	26	4	-1
	Reboiler	Dischg	D	-7.28	6.33	0.34	26	6	13
	Separator	Dischg	D	0.84	-1.05	-0.05	-1	1	19
	Pump	Inlet	E	6.32	7.28	1.64	35	16	142
	Reboiler	Dischg	E	5.65	8.42	2.00	137	27	276
	Separator	Dischg	E	8.94	5.61	1.88	69	66	100
	Pump	Inlet	T	-3.70	3.70	1.55	58	-7	78
	Reboiler	Dischg	T	-1.29	-0.05	1.42	75	-14	26
	Separator	Dischg	T	-12.18	-6.47	-1.73	29	26	170
Case 8o	Pump	Inlet	D	-0.25	0.10	-1.58	26	4	3
	Reboiler	Dischg	D	0.30	-0.32	0.36	-9	2	13
	Separator	Dischg	D	0.92	-1.02	-0.10	0	2	17
	Pump	Inlet	E	4.52	7.33	1.57	67	28	117
	Reboiler	Dischg	E	5.89	9.28	1.42	152	25	306
	Separator	Dischg	E	12.75	9.19	3.79	67	74	72
	Pump	Inlet	T	-2.46	0.40	2.62	73	-27	83
	Reboiler	Dischg	T	-1.00	0.00	1.09	62	-9	10
	Separator	Dischg	T	-0.91	-1.14	-0.29	36	2	3
Case 8p	Pump	Inlet	D	-0.11	0.04	-1.58	26	4	1
	Reboiler	Dischg	D	-7.28	6.33	0.34	26	6	13
	Separator	Dischg	D	0.97	-0.99	-0.06	-1	1	17
	Pump	Inlet	E	4.41	6.20	1.05	30	10	102
	Reboiler	Dischg	E	5.69	8.54	1.62	139	26	280
	Separator	Dischg	E	12.77	9.20	2.67	66	57	71
	Pump	Inlet	T	-2.12	0.25	2.74	79	-29	79
	Reboiler	Dischg	T	-0.99	0.00	1.08	61	-9	10
	Separator	Dischg	T	-0.80	-1.06	-0.15	36	-1	2

Notes Results are at the center of each elbow listed nearest the nozzle listed.  
 Forces & moments are in the SAP2000 frame local coordinate system.  
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Draft

CALCULATION SHEET

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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

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Mid-Elbow Loads

Case	Location	Load	Kip P	Kip V2	Kip V3	in-Kip T	in-Kip M2	in-Kip M3	
Case 8q	Pump	Inlet	D	-0.11	0.04	-1.58	26	4	1
	Reboiler	Dischg	D	-7.28	6.33	0.34	28	6	13
	Separator	Dischg	D	0.97	-0.99	-0.06	-1	1	17
	Pump	Inlet	E	4.41	6.20	1.05	30	10	102
	Reboiler	Dischg	E	5.69	8.54	1.62	139	26	280
	Separator	Dischg	E	12.77	9.20	2.67	66	57	71
	Pump	Inlet	T	-3.09	0.88	2.51	66	-23	91
	Reboiler	Dischg	T	-1.03	0.00	1.13	64	-9	10
	Separator	Dischg	T	-1.11	-1.30	-0.53	37	6	4
Case 8r	Pump	Inlet	D	-0.11	0.04	-1.58	28	4	1
	Reboiler	Dischg	D	-7.28	6.33	0.34	28	6	13
	Separator	Dischg	D	0.97	-0.99	-0.06	-1	1	17
	Pump	Inlet	E	4.41	6.20	1.05	30	10	102
	Reboiler	Dischg	E	5.69	8.54	1.62	139	26	280
	Separator	Dischg	E	12.77	9.20	2.67	66	57	71
	Pump	Inlet	T	-3.57	0.89	2.39	60	-20	97
	Reboiler	Dischg	T	-1.05	0.00	1.15	65	-9	10
	Separator	Dischg	T	-1.26	-1.41	-0.72	38	9	6
Case 8s	Pump	Inlet	D	-0.16	0.07	-1.57	27	4	2
	Reboiler	Dischg	D	0.30	-0.32	0.36	-9	3	13
	Separator	Dischg	D	0.95	-1.00	-0.07	-1	1	17
	Pump	Inlet	E	4.13	5.79	1.05	29	10	94
	Reboiler	Dischg	E	5.56	8.17	1.61	132	26	265
	Separator	Dischg	E	12.64	9.12	2.56	64	54	70
	Pump	Inlet	T	-3.57	0.89	2.39	60	-20	97
	Reboiler	Dischg	T	-1.05	0.00	1.15	65	-9	10
	Separator	Dischg	T	-1.26	-1.41	-0.72	38	9	6

Notes Results are at the center of each elbow listed nearest the nozzle listed.  
 Forces & moments are in the SAP2000 frame local coordinate system.  
 The user-specified local system for elbows have the 2-axis pointing to the center of the elbow run.  
 M2 is out-of-plane bending. M3 is in-plane bending. Positive P is tension.

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CALCULATION SHEET

24590-PTF-3PS-MEV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Welner  
DATE: 8/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

RGM vs Pre-RGM Nozzle Loads

Nozzle	Load		RGM - Case 8d				Pre-RGM - Case 8h			
			Kip	Kip	in-Kip	in-Kip	Kip	Kip	in-Kip	in-Kip
			P	V	T	M	P	V	T	M
Pump	Inlet	D	-0.05	0.66	2	50	-0.05	0.66	2	50
	Dischg	D	3.37	0.15	6	31	3.37	0.15	6	31
Reboiler	Inlet	D	0.14	4.86	-2	39	0.14	4.86	-2	39
	Dischg	D	-0.62	10.58	20	248	-0.62	10.58	20	248
Separator	Inlet	D	0.21	1.10	-74	18	0.21	1.10	-74	18
	Dischg	D	4.85	0.32	-1	16	4.85	0.32	-1	16
Pump	Inlet	E	4.53	8.79	80	172	4.06	7.87	71	152
	Dischg	E	2.68	15.75	316	432	2.35	14.15	288	388
Reboiler	Inlet	E	19.04	5.66	157	117	17.13	5.05	142	102
	Dischg	E	9.60	32.45	2074	558	7.80	27.02	1725	455
Separator	Inlet	E	11.03	12.47	206	523	9.90	10.46	172	437
	Dischg	E	5.22	24.13	102	829	4.53	21.32	105	729
Pump	Inlet	T	-2.01	3.60	103	67	-2.01	3.60	103	67
	Dischg	T	0.21	2.75	-6	83	0.21	2.75	-6	83
Reboiler	Inlet	T	2.75	0.25	6	15	2.75	0.25	6	15
	Dischg	T	-0.96	1.97	103	13	-0.96	1.97	103	13
Separator	Inlet	T	-0.81	1.75	35	70	-0.81	1.75	35	70
	Dischg	T	-1.14	1.28	20	74	-1.14	1.28	20	74

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**CALCULATION SHEET**

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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

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SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

**Drift Nozzle Loads (Case 8d)**

Nozzle	Load		Kip P	Kip V	In-Kip T	In-Kip M
Pump	Inlet	E	4.53	8.79	80	172
	Dischg	E	2.68	15.75	316	432
Reboiler	Inlet	E	19.04	5.68	157	117
	Dischg	E	9.80	32.45	2074	558
Separator	Inlet	E	11.03	12.47	206	523
	Dischg	E	5.22	24.13	102	829
Pump	Inlet	Dr	0.40	1.08	-23	10
	Dischg	Dr	-0.13	0.85	-9	24
Reboiler	Inlet	Dr	-0.85	0.15	-6	3
	Dischg	Dr	0.18	0.24	-15	6
Separator	Inlet	Dr	-0.01	0.30	10	30
	Dischg	Dr	0.12	4.94	-19	251

**Frame Base Reactions**

Case	Base	Loc	Load	Kip FX	Kip FY	Kip FZ	Kip-ft MX	Kip-ft MY	Kip-ft MZ
Case 8g	Pump Frame	Bottom	E	3	6	8	61	57	12
	Reboiler Frame	Bottom	E	25	38	23	280	141	125
	Separator Frame	Bottom	E	133	153	67	4220	3841	80
Case 8d	Pump Frame	Bottom	Dr	0	0	-1	2	-2	2
	Reboiler Frame	Bottom	Dr	-1	0	0	1	-2	-1
	Separator Frame	Bottom	Dr	-10	-23	0	1236	-475	-3
	Separator Frame	Top	Dr	9	24	0	0	0	-1
	Pump Frame	Bottom	E	4	7	8	66	58	12
	Reboiler Frame	Bottom	E	24	36	21	261	142	115
	Separator Frame	Bottom	E	61	100	65	2007	1011	47
	Separator Frame	Top	E	32	47	1	0	1	41

Notes: Case 8g is Case 8d with top support removed from separator.  
Frame bases constrained to single joint for reactions.  
Components are global.

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CALCULATION SHEET

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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	In U1	In U2	In U3	deg R1	deg R2	deg R3	
Case 8a	Pump	Inlet	D	0.0006	0.0000	-0.0011	0.0000	-0.0012	0.0000
		Dischg	D	0.0010	0.0000	-0.0011	0.0000	-0.0012	0.0000
	Reboiler	Inlet	D	0.0000	-0.0089	-0.0128	-0.0018	0.0001	-0.0001
		Dischg	D	0.0000	-0.0080	-0.0128	-0.0018	0.0001	-0.0001
	Separator	Inlet	D	0.0000	0.0000	-0.0297	0.0000	0.0000	0.0000
		Dischg	D	0.0000	0.0000	-0.0297	0.0000	0.0000	0.0000
	Pump	Inlet	E	0.0178	0.0217	0.0006	0.0005	0.0034	0.0238
		Dischg	E	0.0093	0.0215	0.0005	0.0005	0.0034	0.0238
	Reboiler	Inlet	E	0.0420	0.0245	0.0072	0.0020	0.0071	0.0015
		Dischg	E	0.0420	0.0250	0.0072	0.0020	0.0071	0.0015
	Separator	Inlet	E	0.0710	0.1839	0.0178	0.0229	0.0120	0.0003
		Dischg	E	0.0751	0.1879	0.0187	0.0229	0.0120	0.0003
	Pump	Inlet	T	0.0006	0.0252	0.0402	0.0000	-0.0001	0.0000
		Dischg	T	0.0007	0.0000	0.0238	0.0000	-0.0001	0.0000
	Reboiler	Inlet	T	-0.0298	-0.0036	-0.0020	0.0038	0.0000	0.0000
		Dischg	T	0.0298	-0.0036	-0.0020	0.0038	0.0000	0.0000
	Separator	Inlet	T	0.0221	0.0001	0.0714	0.0000	0.0000	0.0000
		Dischg	T	0.0000	0.0000	0.0506	0.0000	0.0000	0.0000
Case 8b	Pump	Inlet	D	0.0013	-0.0090	0.0007	0.0041	-0.0005	0.0004
		Dischg	D	0.0016	-0.0083	-0.0014	0.0018	0.0001	0.0003
	Reboiler	Inlet	D	-0.0031	-0.0108	-0.0136	-0.0021	0.0048	-0.0011
		Dischg	D	-0.0031	-0.0122	-0.0212	-0.0021	0.0080	-0.0011
	Separator	Inlet	D	-0.0002	0.0002	-0.0313	-0.0001	0.0000	0.0002
		Dischg	D	-0.0002	0.0001	-0.0313	-0.0001	0.0000	0.0002
	Pump	Inlet	E	0.2014	0.4905	0.0189	0.0249	0.0244	0.2407
		Dischg	E	0.1085	0.4751	0.0028	0.0379	0.0413	0.2425
	Reboiler	Inlet	E	0.0583	0.0769	0.0127	0.0057	0.0129	0.0572
		Dischg	E	0.0592	0.0418	0.0135	0.0069	0.0138	0.0527
	Separator	Inlet	E	0.0759	0.1572	0.0175	0.0204	0.0128	0.0082
		Dischg	E	0.0806	0.1557	0.0159	0.0201	0.0128	0.0087
	Pump	Inlet	T	-0.1541	-0.0214	0.0380	-0.0029	0.0046	0.0190
		Dischg	T	-0.1404	-0.0487	0.0226	0.0014	-0.0026	0.0215
	Reboiler	Inlet	T	-0.0355	-0.0109	-0.0026	0.0041	0.0011	0.0013
		Dischg	T	0.0252	-0.0098	-0.0043	0.0049	0.0012	0.0006
	Separator	Inlet	T	0.0227	0.0113	0.0713	0.0015	0.0001	0.0013
		Dischg	T	-0.0003	0.0112	0.0499	0.0014	0.0001	0.0012

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up
2. Case 8a seismic displacements are from the frame/vessel model analysis. Seismic anchor movements were input to the piping model as zero.

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	in			deg			
			U1	U2	U3	R1	R2	R3	
Case 8c	Pump	Inlet	D	0.0018	-0.0087	0.0007	0.0042	-0.0004	0.0006
		Dischg	D	0.0021	-0.0079	-0.0015	0.0018	0.0003	0.0005
	Reboiler	Inlet	D	-0.0035	-0.0105	-0.0129	-0.0021	0.0054	-0.0011
		Dischg	D	-0.0035	-0.0120	-0.0215	-0.0020	0.0066	-0.0011
	Separator	Inlet	D	-0.0004	0.0002	-0.0314	-0.0001	0.0001	0.0001
		Dischg	D	-0.0005	0.0001	-0.0313	-0.0001	0.0001	0.0001
	Pump	Inlet	E	0.2583	2.0886	0.0180	0.0222	0.0459	0.5562
		Dischg	E	0.2316	2.0768	0.0049	0.0281	0.0807	0.6103
	Reboiler	Inlet	E	0.0778	0.0748	0.0198	0.0074	0.0210	0.0588
		Dischg	E	0.0771	0.0679	0.0189	0.0130	0.0213	0.0547
	Separator	Inlet	E	0.0842	0.1997	0.0198	0.0210	0.0138	0.0028
		Dischg	E	0.0895	0.2027	0.0183	0.0209	0.0138	0.0028
	Pump	Inlet	T	-0.1559	-0.1031	0.0375	-0.0040	0.0058	0.0332
		Dischg	T	-0.1348	-0.1293	0.0227	-0.0009	0.0000	0.0379
	Reboiler	Inlet	T	-0.0329	-0.0075	-0.0023	0.0038	0.0004	0.0013
		Dischg	T	0.0277	-0.0060	-0.0031	0.0040	0.0005	0.0010
Separator	Inlet	T	0.0219	0.0049	0.0716	0.0008	0.0002	0.0002	
	Dischg	T	-0.0011	0.0049	0.0502	0.0006	0.0002	0.0002	
Case 8d	Pump	Inlet	D	0.0020	-0.0006	0.0006	0.0041	-0.0006	-0.0013
		Dischg	D	0.0014	0.0001	-0.0015	0.0017	0.0001	-0.0016
	Reboiler	Inlet	D	-0.0037	-0.0102	-0.0128	-0.0021	0.0054	-0.0013
		Dischg	D	-0.0037	-0.0120	-0.0215	-0.0020	0.0067	-0.0012
	Separator	Inlet	D	-0.0004	0.0003	-0.0314	-0.0001	0.0001	0.0001
		Dischg	D	-0.0005	0.0001	-0.0313	-0.0001	0.0001	0.0001
	Pump	Inlet	E	0.1957	0.0551	0.0057	0.0070	0.0227	0.1026
		Dischg	E	0.1292	0.0555	0.0028	0.0057	0.0411	0.0820
	Reboiler	Inlet	E	0.0534	0.0302	0.0068	0.0067	0.0133	0.0306
		Dischg	E	0.0532	0.0600	0.0168	0.0116	0.0141	0.0324
	Separator	Inlet	E	0.0751	0.1859	0.0174	0.0206	0.0127	0.0020
		Dischg	E	0.0798	0.1882	0.0160	0.0205	0.0127	0.0019
	Pump	Inlet	T	-0.1479	0.0187	0.0363	-0.0055	0.0033	-0.0031
		Dischg	T	-0.1470	-0.0083	0.0224	-0.0030	-0.0045	-0.0023
	Reboiler	Inlet	T	-0.0361	-0.0044	-0.0013	0.0038	0.0016	-0.0015
		Dischg	T	0.0248	-0.0066	-0.0036	0.0041	0.0016	-0.0016
Separator	Inlet	T	0.0221	0.0056	0.0717	0.0007	0.0001	0.0001	
	Dischg	T	-0.0009	0.0058	0.0503	0.0007	0.0001	0.0000	

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up

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CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 9/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	in U1	in U2	in U3	deg R1	deg R2	deg R3		
Case 8e	Pump	Inlet	D	0.0006	0.0000	-0.0011	0.0000	-0.0012	0.0000	
		Dischg	D	0.0010	0.0000	-0.0011	0.0000	-0.0012	0.0000	
	Reboiler	Inlet	D	0.0000	-0.0089	-0.0128	-0.0018	0.0001	-0.0001	
		Dischg	D	0.0000	-0.0090	-0.0128	-0.0018	0.0001	-0.0001	
	Separator	Inlet	D	0.0000	0.0000	-0.0297	0.0000	0.0000	0.0000	
		Dischg	D	0.0000	0.0000	-0.0297	0.0000	0.0000	0.0000	
	Pump	Inlet	E	0.0178	0.0217	0.0006	0.0005	0.0034	0.0238	
		Dischg	E	0.0093	0.0215	0.0005	0.0005	0.0034	0.0238	
	Reboiler	Inlet	E	0.0420	0.0245	0.0072	0.0020	0.0071	0.0015	
		Dischg	E	0.0420	0.0250	0.0072	0.0020	0.0071	0.0015	
	Separator	Inlet	E	0.0710	0.1839	0.0178	0.0229	0.0120	0.0003	
		Dischg	E	0.0751	0.1879	0.0167	0.0229	0.0120	0.0003	
	Pump	Inlet	T	0.0006	0.0252	0.0402	0.0000	-0.0001	0.0000	
		Dischg	T	0.0007	0.0000	0.0238	0.0000	-0.0001	0.0000	
	Reboiler	Inlet	T	-0.0296	-0.0038	-0.0020	0.0038	0.0000	0.0000	
		Dischg	T	0.0296	-0.0038	-0.0020	0.0038	0.0000	0.0000	
	Separator	Inlet	T	0.0221	0.0001	0.0714	0.0000	0.0000	0.0000	
		Dischg	T	0.0000	0.0000	0.0506	0.0000	0.0000	0.0000	
	Case 8f	Pump	Inlet	D	0.0024	-0.0008	-0.0013	0.0007	-0.0009	-0.0009
			Dischg	D	0.0021	-0.0008	-0.0016	0.0000	-0.0002	-0.0013
Reboiler		Inlet	D	-0.0023	-0.0093	-0.0122	-0.0019	0.0035	-0.0009	
		Dischg	D	-0.0023	-0.0106	-0.0177	-0.0018	0.0042	-0.0009	
Separator		Inlet	D	-0.0003	0.0001	-0.0314	-0.0001	0.0001	0.0001	
		Dischg	D	-0.0003	0.0000	-0.0314	-0.0001	0.0001	0.0001	
Pump		Inlet	E	0.1477	0.0420	0.0044	0.0045	0.0197	0.0840	
		Dischg	E	0.1075	0.0427	0.0025	0.0043	0.0348	0.0524	
Reboiler		Inlet	E	0.0459	0.0247	0.0086	0.0045	0.0089	0.0181	
		Dischg	E	0.0458	0.0393	0.0111	0.0074	0.0093	0.0191	
Separator		Inlet	E	0.0745	0.1808	0.0171	0.0204	0.0128	0.0014	
		Dischg	E	0.0791	0.1831	0.0158	0.0202	0.0128	0.0013	
Pump		Inlet	T	-0.1479	0.0187	0.0383	-0.0055	0.0033	-0.0031	
		Dischg	T	-0.1470	-0.0083	0.0224	-0.0030	-0.0045	-0.0023	
Reboiler		Inlet	T	-0.0381	-0.0044	-0.0013	0.0038	0.0016	-0.0015	
		Dischg	T	0.0246	-0.0086	-0.0036	0.0041	0.0016	-0.0016	
Separator		Inlet	T	0.0221	0.0056	0.0717	0.0007	0.0001	0.0001	
		Dischg	T	-0.0009	0.0058	0.0503	0.0007	0.0001	0.0000	

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up
2. Case 8e seismic displacements are from the frame/vessel analysis. Seismic anchor movements were input to the piping model as zero.

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CALCULATION SHEET

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Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/08

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	in U1	in U2	in U3	deg R1	deg R2	deg R3	
Case 8i	Pump	Inlet	D	0.0020	-0.0006	0.0008	0.0041	-0.0008	-0.0012
		Dischg	D	0.0014	0.0001	-0.0015	0.0017	0.0001	-0.0016
	Reboiler	Inlet	D	-0.0037	-0.0102	-0.0128	-0.0021	0.0054	-0.0012
		Dischg	D	-0.0037	-0.0120	-0.0215	-0.0020	0.0067	-0.0012
	Separator	Inlet	D	-0.0004	0.0003	-0.0314	-0.0001	0.0001	0.0001
		Dischg	D	-0.0005	0.0002	-0.0313	-0.0001	0.0001	0.0001
	Pump	Inlet	E	0.1957	0.0556	0.0052	0.0056	0.0228	0.1032
		Dischg	E	0.1288	0.0561	0.0028	0.0050	0.0411	0.0824
	Reboiler	Inlet	E	0.0525	0.0304	0.0090	0.0042	0.0107	0.0064
		Dischg	E	0.0523	0.0295	0.0114	0.0043	0.0113	0.0062
	Separator	Inlet	E	0.0749	0.1902	0.0178	0.0206	0.0127	0.0008
		Dischg	E	0.0796	0.1927	0.0164	0.0205	0.0126	0.0008
	Pump	Inlet	T	-0.1478	0.0187	0.0363	-0.0055	0.0033	-0.0030
		Dischg	T	-0.1469	-0.0083	0.0224	-0.0030	-0.0045	-0.0022
	Reboiler	Inlet	T	-0.0360	-0.0043	-0.0013	0.0037	0.0014	-0.0011
		Dischg	T	0.0247	-0.0059	-0.0034	0.0039	0.0015	-0.0011
Separator	Inlet	T	0.0221	0.0058	0.0717	0.0007	0.0001	0.0001	
	Dischg	T	-0.0009	0.0060	0.0503	0.0007	0.0001	0.0001	
Case 8j	Pump	Inlet	D	0.0015	-0.0005	0.0008	0.0040	-0.0008	-0.0009
		Dischg	D	0.0012	0.0001	-0.0015	0.0016	0.0000	-0.0013
	Reboiler	Inlet	D	-0.0037	-0.0102	-0.0128	-0.0021	0.0055	-0.0013
		Dischg	D	-0.0037	-0.0120	-0.0215	-0.0020	0.0067	-0.0012
	Separator	Inlet	D	-0.0004	0.0003	-0.0314	-0.0001	0.0001	0.0001
		Dischg	D	-0.0005	0.0002	-0.0313	-0.0001	0.0001	0.0001
	Pump	Inlet	E	0.0582	0.0437	0.0036	0.0057	0.0056	0.0698
		Dischg	E	0.0257	0.0452	0.0012	0.0058	0.0111	0.0541
	Reboiler	Inlet	E	0.0391	0.0301	0.0078	0.0043	0.0086	0.0049
		Dischg	E	0.0392	0.0301	0.0103	0.0043	0.0094	0.0048
	Separator	Inlet	E	0.0752	0.1924	0.0178	0.0207	0.0127	0.0007
		Dischg	E	0.0796	0.1951	0.0164	0.0206	0.0127	0.0007
	Pump	Inlet	T	-0.0512	0.0202	0.0405	-0.0041	0.0200	0.0133
		Dischg	T	-0.0537	-0.0065	0.0258	-0.0022	0.0287	0.0096
	Reboiler	Inlet	T	-0.0128	-0.0050	-0.0069	0.0036	-0.0054	-0.0003
		Dischg	T	0.0479	-0.0055	0.0006	0.0039	-0.0051	-0.0003
Separator	Inlet	T	0.0225	0.0068	0.0719	0.0008	-0.0001	-0.0002	
	Dischg	T	-0.0004	0.0071	0.0504	0.0008	-0.0001	-0.0002	

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up

Draft

CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 8/15/08

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	in U1	in U2	in U3	deg R1	deg R2	deg R3		
Case 8k	Pump	Inlet	D	0.0020	-0.0003	0.0008	0.0041	-0.0005	-0.0008	
		Dischg	D	0.0016	0.0004	-0.0015	0.0017	0.0001	-0.0013	
	Reboiler	Inlet	D	-0.0036	-0.0102	-0.0128	-0.0021	0.0054	-0.0013	
		Dischg	D	-0.0036	-0.0120	-0.0215	-0.0020	0.0066	-0.0012	
	Separator	Inlet	D	-0.0004	0.0010	-0.0314	0.0000	0.0001	0.0001	
		Dischg	D	-0.0005	0.0010	-0.0313	0.0001	0.0001	0.0001	
	Pump	Inlet	E	0.2337	0.0501	0.0067	0.0068	0.0289	0.1032	
		Dischg	E	0.1620	0.0504	0.0036	0.0053	0.0518	0.0831	
	Reboiler	Inlet	E	0.0655	0.0311	0.0104	0.0042	0.0126	0.0070	
		Dischg	E	0.0652	0.0294	0.0121	0.0043	0.0131	0.0068	
	Separator	Inlet	E	0.0747	0.1391	0.0174	0.0205	0.0126	0.0010	
		Dischg	E	0.0794	0.1394	0.0161	0.0204	0.0128	0.0010	
	Pump	Inlet	T	-0.1570	0.0335	0.0373	-0.0039	0.0042	0.0189	
		Dischg	T	-0.1442	0.0088	0.0225	-0.0019	-0.0033	0.0144	
	Reboiler	Inlet	T	-0.0353	-0.0030	-0.0013	0.0036	0.0013	-0.0020	
		Dischg	T	0.0254	-0.0059	-0.0033	0.0039	0.0013	-0.0020	
	Separator	Inlet	T	0.0218	0.0336	0.0725	0.0065	0.0001	0.0000	
		Dischg	T	-0.0013	0.0370	0.0512	0.0067	0.0001	0.0000	
	Case 8L	Pump	Inlet	D	0.0014	-0.0003	0.0006	0.0041	-0.0006	-0.0006
			Dischg	D	0.0012	0.0004	-0.0015	0.0016	0.0000	-0.0010
Reboiler		Inlet	D	-0.0037	-0.0102	-0.0128	-0.0021	0.0055	-0.0013	
		Dischg	D	-0.0037	-0.0120	-0.0215	-0.0020	0.0067	-0.0012	
Separator		Inlet	D	-0.0004	0.0010	-0.0314	0.0000	0.0001	0.0001	
		Dischg	D	-0.0005	0.0009	-0.0313	0.0001	0.0001	0.0001	
Pump		Inlet	E	0.0765	0.0455	0.0049	0.0079	0.0072	0.0860	
		Dischg	E	0.0287	0.0472	0.0012	0.0068	0.0134	0.0670	
Reboiler		Inlet	E	0.0389	0.0312	0.0081	0.0043	0.0089	0.0058	
		Dischg	E	0.0390	0.0304	0.0104	0.0044	0.0097	0.0057	
Separator		Inlet	E	0.0752	0.1506	0.0173	0.0207	0.0128	0.0006	
		Dischg	E	0.0799	0.1516	0.0160	0.0207	0.0128	0.0006	
Pump		Inlet	T	-0.0608	0.0348	0.0416	-0.0021	0.0207	0.0324	
		Dischg	T	-0.0528	0.0082	0.0258	-0.0007	0.0282	0.0235	
Reboiler		Inlet	T	-0.0124	-0.0036	-0.0068	0.0035	-0.0054	-0.0011	
		Dischg	T	0.0481	-0.0054	0.0007	0.0038	-0.0051	-0.0011	
Separator		Inlet	T	0.0222	0.0358	0.0727	0.0070	-0.0001	-0.0003	
		Dischg	T	-0.0008	0.0396	0.0512	0.0072	-0.0001	-0.0003	

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up

Draft

CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 9/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	In U1	In U2	In U3	deg R1	deg R2	deg R3		
Case 8a	Pump	Inlet	D	0.0063	-0.0005	0.0006	0.0041	-0.0006	-0.0003	
		Dischg	D	0.0063	0.0002	-0.0016	0.0016	0.0001	-0.0008	
	Reboiler	Inlet	D	0.0005	-0.0094	-0.0153	-0.0020	-0.0020	-0.0005	
		Dischg	D	0.0005	-0.0101	-0.0125	-0.0020	-0.0018	-0.0005	
	Separator	Inlet	D	-0.0001	0.0001	-0.0316	-0.0001	0.0000	0.0001	
		Dischg	D	-0.0001	0.0000	-0.0316	-0.0001	0.0000	0.0001	
	Pump	Inlet	E	0.1957	0.0556	0.0052	0.0056	0.0228	0.1032	
		Dischg	E	0.1288	0.0581	0.0028	0.0050	0.0411	0.0824	
	Reboiler	Inlet	E	0.0525	0.0304	0.0090	0.0042	0.0107	0.0084	
		Dischg	E	0.0523	0.0295	0.0114	0.0043	0.0113	0.0082	
	Separator	Inlet	E	0.0749	0.1902	0.0176	0.0206	0.0127	0.0008	
		Dischg	E	0.0796	0.1927	0.0184	0.0205	0.0126	0.0008	
	Pump	Inlet	T	-0.1110	0.0142	0.0378	-0.0069	0.0041	-0.0022	
		Dischg	T	-0.1106	-0.0070	0.0287	-0.0036	-0.0028	-0.0018	
	Reboiler	Inlet	T	-0.0275	-0.0042	0.0055	0.0037	0.0015	-0.0009	
		Dischg	T	0.0188	-0.0055	0.0033	0.0039	0.0015	-0.0009	
	Separator	Inlet	T	0.0165	0.0043	0.0859	0.0006	0.0002	0.0000	
		Dischg	T	-0.0011	0.0045	0.0797	0.0006	0.0002	0.0000	
	Case 8r	Pump	Inlet	D	0.0018	-0.0006	0.0006	0.0040	-0.0006	-0.0013
			Dischg	D	0.0012	0.0001	-0.0015	0.0016	0.0000	-0.0016
Reboiler		Inlet	D	-0.0037	-0.0102	-0.0128	-0.0021	0.0055	-0.0012	
		Dischg	D	-0.0037	-0.0120	-0.0215	-0.0020	0.0067	-0.0012	
Separator		Inlet	D	-0.0004	0.0003	-0.0314	-0.0001	0.0001	0.0001	
		Dischg	D	-0.0005	0.0002	-0.0313	-0.0001	0.0001	0.0001	
Pump		Inlet	E	0.0805	0.0494	0.0030	0.0048	0.0058	0.0676	
		Dischg	E	0.0380	0.0501	0.0008	0.0048	0.0105	0.0701	
Reboiler		Inlet	E	0.0390	0.0306	0.0070	0.0043	0.0081	0.0055	
		Dischg	E	0.0390	0.0304	0.0103	0.0044	0.0089	0.0053	
Separator		Inlet	E	0.0752	0.1922	0.0177	0.0207	0.0127	0.0006	
		Dischg	E	0.0798	0.1948	0.0165	0.0206	0.0127	0.0006	
Pump		Inlet	T	-0.0742	0.0150	0.0398	-0.0065	0.0104	0.0051	
		Dischg	T	-0.0743	-0.0061	0.0305	-0.0034	0.0100	0.0038	
Reboiler		Inlet	T	-0.0184	-0.0044	0.0033	0.0036	-0.0011	-0.0006	
		Dischg	T	0.0278	-0.0053	0.0049	0.0039	-0.0010	-0.0006	
Separator		Inlet	T	0.0166	0.0047	0.0860	0.0006	0.0001	-0.0001	
		Dischg	T	-0.0010	0.0049	0.0797	0.0006	0.0001	-0.0001	

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up

Draft

CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Nozzle Displacements

Case	Location	Load	in U1	in U2	in U3	deg R1	deg R2	deg R3	
Case 8a	Pump	Inlet	D	0.0036	-0.0005	0.0004	0.0040	-0.0011	-0.0008
		Dischg	D	0.0037	0.0001	-0.0016	0.0016	-0.0009	-0.0012
	Reboiler	Inlet	D	-0.0002	-0.0084	-0.0152	-0.0020	-0.0018	-0.0005
		Dischg	D	-0.0002	-0.0101	-0.0128	-0.0020	-0.0018	-0.0005
	Separator	Inlet	D	-0.0001	0.0001	-0.0318	-0.0001	0.0001	0.0001
		Dischg	D	-0.0002	0.0000	-0.0318	-0.0001	0.0000	0.0001
	Pump	Inlet	E	0.0737	0.0467	0.0030	0.0048	0.0055	0.0814
		Dischg	E	0.0353	0.0475	0.0008	0.0047	0.0100	0.0651
	Reboiler	Inlet	E	0.0372	0.0306	0.0068	0.0043	0.0078	0.0052
		Dischg	E	0.0372	0.0304	0.0102	0.0043	0.0087	0.0051
	Separator	Inlet	E	0.0728	0.1921	0.0176	0.0207	0.0124	0.0006
		Dischg	E	0.0773	0.1947	0.0164	0.0206	0.0124	0.0006
	Pump	Inlet	T	-0.0742	0.0150	0.0398	-0.0065	0.0104	0.0051
		Dischg	T	-0.0743	-0.0061	0.0305	-0.0034	0.0100	0.0038
	Reboiler	Inlet	T	-0.0184	-0.0044	0.0033	0.0036	-0.0011	-0.0006
		Dischg	T	0.0278	-0.0053	0.0049	0.0039	-0.0010	-0.0006
	Separator	Inlet	T	0.0186	0.0047	0.0960	0.0006	0.0001	-0.0001
		Dischg	T	-0.0010	0.0049	0.0797	0.0006	0.0001	-0.0001

Notes

1. Displacement components are global: 1 = East 2 = North 3 = Up

Draft

CALCULATION SHEET

24590-PTF-3PS-MEUV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

Modal Participation

Case	Mode Num	Hz Freq	Mass Participation			Feature
			X	Y	Z	
Case 8a	1	6.2	0.10	0.09	0.01	Reboiler Dischg EW & NS
	2	6.8	0.07	0.28	0.01	Separator Inlet NS
	3	13.4	0.01	0.28	0.00	Pump Inlet NS
	5	20.0	0.00	0.00	0.12	Separator Inlet Vert
	8	20.7	0.11	0.01	0.01	Pump Inlet EW
	14	47.4	0.00	0.00	0.11	
	17	63.8	0.22	0.01	0.01	
	19	85.7	0.00	0.00	0.15	
	23	181.5	0.00	0.02	0.13	
	24	183.3	0.12	0.00	0.00	
	Total		0.83	0.91	0.86	
Case 8d	1	3.8	0.00	0.12	0.00	Reboiler Dischg NS
	3	7.2	0.01	0.55	0.00	Separator NS
	4	7.5	0.14	0.02	0.00	Pump EW
	5	9.9	0.50	0.00	0.00	Separator EW
	8	12.7	0.01	0.19	0.01	Reboiler NS
	12	18.2	0.00	0.00	0.39	Separator Vert
	17	28.5	0.00	0.01	0.13	Reboiler Vert
	24	71.0	0.01	0.00	0.11	Pump Vert
	Total		0.85	0.97	0.92	
Case 8e	1	3.9	0.00	0.41	0.00	Reboiler Dischg NS
	2	5.9	0.16	0.00	0.02	Reboiler Dischg EW
	3	13.4	0.01	0.28	0.00	Pump Inlet NS
	4	13.6	0.10	0.00	0.00	Separator Inlet EW
	7	20.6	0.11	0.01	0.01	Pump Inlet EW
	13	38.9	0.11	0.00	0.01	Reboiler Inlet EW
	18	57.2	0.12	0.00	0.02	
	19	62.5	0.14	0.00	0.06	
	21	93.2	0.00	0.00	0.11	
23	105.6	0.00	0.00	0.14		
	Total		0.89	0.91	0.86	
Case 8g	1	3.9	0.00	0.13	0.00	Reboiler Dischg NS
	2	5.6	0.00	0.50	0.00	Separator NS
	4	6.7	0.53	0.00	0.00	Separator EW
	11	18.3	0.00	0.00	0.38	Separator Vert
	17	31.7	0.22	0.00	0.00	Reboiler EW
	19	34.3	0.00	0.19	0.00	Reboiler NS
24	79.2	0.00	0.00	0.28		
	Total		0.93	0.93	0.89	

Notes: Modes shown for participation > 10%.  
Total participation includes modes not shown.

**Draft**

**CALCULATION SHEET**

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner

DATE: 9/15/06

SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

**Modal Participation**

Case	Mode Num	Hz Freq	Mass Participation			Feature
			X	Y	Z	
Case Bi	2	7.2	0.01	0.59	0.00	Separator NS
	3	7.5	0.14	0.02	0.00	Pump EW
	4	9.9	0.50	0.00	0.00	Separator EW
	7	12.7	0.01	0.21	0.01	Reboiler NS
	12	18.4	0.00	0.00	0.48	Separator Vert
	17	28.8	0.00	0.00	0.18	Reboiler Vert
	Total		0.95	0.95	0.91	
Case Bj	2	7.2	0.00	0.81	0.00	Separator NS
	4	9.9	0.50	0.00	0.00	Separator EW
	5	11.5	0.21	0.01	0.00	Reboiler EW
	7	12.8	0.00	0.19	0.02	Reboiler NS
	12	18.4	0.00	0.00	0.47	Separator Vert
	17	28.7	0.00	0.00	0.11	Reboiler Vert
	Total		0.95	0.96	0.91	

Notes: Modes shown for participation > 10%.  
Total participation includes modes not shown.

# Draft

# CALCULATION SHEET

24590-PTF-3PS-MEVV-T0001, Rev. 2  
Forced Circulation Vacuum Evaporator System

BY: E.O. Weiner  
DATE: 6/15/06

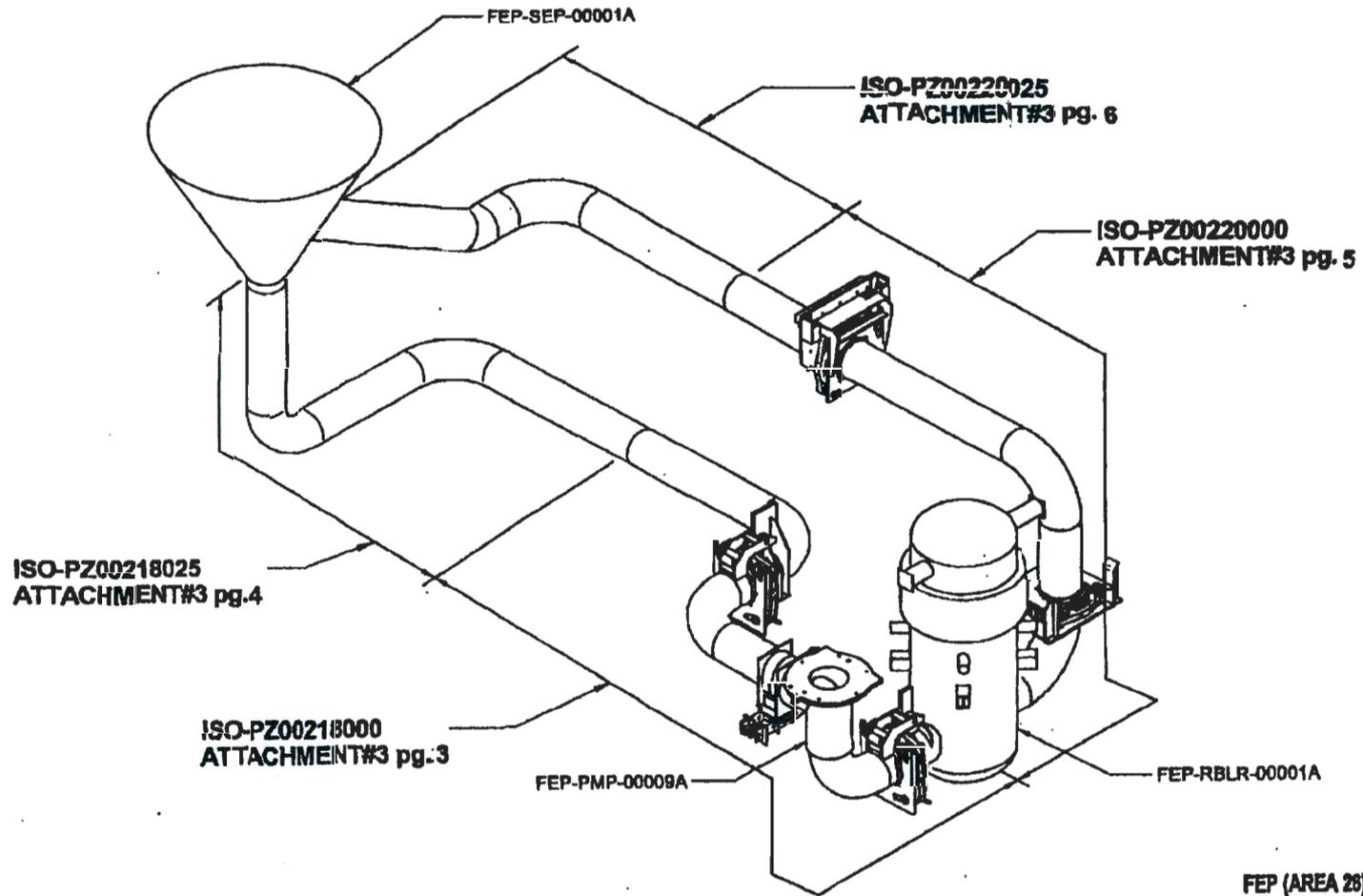
SUBJECT: PT TLP Coupled Structural Analysis for Evaluation of Nozzle Loads

## 9 References

- SCN 24590-PTF-3PN-MEVV-00012. Implementation of parametric study and high pressure steam design change.
- A402 AREVA Doc Id 32-5058402-00 HEP 1 TLP Reboiler Vessel Skid Seismic Qualification
- A472 AREVA Doc Id 32-5034472-03, HEP 1 FPE and TLP Separator Vessel Skids Seismic Qualification
- A603 AREVA Doc Id 51-5071603-01, Recirculation Pump Support Arrangement
- A647B AREVA Doc Id 51-5048647B-00, WTP 24590-QL-P0A-MEW-00001-01-00550, Rev. 00A
- SAPVV 24590-WTP-VV-ST-05-004 Rev 1. SAP 2000 Verification and Validation Test Report
- SAP Analysis Reference Manual, SAP2000, Integrated Software for Structural Analysis and Design, Version 10.0.1, Computer and Structure, Inc. (CSI), 1995 University Avenue, Berkeley, California 94704 USA.
- GTS GTSTRUDL User Reference Manual, Rev 25, Computer Aided Structural Engineering Center, School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA 30332-0355.
- B31.3 ASME B31.3-2004, ASME Code for Process Piping.
- ECO E.C. Ocoma verbal instructions
- 00005A Calculation 24590-PTF-S0C-S15T-00005-RevA

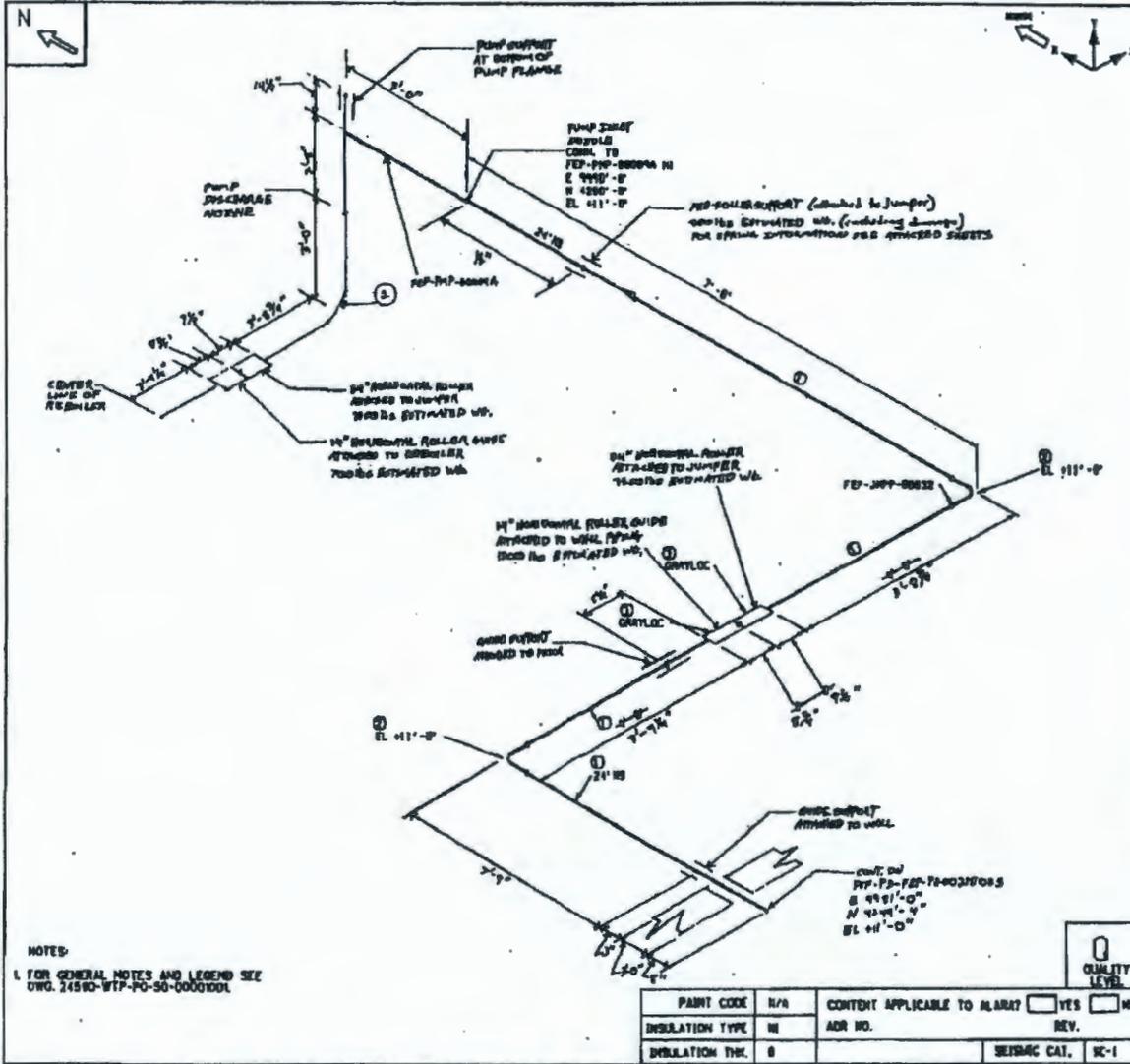
**ATTACHMENT #3**

**FEP & TLP Separator Recirculation Isometrics  
And Mid Roller Details**



FEP (AREA 28)  
PROCESS LOOP  
INFORMATION ISO

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTP-PC-50-0000000

LENGTH (FT.) AND DATA (FOR INFO ONLY) JSH Created JUN-26-2006 16:21

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INSULATION TYPE	IN	ADR NO.
INSULATION THK.	0	SEISMIC CAT. SC-1

See Created JUN-26-2006 16:21

PCF File 24590-PTF-3P-FEP-P200210000

ITEM NO.	COMPONENT DESCRIPTION	R/R (INCHES)	QTY	UNITS	REMARKS
1	PIPE, AS 27054/204, - GPL, S. 370, ONE	24	0'	FT	PPICV01100
2	FLANGES	24	0	PCS	PP0001100
3	FLANGES	24	0	PCS	PP0001100

AREA 3-6

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STRESS ANALYST:		DATE:



SEWER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2425 STEVENS CENTER PLACE  
RICHLAND, WA 99352

CONTRACT No: DE-AC27-01RV14138

PAID: 24590-PTF-3P-FEP-00002 CONST. WORK AREA: 21

**PRETREATMENT FACILITY  
ISOMETRIC**

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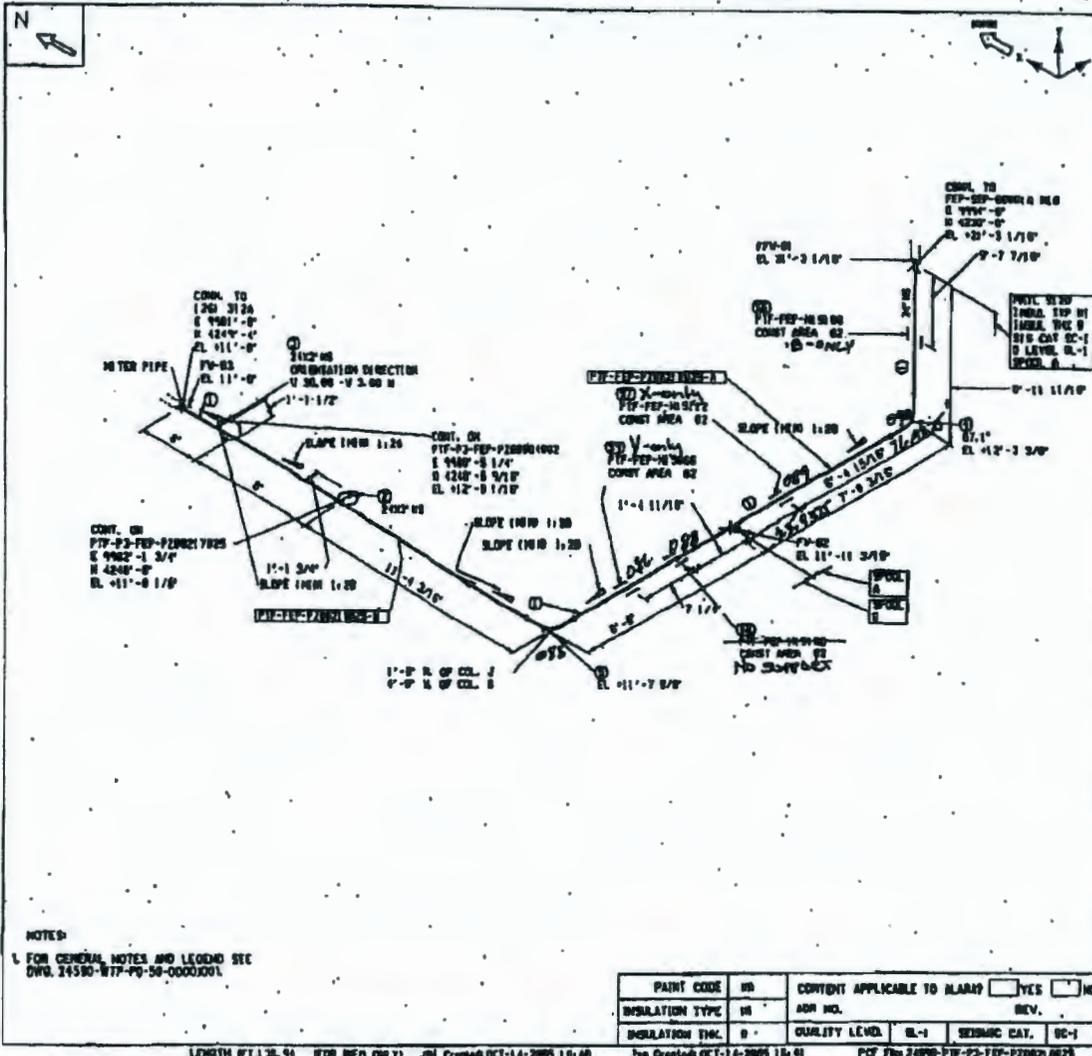
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COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
 1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-P7F-P2-50-0000001.

SHOP MATERIALS		U.S. LBS/TON	QTY	REMARKS
PIPE	DESCRIPTION			
1	PIPE, 40175/34/200, 67.4, 3.375, 30C	24	27' 0"	PIPE/BLIND
<b>FITTINGS</b>				
4	FLANGE, 40175/34/200, 67.4, 3.375, 30C	212		FLANGE/BLIND
5	FLANGE, 40175/34/200, 67.4, 3.375, 30C	212		FLANGE/BLIND
6	ELBOW, 40175/34/200, 67.4, 3.375, 30C	24		FLANGE/BLIND

FIELD MATERIALS		U.S. LBS/TON	QTY	REMARKS
<b>SUPPORTS</b>				
1	PIPE, 40175/34/200, 67.4, 3.375, 30C			
2	PIPE, 40175/34/200, 67.4, 3.375, 30C			
3	PIPE, 40175/34/200, 67.4, 3.375, 30C			

*ECO 10/17/05*

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<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:	
STRESS ANALYST:		DATE:



WATER PROTECTION PROJECT  
 WASTE TREATMENT PLANT  
 2435 STEVENS CENTER PLACE  
 ROCKLAND, VA 23151

CONTRACT No. DE-AC27-01RV14136  
 P.O. No. 24590-P7F-P2-0802      CONST. WORK AREA: 02

**PRETREATMENT FACILITY  
 ISOMETRIC**

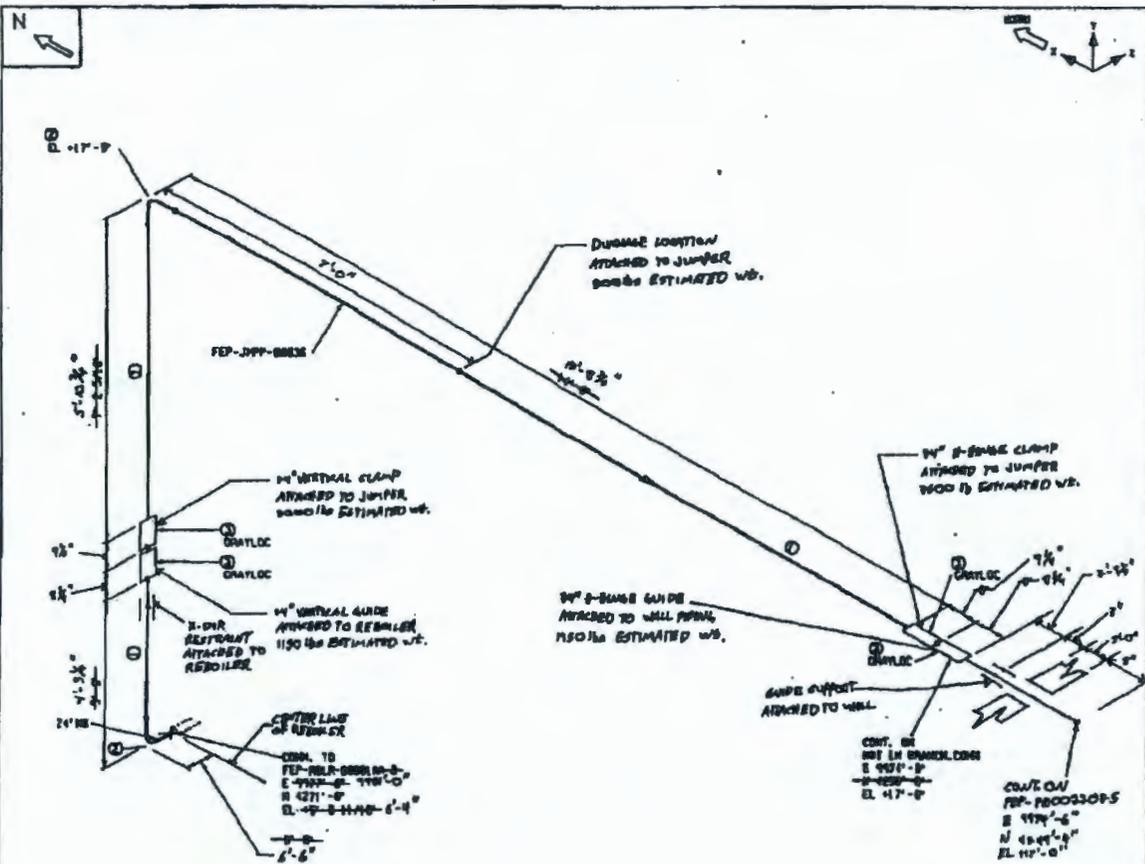
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LENGTH 87.33, 94    FOR DFD ONLY    2d Created OCT-14-2005 10:40    2d Created OCT-14-2005 10:41    P7F P2 24590-P7F-P2-FEP-P208218825    PLOTTED BY: *acorn*    PLOT DATE: 10/17/2005 10:40:22 AM    SHEET 1 OF 1

AREA 26

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTP-PG-50-0000001

PIPE	COMPONENT DESCRIPTION	U.S. FEET	REV	REVISED DATE
1	PIPE, 4027P204/204L, 8IN. O. 37P, 800	24	10 P	PPPCB/ML/VC
<b>ATTACHED</b>				
1	CL. - 20. LA. 24. 4027P204/204L-10, 0.37P	24		PPPCB/ML/VC
<b>NOT ATTACHED</b>				

**AREA 2-6**

STRESS REVIEW PRINT		REV
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STRESS ANALYST:		DATE:



WATER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2426 STEVENS CENTER PLACE  
RICHLAND, WA 99354

CONTRACT NO:	DE-AC27-01RV14136
PAID: 24590-PTF-10-FEP-09002	CONST. WORK AREA: 21

**PRETREATMENT FACILITY ISOMETRIC**

LINE No.	FEP-PZ-00220-SI 20-24	PIPE SPEC:	SI 20
DWG No.	24590-PTF-P3-FEP-PZ00220000	REV	A

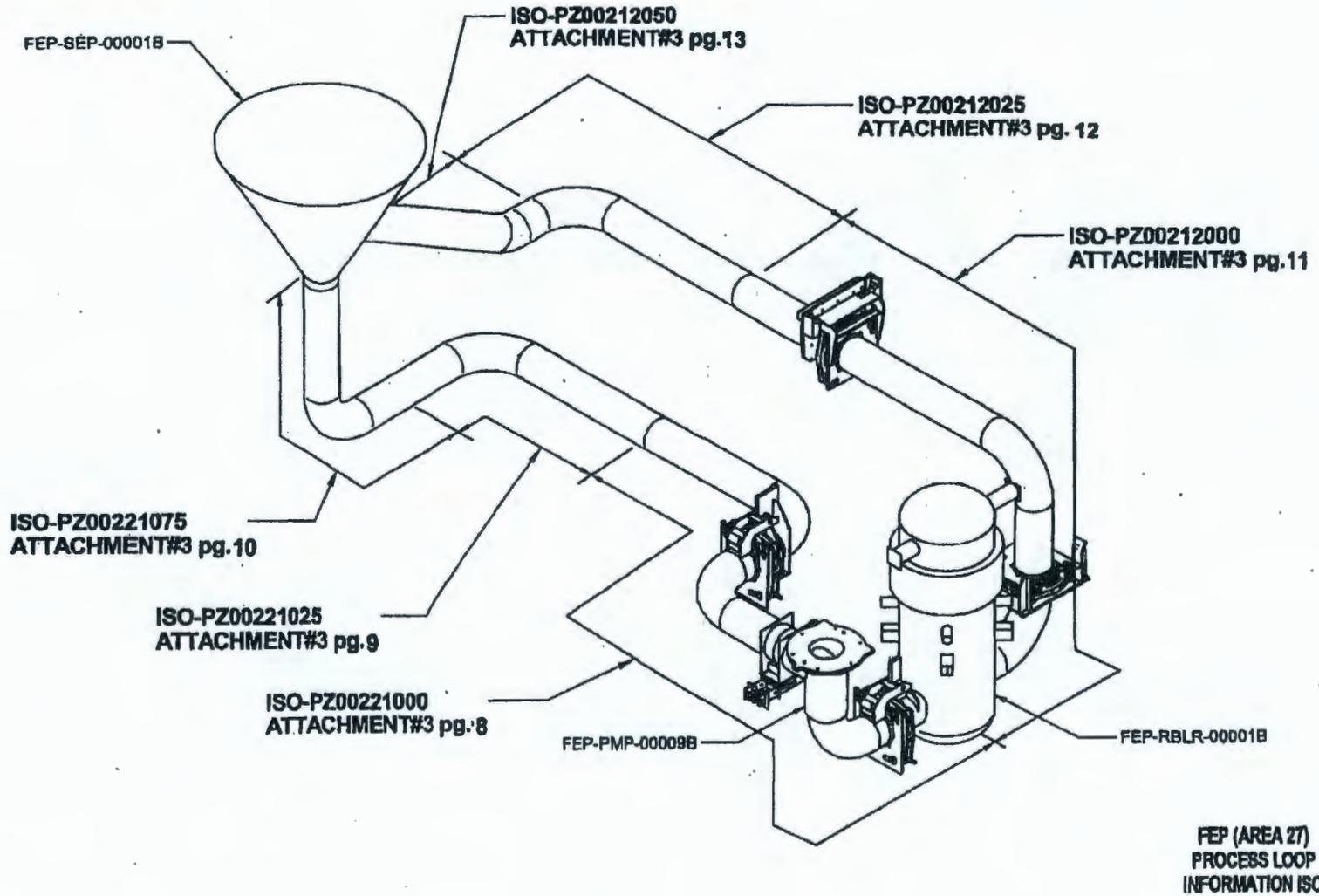
PAIN CODE	N/A	CONTENT APPLICABLE TO HAZAR?	YES	NO
INSULATION TYPE	NI	ADR NO.	REV.	
INSULATION THK.	0	SEISMIC CAT.	BC-1	

Q  
QUALITY LEVEL

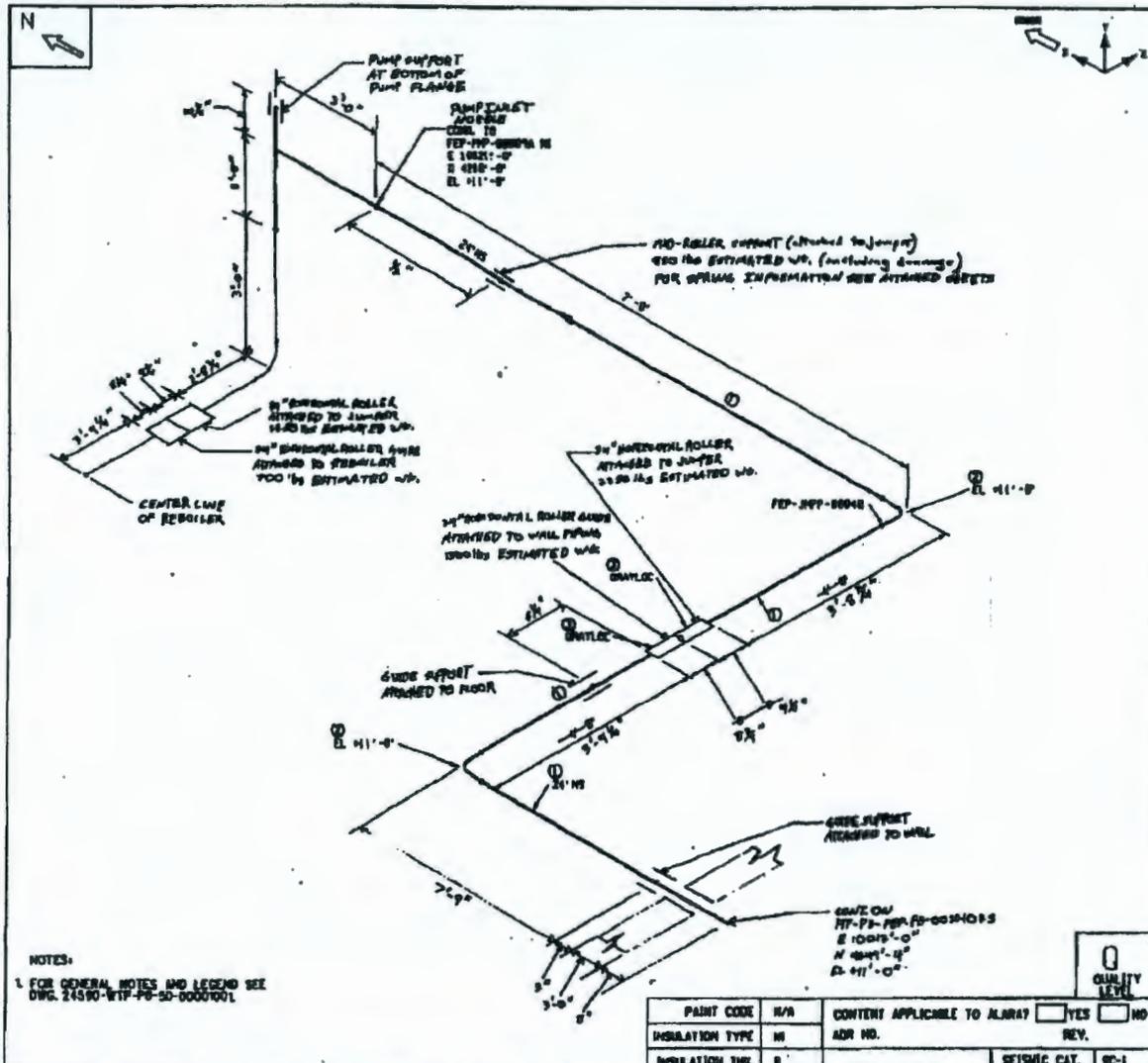
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I:\STRESS\STRESS\_ISO\jumper\area\_26\24590-PTF-P3-FEP-PZ00220000.DGN





COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTF-P3-50-0000001

PART NO.	COMPONENT DESIGNATION	U.S. UNITS	QTY.	RECORD SIZE CODE
1	PIPE 42.125"/384.000 0% 0.375" 002	34	000	PP00001000
2	EL. 10.12.00 0% 0.375"/384.000 0.375" 002	34	1	PP00001000

MEAF

STRESS REVIEW PRINT		REV
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<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:	

STRESS ANALYST: \_\_\_\_\_ DATE: \_\_\_\_\_

RIVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
3438 STEVENS CENTER PLACE  
RICHLAND, WA 99352

CONTRACT No: DE-AC27-00RV14136  
 P&ID: 24590-P1F-P3-FEP-08004 CONST. WORK AREA: 21  
**PRETREATMENT FACILITY ISOMETRIC**

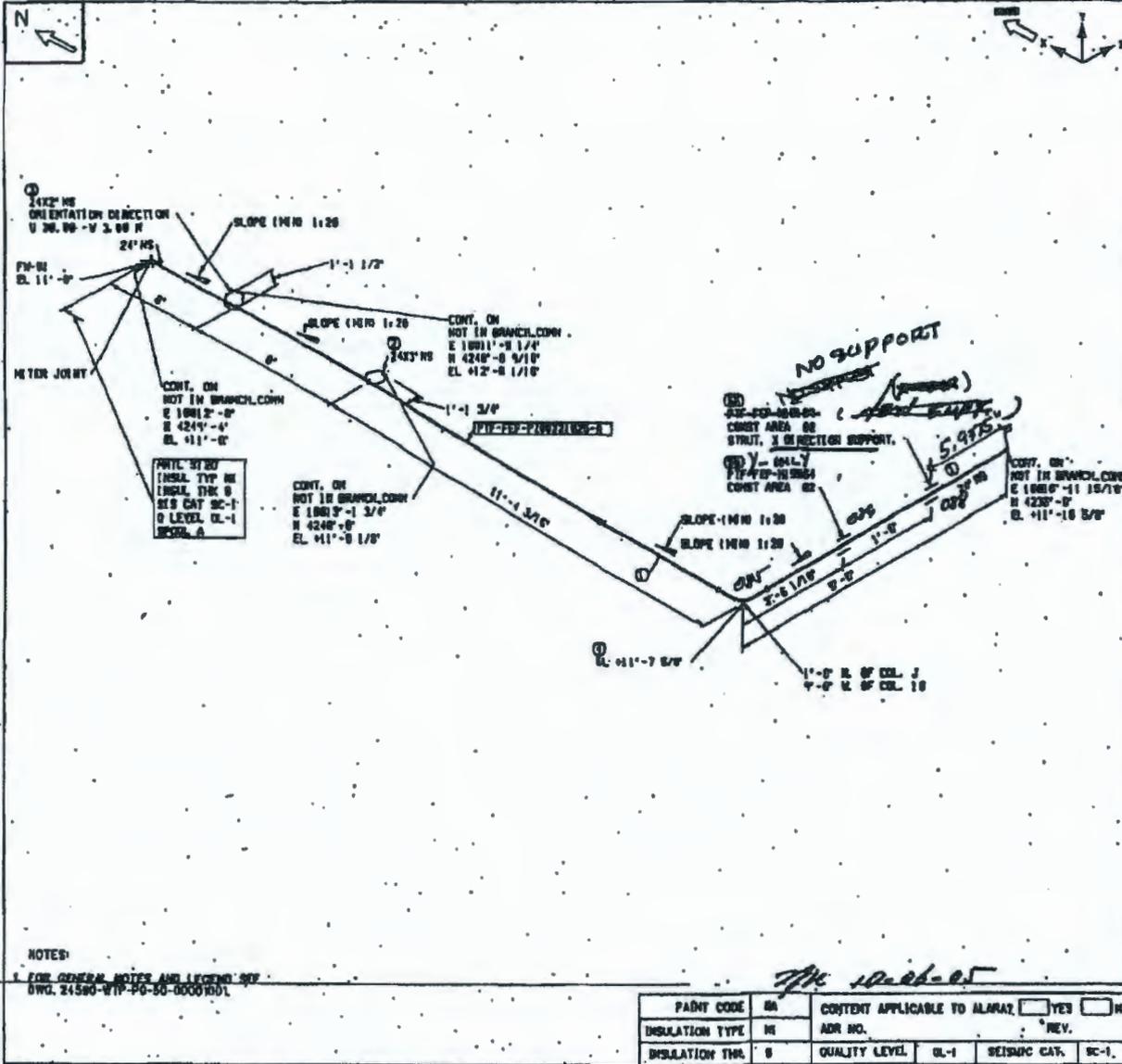
LINE No. FEP-PZ-08221-S12D-24	PIPE SPEC: S12D
DWG No. 24590-P1F-P3-FEP-P208221800	REV A

PAIN CODE	R/R	CONTENT APPLICABLE TO ALARM?	YES <input type="checkbox"/> NO <input type="checkbox"/>
INSULATION TYPE	NI	ADR NO.	REV.
INSULATION THK.	0'	SEISMIC CAT.	SC-1

LENGTH (FT.) NO DATA FOR SFD ONLY JSD Created JUN-24-2006 15:14 Iso Created JUN-24-2006 15:15 PCF File 24590-P1F-P3-FEP-P208221800 PLOTTED BY: bwinson PLOT DATE: 06/20/2006 03:44:50 PM SHEET 1 OF 1

ISO TYPE PT\_3 STRESS 0:48 02:4590-P1F-P3-FEP-P208221800.DWG

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
FOR GENERAL NOTES AND LEGENDS SEE  
DWG. 24590-WTP-P0-00-00001001

PAINT CODE	NA	CONTENT APPLICABLE TO ALARAZ	<input type="checkbox"/> YES	<input type="checkbox"/> NO
INSULATION TYPE	NI	ADR NO.		
INSULATION THK.	0	QUALITY LEVEL	DL-1	SEISMIC CAT. SC-1.

SHOP MATERIALS		U.S.	QTY	REMARKS
PART NO.	COMPONENT DESCRIPTION	FEET/INCHES		SEE CODE
<b>PIPE</b>				
1	PIPE, 3" PIP-3S-3PS, 3PS, 0.375", 300'	34	11'0"	PPH0001100
<b>FLANGES</b>				
2	FLANGE, 3" PIP-3S-3PS, 0.375", 300'	34		PPH0001100
3	FLANGE, 3" PIP-3S-3PS, 0.375", 300'	34		PPH0001100
4	EL. - 3" LA. FL. 3" PIP-3S-3PS, 0.375", 300'	34		PPH0001100

FIELD MATERIALS		U.S.	QTY	REMARKS
PART NO.	COMPONENT DESCRIPTION	FEET/INCHES		SEE CODE
<b>PIPE</b>				
5	PIPE 3" PIP-3S-3PS			
6	FLANGE 3" PIP-3S-3PS			

STRESS REVIEW PRINT		REV
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<input type="checkbox"/> ACCEPTED BY COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:	
STRESS ANALYST:		DATE:



RIVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2324 STEVENS CENTER PLACE  
RICHLAND, WA 99353

CONTRACT No: DE-AC27-DIRV14136

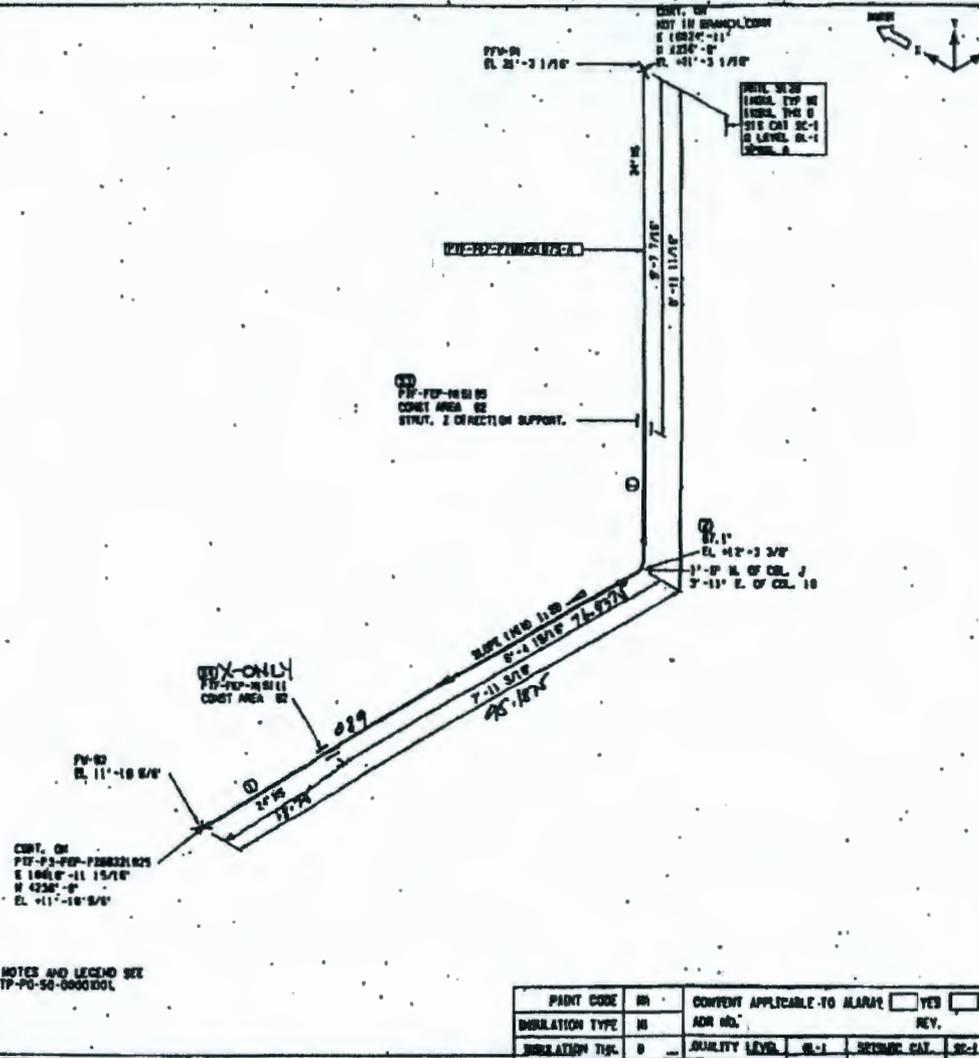
PLD: 24590-WTP-P0-00-00001001 CONST. WORK AREA: 02

**PRETREATMENT FACILITY  
ISOMETRIC**

LINE No.: FEP-PZ-00221-S120-24 PIPE SPEC: S120

DWG No.: 24590-WTP-P3-FEP-P200221-025 REV: A

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
 1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTP-P0-50-00001001

SHOP MATERIALS		U.S.	U.S.	U.S.
PART NO.	COMMENT DESCRIPTION	LENGTH	WT.	MODEL FOR DRAW.
1	PIPE, AS277304/304, 07E 4.500, 00E	34	11'3"	PP000L100E
2	THEME 2.500, 07.12 00E, 0 - 0L 0L 0L	24		PP000L100E

FIELD MATERIALS		U.S.	U.S.	U.S.
PART NO.	COMMENT DESCRIPTION	LENGTH	WT.	MODEL FOR DRAW.
3	PIPE SPT, FIP-FEP-40000			
4	PIPE SPT, REVIEWE			

STRESS REVIEW PRINT		REV
<input type="checkbox"/> ACCEPTED	<input type="checkbox"/> NOT ACCEPTED	
<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:	
STRESS ANALYST:		DATE:

**SECURITY**

RIVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
154 RIVERS CENTER PLACE  
ROCK SPRING, VA 22841

CONTRACT No. DE-AC27-D1RV14136  
 Pk'd: 24590-WTP-P0-50-00001001      COST. WORK AREA: 02

### PRETREATMENT FACILITY ISOMETRIC

LINE No. FEP-P2-00221-0120-24      PIPE SPEC: S120  
 DWG No. 24590-PTF-P3-FEP-P200221075      REV: A

PLOTTED BY: *scott*      PLOT DATE: 10/17/2005 10:47:05 AM      SHEET 1 OF 1

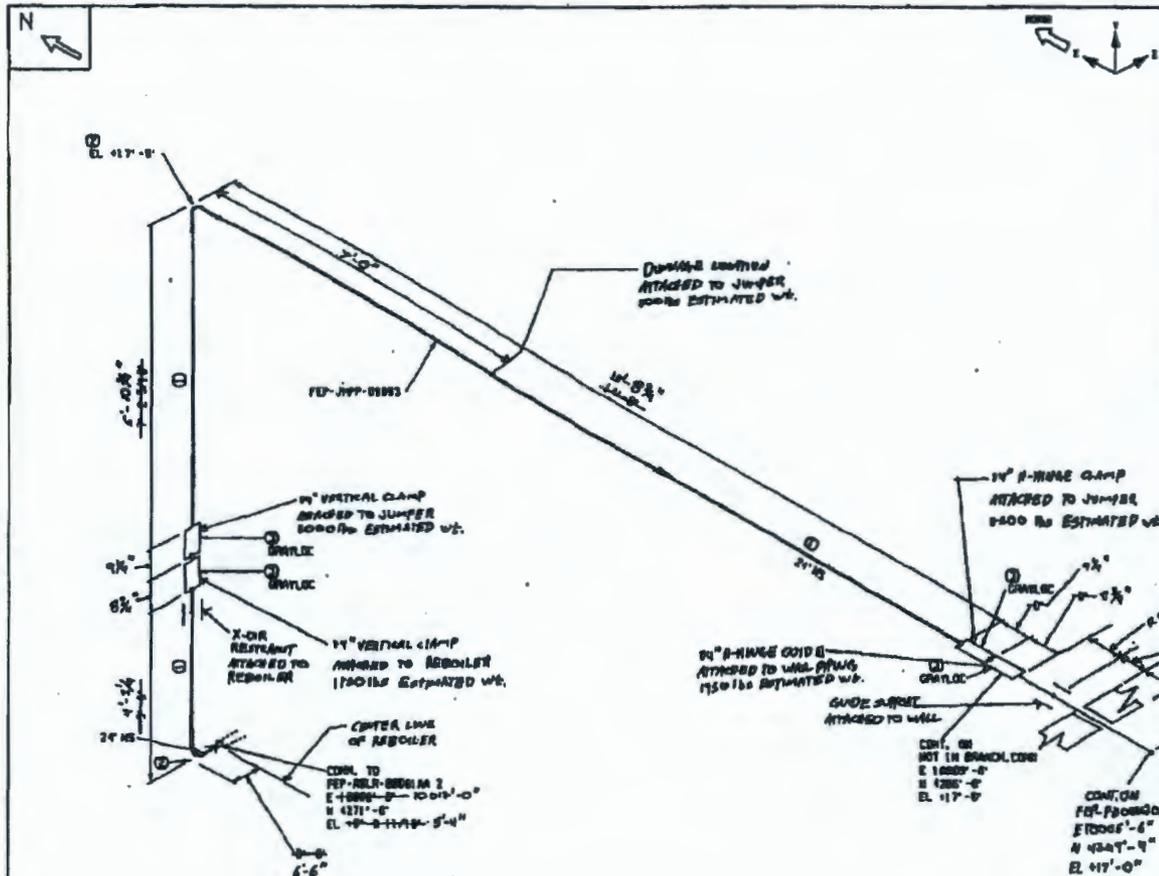
LENGTH: 07.110.9, 0700 0700 ONLY      DWG. Created: OCT-14-2005 10:40      PLOT File: 24590-PTF-P3-FEP-P200221075

Use view 1 to place lines for plotting to and print data table

*AREA 27*

ISO TYPE: P1\_us1STRESS      C:\Documents and Settings\scott\My Documents\Temp\Temp\Internet Files\COLL\FEP-P200221075-070001.DWG

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
 1. FOR GENERAL NOTES AND LEGEND SEE  
 DWG. 24590-WTP-P0-50-0000101.

PIPE MATERIALS			
PIPE	COMPONENT DESCRIPTION	S.S. NUMBER	RECORDS SHE CODE
1	PIPE: A312P/304/304L, EPA 6.37P, 800	24	18"Y PFC0801100C
<b>FLANGES</b>			
1	6" - 16" LB. RA. A193B/304-16, 6.37P	24	PFC0801100V
1	RCC. BRANLC	24	N/A

**AREA 27**

STRESS REVIEW PRINT		REV
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<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL	BY:
STRESS ANALYST:		DATE:

**SCHEIFFEL**

RIVER PROTECTION PROJECT  
 WASTE TREATMENT PLANT  
 3438 STEVENSON CEMETARY PLACE  
 RICHLAND, WA 99352

CONTRACT No: DE-AC27-01RV14138  
 P&ID: 24590-PTF-16-FEP-00004      CONST. WORK AREA: 21

**PRETREATMENT FACILITY  
 ISOMETRIC**

LINE No.	FEP-P2-00212-S120-24	PIPE SPEC	S120
DWG No.	24590-PTF-P3-FEP-P200212000	REV	A

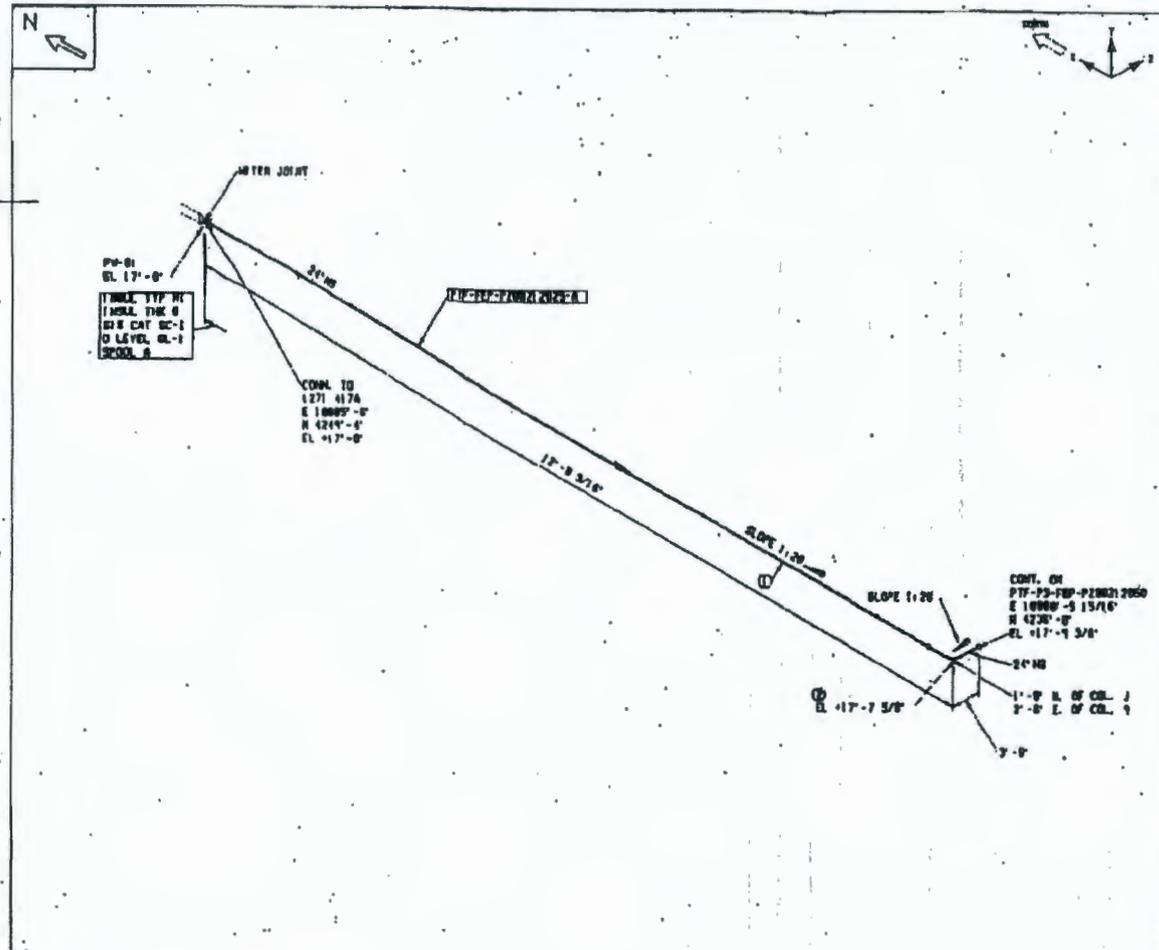
PLOTTED BY: [unclear]      PLOT DATE: 07/05/2006 04:23:07 PM      SHEET 1 OF 1

PAIN CODE	N/A	CONTENT APPLICABLE TO HAZAR?	<input type="checkbox"/> YES <input type="checkbox"/> NO
INSULATION TYPE	NI	ADD NO.	REV.
INSULATION THK.	0	ISOMETRIC CAT.	SC-1

LENGTH (FT.) NO DATA FOR INFO ONLY      JSH Created JUN-29-2006 15:14      Iso Created JUN-29-2006 15:18      P&ID File: 24590-PTF-P3-FEP-P200212000      PLOTTED BY: [unclear]      PLOT DATE: 07/05/2006 04:23:07 PM      SHEET 1 OF 1

Use sheet 1 to place items for plotting to not plot data fields

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



- NOTES:
- FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-PTF-P3-P367-0000.
  - SEE DWG. 24590-PTF-P3-P367-0000 FOR CONVERSION FROM PTF FACILITY ELEVATIONS TO SITE ELEVATIONS. PTF FACILITY ELEVATION 0'-0" EQUALS SITE ELEVATION 678'-0".

PAINT CODE	00	CONTENT APPLICABLE TO ALARM	<input type="checkbox"/> YES	<input type="checkbox"/> NO
INSULATION TYPE	00	ADR NO.	REV.	
INSULATION THK	0	QUALITY LEVEL	0L-1	SEISMIC CAT. SC-1

PART NO.	DESCRIPTION	QTY	REV.	REVISION
1	PIPE, 48\"/>			
2	FLANGE, 48\"/>			

STRESS REVIEW PRINT		REV
<input type="checkbox"/> ACCEPTED	<input type="checkbox"/> NOT ACCEPTED	
<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:	
STRESS ANALYST:	DATE:	

**BECHTEL**

RIVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2435 STEVENS CENTER PLACE  
RICHLAND, WA 99352

CONTRACT No: DE-AC27-03RV14136

PLANT: 24590-PTF-ME-FEP-00001      CONST. WORK AREA: 02

**PRETREATMENT FACILITY  
ISOMETRIC**

LINE No. FEP-PZ-0021.2-S120-24      PIPE SPEC: S120

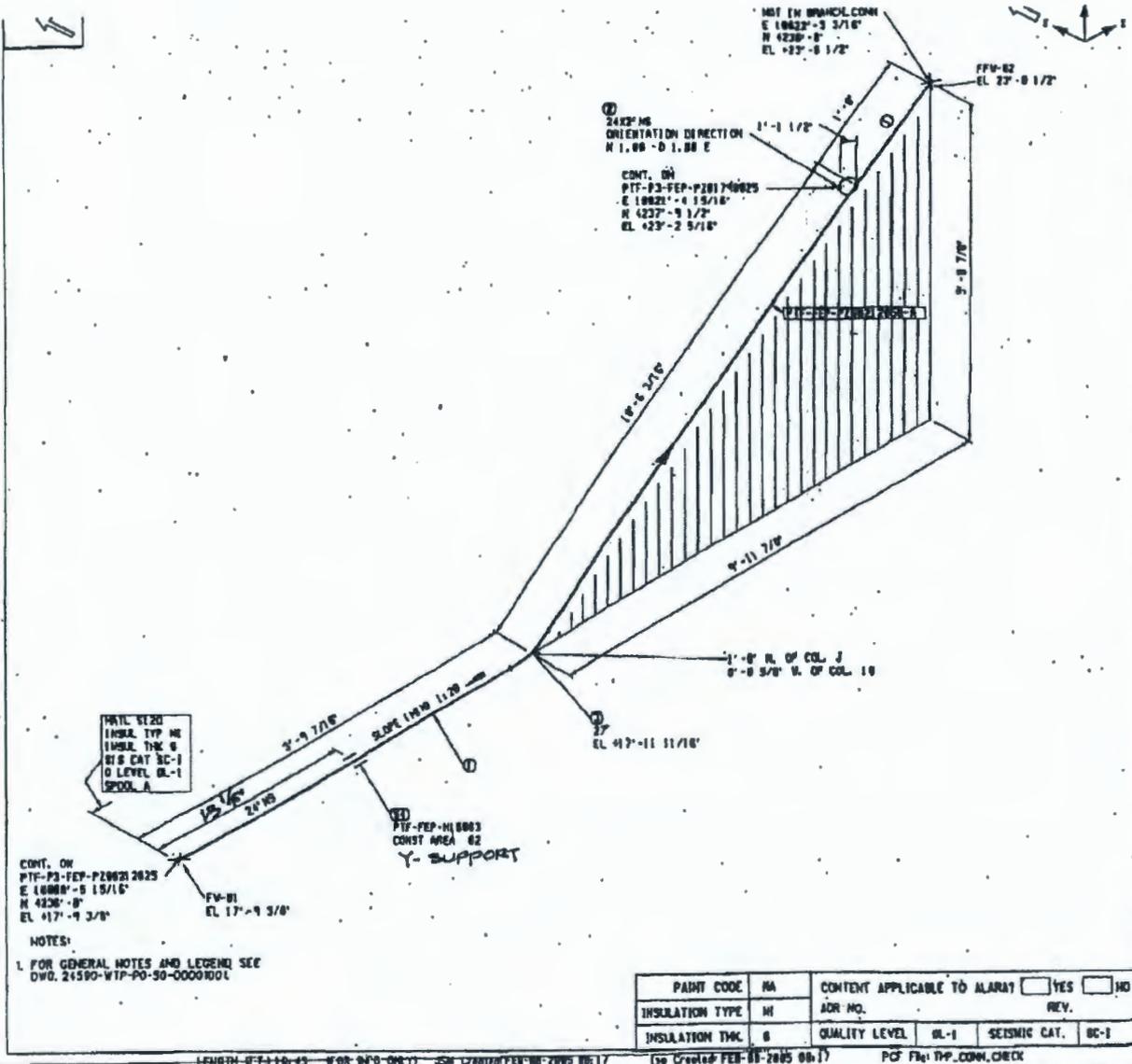
DWG No. 24590-PTF-P3-FEP-P200212025      REV: A

PLOTTED BY: bshubert      PLOT DATE: 06/27/2005 10:30:53 AM      SHEET 1 OF 1

Use view 1 to place fence for plotting to not print data table

ISO TYPE: PTF\_STRESS    H:\STRESS\PTF\_01\14\rev\_00\24590-24.DWG

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



CONT. ON  
 PTF-P3-FEP-P20022025  
 E 10622'-3 3/16"  
 H 4237'-0 1/2"  
 EL 4237'-0 1/2"

FV-B1  
 EL 17'-9 5/8"

PTF-FEP-H10003  
 CONST AREA 02  
 Y-SUPPORT

1'-0" R. OF COL. J  
 0'-0 5/8" R. OF COL. 10

17'-0 1/2"  
 10'-6 3/16"  
 9'-8 7/8"  
 9'-8 7/8"  
 2'-9 7/16"  
 2'-9 7/16"  
 1'-5 1/8"  
 2'-0"  
 1'-0" R. OF COL. J  
 0'-0 5/8" R. OF COL. 10

FV-B1  
 EL 17'-9 5/8"

PTF-FEP-H10003  
 CONST AREA 02  
 Y-SUPPORT

NOTES:  
 1. FOR GENERAL NOTES AND LEGEND SEE  
 DWD. 24590-WTP-P0-30-00001001

PART CODE	NA	CONTENT APPLICABLE TO ALARAT	<input type="checkbox"/> YES	<input type="checkbox"/> NO
INSULATION TYPE	NI	ADR NO.	REV.	
INSULATION THK	0	QUALITY LEVEL	0L-1	SEISMIC CAT. 0C-1

PART NO	COMPONENT DESCRIPTION	R. U. (INCHES)	QTY	REMARKS / SITE CODE
1	PIPE, A182F304/304L, 074, 0.375, 002	24	12 11'	PPCR0010VNC
2	WELDOCK, A182-F304/304L, 0.375, 00005	24		PPCR0010VNC
3	TRIMMED ELBOW, 37.00 O.D., 1.5, 1A, 04, A182F304/304L, 0.375	24		PPCR0010VNC

PART NO	COMPONENT DESCRIPTION	R. U. (INCHES)	QTY	REMARKS / SITE CODE
0	PIPE TRIP, PTF-FEP-H10003			

2-9-05  
 STRESS REVIEW PRINT

<input type="checkbox"/> ACCEPTED	<input type="checkbox"/> NOT ACCEPTED
<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:

STRESS ANALYST: \_\_\_\_\_ DATE: \_\_\_\_\_

RIVER PROTECTION PROJECT  
 WASTE TREATMENT PLANT  
 2433 STEVENS CENTER PLACE  
 RICHLAND, WA 99302

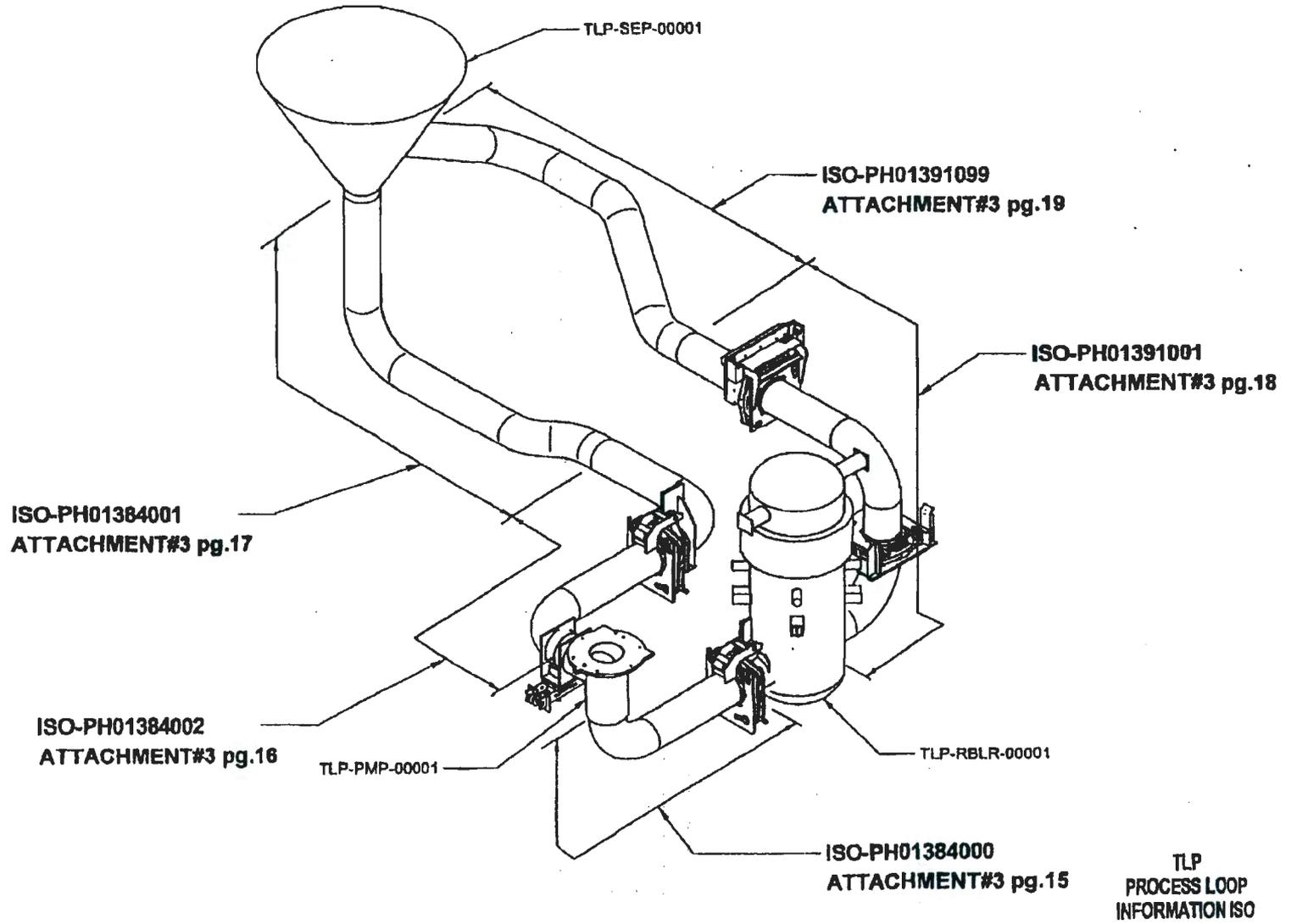
CONTRACT No. DE-AC27-01RV14138  
 P&ID: 24590-PTF-P3-FEP-00004 CONST. WORK AREA: 02

**PRETREATMENT FACILITY ISOMETRIC**

LINE No.	FEP-PZ-00212-SI 20-24	PIPE SPEC.	SI 20
DWG No.	24590-PTF-P3-FEP-P200212050	REV.	A

PLOTTED BY: jhm PLOT DATE: 02/08/2005 08:45 AM SH.1 OF 1

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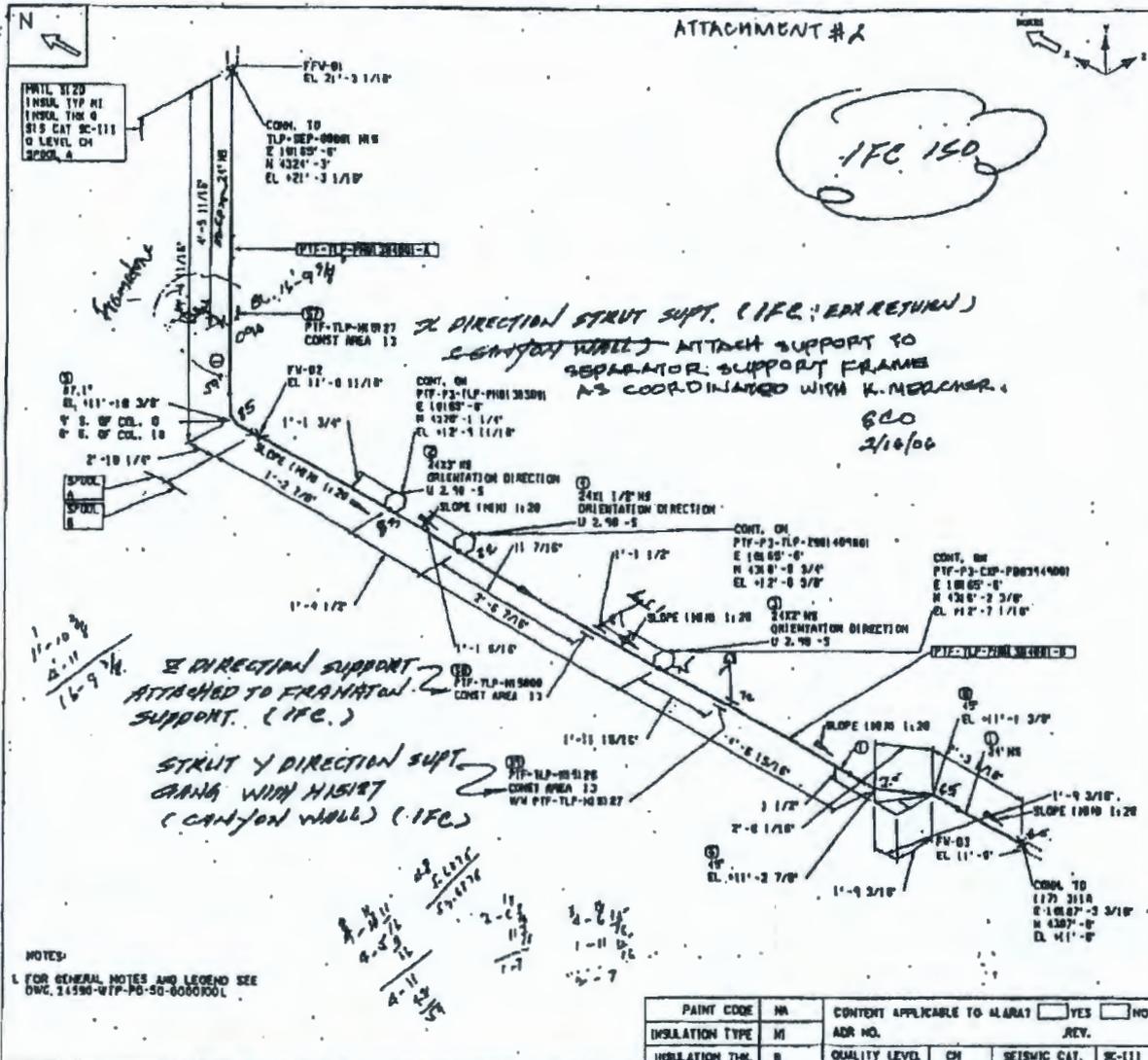
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PROCESS LOOP  
INFORMATION ISO





24590-PTF-3PS-MEVV-0001A

ATTACHMENT # 2



COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED

NOTES:  
1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-WTP-P3-50-00001001

PAINT CODE	NR	CONTENT APPLICABLE TO ALARAY	YES	NO
INSULATION TYPE	MI	ADR NO.	REV.	
INSULATION THK.	0	QUALITY LEVEL	CH	SEISMIC CAT. SE-111

SHOP MATERIALS				
PART NO.	COMPONENT DESCRIPTION	N.S. (LBS)	QTY.	WEIGHT SITE CODE
<b>PIPE</b>				
1	PIPE, SCH 20/30/40, 60% G. 372, 80E	34	10'	PPC00BL10C
<b>WELDS</b>				
2	WELDED, A102-F301/304L, G. 372, SCH05	2122		PLV00BL10A
3	WELDED, A102-F301/304L, G. 372, SCH05	2122		PLV00BL10A
4	WELDED, A102-F301/304L, G. 372, SCH05	2121 1/2		PLV00BL10A
5	TRIMMED FLANGE, 2014 DEL., CL. - 4, 1A, 6L			FF000BL10A
6	ASTM A214/204L-10, G. 1370			
7	EL. - 45, 1A, 6L, A102-F301/304L-V, G. 372	34	2	PP000BL10A

FIELD MATERIALS				
PART NO.	COMPONENT DESCRIPTION	N.S. (LBS)	QTY.	WEIGHT SITE CODE
<b>SUPPORTS</b>				
7	PIPE SPT., PTF-TLP-H01017			
8	PIPE SPT., PTF-TLP-H01018			
9	PIPE SPT., VS-A10-01.1-1-C			

APC 11-25-05

STRESS REVIEW PRINT	REV
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<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:
STRESS ANALYST:	DATE:



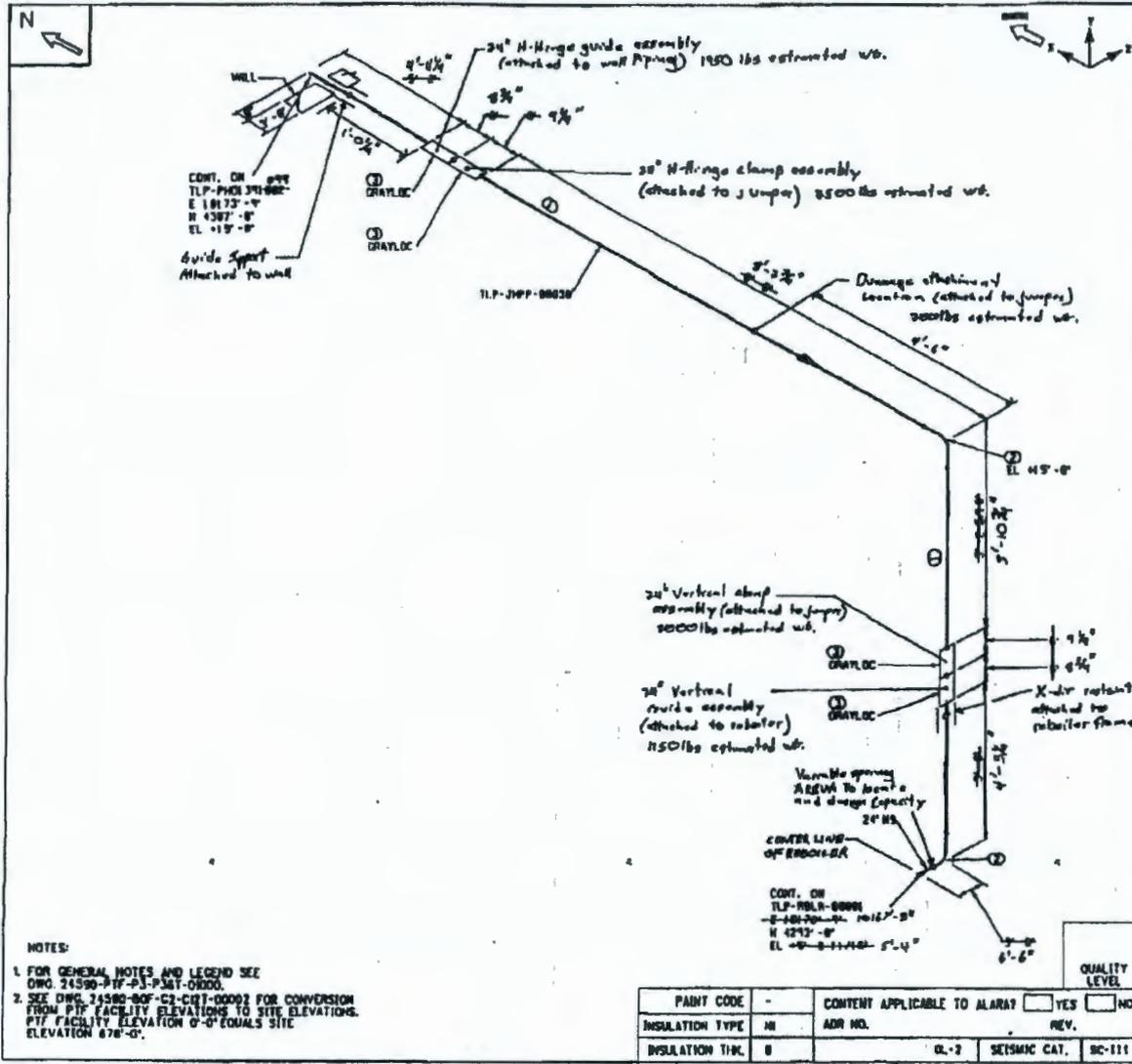
RIVER PROTECTION PROJECT  
WASTE TREATMENT PLANT  
2435 STEVENS CENTER PLACE  
RICHLAND, WA 99352

CONTRACT No: DE-AC27-01RV14136  
P&ID: 24590-PTF-10-TLP-0003 CONST. WORK AREA: 13

PRETREATMENT FACILITY  
ISOMETRIC

LINE No.: TLP-PH-01384-S120-24 PIPE SPEC: S120  
DWG No.: 24590-PTF-P3-TLP-PH01384001 REV: A

COMPUTER GENERATED - MANUAL CHANGES NOT PERMITTED



NOTES:  
 1. FOR GENERAL NOTES AND LEGEND SEE DWG. 24590-PTF-P3-P347-0000.  
 2. SEE DWG. 24590-00F-C2-C07-0000 FOR CONVERSION FROM PTF FACILITY ELEVATIONS TO SITE ELEVATIONS. PTF FACILITY ELEVATION 0'-0" EQUALS SITE ELEVATION 678'-0".

LENGTH (FT.) NO DATA FOR INFO ONLY JSH Created

PAINT CODE	-	CONTENT APPLICABLE TO ALARMA?	<input type="checkbox"/> YES <input type="checkbox"/> NO
INSULATION TYPE	NI	ADR NO.	REV.
INSULATION THK.	0	OL-2	SEISMIC CAT. SC-111

ISO Created: PCF For PTF-TLP-PH01391001

BREP MATERIALS		R.E.		RECHTL	
PART NO.	COMPONENT DESCRIPTION	(INCHES)	QTY	SIZE	CODE
1	PIPE, 4027P304/304L, 074, 0.377, 002	24	1	0"	PPH000110C
FITTINGS					
2	EL - 08. 1A. 08. 0402P304/304L, 074, 0.377	24	2	0"	PPH000110C
3	ACC 1 GRAYLOC	24	1	0"	0"

AREA: 17

STRESS REVIEW PRINT		REV	
<input type="checkbox"/> ACCEPTED	<input type="checkbox"/> NOT ACCEPTED		
<input type="checkbox"/> ACCEPTED W/ COMMENTS	<input type="checkbox"/> SUPPORTS ADDED TO MODEL BY:		
STRESS ANALYST:		DATE:	



RIVER PROTECTION PROJECT  
 WASTE TREATMENT PLANT  
 2435 STEVENS CENTER PLACE  
 RICHLAND, WA 99352

CONTRACT No: DE-AC27-07RV14136

PNR: 24590-PTF-H0-TLP-00001 CONST. WORK AREA: 21

**PRETREATMENT FACILITY ISOMETRIC**

LINE No.	TLP-PH-01391-S120-24	PIPE SPEC:	S120
DWG No.	24590-PTF-P3-TLP-PH01391001	REV	A

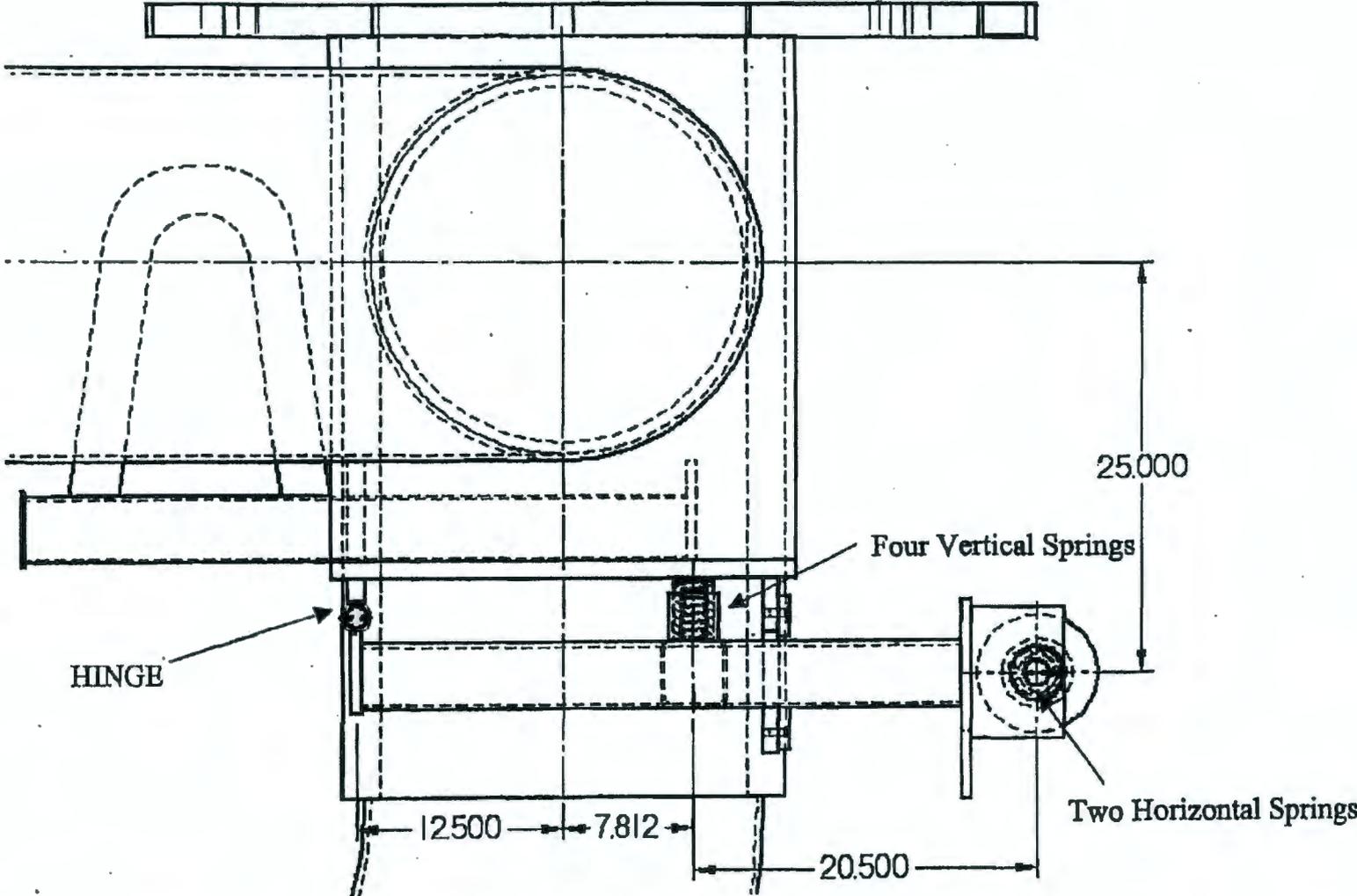
PLOTTED BY: hrbcan PLOT DATE: 08/21/2008 09:43:41 AM SHT. 1 OF 1

Use view 1 to place fences for plotting to not plot data blocks

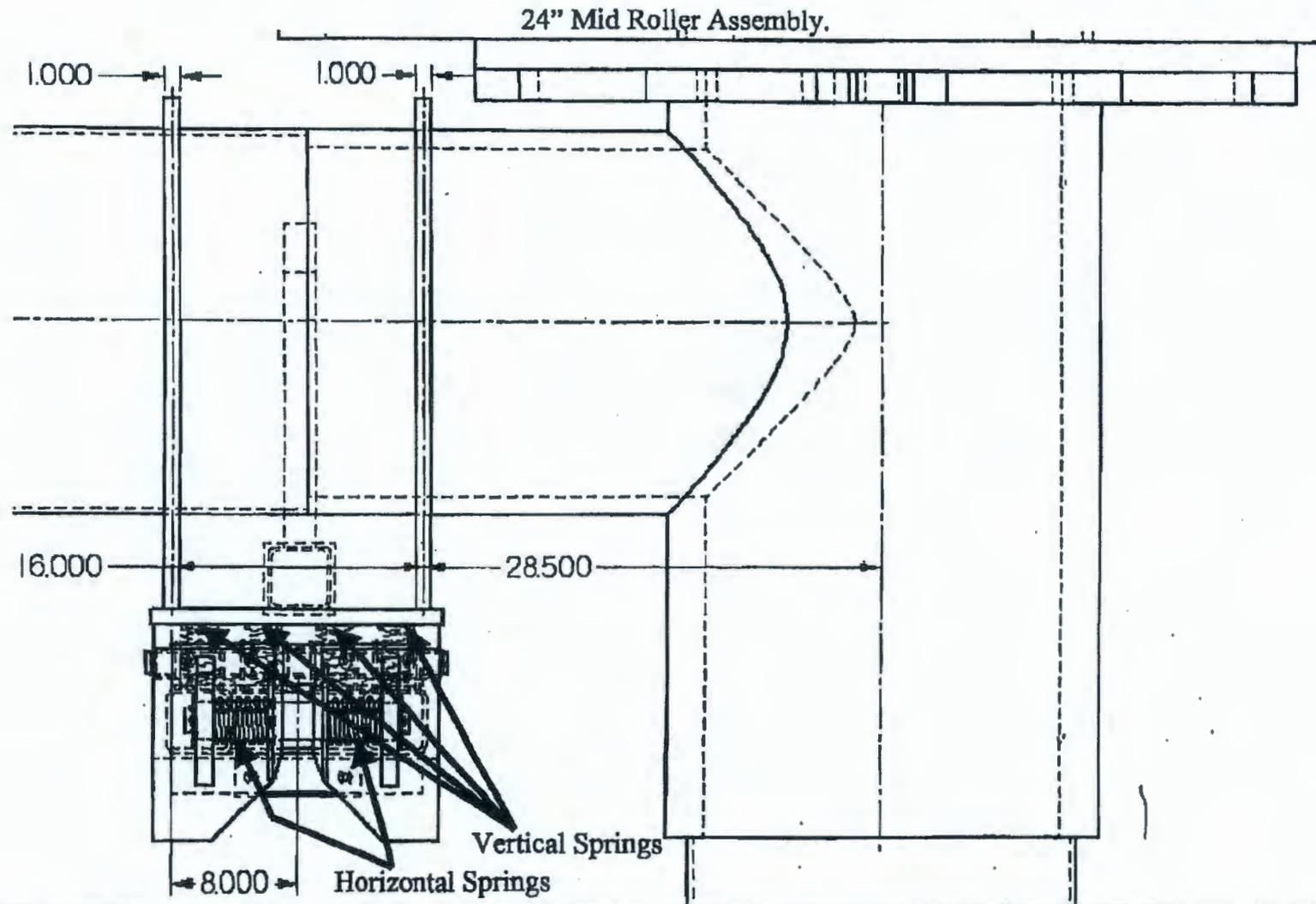
H:\STRESS\STRESS\_150\jumar\Area\_17\ptf-ph-01391001.dwg



24" Mid Roller Assembly.



Note: Use Mid Roller Assembly spring configuration <sup>shown here</sup> for all Mid Roller Assemblies until finalized information is available.



**Vertical Spring:**

•Spring Rate: 1310 lbs/in

•Preload: Four springs are compressed approximately 0.150" during installed cold condition. (Springs are in parallel)

**Horizontal Spring (North-South):**

•Spring Rate: 76 lbs/in

•Preload: 0.000" preload during the installed cold condition. (One spring acting in north direction, one acting spring in south direction)

## ATTACHMENT # 4

Attached tables show the design load requirements for forces and moments applied to piping nozzles on separator vessels, reboilers, and condensers.

The direction of the listed forces and moments for vertical nozzles into the equipment head are provided in global coordinates (X = North/South, y = vertical, and z = East/West - Vessel 0° defined as North).

The directions of the listed forces and moments for horizontal nozzles into the equipment shell are provided in local coordinates per 24590-WTP-3PS-MV00-T0001.

FEP-SEP-00001A SC-I : TABLE 1

CCN 124031

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (In)	Orientation (V° / H**)	Load Case	Design Loads (Force in lbs, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N01*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N02*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	21	10	39	20
N03*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N04	30	H	Weight	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
			Seismic	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
			Thermal	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
N05	2	H	Weight	50	60	50	75	75	75
			Seismic	106	70	106	158	237	237
			Thermal	30	38	40	68	80	80
N07	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	12	10	10	20	32
N08*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N09*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N10 <sup>1</sup>	24	V	Weight	Later	Later	Later	Later	Later	Later
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal	Later	Later	Later	Later	Later	Later
N11 <sup>1</sup>	24	H	Weight	Later	Later	Later	Later	Later	Later
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal	Later	Later	Later	Later	Later	Later
N13	4	H	Weight	90	242	90	257	161	398
			Seismic	626	712	626	2220	3330	3330
			Thermal	80	70	110	270	540	540
N14	2	H	Weight	50	64	50	75	75	188
			Seismic	106	189	106	158	237	593
			Thermal	86	33	46	94	154	80
N17	2	H	Weight	50	80	50	75	75	88
			Seismic	106	106	106	158	237	254
			Thermal	159	30	67	40	236	80
N19	1	H	Weight	15	20	15	20	20	20
			Seismic	33	29	55	37	55	55
			Thermal	16	13	25	10	20	20

1. Values to be provided later upon completion of piping analysis.

FEP-SEP-00001A SC-I : TABLE 1 (CONT.)

CCN 124031

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (In)	Orientation (V* / H**)	Load Case	Design Loads (Force in lbs, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N21*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N22	1	H	Weight	15	20	15	20	20	20
			Seismic	30	21	30	37	55	55
			Thermal	10	21	10	10	20	20
N23	1	H	Weight	15	20	15	20	20	20
			Seismic	30	23	30	37	55	55
			Thermal	10	10	10	10	20	20
N24	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N25	1	H	Weight	15	20	15	20	20	20
			Seismic	30	23	30	37	73	55
			Thermal	10	10	10	10	20	20
N27*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N28*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	12	10	10	10	20	20
N30	24	Manway	Weight	Manway	Manway	Manway	Manway	Manway	Manway
			Seismic	Manway	Manway	Manway	Manway	Manway	Manway
			Thermal	Manway	Manway	Manway	Manway	Manway	Manway
N32 Spare	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20

\*Nozzle loads for these bubblers due to hydrogen accumulation are not available and will be provided later.

3/3

FEP-SEP-00001B SC-I : TABLE 2

CCN 124032

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (In)	Orientation (V° / H°)	Load Case	Design Loads (Force in lbe, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N01*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N02*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N03*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N04	30	H	Weight	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
			Seismic	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
			Thermal	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor	By Vendor
N05	2	H	Weight	50	60	50	75	75	75
			Seismic	106	70	106	158	237	237
			Thermal	30	30	40	40	80	80
N07	1	H	Weight	15	20	15	20	20	20
			Seismic	33	20	30	37	55	55
			Thermal	10	20	10	10	20	48
N08*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N09*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N10'	24	V	Weight	Later	Later	Later	Later	Later	Later
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal	Later	Later	Later	Later	Later	Later
N11'	24	H7	Weight	Later	Later	Later	Later	Later	Later
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal	Later	Later	Later	Later	Later	Later
N13	4	H	Weight	90	215	90	257	161	347
			Seismic	626	418	626	2220	3330	3330
			Thermal	80	70	116	407	540	540
N14	2	H	Weight	50	64	50	75	75	142
			Seismic	106	70	106	201	237	237
			Thermal	69	33	40	70	118	80
N17	2	H	Weight	50	60	50	75	75	80
			Seismic	106	70	106	188	237	237
			Thermal	158	30	53	40	298	80
N19	1	H	Weight	15	20	15	20	20	20
			Seismic	39	20	38	37	55	55
			Thermal	14	10	15	10	20	20

1. Values to be provided later upon completion of piping analysis.

FEP-SEP-00001B SC-I : TABLE 2 (cont.)

CCN 124032

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (in)	Orientation (V* / H**)	Load Case	Design Loads (Force in lbs, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N21*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	21	30	37	55	55
			Thermal	10	10	10	10	20	20
N22	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	20	10	10	20	20
N23	1	H	Weight	15	20	15	20	20	20
			Seismic	30	21	30	37	55	55
			Thermal	10	10	10	10	20	20
N24	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N25	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N27*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N28*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20
N30	24	Manway	Weight	Manway	Manway	Manway	Manway	Manway	Manway
			Seismic	Manway	Manway	Manway	Manway	Manway	Manway
			Thermal	Manway	Manway	Manway	Manway	Manway	Manway
N32 Spare	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	10	10	10	10	20	20

\* Nozzle loads for these bubblers due to hydrogen accumulation are not available and will be provided later.

TLP-SEP-00001 SC-I : TABLE 3

CCN 139984

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (In)	Orientation (V° / H°)	Load Case	Design Loads (Force in lbs, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N01*	1	H	Weight	15	20	15	20	20	20
			Seismic	69	21	30	37	55	69
			Thermal	20	37	20	33	30	55
N02*	1	H	Weight	15	24	15	20	20	25
			Seismic	117	28	46	43	55	117
			Thermal	20	10	20	20	30	30
N03*	1	H	Weight	15	20	15	20	20	23
			Seismic	60	26	30	37	78	60
			Thermal	20	10	20	20	30	30
N04	30	Vendor	Weight						
			Seismic	Vendor	Vendor	Vendor	Vendor	Vendor	Vendor
			Thermal						
N07	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	13	20	20	30	30
N08*	1	H	Weight	15	28	15	29	20	49
			Seismic	64	32	30	42	59	64
			Thermal	20	12	20	20	30	30
N09*	1	H	Weight	15	21	15	20	20	42
			Seismic	89	33	64	37	145	89
			Thermal	20	10	20	20	30	30
N10	24	V	Weight						
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal						
N11	24	H	Weight						
			Seismic	Later	Later	Later	Later	Later	Later
			Thermal						
N13	4	H	Weight	87	281	87	216	142	748
			Seismic	1722	541	274	878	1320	1722
			Thermal	150	246	200	480	950	950
N14	2	H	Weight	50	60	50	75	75	89
			Seismic	162	70	106	158	237	237
			Thermal	115	40	60	70	130	130
N17	2	H	Weight	50	60	50	75	75	75
			Seismic	106	70	106	158	237	237
			Thermal	136	81	60	75	130	130
N19	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	10	20	20	30	30

**TLP-SEP-00001 SC-I : TABLE 3 (CONT.)**

CCN 139984

Note:

\*V = vertical head nozzle - values are x = North/South, y = vertical, z = East/West (global coordinates), Vessel 0° defined as North

\*\*H = horizontal shell nozzle - values are per axes shown in 24590-WTP-3PS-MV00-T0001 Rev 2, Appendix A (local coordinates)

Nozzle Number	Nozzle Size (In)	Orientation (V / H*)	Load Case	Design Loads (Force in lbs, Moment in ft-lb)					
				Fx	Fy	Fz	Mx	My	Mz
N21*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	10	20	20	30	30
N22	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	12	20	20	30	30
N23	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	23	20	20	30	30
N24	1	H	Weight	15	20	15	20	20	36
			Seismic	77	26	34	37	85	77
			Thermal	20	11	20	20	30	30
N25	1	H	Weight	15	20	15	20	20	20
			Seismic	41	20	30	37	62	55
			Thermal	20	10	20	20	30	30
N27*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	15	20	20	30	30
N28*	1	H	Weight	15	20	15	20	20	20
			Seismic	30	20	30	37	55	55
			Thermal	20	10	20	20	30	30

\* Nozzle loads for these bubblers due to hydrogen accumulation are not available and will be provided later.

TABLE 4

PRELIMINARY Nozzle Loads on Non-Black Cell Vessels Designated as SC-1							
Pipe Size	Load Type	Forces			Moments		
		Fx (lb)	Fy (lb)	Fz (lb)	Mx (ft-lb)	My (ft-lb)	Mz (ft-lb)
1 in	Weight	15	20	15	20	20	20
1 in	Seismic	45	30	45	56	83	83
1 in	Thermal	30	26	40	38	77	77
1-1/2 in	Weight	35	45	35	40	40	40
1-1/2 in	Seismic	90	60	90	137	206	206
1-1/2 in	Thermal	64	56	86	96	192	192
2 in	Weight	50	60	50	75	75	75
2 in	Seismic	159	105	159	237	356	356
2 in	Thermal	114	100	152	169	337	337
3 in	Weight	69	111	69	158	99	99
3 in	Seismic	323	215	323	935	1401	1401
3 in	Thermal	228	203	305	664	1330	1330
4 in	Weight	116	186	116	288	180	180
4 in	Seismic	548	365	548	1755	2640	2640
4 in	Thermal	393	350	524	1260	2520	2520
6 in	Weight	279	446	279	797	498	498
6 in	Seismic	1326	885	1326	4845	7275	7275
6 in	Thermal	980	872	1310	3580	7160	7160
8 in	Weight	311	497	311	988	618	618
8 in	Seismic	1467	980	1467	5895	8835	8835
8 in	Thermal	1190	1060	1590	4800	9590	9590
10 in	Weight	351	561	351	1880	1180	1180
10 in	Seismic	1635	1092	1635	11010	16500	16500
10 in	Thermal	1270	1130	1690	8500	17000	17000
12 in	Weight	485	776	485	2710	1700	1700
12 in	Seismic	2265	1515	2265	15750	23700	23700
12 in	Thermal	1780	1580	2370	12400	24800	24800
14 in	Weight	581	930	581	3320	2080	2080
14 in	Seismic	2700	1800	2700	18900	28350	28350
14 in	Thermal	2140	1900	2860	15000	30100	30100
16 in	Weight	729	1170	729	4170	2610	2610
16 in	Seismic	3420	2280	3420	24150	36300	36300
16 in	Thermal	2800	2490	3730	19800	39500	39500
18 in	Weight	911	1460	911	5070	3170	3170
18 in	Seismic	4230	2820	4230	30000	44850	44850
18 in	Thermal	3550	3160	4730	25200	50300	50300
20 in	Weight	1120	1790	1120	6310	3950	3950
20 in	Seismic	5100	3405	5100	35850	53700	53700
20 in	Thermal	4440	3950	5920	31200	62400	62400
22 in	Weight	1340	2150	1340	7300	4560	4560
22 in	Seismic	6045	4035	6045	42150	63300	63300
22 in	Thermal	5430	4830	7240	37900	75800	75800
24 in	Weight	1570	2510	1570	8510	5320	5320
24 in	Seismic	7065	4710	7065	48600	73050	73050
24 in	Thermal	6560	5840	8750	45200	90400	90400

**TABLE 5: FEP/TLP Reboiler Steam Design Nozzle Loads**

Reboiler Vessel ID Number	Nozzle Number	Calculation Number	Load Case	Reboiler Steam Nozzle Design Loads					
				Fx (lb)	Fy (lb)	Fz (lb)	Mx (ft-lb)	My(ft-lb)	Mz (ft-lb)
FEP-RBLR-00001A	N03	24590-PTF-P61C-FEP-00015	WT01	55	-1500	-238	-5750	4974	-5670
			OCC	6023	8655	1823	11131	2714	2101
			THRM01	-318	-261	-211	-6381	5289	510
FEP-RBLR-00001B	N03	24590-PTF-P61C-FEP-00015	WT01	-16	-1036	93	-1029	343	246
			OCC	5761	15950	1181	10124	4741	3286
			THRM01	-1285	1069	-73	-1230	1208	1243
TLP-RBLR-00001	N03	24590-PTF-P61C-TLP-00007	WT01	-174	3798	-70	-285	896	6518
			OCC	3283	3484	3728	15635	2205	5629
			THRM01	-2071	5003	253	3144	-53	6870

**NOTES:**

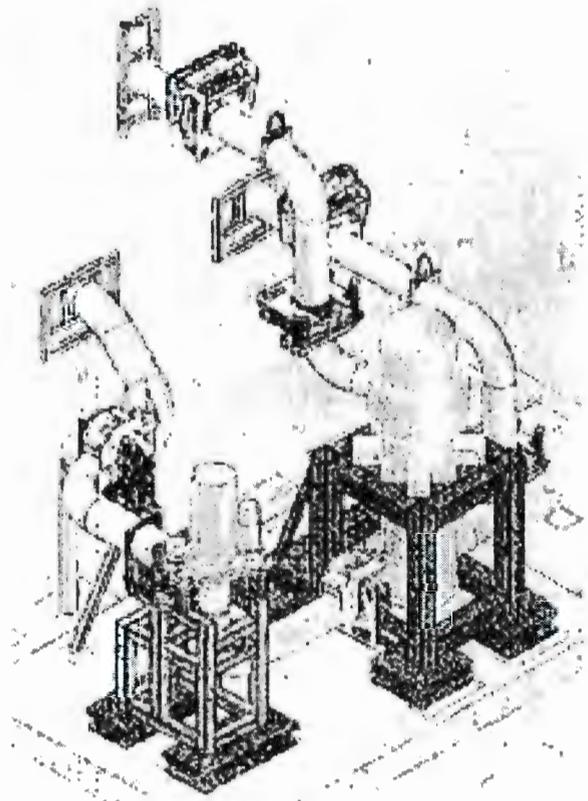
- ❖ Load direction per 24590-WTP-3PS-MV000-T0001, APPENDIX A.
- ❖ Tabulated loads are from ME101 analyses results with 25% increase factor for design purposes.
- ❖ Seismic loads considered the new ISRS, 5% damping and Modal Sum by CQC. Applied  $F_{\mu}$  is unity.
- ❖ Ref. CCN 110509

**ATTACHMENT #5**

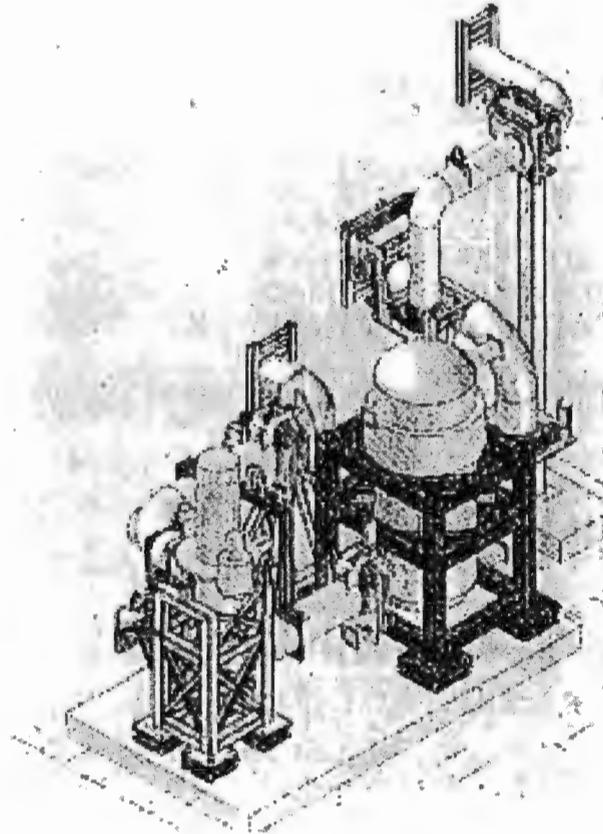
**Design Concepts**

# Design Concepts

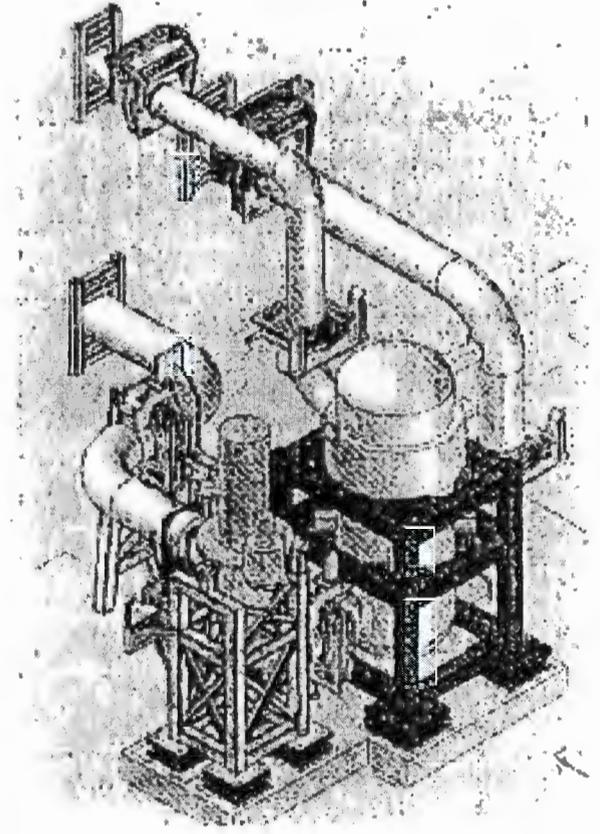
2500-119-315 M/VV-10801 Rev. 1  
Fig. V-150



Area 9  
CNP



Area 17  
TLP



Area 26/27  
IEP

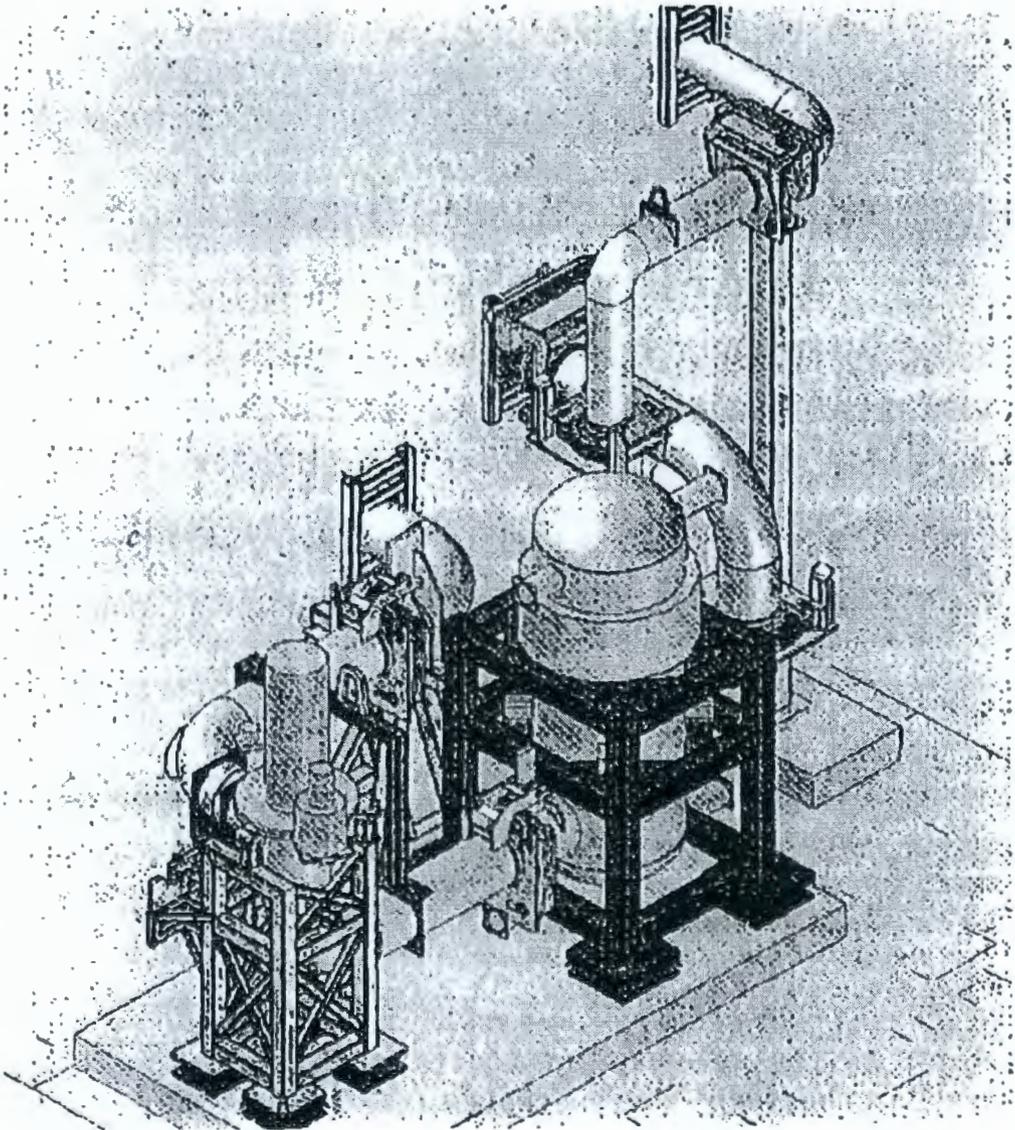
# Assumptions

- Top of concrete pad elevation will be 1'-4"
- Concrete pad will be rigid, e.g. 33 hz
- Bottom of Pump and Reboiler frames/top of remote interface will be 2'-2". With the exception of the FEP and TLP Reboilers, which will be 2'-2 5/16".
- AREVA will qualify Structural steel between 1'-4" and 2'-2", BNI will be responsible for remotability interface and fabrication drawings. Structural members will be same size as Reboiler and Pump frames or larger, see attached.
- There will be two 4" Dowel Pins per frame (opposing corners) as shown on drawings which will take the sheer loads.

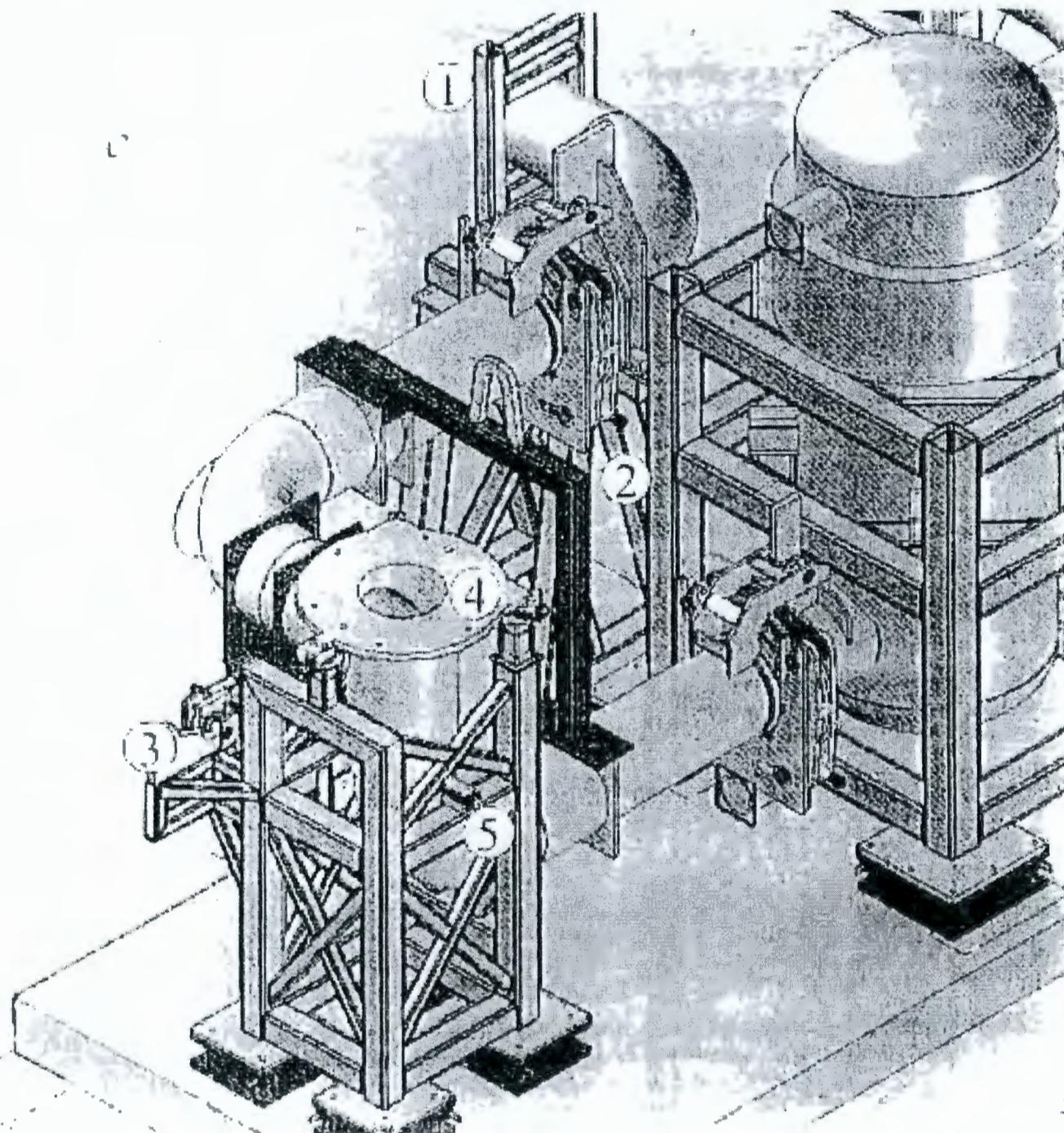
# Assumptions

- AREVA to qualify all plates, structural steel, dowel pins and the bolting interface.
- Initial assumption, bolts will be 1.25" diameter with two bolts per plate. Final diameter / quantity will be determined by analysis. Note: Max available torque from impact wrench is 400 ft-lbs
- AREVA to determine final dowel pin diameter and final number of bolts required. Note: Two dowel pins are required due to remote handling constraints.
- AREVA to qualify pump frame, BNI will be responsible for remotability interface and fabrication drawings.

# Area 17 (TLP) Design Concepts



Current Layout



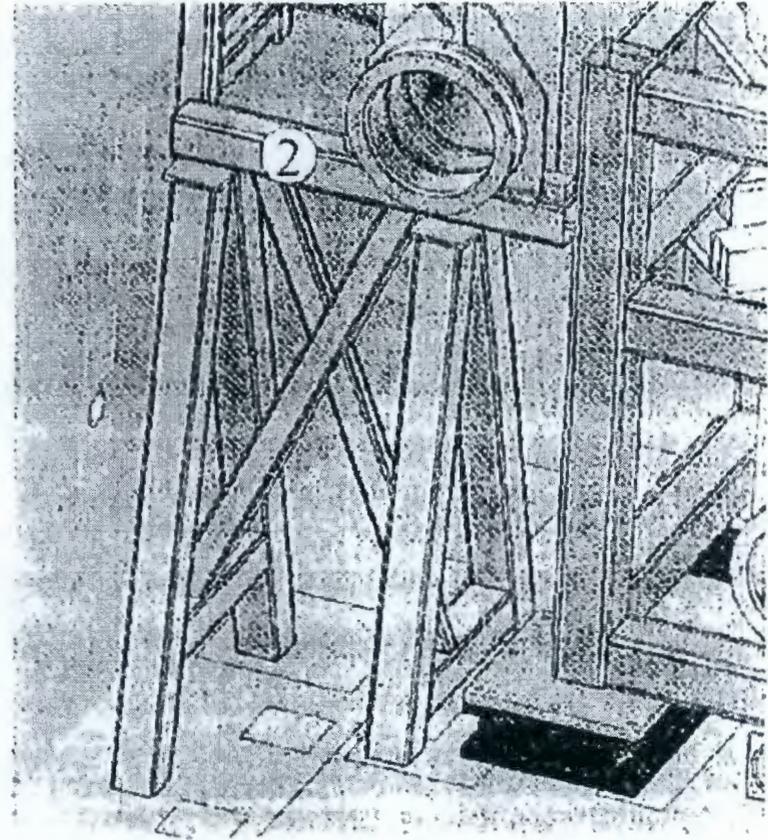
**Proposed Support  
Configuration  
(LLP)**

See corresponding detail  
of following states

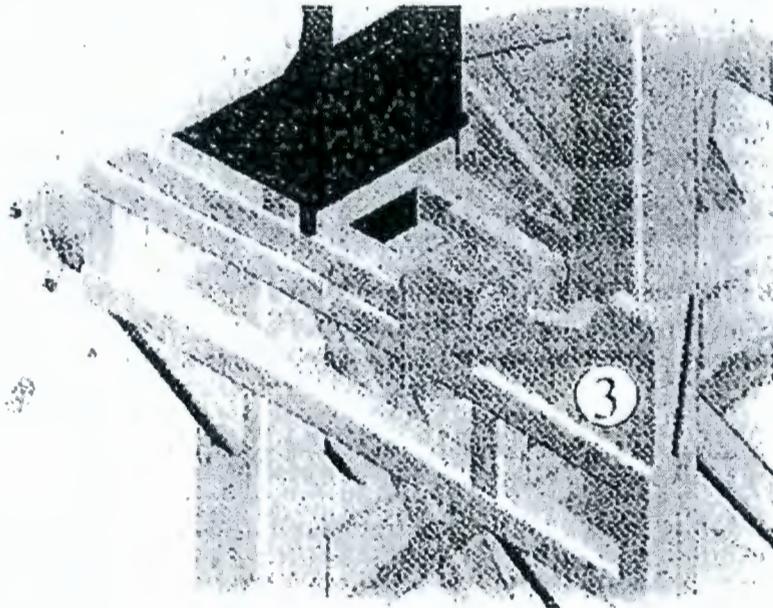
TLP



Guide supports at face of hot cell wall

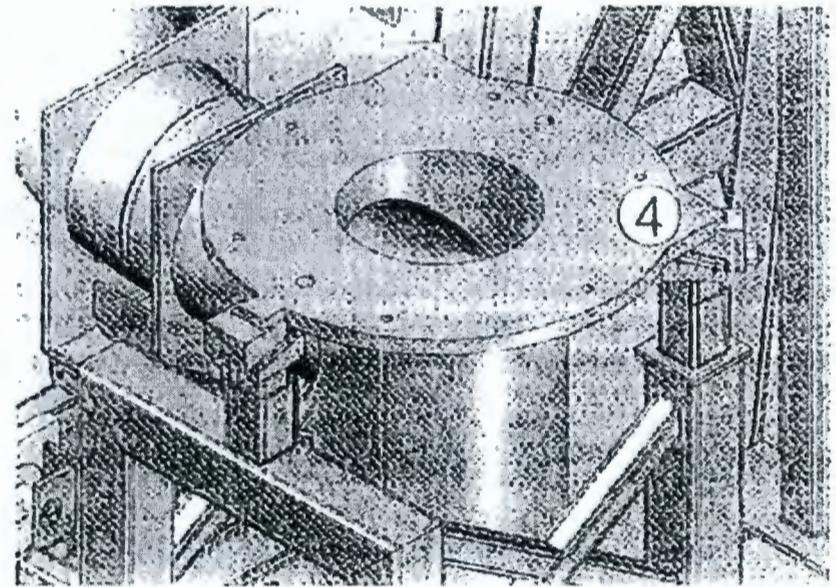


Guide support on back side of wall Grayloc hub

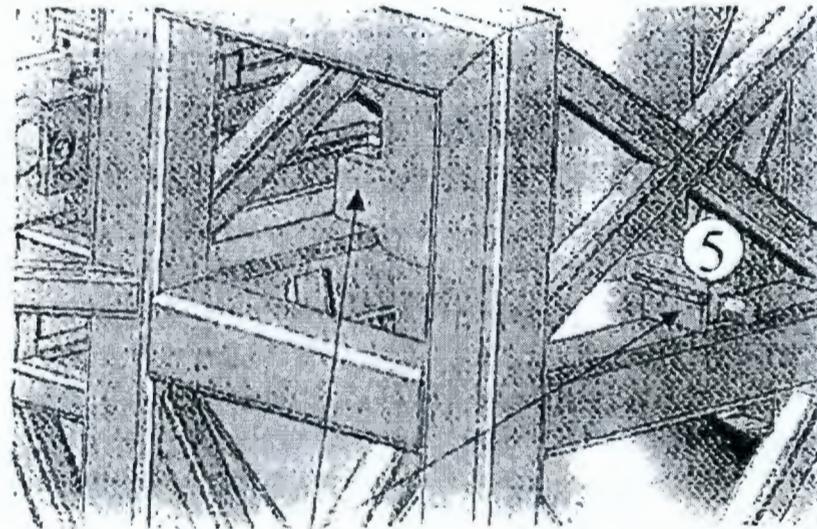


Midroller support

TLP

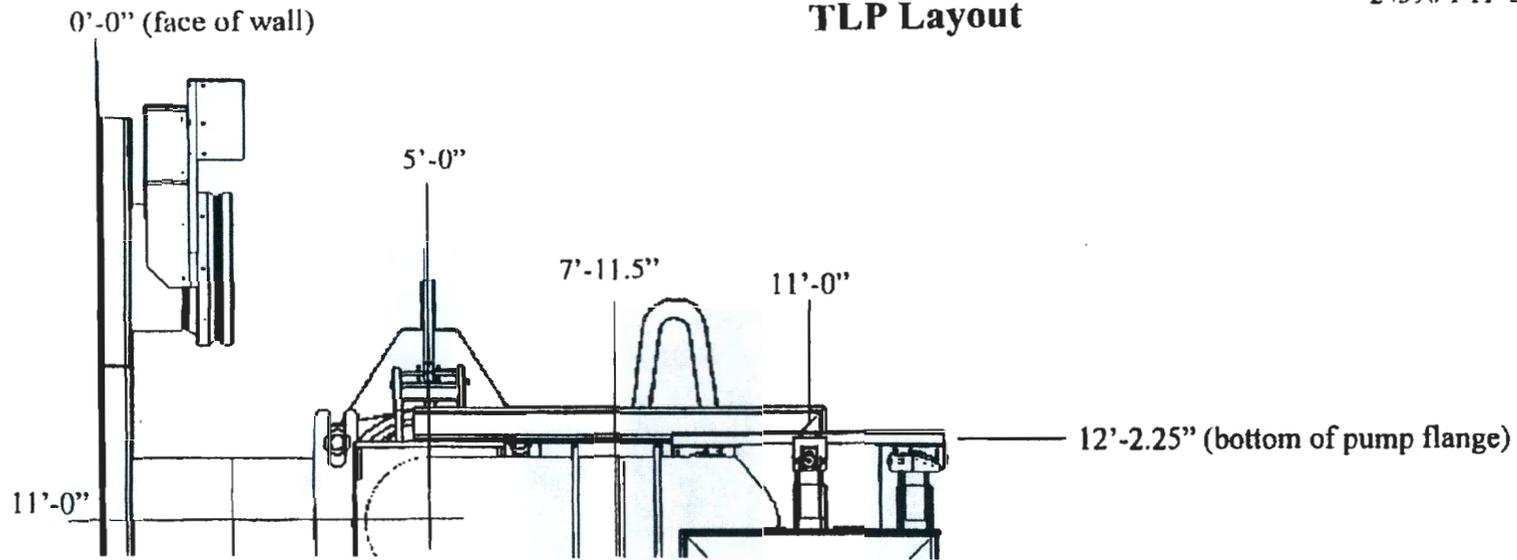


Three point pump support at pump flange

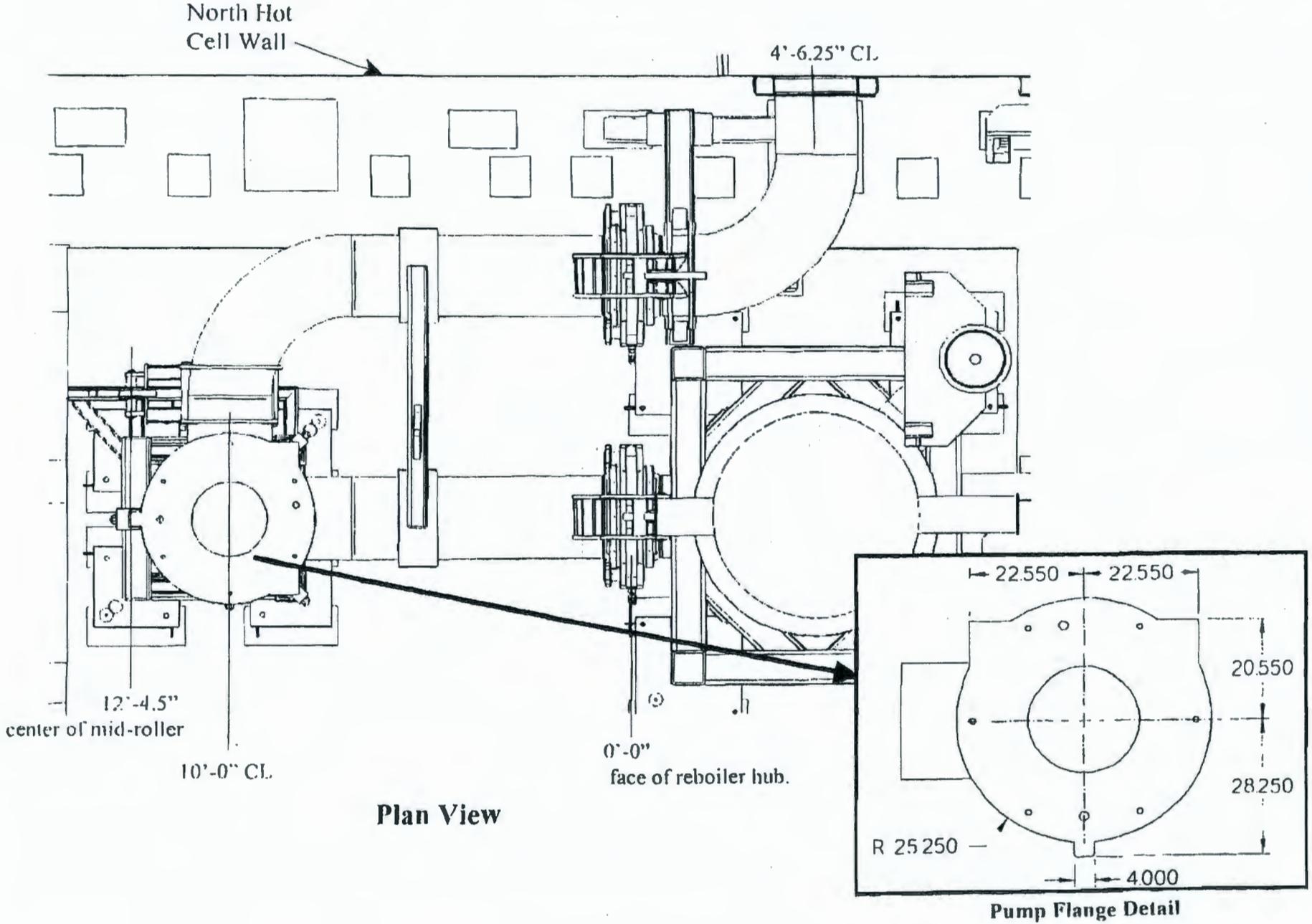


Pump discharge nozzle support.  
(only if required by analysis)

### TLP Layout



### TLP Layout

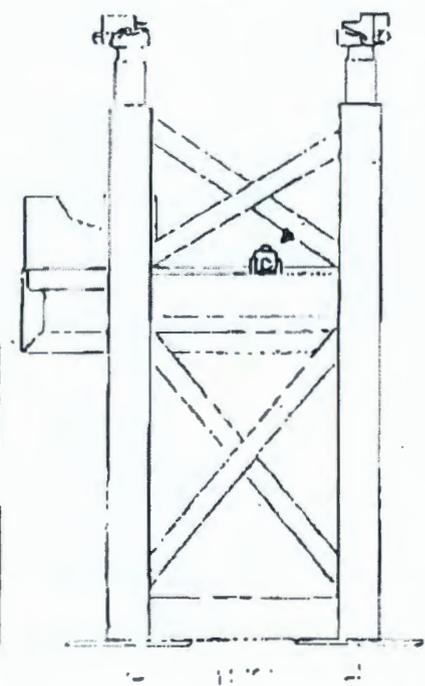
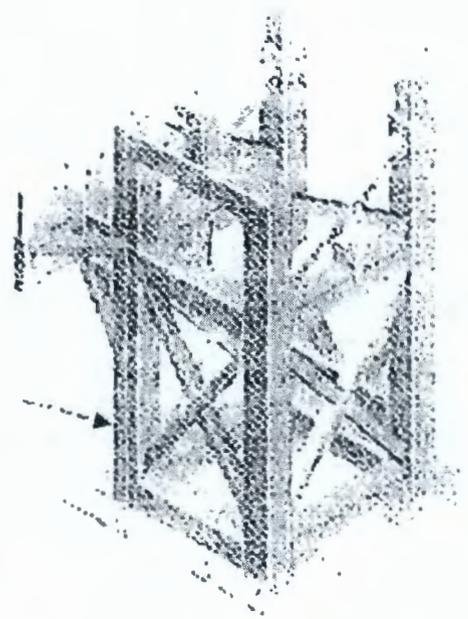


# Pump Support Frame (TLP)

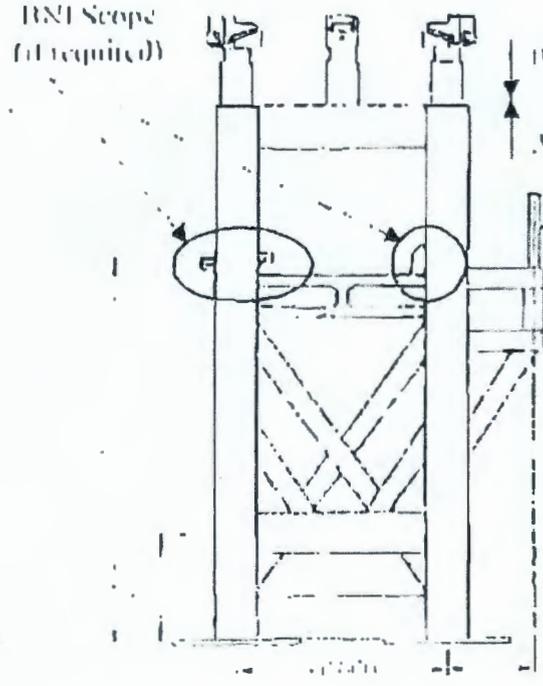
Stud location as required  
Must be accessible with  
impact wrench



Proposed main member tube  
steel size: 8" x 8" x 1/2"



BNI Scope  
(if required)

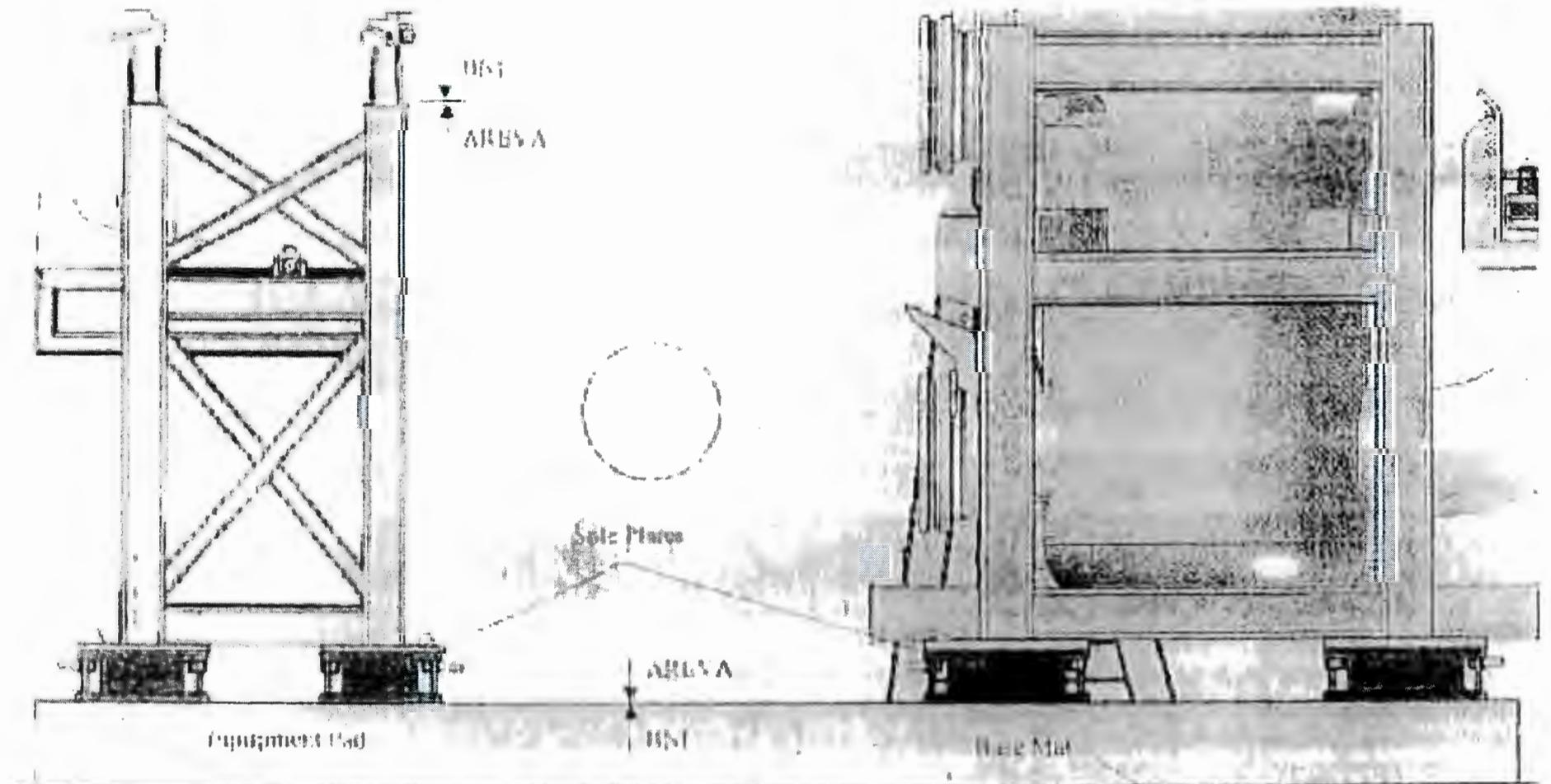


BNI

ARLVA

BNI Scope

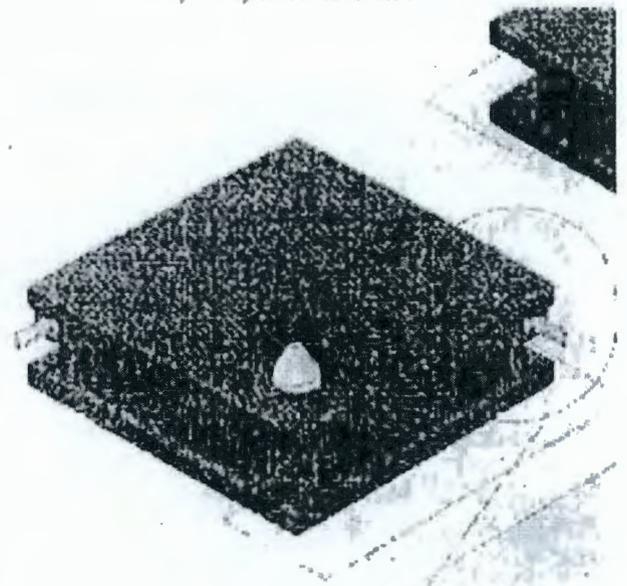
### Equipment Pad and Sole Plates (CLP)



# Sole Plates (CLP)

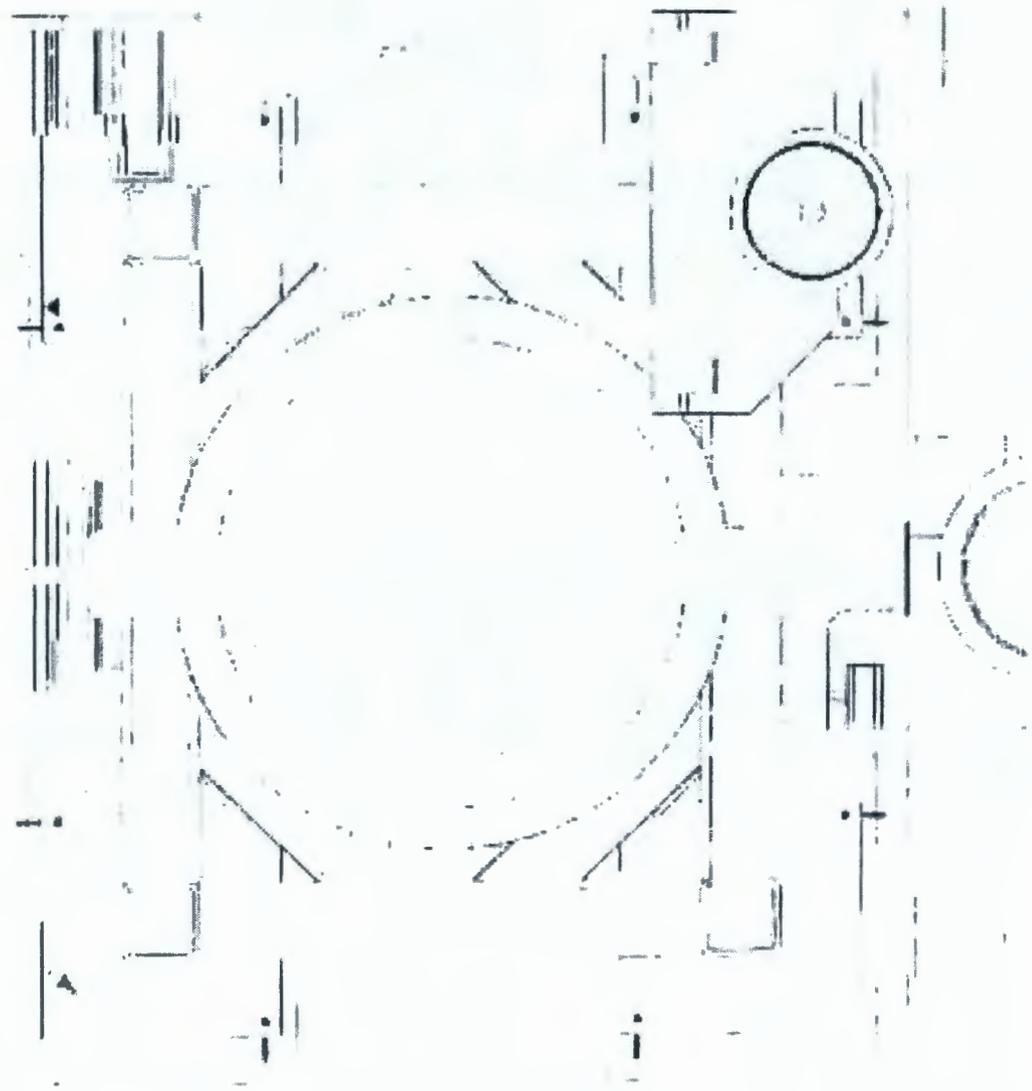
See Figure 4-100 for  
Member Details with  
applicable notes.

Example Sole Plate

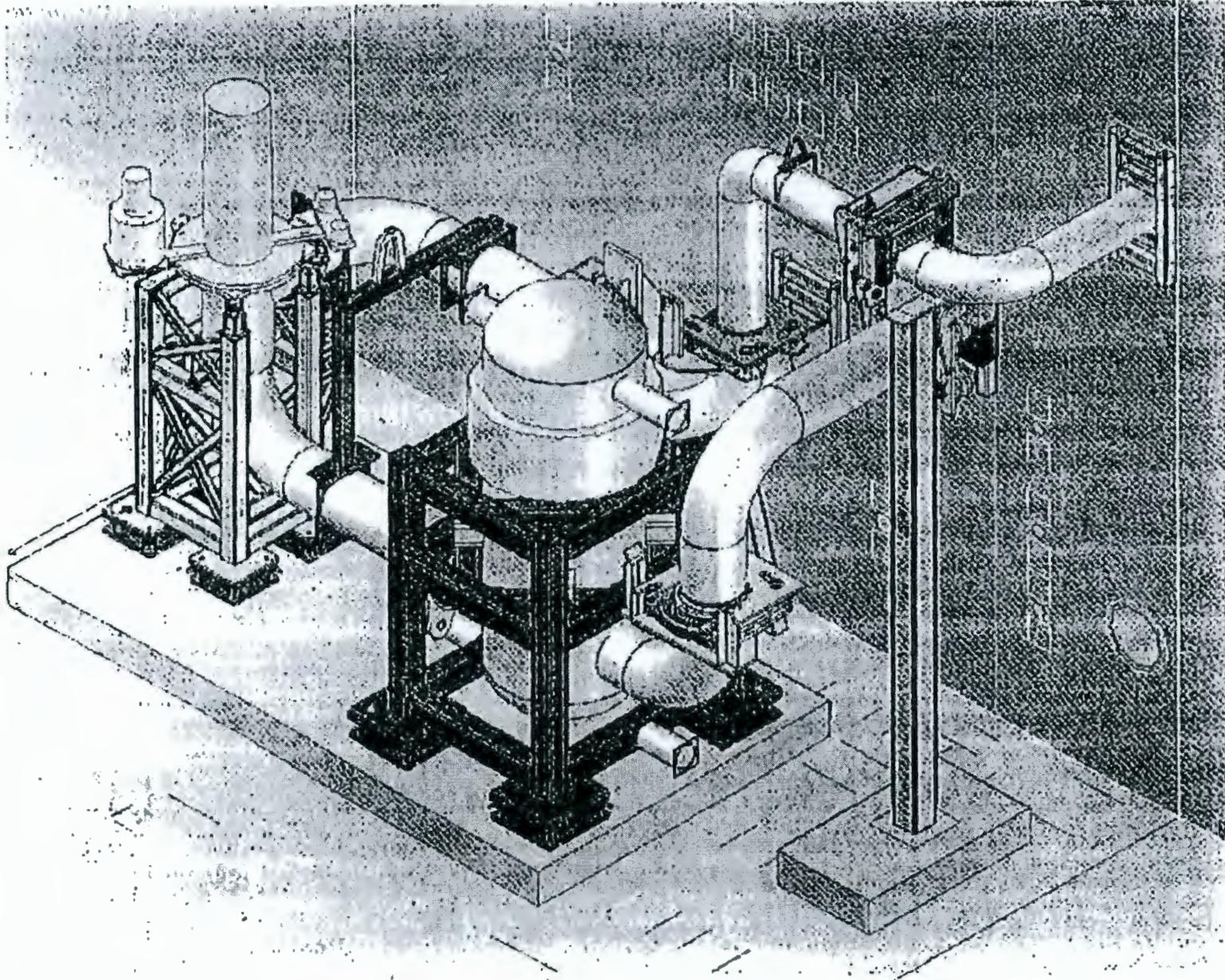


150.0000

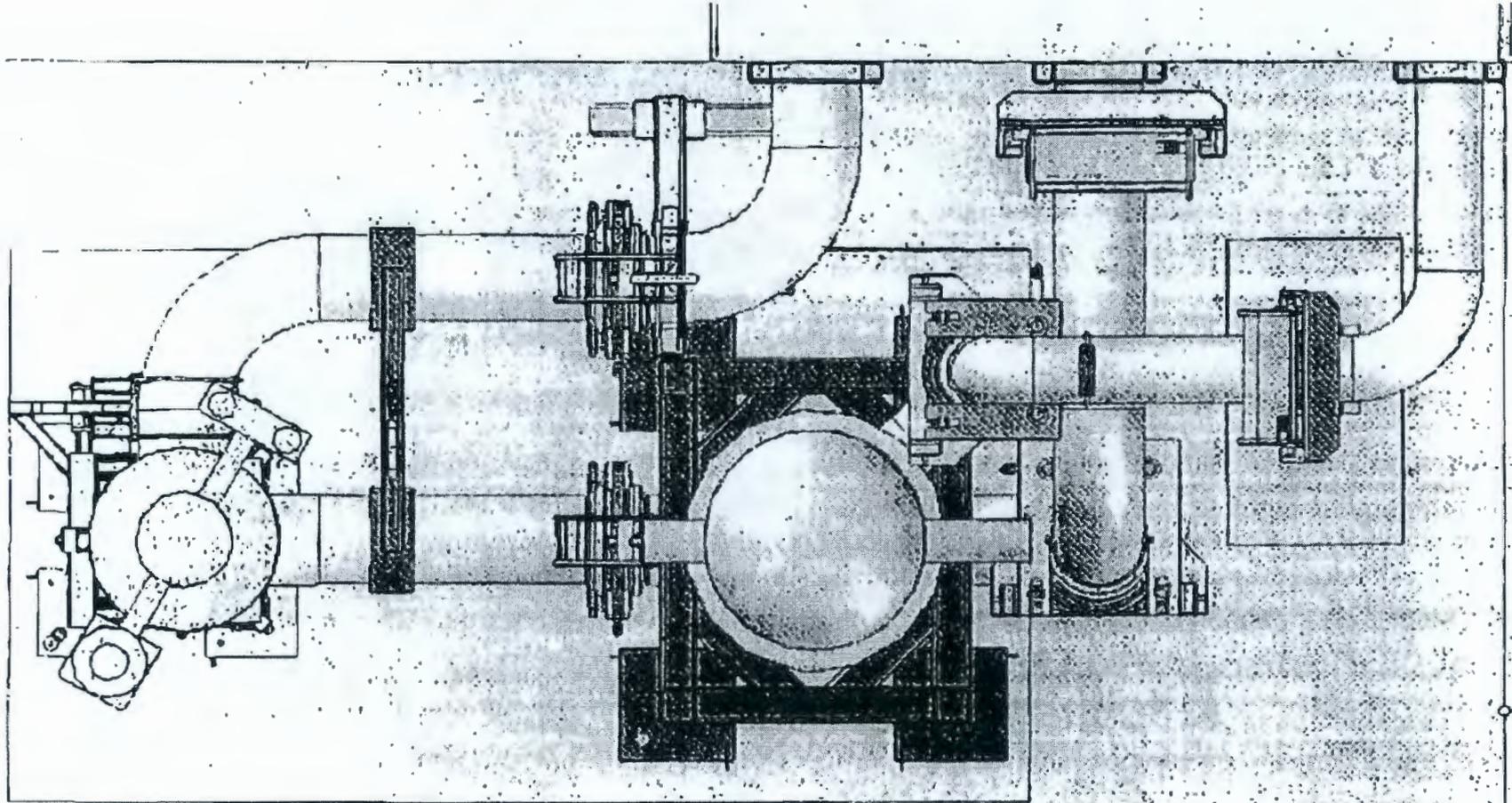
Applied No. 1000000  
Possibly with  
Power & Motion



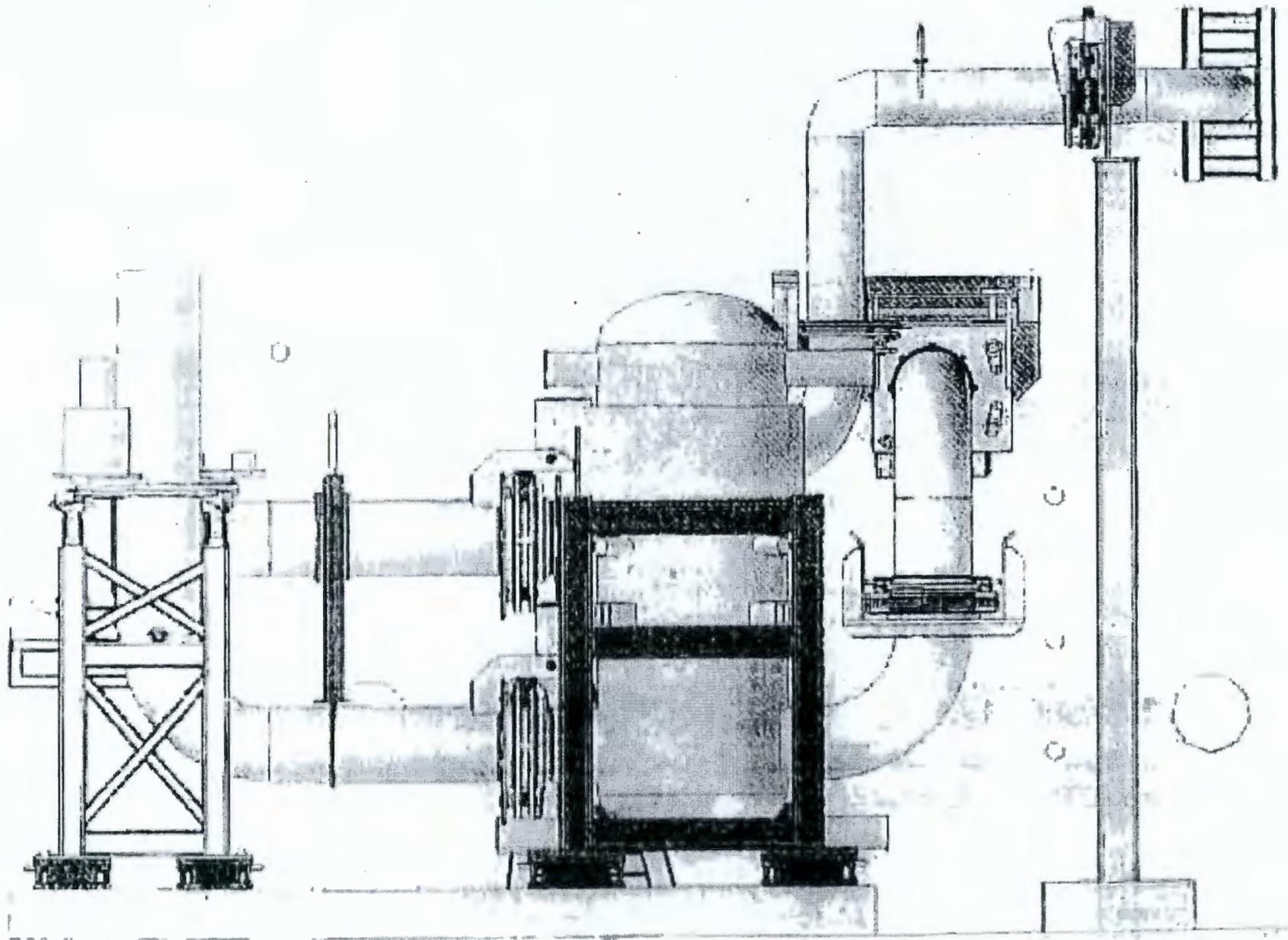
TLP



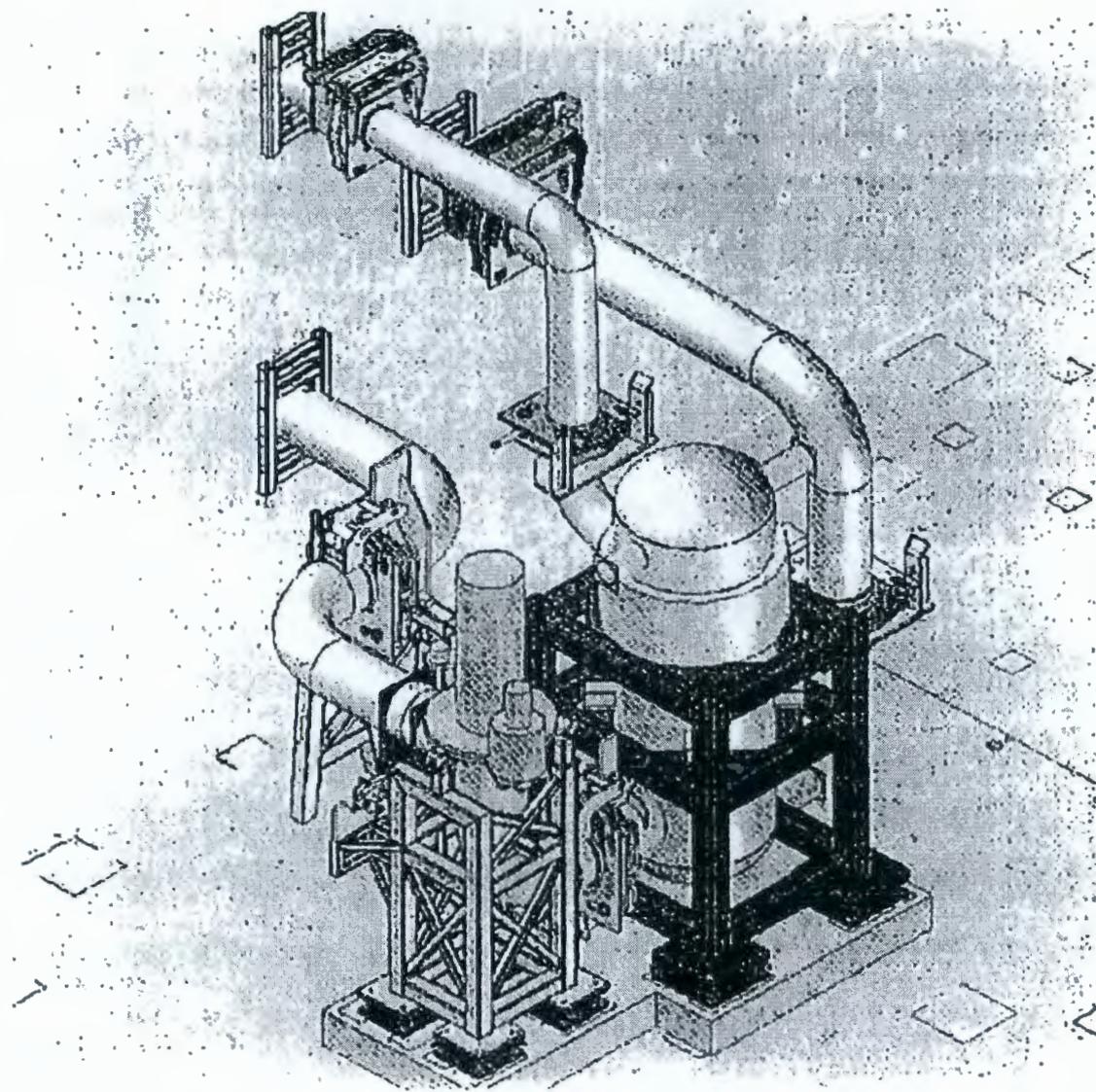
TLP



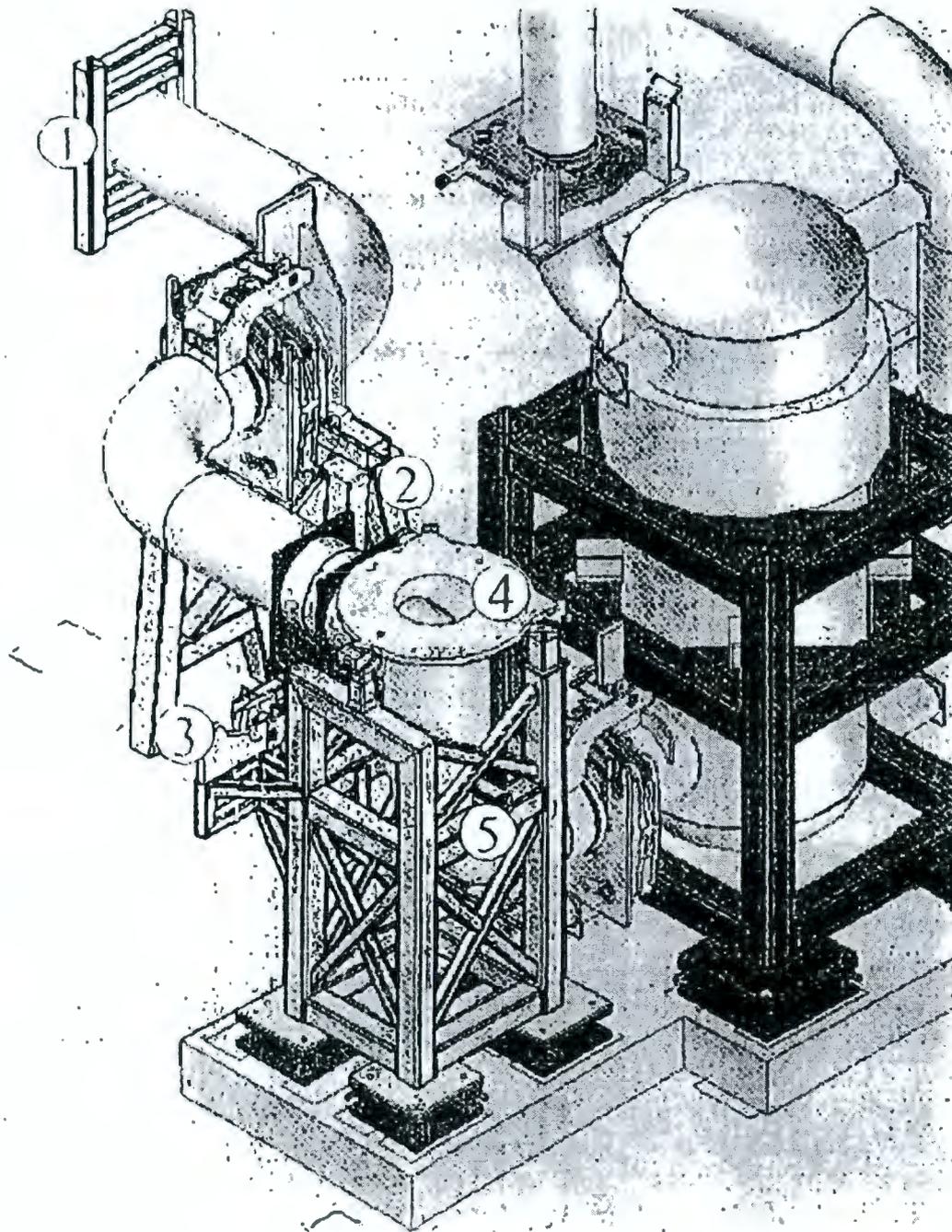
111



### Area 26/27 (FEP) Design Concepts



Current Layout



## Proposed Support Configuration (FEP)

See corresponding details  
on following slides.

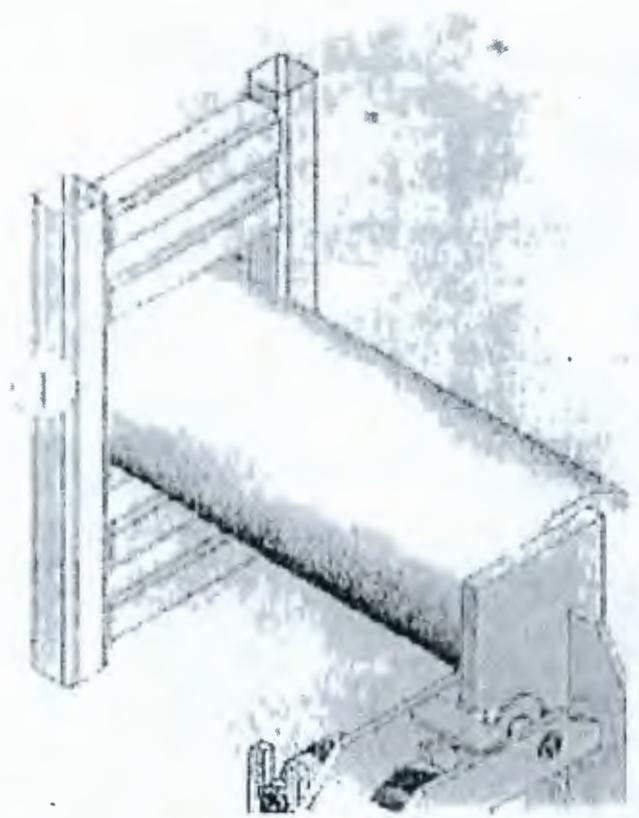


Fig. 1. A simple frame structure.

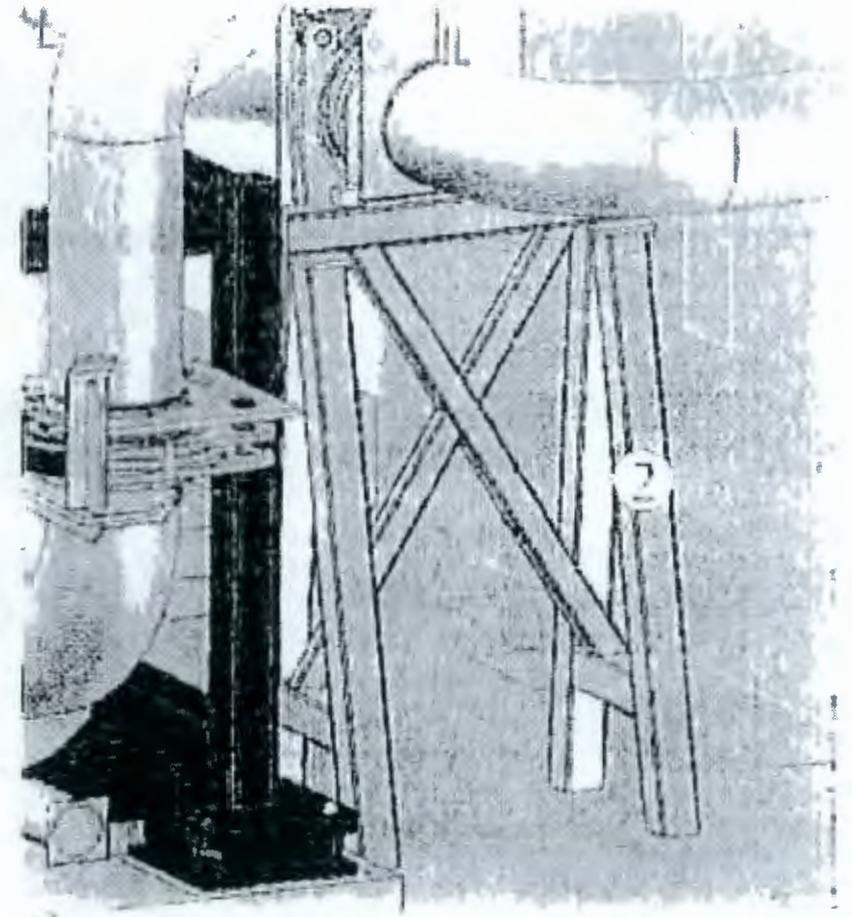
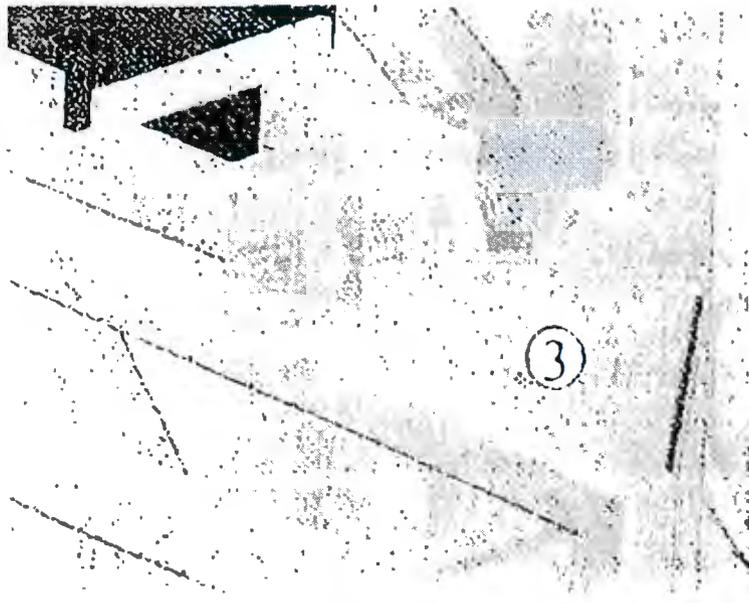
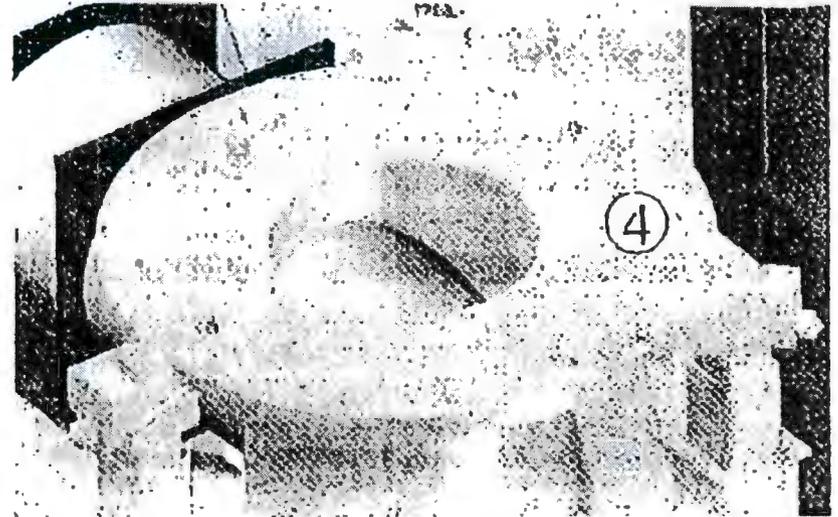


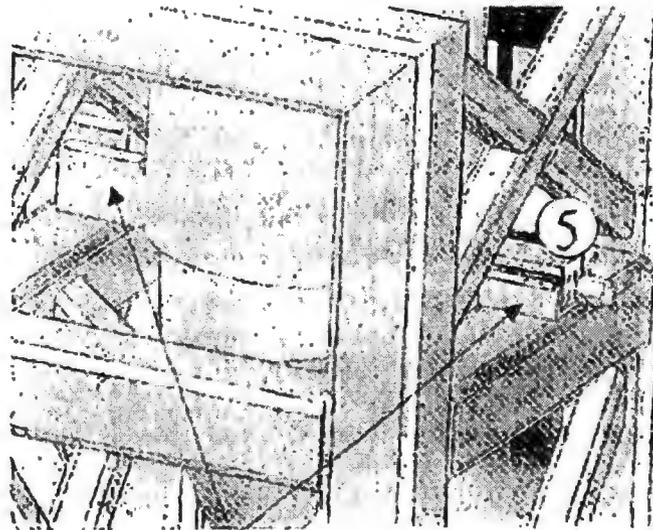
Fig. 2. A complex mechanical or structural assembly.



Midroller support

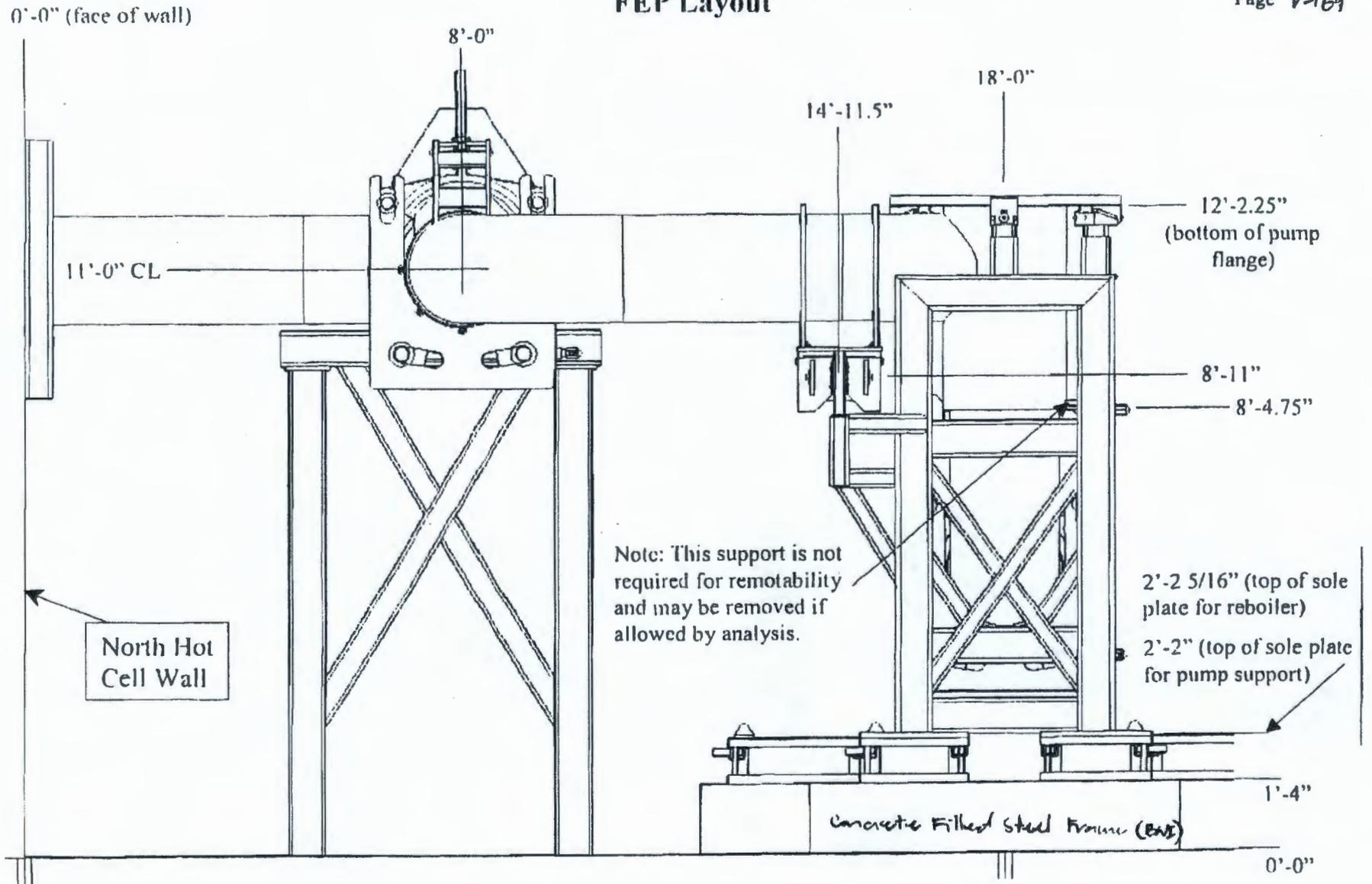


Three point pump support at pump flange.

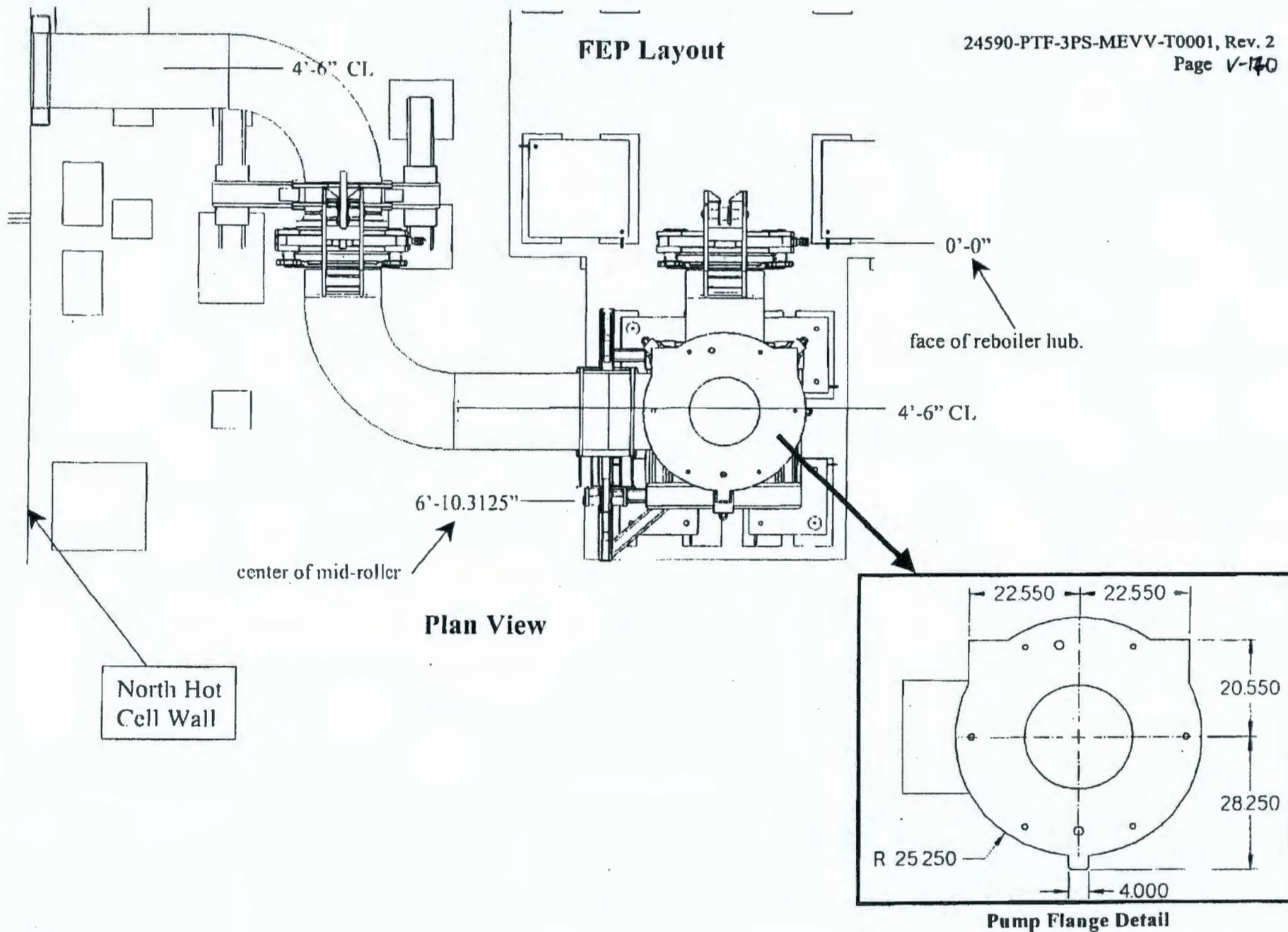


Pump discharge nozzle support  
(only if required by analysis)

### FEP Layout



Elevation View (looking west)

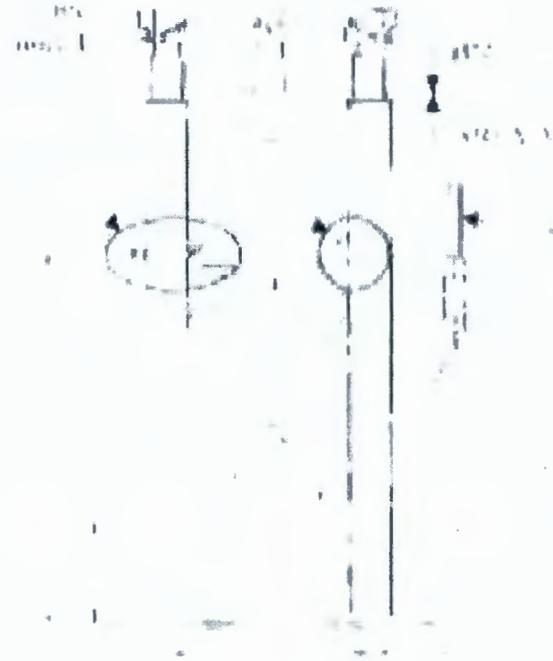
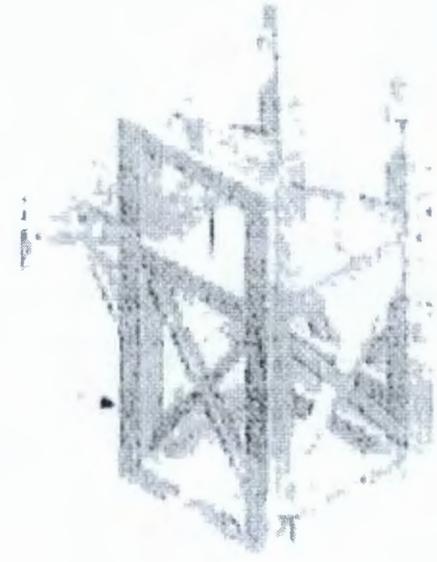


# Pump Support Frame (FPF)

Scale: 1/2" = 1'-0"  
 Date: 11/15/00  
 Project: 0000



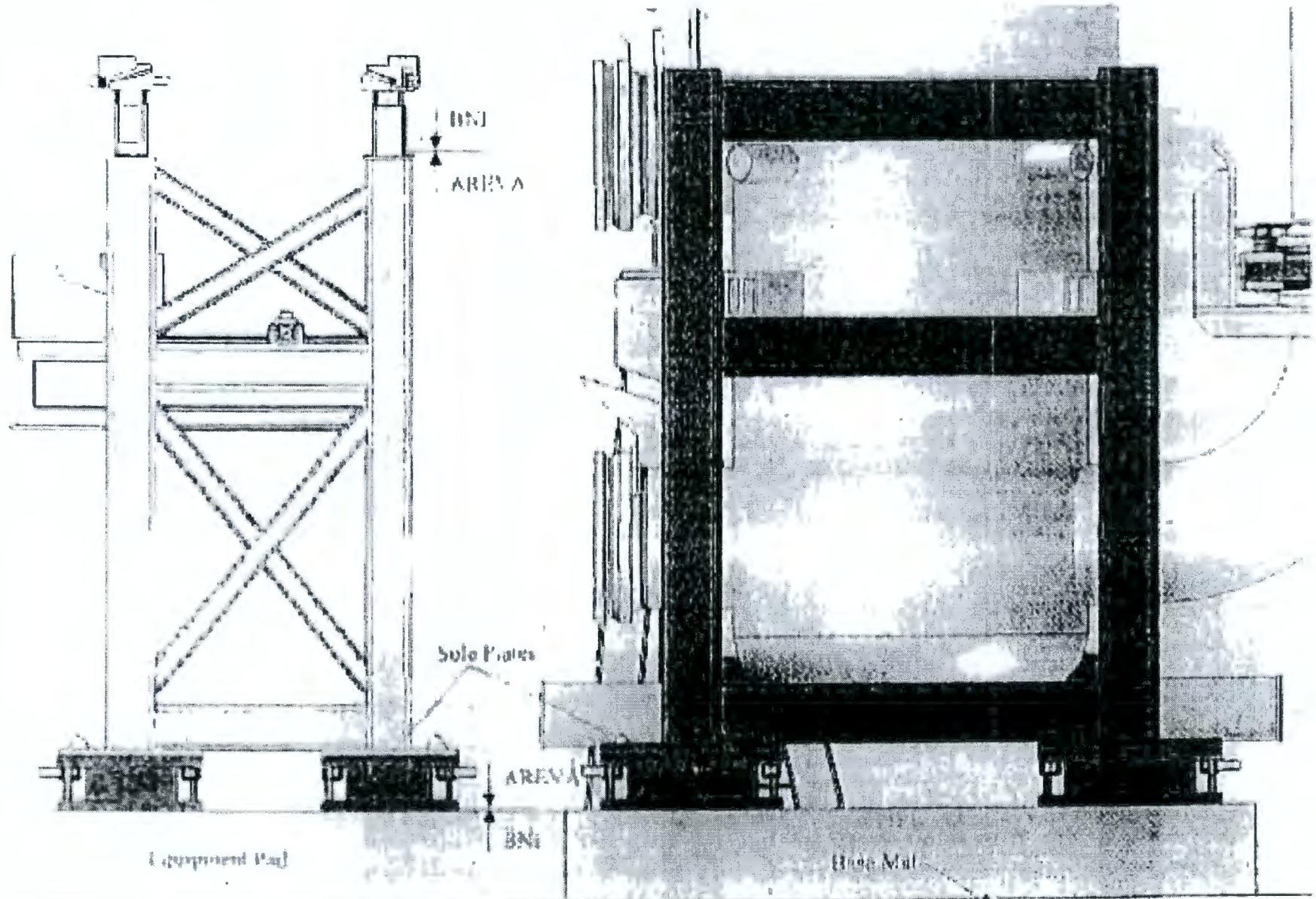
Scale: 1/2" = 1'-0"  
 Date: 11/15/00  
 Project: 0000



FINISH

02/20/01 08:41:51 AM 1/2" = 1'-0"  
 Page 2 of 2

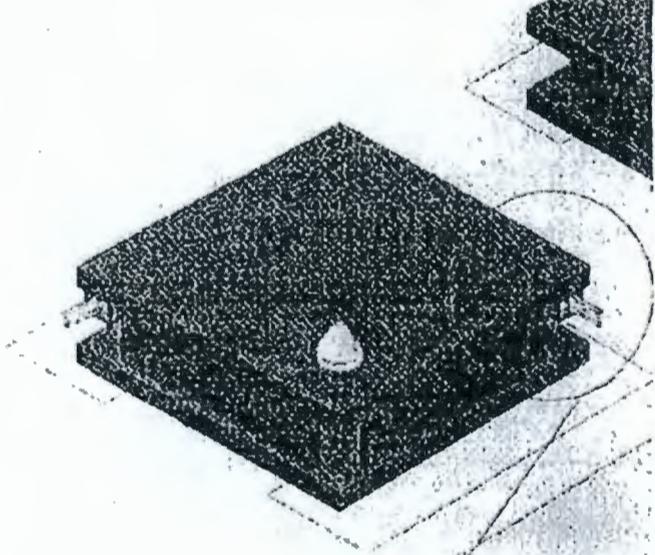
# Equipment Pad and Sole Plates (E-1 P)



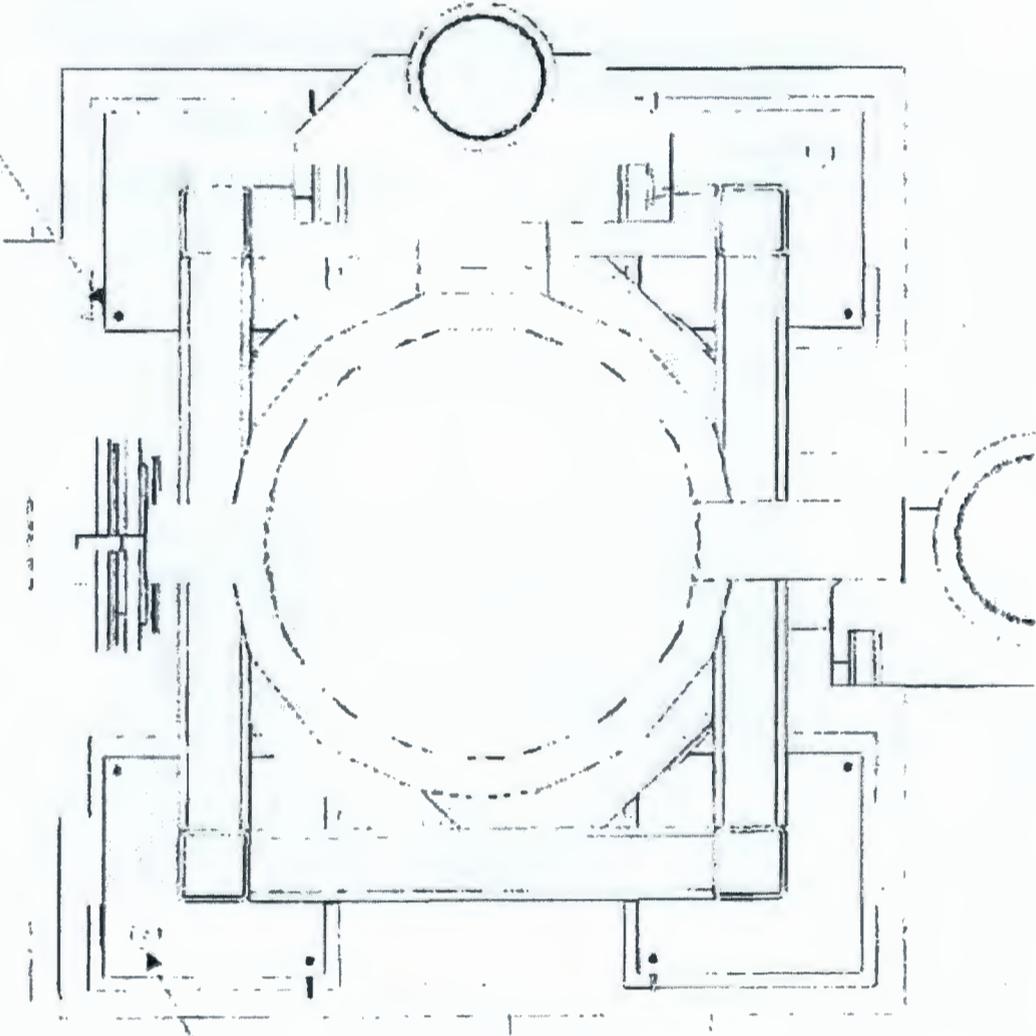
# Sole Plates (FEP)

Stud location as required.  
Must be accessible with  
impact wrench

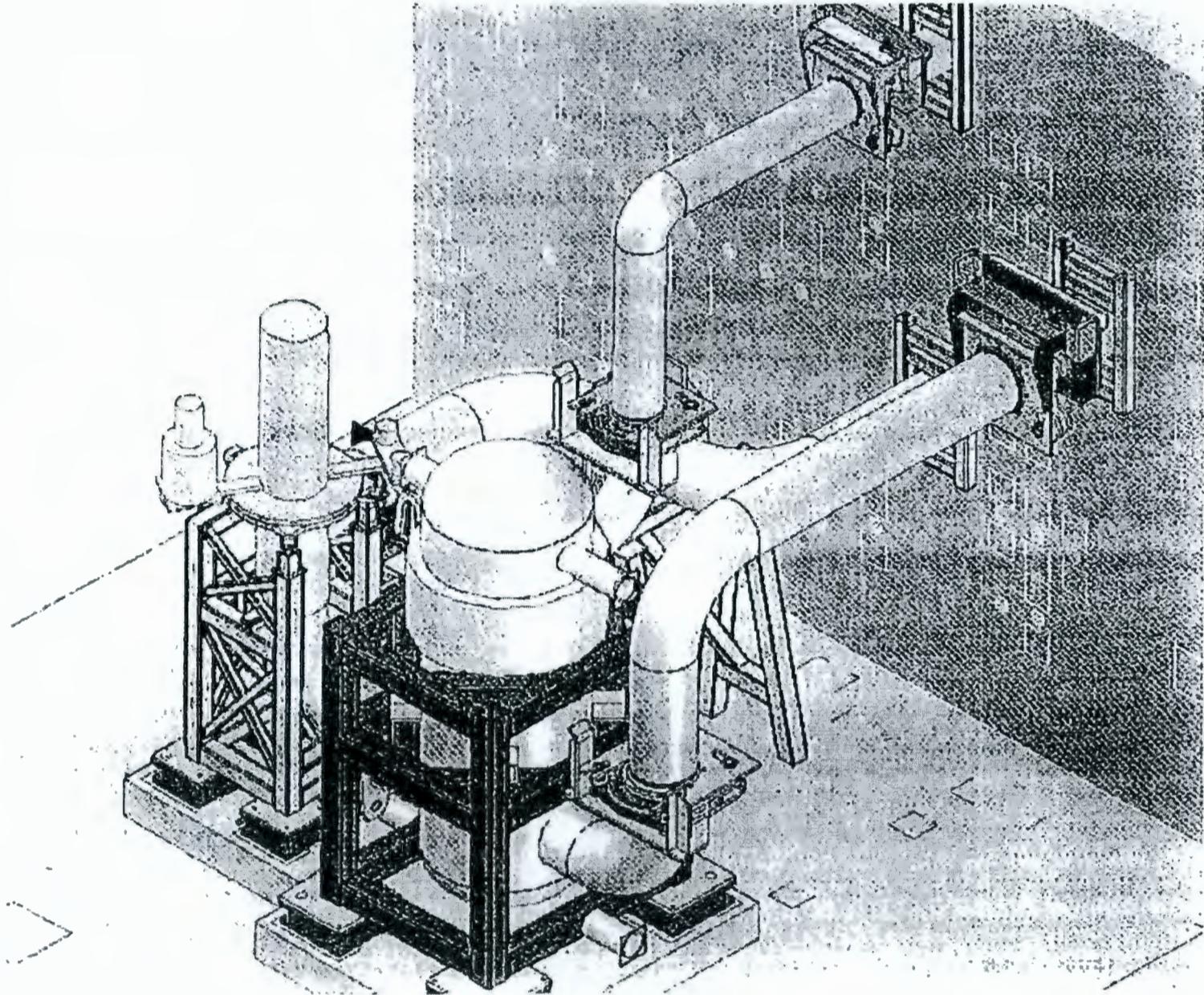
Example Sole Plate



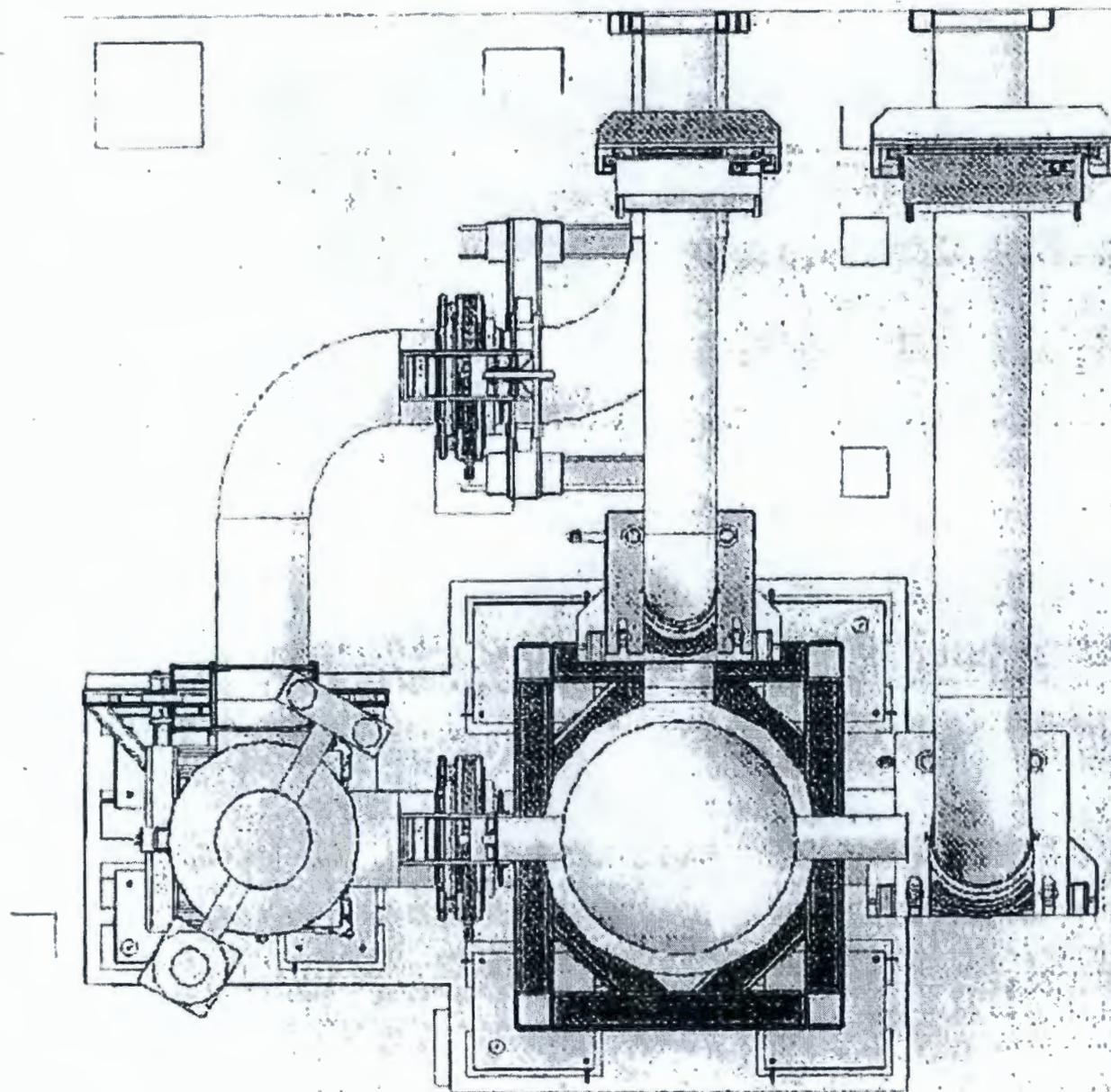
Captured Nuts must be  
accessible with the  
Power Manipulator



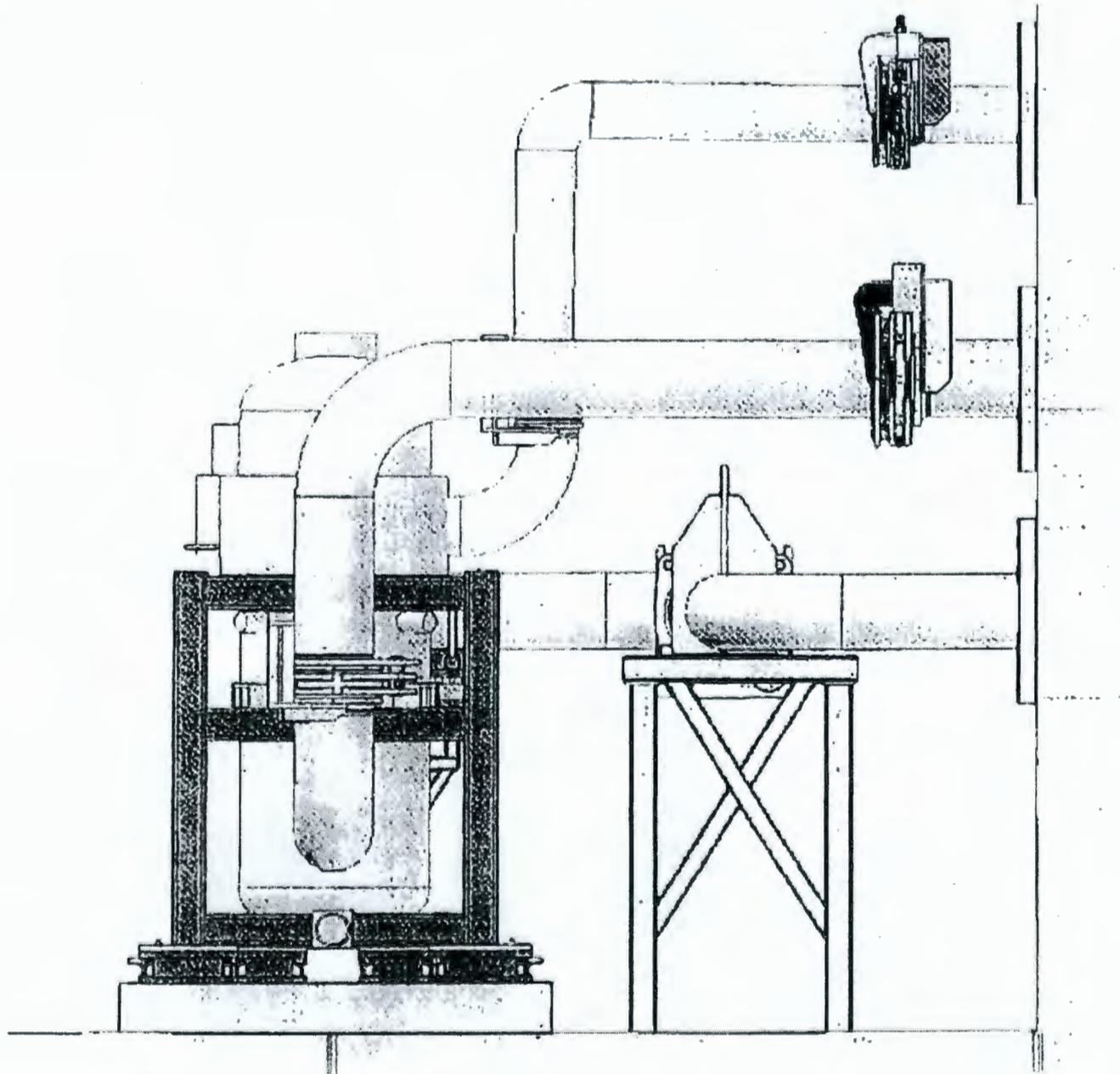
Dowel Pin Type

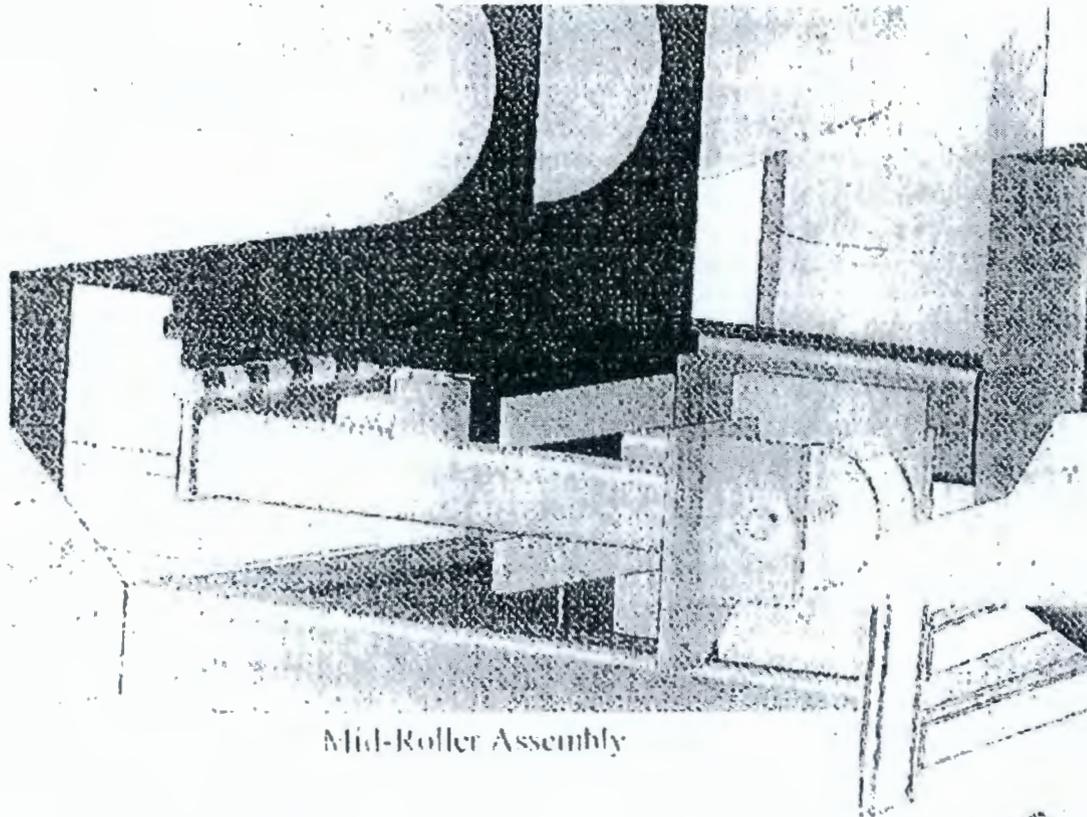


FEP

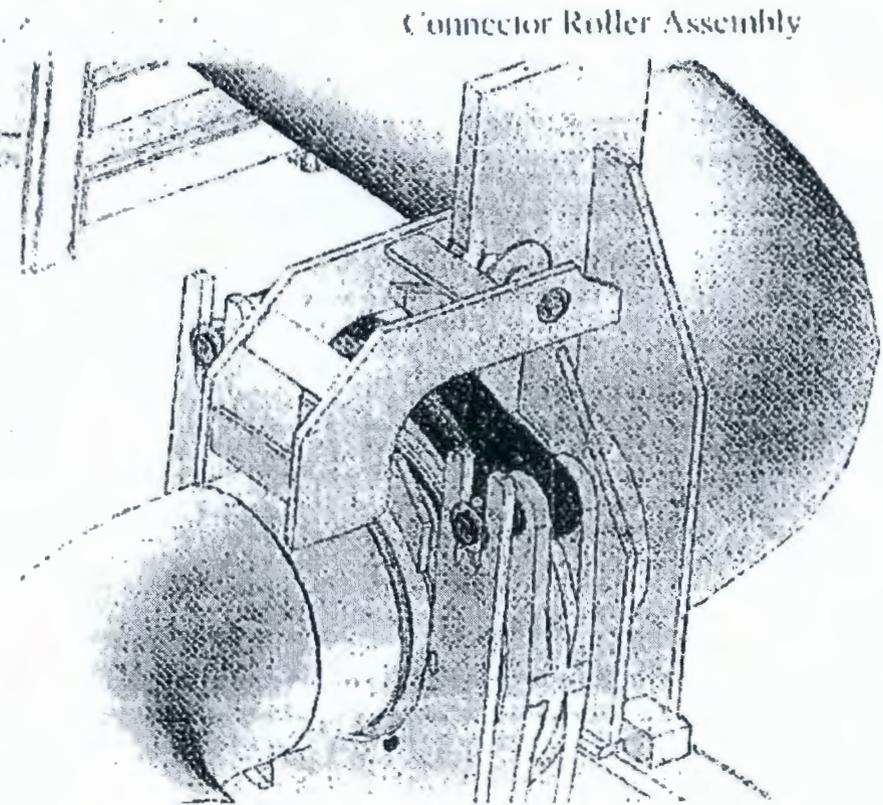


FEP





Mid-Roller Assembly



Connector Roller Assembly

**ATTACHMENT #6**

**SC-I/SC-II Seismic Analysis Qualification and FEA Report Check List**

## SC-I/II Seismic Analysis Qualification and FEA Report Check List

Required Data	Source Reference	Applicable Section of Seismic Qualification Report
<b>1. Identification and Description of Equipment</b>		
1.1 Equipment Tag Number or other identification that uniquely defines the equipment	24590-WTP-3PS-SS90-T0001 §7.1.2(a)	
1.2 Identification of safety functions of the equipment that must be provided during and after a design basis earthquake (DBE)	24590-WTP-3PS-SS90-T0001 §7.1.2(d) 24590-WTP-3PS-MV00-T0002 §7.3.1 Equipment specification and/or data sheet	
1.3 Identification and description of the parts or features of the equipment that perform the safety functions and are therefore required to resist the DBE (this includes identification of Seismic Categories of relevant components or parts of the equipment)	Equipment specification and/or data sheet 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §1.4 (page 1-7) and §C.8 (page C-65)	
1.4 Identification of basic material properties, key dimensions, and physical configuration of the equipment, including reference to design drawings/documents (including revision designation) that are used to control the design/configuration of the equipment	24590-WTP-3PS-SS90-T0001 §7.1.2(c)	
<b>2. Description of Analyses and Methodology</b>		
2.1 Reference to governing code(s) that specify ultimate or yield values (code allowable strength or stress levels)	Equipment specification and/or data sheet 24590-WTP-3PS-SS90-T0001 §7.1.2(e) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	
2.2 Identification of the code-defined strength or stress levels used in the analyses (the capacity of the equipment based on code ultimate or yield values)	24590-WTP-3PS-SS90-T0001 §7.1.2(e) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	
2.3 Definition of the seismic loads (earthquake loadings) used in the analysis (e.g., in-structure response spectra)	24590-WTP-3PS-SS90-T0001 §7.1.2(e) DOE-STD-1020-94 §1.4 (page 1-7), §2.2 (page 2-4), §C.8 (page C-65) 24590-WTP-3PS-MV00-T0002 §2.2.4	
2.4 Identification of equipment aging processes (e.g., corrosion, erosion, radiation, vibration/thermal fatigue, etc.), documentation or reference to documentation of these affects on material properties over the design life of the equipment, and evidence that the equipment will continue to provide its safety functions during and after a DBE at the end of design life	Equipment specification and/or data sheet 24590-WTP-3PS-SS90-T0001 §2.3 IEEE Std 344	

## SC-I/II Seismic Analysis Qualification and FEA Report Check List

Required Data	Source Reference	Applicable Section of Seismic Qualification Report
2.5 If an equivalent static analysis model is used in lieu of dynamic analyses, include justification of the adequacy of this approach (e.g., evidence that the structural features of the equipment are relatively simple, symmetric, and have essentially uniform distribution of mass and stiffness)	24590-WTP-3PS-SS90-T0001 §6.1.2 and §7.1.2(g) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.2, page 2-4	
2.6 Description of how the analysis considers 3 orthogonal components of earthquake ground motion (two horizontal and one vertical), and how the responses from the various direction components are combined in accordance with American Society of Civil Engineers (ASCE) Standard 4.	24590-WTP-3PS-SS90-T0001 §6.1.3 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	
2.7 Identification of the damping values used in the analyses (e.g., damping values of 2 for massive low-stressed equipment with 0.5 for sloshing modes in liquid-containing metal tanks, or 3 for electrical cabinets and other equipment)	24590-WTP-3PS-SS90-T0001 §6.1.1(b) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.3 (page 2-15)	
2.8 Evidence that connecting structural supports and piping (and the associated dynamic coupling effects) are properly represented in the analytical model	Equipment specification and/or data sheet 24590-WTP-3PS-SS90-T0001 §6.2.3 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §C.6.1, Items 2 & 3 (page C-58)	
2.9 Identification of the best estimate of all non-seismic demands expected to occur concurrently with a DBE (in a comparable format to the code allowable values)	Equipment specification and/or data sheet 24590-WTP-3PS-SS90-T0001 §4 and §5 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	
<b>3. Results/Conclusions</b>		
3.1 Identification of the important natural frequencies of the equipment (or the peak of the design response spectrum must be used)	24590-WTP-3PS-SS90-T0001 §6.1.1(a) and §6.1.2(a) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.2 (page 2-4)	done
3.2 Identification of the computed elastic seismic response of the equipment (in a comparable format to the code allowable values)	24590-WTP-3PS-SS90-T0001 §7.1.2(g) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	

## SC-I/II Seismic Analysis Qualification and FEA Report Check List

Required Data	Source Reference	Applicable Section of Seismic Qualification Report
3.3 Description of how the analyses address the distribution of resulting seismic-induced inertial forces and evaluation of the load path(s)	24590-WTP-3PS-SS90-T0001 §7.1.2(g) 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.2 (page 2-4)	
3.4 Description of method used to combine seismic and non-seismic loads (using code-defined load factors) and to compare the result with code-defined strength or stress levels to confirm the design is adequate	Equipment specification and/or data sheet 24590-WTP-3PS-SS90-T0001 §5 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.3.2 (page 2-12)	
3.5 Identification of relative seismic anchor motion (SAM) between equipment and interconnected piping	24590-WTP-3PS-SS90-T0001 §7.4 24590-WTP-3PS-MV00-T0002 §2.2.4 DOE-STD-1020-94 §2.2 (page 2-6) and §2.4.1 (page 2-19)	
3.6 Identification of reaction loads on connecting structural supports and piping (individual loads as well as load combinations)	24590-WTP-3PS-SS90-T0001 §7.2	
<b>4 Quality Assurance</b>		
4.1 Signature of responsible engineer who performed the calculation	24590-WTP-3PS-MV00-T0002 §2.2.4 NQA-1-1989 DOE-STD-1020-94 §1.4 (page 1-7) and §C.8 (page C-65)	
4.2 Signature of engineer(s) who checked the calculation for numerical accuracy, and theory and assumptions	24590-WTP-3PS-MV00-T0002 §2.2.4 NQA-1-1989 Supplement 3S-1 DOE-STD-1020-94 §1.4 (page 1-7) and §C.8 (page C-65)	
4.3 Description of theory (analytical method) and assumptions used in the seismic analyses	NQA-1-1989 Supplement 3S-1 24590-WTP-3PS-SS90-T0001 §7.1.2(g)	
4.4 Description of computer program(s) used in the analyses, including model(s) used, input values, and output results calculated by the computer program	24590-WTP-3PS-SS90-T0001 §7.1.2(g) 24590-WTP-3PS-MV00-T0002 §2.2.4 NQA-1-1989 Supplement 3S-1 DOE-STD-1020-94 §C.8 (page C-65)	
4.5 Printout of output of computer analyses, including signature of responsible engineer who performed the computer analyses on first page of output	24590-WTP-3PS-MV00-T0002 §2.2.4 NQA-1-1989 Supplement 3S-1 DOE-STD-1020-94 §C.8 (page C-65)	

## SC-I/II Seismic Analysis Qualification and FEA Report Check List

Required Data	Source Reference	Applicable Section of Seismic Qualification Report
4.6 Documentation or reference to documentation of verification of computer program accuracy	24590-WTP-3PS-SS90-T0001 §7.1.2(g) 24590-WTP-3PS-MV00-T0002 §2.2.4 NQA-1-1989 Supplement 3S-1 DOE-STD-1020-94 §C.8 (page C-65)	

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## Monday

PO w/ envs

Tank

Grapes, apricots, salads

Advantix, Front Line

Schedule stove cleaning

Omega 3, Brain Lightning, arginine

▶ 5:50 Sun

▶ 7:30 Wholly Brass

Replace contacts?

## Tuesday

▶ 5:00 Rob—fitness center

▶ 7:00 MD class

## Wednesday

▶ 5:00 HC

▶ Hot pack

Middle F on piano

▶ Scuba book study

Listen to C2L5—send to K

Water > fixing leaks

## Thursday

Dry suit bag, Ester-C

▶ 6:30 SOM

## Friday

▶ Update CPL

Paint door

▶ Seattle w/ journal, sweats, etc.

## Saturday

▶ Seattle

## Monday

▶ 4:45 Julie

## Other

- Dave Stafford 947.5628—fender, gas cap & tank

- Left saddle bag, ignition (miss/backfire/stall), leaking SOV, fender, tire

- Accessory harness

- Anti-fog/cleaner

Patch Perfect

Copy CD

Intuition/Kundalini—Om

Govt. grant for RW; Chinese equipment

Paint garage; floor

▶ Sheepskin/thick mat & small blanket

▶ Alt. dive dates 10/18-19 or 10/25-26

Scorbate

- Am Yellow Saffron tea—Baar

- Next river dive?

[WhiteTantricYoga.com](http://WhiteTantricYoga.com)

Budget

Fix tree

Recon accts

Red rocks, Weed B Gon

Turn on phish filter

You Tube, Google: Anulom-Vilom,

Kapalbhati, Ujjani

[AssurantHealth.com](http://AssurantHealth.com)

Brown's Gas

C Centerpointe

Car purifier

Cayce: Revelations, Kundalini

Deut. 30 Ex. 19:6

Fix house air purifier

Fortune City web hosting

Isha—*Why Walk When You Can Fly?*

[isha.com](http://isha.com)

Jung—*Man & His Symbols*

Lao Tzu's Tao essay on love translated by

Dwight Goddard

[Lifelock.com](http://Lifelock.com) Code: Free month

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-016

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Update PTF Plant Item Material Selection Data Sheet for the Spent Resin Slurry Vessel (RDP-VSL-00002  
A/B/C) in Appendix 8.9 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein      8/11/08  
D. A. Klein      Date

S. J. Olinger      8/28/08  
S. J. Olinger      Date

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-016

### Hanford Facility RCRA Permit Modification Notification Form

Unit:

**Waste Treatment and Immobilization Plant**

Permit Part &amp; Chapter:

**Part III, Operating Unit 10**Description of Modification:

The purpose of this Class 1 modification is to update 24590-PTF-N1D-RDP-P0001, *Plant Item Material Selection Data Sheet for the Pretreatment Spent Resin Slurry Vessel (RDP-VSL-00002 A/B/C)*.

The following corrosion evaluation is being submitted to replace the data sheet currently in Appendix 8.9.

## Appendix 8.9

Replace:	24590-PTF-N1D-RDP-P0001, Rev. 2	With:	24590-PTF-N1D-RDP-00001, Rev. 6
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This modification requests Ecology approval and incorporation into the permit the specific changes to this specification that are identified by revision bars shown on the specification that have been issued since the last revision of the specification. Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design) and incorporates general criteria from a design verification review. The following identifies the significant changes that have been revised on the attached specification.

- Global: specifies "type" of stainless steel approved
- Increases design temperature (from 138°F to 148°F max), adds associated item RDP-PMP-00008A/B
- Modifies corrosion considerations as follows:
  - Normal operating temperature range is modified (from 100°F - 113°F to 50°F - 123°F)
  - Adds CCN 170127 as a reference
- Adds the Contract Max Leach/No Leach specification for Nitrate (6.00E-00 g/L) and deletes the Non-Routine Leach/No-Leach specifications (Sheet 6 of 7). Indicates document number CCN 163061 for the source of these values
- Includes a complete revision of Corrosion Evaluation excerpt from 24590-WTP-RPT-PR-04-0001, the source of excerpt 4.10.1 *Spent Resin Slurry Vessel (RDP-VSL-00002 A/B/C)* (Sheet 7 of 7)

The following is a list of outstanding change documents that have not been incorporated into this modification:

- None to date

Quarter Ending September 30,  
2008

24590-PTF-PCN-ENV-08-016

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3
Please mark the Modification Class:	X			
Enter Relevant WAC 173-303-830, Appendix I Modification citation number: N/A				
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: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
Reason for denial:		 9/9/08 B. Becker-Khaleel Date		

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

**CORROSION EVALUATION**

ISSUED BY  
RPP/WTP PDC



**RDP-VSL-00002A/B/C (PTF)**

**Spent Resin Slurry Vessels**

- Design Temperature (°F)(Max/min): 148/30
- Design Pressure (psig) (Max/min): 15/FV
- Location: Incell
- PJM Discharge Velocity (fps): 40
- Drive Cycle: 17 % (at 40 fps)

**Associated Items**

- RDP-PJM-00001 - RDP-PJM-00012
- RDP-PMP-00008A/B

**Contents of this document are Dangerous Waste Permit affecting**

**Operating conditions are as stated on attached Process Corrosion Data Sheets**

**Options Considered:**

- Normal operations include receipt, storage and transfer of spent IX media
- Slurry received contains approximately 20 volume% solids (not considered normal operating condition)
- Off-normal conditions include the receipt of fresh resin overflow from system CRP and the receipt of un-eluted or off-spec Cs resin to be returned for further elution

**Materials Considered:**

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
Type 304L (S30403)	1.00		X
Type 316L (S31603)	1.18	X	
6% Mo (N08367/N08926)	7.64	X	
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1	X	

**Recommended Material: Type 316 (max 0.030% C; dual certified)**

**Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance; localized protection will be provided as necessary as discussed in section j)**

**Process & Operations Limitations:**

- Develop flushing/rinsing procedure

Concurrence JR for KW  
Operations

6	7/30/08	Incorporate revised PCDS Update design temperature	<i>Adler</i>	<i>JR Divine</i>	<i>RBD</i> RBDavis	<i>SWVail</i> SWVail
REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER

## CORROSION EVALUATION

## REVISION HISTORY

5	1/6/05	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	RBDavis	SWVail
4	1/24/05	Update PJM and erosion info based on 24590-WTP-MOE-50-00003	DLAdler	JRDivine	NA	SWVail for APRangus
3	5/17/04	Addition of information regarding inadvertent nitric acid addition Append updated PCDS	DLAdler	APRangus	NA	SWVail
2	5/12/04	Revised to incorporate new PCDS	DLAdler	JRDivine	NA	APRangus
1	4/26/04	Update design temp/pressure Include assoc. items Add PJM information Delete reference to system TRP and Tc resin Revise erosion section Re-format references Add DWP note Append updated MSDS	DLAdler	JRDivine	NA	APRangus
0	6/2/02	Initial Issue	DLAdler	JRDivine	SS	SMKirk
<b>REV</b>	<b>DATE</b>	<b>REASON FOR REVISION</b>	<b>PREPARE R</b>	<b>CHECKER</b>	<b>MET</b>	<b>APPROVER</b>

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.

This bound document contains a total of 7 sheets.

## CORROSION EVALUATION

### Corrosion Considerations:

RDP-VSL-00002A/B/C collect and transfer spent resin. These vessels receive both transport liquid and spent resin slurry streams. Normally the vessels operate between 50 and 123 °F.

#### a General Corrosion

Hanner (1981) lists a corrosion rate for 304 (and type 304L) in 2 M HNO<sub>3</sub> of less than 2 mpy. Davis (1994) states the corrosion rate for type 304L in 12% HNO<sub>3</sub> will be less than about 1 mpy up to about 212°F.

In this system, the conditions are such that type 304L stainless steel will be acceptable.

#### Conclusion:

Under normal conditions either type 304L or type 316L will be satisfactory.

#### b Pitting Corrosion

While chloride is known to cause pitting in acid and neutral solutions, with no chloride present in reportable concentrations, both type 304L and type 316L stainless steel are acceptable.

#### Conclusion:

The use of type 304L or type 316L is acceptable.

#### c End Grain Corrosion

End grain corrosion only occurs in metal with exposed end grains and in highly oxidizing acid conditions.

#### Conclusion:

Not expected in this system.

#### d Stress Corrosion Cracking

The exact amount of chloride required to cause stress corrosion cracking is unknown. In part this is because the amount varies with temperature, metal sensitization, and the environment. But it is also unknown because chloride tends to concentrate under heat transfer conditions, by evaporation, and electrochemically during a corrosion process. Hence, even as little as a few ppm can lead to cracking under some conditions. Generally, as seen in Sedriks (1996) and Davis (1987), chloride stress corrosion cracking does not usually occur below about 140°F. During the normal operations, either type 304L or type 316L is expected to be satisfactory.

#### Conclusion:

At the normal operating environment, either type 304L or type 316L is acceptable.

#### e Crevice Corrosion

Comments under Pitting are generally applicable here. However, the one additional factor is the presence of resin beads. These will form crevices at the wall that could initiate crevice corrosion.

#### Conclusion:

The presence of resin increases the probability of initiating crevice corrosion. The more resistant type 316L is recommended.

#### f Corrosion at Welds

Corrosion at welds is not considered a problem in the proposed environment.

#### Conclusion:

Weld corrosion is not considered a problem for this system.

#### g Microbiologically Induced Corrosion (MIC)

MIC is not considered a problem in this system.

#### Conclusion:

Not a concern.

#### h Fatigue/Corrosion Fatigue

Corrosion fatigue is not expected to be a concern. The pressures encountered are so low and the strength of the material is so comparatively high that corrosion fatigue is not a problem.

#### Conclusions

Not a concern.

#### i Vapor Phase Corrosion

Not expected in this system.

#### Conclusion:

Not considered to be a concern.

## CORROSION EVALUATION

### j Erosion

Based on past experiments by Smith & Elmore (1992), the solids are soft and erosion is not expected to be a concern for the vessel wall. Based on 24590-WTP-RPT-M-04-0008, a general erosion allowance of 0.016 inch is adequate for components with maximum solids content up to 27.3 wt%. Additional type 316L stainless steel should be provided as localized protection for the applicable portions of the bottom head to accommodate PJM discharge velocities of up to 12 m/s with normal maximum solids concentrations of 7.0 wt% and maximum solids concentrations of 53 wt% with a usage of 19 % operation as documented in 24590-WTP-MOC-50-00004. Vessels RDP-VSL-00002A/B/C require at least 0.060-inch additional protection. The 53 wt% is considered to be conservative. The fraction of time the solids concentration is expected to be at maximum is 10 %. During normal operation, 90 % of the time, the solids content of RDP-VSL-00002A/B/C is expected to be 7.0 wt%.

The wear of the PJM nozzles can occur from flow for both the discharge and reflow cycles of operation. At least 0.038-inch of additional type 316L stainless steel should be provided on the inner surface of the PJM nozzle to accommodate wear due to PJM discharge and suction velocities with normal solids concentrations of 7.0 wt% and a maximum solids concentrations of 53 wt% with a usage of 19 % operation as documented in 24590-WTP-MOC-50-00004.

#### Conclusion:

The recommended corrosion allowance provides sufficient protection for erosion of the vessel wall. Additional localized protection for the bottom head will accommodate PJM discharge velocities and for the PJM nozzles will accommodate PJM discharge and reflow velocities.

### k Galling of Moving Surfaces

Not applicable.

#### Conclusion:

Not applicable.

### l Fretting/Wear

No contacting surfaces expected.

#### Conclusion:

Not applicable.

### m Galvanic Corrosion

No dissimilar metals are present.

#### Conclusion:

Not applicable.

### n Cavitation

None expected.

#### Conclusion:

Not believed to be of concern.

### o Creep

The temperatures are too low to be a concern.

#### Conclusion:

Not applicable.

### p Inadvertent Nitric Acid Addition

Vessels normally operate at low pH.

#### Conclusion:

Not applicable.

## CORROSION EVALUATION

## References:

1. 24590-WTP-MOC-50-00004, *Wear Allowance for WTP Waste Slurry Systems*
2. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
3. 24590-WTP-RPT-FR-04-0001, Rev. C, *WTP Process Corrosion Data*
4. Davis, JR (Ed), 1987, *Corrosion, Vol 13*, In "Metals Handbook", ASM International, Metals Park, OH 44073
5. Davis, JR (Ed), 1994, *Stainless Steels*, In ASM Metals Handbook, ASM International, Metals Park, OH 44073
6. Hamner, NE, 1981, *Corrosion Data Survey, Metals Section*, 5th Ed, NACE International, Houston, TX 77218
7. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
8. Smith, H. D. and M. R. Elmore, 1992, *Corrosion Studies of Carbon Steel under Impinging Jets of Simulated Slurries of Neutralized Current Acid Waste (NCAW) and Neutralized Cladding Removal Waste (NCRW)*, PNL-7816, Pacific Northwest Laboratory, Richland, Washington.
9. Zapp, PE, 2000, *Material Corrosion and Plate-Out Test of Types 304L and 316L Stainless Steel*, WSRC-TR-2000-00434, Savannah River Site, Aiken, SC

## Bibliography:

1. CCN 130171, Ohi, PC to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Technical Bases for Cl- and pH Limits for Liquid Waste Tank Cars*, MA: PCO:90/01, January 16, 1990.
2. CCN 130172, Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
3. CCN 170127, Cook, S to J Julyk, "Red Lined Data Sheets for the Equipment & In-Line Components for the RDP in the PT Facility", 30 January 2008.
4. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
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6. Koch, GH, 1995, *Localized Corrosion in Halides Other Than Chlorides*, MTL Pub No. 41, Materials Technology Institute of the Chemical Process Industries, Inc, St Louis, MO 63141
7. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
8. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

**CORROSION EVALUATION**

Attachment to CCN 163061  
Replaces Page A-45 of  
24590-WP-RPT-PR-04-0001, Rev C  
WTP Process Corrosion Data

**PROCESS CORROSION DATA SHEET**

Component(s) (Name/ID #) Spent resin slurry vessel (RDP-VSL-00002 A/B/C)  
Spent resin dewatering moisture separation vessel (RDP-VSL-00004)  
Facility PTF  
In Black Cell? Yes (RDP-VSL-00002A/B/C only)

Chemicals	Unit <sup>1</sup>	Contract Max <sup>2</sup>		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/L					
Chloride	g/L					
Fluoride	g/L					
Iron	g/L					
Nitrate	g/L	6.0E+00	6.0E+00			
Nitrite	g/L					
Phosphate	g/L					
Sulfate	g/L					
Mercury	g/L					
Carbonate	g/L					
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/L					
Other	g/L					
pH	N/A					Note 4
Temperature	°F					Note 3, Assumption 1

List of Organic Species:

References

System Description: 24590-PTF-3YD-RDP-00001  
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A  
Normal Input Stream #: CXP19, CXP18, RDP01  
Off Normal Input Stream # (e.g., overflow from other vessels): N/A  
P&ID: N/A  
PFD: 24590-PTF-M5-V17T-00020

Technical Reports:

Notes:

- Concentrations less than  $1 \times 10^{-4}$  g/L do not need to be reported, list concentration values to three significant digits max.
- Data developed from a mass balance model which has constituents in the plant feed which are important to corrosion, adjusted to contract maximum values.
- For RDP-VSL-00002ABC: 50 °F to 123 °F (24590-WTP-RPT-ENG-07-007, Rev 0)
- Minimum pH approximately 1

Assumptions:

- For RDP-VSL-00004: 123 °F maximum operating temperature based on maximum temperature in RDP-VSL-00002ABC, and given that there is no heating in the dewatering unit.

## CORROSION EVALUATION

24590-WTP-RPT-PR-04-0001, Rev. C  
WTP Process Corrosion Data

### 4.10.1 Spent Resin Slurry Vessel (RDP-VSL-00002 A/B/C)

#### Routine Operations

The spent resin slurry vessels (RDP-VSL-00002-A/B/C) are designed to collect and transfer a batch of spent resin every week. After commissioning, the time between spent resin batch transfers will be determined by operational experience.

The spent resin slurry vessels (RDP-VSL-00002-A/B/C) receive both liquid and slurry streams.

These vessels, with associated piping and controls, serve as both the source of transport liquid and the receipt vessels for spent resin slurry. Each vessel is designed to contain one full batch of IX resin plus the transport liquid associated with transferring the resin bed out of an IX column. The total batch volume required for removing the spent resin from an IX column is 7500 gallons per vessel (6900 gallons of transport fluid and 600 gallons of resin). During normal operation, the vessels will contain approximately 8 % vol/vol solids. The solids content is greater during the first few minutes of displacement when the incoming slurry line could be very high in solids, but the high solids content is gradually diluted to 8 % vol/vol solids as the clear column sequence is completed and the full batch of transport fluid is transferred. Nozzles will be included as required for process feed streams, overflow lines, reagent addition, ventilation, and recycle return lines.

Each vessel contains pulse jet mixers which provide mixing of the vessel contents to suspend resin particles for slurry transport and representative sample collection.

#### Non-Routine Operations that Could Affect Corrosion or Erosion

None identified.

See Appendix A for process corrosion data sheet.

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-05-013

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Replace Permit Specification 24590-WTP-3PS-MWK0-TP001 (Engineering Specification for Activated  
Carbon Bed Adsorbers) in Appendix 7.7 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein                      6/18/08  
D. A. Klein                      Date

S. J. Olinger                      7/29/08  
S. J. Olinger                      Date

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-05-013

### Hanford Facility RCRA Permit Modification Notification Form

Unit:

**Waste Treatment and Immobilization Plant**

Permit Part & Chapter:

**Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 modification is to update 24590-WTP-3PS-MWK0-TP001, *Engineering Specification for Activated Carbon Bed Adsorbers*.

The following specification is being submitted to replace the specification currently in Appendix 7.7.

Appendix 7.7

Replace:	24590-WTP-3PS-MWK0-TP001, Rev. 0	With:	24590-WTP-3PS-MWK0-T0001, Rev. 3
----------	----------------------------------	-------	----------------------------------

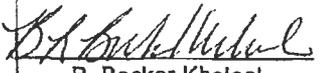
Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design) and incorporates general criteria from a design verification review. The following identifies the significant changes that have been revised on the attached specification.

- Revised LAW instrumentation requirements for remote mounting of analyzers and transmitters (Section 3.16.2.10).
- Reformatted Section 3.4, Performance.
- Revised Figures 1 and 2 to clarify instrumentation requirements.
- Changed CO and COx analyzers from supplier's scope to buyer's scope (Section 3.16.2).
- Added Figure 3, Hg Monitor Probe connection detail.
- Added Section 5.5, Coating, to add project coating specification.
- Deleted Section 2.2.7, WAC 296-24, General Safety and Health Standards.
- Added Section 2.2.9, 29 CFR 1910, Occupational Safety and Health Standards (OSHA), and added appropriate references to 29 CFR 1910 in other sections of specification.
- Added Reference Documents and Drawings 2.4.20 through 2.4.28.
- Revised Section 3.6, Environmental Conditions, to reflect Equipment Qualification data sheet information.
- Added Section 11, References.
- Added Appendices B and C to clarify testing requirements for carbon media.
- Revised various sections to reflect addition of Appendices D-J.
- Added Appendix D, WTP Specific Tailoring of ASME AG-1-1997.
- Added Appendix E, WTP Specific Tailoring of ASME B31.3-1996.
- Added Appendix F, WTP Specific Tailoring of AISC (ASD).
- Added Appendix G, WTP Specific Tailoring of ASME NQA-1-1989.
- Added Appendix H, WTP Specific Tailoring of IEEE Std. 384.
- Added Appendix I, WTP Specific Tailoring of IEEE Std. 323.
- Added Appendix J, WTP Specific Tailoring of IEEE Std. 344.

There are no outstanding change documents that have not been incorporated into this modification.

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-05-013

WAC 173-303-830 Modification Class: <sup>1 2</sup>	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.1. Administrative and informational changes.		
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
Reason for denial:				
		9/11/08 B. Becker-Khaleel                      Date		

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.



ISSUED BY  
RPP-WTP PDC

# RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT

## ENGINEERING SPECIFICATION

FOR

### Activated Carbon Bed Adsorbers

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.

Content applicable to ALARA?  Yes  No

ADR No.  
24590-WTP-ADR-M-04-0004

Rev  
0

Quality Level

Q

DOE Contract No.  
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPFM
3	4/8/08	R. Jablonski	C. Knauss	G. Goolsby	S. Woolfolk/ Todd Allen	G. Warner	M. Hoffmann
2	18-May-05	D. Pease	K. Chin	C. Morley	S. Woolfolk/ Todd Allen	G. Warner	M. Hoffmann
1	02-Nov-04	D. Pease	S. Ngakan	C. Morley	S. Woolfolk/ M. Medsker	G. Warner	M. Hoffman
0	06-Aug-04	D. Pease	S. Ngakan	C. Morley	B. Spezialetti	G. Warner	M. Hoffmann
SPECIFICATION No. 24590-WTP-3PS-MWK0-T0001							Rev 003

Revision History

Revision	Reason for Revision
0	Issued for Purchase of HLW adsorbers. LAW adsorbers are on hold pending approval of ABAR 24590-WTP-SE-ENS-03-1261 Rev 0.
1	Issued for Purchase based on DTD number 24590-LAW-DTD-ENS-04-0002, with LAW adsorber ITS equipment for carbon bed fire mitigation on hold. This includes: Isolation valves, high temperature switch and interlock, and COx monitor and interlocks.
2	Incorporated SCN number 24590-WTP-3PN-MWK0-00001 and SDDRs 24590-WTP-SDDR-PROC-04-01020, 24590-WTP-SDDR-PROC-04-01040, 24590-WTP-SDDR-PROC-05-00392, 24590-WTP-SDDR-PROC-05-00602, 24590-WTP-SDDR-PROC-05-00652, 24590-WTP-SDDR-PROC-05-00701, and 24590-WTP-SDDR-M-05-00018. Revised LAW instrumentation requirements for remote mounting of analyzers and transmitters. Revised Figures 1 and 2 to clarify instrumentation requirements. Added appendix B and C to clarify testing requirements for carbon media. LAW adsorber ITS equipment for carbon bed fire mitigation is still on hold. This includes: Isolation valves, high temperature switch and interlock, and COx monitors and interlocks.
3	Incorporated SCN 24590-WTP-3PN-MWK0-00002 and <del>SDDRs 24590-WTP-SDDR-M-06-00286, 24590-WTP-SDDR-M-06-00287,</del> and 24590-WTP-SDDR-MS-07-00051. Revised Appendix B and C testing requirements. Added WTP specific tailoring of codes (appendix D-J). Updated HLW ITS List. Updated Environmental Requirements based on EQ Room Data Sheets. Changed CO and COx analyzers from supplier's scope to buyer's. Added Hg Monitor Probe connection detail (Fig 3).

RS  
4/2/05

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# 1 Scope

## 1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (DOE) Hanford Site tank waste will be pretreated and immobilized into stable glass form via vitrification. The WTP Contractor will design, build, and startup the WTP pretreatment and vitrification facilities for the DOE 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 Richland, WA in the U.S.A. The WTP Facility will be constructed at the east end of the 200 East Area of the Hanford Site. The counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

This specification provides the requirements for the design, analysis, fabrication, project management, quality assurance, inspection, testing, qualification, and labeling of the Activated Carbon Bed Adsorbers, associated filters, gaskets, insulation, piping, fasteners, shims, and special tools for use in the High Level Waste (HLW) and Low Activity Waste (LAW) facilities. This specification also provides the requirements for the conception, demonstration, design, fabrication, quality assurance, inspection, testing, qualification, and supply of activated carbon, testing equipment, testing apparatus, testing materials, manuals, instructions, and procedures.

The scope of work for the Seller includes all work specifically defined in this specification. Work shall include, but is not limited to, the following:

- 1.2.1 Provide fully detailed designs, drawings, supporting calculations, supporting analysis, supporting models, procedures, and all labor, materials, fasteners, tooling, equipment, apparatus, instrumentation, shop drawings, and services necessary to manufacture, test, inspect, label, and package Activated Carbon Bed Adsorbers in accordance with this specification and the Mechanical Data Sheets in Section 2 of the purchasing documents.
- 1.2.2 Provide Buyer with a breakdown (by paragraph) of the following codes, industry standards, and referenced documents to be applied to each aspect of the Activated Carbon Bed Adsorbers detailed design, drawings, analysis, fabrication, quality assurance, inspection, testing, qualification, labeling, packaging, handling, and shipment for review prior to beginning detailed design:
  - ASME AG-1-1997, including WTP specific tailoring
  - ASME AG-1a-2000
  - ASME N509-1989
  - ASME B&PVC, Section VIII, Div 1

If an entire section or part of the above listed codes and standards applies, a breakdown by paragraph is not required. Only the part or section shall be listed.

- 1.2.3 Provide design calculation in accordance with this specification and applicable codes. Calculations shall include, but not be limited to:
- Code calculations
  - Seismic calculations
  - Support calculations (Include resultant reactions at support locations)
  - Calculations associated with lifting and erection of the vessel
  - Nozzle loads and movements per thermal and seismic calculations
  - Thermal and discontinuity stresses as applicable
  - Fatigue analysis as applicable for pressure vessels in fatigue services
- 1.2.4 Provide a three-dimensional (3-D) computational fluid dynamics (CFD) model and analysis of the Activated Carbon Bed Adsorbers. CFD model and analysis shall include necessary Buyer supplied inlet piping to model the velocity profile of the offgas air stream entering the adsorber.
- 1.2.5 Provide thermal calculations for the Activated Carbon Bed Adsorber units and support frames in accordance with the requirements of this specification and Mechanical Data Sheets (MDSs) in section 2 of the purchasing documents. Select insulation material (i.e. calcium silicate, mineral wool, etc.) to meet thermal requirements of this specification.
- 1.2.6 Provide an analysis of the Activated Carbon Bed Adsorber design to determine expected adsorber changeout frequency.
- 1.2.7 Delete.
- 1.2.8 Provide connecting piping and actuated on/off control valves to configure two (2) Activated Carbon Bed Adsorber units in a single offgas stream to be operated in either series or parallel with the ability to isolate one unit for maintenance and still operate. Activated Carbon Bed Adsorber units shall be configured for automatic (remote) operation from Buyer's integrated control network.
- 1.2.9 Provide internal water deluge fire suppression system to allow flooding of the Activated Carbon Beds. Fire detection shall include a combination of carbon monoxide (CO/CO<sub>x</sub>) monitors, temperature monitors, and isolation valves. CO/CO<sub>x</sub> monitors shall be interlocked to isolation valves. Process water for carbon bed flooding is a backup to bed isolation. Provide high liquid level interlocks operated from radar level indicators.
- 1.2.10 Provide fire detection and suppression system acceptance tests.
- 1.2.11 Provide control logic and I/O mapping for automatic configuration and fire suppression system.
- 1.2.12 In addition to the field testing requirements set forth in ASME AG-1, Section TA, and/or ASME N509, Section 9, conduct the following acceptance tests in the shop, on each Activated Carbon Bed Adsorber unit prior to shipment:
- Visual Inspection
  - Structural Capability Test
  - System Bypass Test

- Mechanical Test
  - Differential Pressure Test
  - Airflow Distribution Test
  - Electrical Air Heater Performance Test (per design)
- 1.2.13 Provide challenge gas and challenge gas injection and sampling ports/manifolds.
- 1.2.14 Provide detailed bag-in/bag-out procedure for removal and replacement of adsorbent and any other filter(s) required.
- 1.2.15 Provide all personnel, equipment, apparatus, labor, personal protection equipment (PPE), materials, glovebags, bags, HEPA filters, etc. to simulate field conditions, demonstrate, and videotape the bag-in/bag-out procedure using fully assembled Activated Carbon Bed Adsorber equipment in shop.
- 1.2.16 Provide material certified test reports, welding procedures, insulation installation procedures, testing procedures, testing results, quality assurance procedures, quality assurance inspection results, and all other procedures and documentation required per this specification.
- 1.2.17 Provide transportation, storage, and installation instructions for the Activated Carbon Bed Adsorber units per the Seller's recommendations and the requirements of this specification.
- 1.2.18 Package and prepare the Activated Carbon Bed Adsorber units for shipment to the WTP site. Packaging shall be sufficient to allow outdoor storage for a period of up to one year at the WTP site, without Buyer action except routine inspection. Environmental conditions for storage are found in section 3.6 of this specification.
- 1.2.19 Provide all equipment, instrumentation, labor, and materials to perform a shop lifting test, demonstrating that the lifting lugs or attachment points are adequate to support the Activated Carbon Bed Adsorber units without distortion. Lifting lugs or attachment points shall be placed such that the equipment remains essentially level during the lift without tilting or swaying. Seller shall provide shop test report on lifting points provided on the Activated Carbon Bed Adsorber equipment.
- 1.2.20 Provide Material Safety Data Sheets (MSDSs) for loaded Activated Carbon Bed Adsorber and all other materials used in the construction of the Activated Carbon Bed Adsorber units.
- 1.2.21 Provide operation and maintenance manuals, with sequence of operations, and recommended spare parts list.
- 1.2.22 Provide a set of special tools for each Activated Carbon Bed Adsorber required for operation, bag-in/bag-out, sampling, and maintenance.
- 1.2.23 Provide design for structural attachment to the Buyer's provided embeds.
- 1.2.24 Provide junction boxes to accommodate wiring to remote mounted Seller control panels as requirement for LAW Buyer supplied instrumentation racks. Seller shall provide wiring schedule, diagrams, and documentation to facilitate installation of wiring from equipment to remote control panels and LAW instrumentation racks.

### 1.3 Work by Others

Any item not specifically listed as being supplied by the Buyer shall be provided by the Seller. The Buyer shall supply the following:

- 1.3.1 Shipping to jobsite.
- 1.3.2 Unloading and storage of all materials and equipment at jobsite.
- 1.3.3 Activated Carbon Bed Adsorber installation labor at jobsite.
- 1.3.4 Foundation, embeds, and anchor bolts.
- 1.3.5 Electric power supply.
- 1.3.6 External wiring.
- 1.3.7 External connection to Buyer's instrumentation and controls.
- 1.3.8 Control system.
- 1.3.9 Piping external to the Activated Carbon Bed Adsorber unit package.
- 1.3.10 Pressure drop indicators for pressure drop piping connections.
- 1.3.11 Installation of insulation.
- 1.3.12 Instrument racks.

### 1.4 Acronyms

AGS	American Glovebox Society
AISC	American Institute of Steel Construction
ASD	Adjustable Speed Drive
ASME	American Society of Mechanical Engineers
ASTM	International Society for Testing and Materials
AWS	American Welding Society
CFD	Computational Fluid Dynamics
CFR	Code of Federal Regulations
3-D	Three-Dimensional
DF	Decontamination Factor
DOE	US Department of Energy

ESF	Engineered Safety Feature
ERDA	Energy Research and Development Administration
FMEA	Failure Mode and Effect Analysis
HEPA	High Efficiency Particulate Air
HCl	Hydrogen Chloride
HLW	High Level Waste
HF	Hydrogen Fluoride
HVAC	Heating, Ventilation, and Air-Conditioning
HOP	High Level Waste Secondary Offgas Treatment System
FFB	Foundation Field Bus
ICN	Integrated Control Network
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrument Service Air
ITS	Important to Safety
LAW	Low Activity Waste
LVP	Low Activity Waste Secondary Offgas System
MR	Material Requisition
MDS	Mechanical Data Sheet
MSDS	Material Safety Data Sheet
NDE	Nondestructive Evaluation/Examination
NRTL	Nationally Recognized Testing Laboratory
ORP	Office of River Protection
OSHA	Occupational Safety and Health Administration
P&ID	Piping and Instrumentation Diagram
PMI	Positive Material Identification
PPE	Personal Protection Equipment
ppm	Parts per million
psf	pounds per square foot (lb/ft <sup>2</sup> )
PSV	Pressure Safety Valve
QA	Quality Assurance
QAP	Quality Assurance Program
QL	Quality Level
SC	Seismic Category
scfm	Standard Cubic Feet per Minute

SDDR	Supplier Deviation Disposition Request
SS	Stainless Steel
TBD	To Be Determined
UL	Underwriters Laboratories, Inc.
VSL	Vitreous State Laboratory of The Catholic University of America
WAC	Washington Administrative Code
WTP	Hanford Tank Waste Treatment and Immobilization Plant

## 1.5 Definitions

*Activated Carbon Bed Adsorber Unit:* Refers to complete Carbon Bed equipment assembly. This includes two (2) full capacity Carbon Bed Adsorbers, connecting pipe work, valves, instrumentation, and support frame for Carbon Bed Adsorbers and piping.

*Activated Carbon Bed Adsorber expert:* One who has extensive knowledge regarding the characteristics and application of Activated Carbon Bed Adsorbers. Must have a minimum of five (5) years experience.

*Adsorbent Media:* A solid having the ability to concentrate and hold other substances.

*Adsorber:* A device or vessel containing adsorbent (e.g., an adsorber cell filled with adsorbent).

*Bag-in/Bag-out:* A method of introducing and removing items from a contaminated enclosure where a bag provides a physical barrier at all times during the operation that prevents the spread of contamination.

*Buyer's Representative(s):* The Buyer's designee(s), who shall witness onsite operations at the seller and sub-seller sites and perform onsite inspections and surveillance.

*Bypass, Leakage:* A pathway through which contaminated air can escape treatment by the installed HEPA and/or adsorber banks. Examples are leaks in filters and filter mounting frames, defective or inefficient isolation dampers that result in the uncontrolled flow through adjacent plenums, and unsealed penetrations for electrical conduits, pipes, floor drains, etc.

*Challenge Gas:* A gas of known characteristics, under specified conditions, used for the purpose of testing. For in-shop and in-place/field testing of adsorbers required by this specification. The challenge gas to be used shall depend on what is recommended by the Activated Carbon Bed Adsorber manufacturer. Challenge gas shall be an environmentally safe non-ozone depleting substance, if possible.

*Engineered Safety Feature (ESF):* A nuclear air treatment system, HVAC system, gas processing system, or a component that serves to control and limit the consequences of releases of energy and radioactivity.

*Glovebag:* A temporary barrier to contain or prevent the spread of contamination generally during system maintenance or production. The area or component is surrounded by the portable glovebox boundary material, usually a flexible plastic film. Personnel perform work inside the glovebag through glovesleeves and gloves while remaining outside the containment area. Other access ports are provided to allow for equipment and service penetrations as necessary. Additional openings can be provided through the use of zippers, velcro closures, and bag-out ports.

*HEPA Filter:* A high efficiency particulate air filter having a fibrous medium with a particle removal efficiency of at least 99.97 % when tested with essentially monodispersed 0.3  $\mu\text{m}$  test aerosol particles.

*Mounting Frame:* A structure against which adsorbers may be snugly mounted and supported in a position that permits the passage of air or gas and provides a surface to hold the sealing gasket, thereby avoiding a potential bypass or leakage path for the non-filtered air or gas.

*Paragraph:* When a paragraph of this specification, referenced documents, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced and all subparagraphs and sub-subparagraphs of the paragraph referenced shall be considered inclusive.

*Quality Level:* The quality level identifies the quality requirements to be applied to the equipment. The identified quality levels are Q and CM (Commercial). Quality requirements are specifically defined on the associated mechanical data sheets (MDSs) and supplier quality assurance program (QAP) requirements data sheets.

*Seismic Category:* Specific requirements for each seismic category are defined in reference documents listed in section 2.4 of this specification.

*Special Tools:* Any tooling required to perform maintenance on the Activated Carbon Bed Adsorber unit or for Activated Carbon Bed Adsorber and discharge filter removal and replacement. Includes tools that must be specially designed and fabricated and tools that are readily available in the commercial market.

## 1.6 Safety/Quality Classifications

- 1.6.1 Activated Carbon Bed Adsorber units for HLW shall meet the quality level requirements of Q as shown on the associated MDSs and supplier quality assurance program requirements data sheet. Seismic category shall be SC-III as shown on the associated MDSs and defined in reference documents listed in section 2.4 of this specification.
- 1.6.2 Activated Carbon Bed Adsorber units for LAW shall meet the quality level requirements of Q as shown on the associated MDSs and supplier quality assurance program requirements data sheet. Seismic category shall be SC-III as shown on the associated MDSs and defined in reference documents listed in section 2.4 of this specification.

## 2 Applicable Documents

### 2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. For the codes and standards listed in section 2, 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. If a date or revision is not identified, the latest issue, including addenda, at the time of quotation, shall apply. The effective dates and revisions listed in section 2 shall apply to subsequent references to the codes and standards within this specification. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing. The use of any other edition, revision, or issue requires buyer's approval.
- 2.1.3 Unless specified otherwise, requirements apply to both HLW and LAW design, fabrication, testing, storage, and handling.

### 2.2 Codes

- 2.2.1 ASME AG-1-1997, Code on Nuclear Air and Gas Treatment, Sections AA, FE, FF, and TA. See Appendix D for WTP specific tailoring.
- 2.2.2 ASME AG-1a-2000, Addenda to ASME AG-1-1997 Code on Nuclear Air and Gas Treatment, Section HA.
- 2.2.3 ASME B31.3-1996, Process Piping. See Appendix E for WTP specific tailoring.
- 2.2.4 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Rules for Construction of Pressure Vessels.
- 2.2.5 DOE-RL-92-36, Hanford Site Hoisting and Rigging Manual.
- 2.2.6 AWS D1.6, Structural Welding Code-Stainless Steel.
- 2.2.7 Delete.
- 2.2.8 AISC (ASD), 9th Edition, American Institute of Steel Construction. See Appendix F for WTP specific tailoring.
- 2.2.9 29 CFR 1910, Occupational Safety and Health Standards (OSHA).

### 2.3 Industry Standards

- 2.3.1 AGS-G001 ©1998, Guideline for Gloveboxes, Second Edition.
- 2.3.2 ASME N509-1989, Nuclear Power Plant Air-Cleaning Units and Components, Sections 1, 2, 3, 4 – (Paragraphs 4.3, 4.4, 4.6.1 through 4.6.7.2, 4.11, 4.12, 4.13(a)), 5 – (Paragraphs 5.5, 5.6.5.5 and 5.6.5.6), 7 – (Paragraph 7.2), 8 – (Paragraph 8.2), 9, Appendix C, and Appendix D.
- 2.3.3 ASME N510-1989, (Rev.1995), Testing of Nuclear Air Treatment Systems, Sections 1 through 8, 11, 13, 14, 15, and appendices.
- 2.3.4 ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities. See Appendix G for WTP specific tailoring.
- 2.3.5 ASME Y14.100, Engineering Drawing Practices.
- 2.3.6 ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- 2.3.7 ASTM F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- 2.3.8 ASTM F594, Standard Specification for Stainless Steel Nuts.
- 2.3.9 ERDA 76-21, Nuclear Air Cleaning Handbook, Chapter 1 (All), Chapter 2 (Paragraphs 2.1 through 2.4.16), Chapter 3 (Paragraphs 3.1, 3.4.1, 3.4.2, 3.4.5, 3.4.6), Chapter 4 (Paragraphs 4.3 through 4.3.5, 4.5.9), Chapter 7 (All), Chapter 8 (All), Chapter 9 (Paragraph 9.4.1).
- 2.3.10 NACE Standard RP0198, The Control of Corrosion Under Thermal Insulation and Fireproofing Materials-A. Systems Approach.
- 2.3.11 PIP INIH1000, Hot Insulation Installation Details.
- 2.3.12 RR-C-271D, Federal Specification for chains and attachments, welded and weldless.
- 2.3.13 NEMA 4, Enclosures for Electrical Equipment.
- 2.3.14 IEEE Std. 384, Standard Criteria for Independence of Class 1E Equipment and Circuits. See Appendix H for WTP specific tailoring.
- 2.3.15 IEEE Std. 323, Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations. See Appendix I for WTP specific tailoring.
- 2.3.16 IEEE Std. 344, Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations. See Appendix J for WTP specific tailoring.

### 2.4 Reference Documents/Drawings

- 2.4.1 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*

- 2.4.2 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI) for Shop Fabrication*
- 2.4.3 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*
- 2.4.4 24590-WTP-3PS-NWP0-T0001, *Engineering Specification for General Welding and NDE Requirements for Supplier Fabricated Piping*
- 2.4.5 24590-WTP-3PS-MVB2-T0001, *Engineering Specification for Welding of Pressure Vessels, Heat Exchangers and Boilers*
- 2.4.6 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*
- 2.4.7 24590-WTP-3PS-SS00-T0001, *Engineering Specification for Welding of Carbon Structural Steel*
- 2.4.8 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*
- 2.4.9 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*
- 2.4.10 24590-WTP-3PS-NN00-T0001, *Engineering Specification for Thermal Insulation for Mechanical Systems*
- 2.4.11 24590-WTP-3PS-JA03-T0001, *Engineering Specification for Gas Analyzers*
- 2.4.12 24590-WTP-3PB-P000-TS11V, *Piping Material Classification, Pipe Class S11V*
- 2.4.13 24590-WTP-3PB-P000-TS11N, *Piping Material Classification, Pipe Class S11N*
- 2.4.14 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves*
- 2.4.15 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*
- 2.4.16 24590-WTP-3PS-EKP0-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*
- 2.4.17 24590-WTP-3PS-MUMI-T0002, *Engineering Specification for Low Voltage Induction Motors*
- 2.4.18 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping*
- 2.4.19 24590-WTP-3PS-MV00-T0001, *Engineering Specification for Pressure Vessel Design and Fabrication*
- 2.4.20 24590-WTP-3PS-JQ06-T0005, *Environmental Qualification of Control and Electrical Systems and Components*

- 2.4.21 24590-WTP-J8-50-00001, *Controls and Instrumentation Radar Installation Wave Guide Spool Joining Details.*
- 2.4.22 24590-WTP-MV-M59T-00016002, *Vessel Connections Standard Details Sheet 2 of 3*
- 2.4.23 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*
- 2.4.24 24590-WTP-3PS-G000-T0015, *Engineering Specification for Environmental Qualification of Mechanical Equipment*
- 2.4.25 24590-WTP-3PS-G000-T0014, *Engineering Specification for Supplier Design Analyses*
- 2.4.26 24590-HLW-M6-HOP-00011, *P&ID - HLW Melter Offgas System Melter 1 Secondary Offgas Treatment Sheet 3 of 3.*
- 2.4.27 24590-HLW-M6-HOP-20011, *P&ID - HLW Melter Offgas System Melter 2 Secondary Offgas Treatment Sheet 3 of 3.*
- 2.4.28 24590-LAW-M6-LVP-00004, *P&ID - LAW Melters Secondary Offgas Vessel Vent Process System Mercury Mitigation Equipment.*

### 3 Design Requirements

#### 3.1 General Requirements

- 3.1.1 The Activated Carbon Bed Adsorbers and support frame shall be designed per this specification, the applicable documents listed in section 2 of this specification, and the MDSs in section 2 of the purchasing documents.
- 3.1.2 The detailed design of the Activated Carbon Bed Adsorbers shall be performed by personnel who have past experience in the design, fabrication, and testing of Activated Carbon Bed Adsorber banks or HEPA filter banks to meet the requirements set forth in ASME AG-1, ASME AG-1a, and NQA-1. Qualifications for personnel conducting the detailed design of the Activated Carbon Bed Adsorber shall be provided to the Buyer for review.
- 3.1.3 All calculations, modeling, analyses, drawings, and documentation shall be performed and/or completed using U.S. customary units.
- 3.1.4 The design of the Activated Carbon Bed Adsorber pressure boundary shall be per the requirements of ASME Boiler and Pressure Vessel Code, Section VIII, Div.1. (Code stamp is not required) Design pressure used shall be as specified on the MDSs. Design temperature shall be determined by Seller based on thermal analysis specified in section 3.13.5 for conditions generated during a carbon bed fire.
- 3.1.5 The design of the Activated Carbon Bed Adsorbers shall be per Seller and shall meet the performance requirements of this specification, appendices, and MDSs in section 2 of the purchasing documents.

- 3.1.6 Each Activated Carbon Bed Adsorber shall be equipped with a fire suppression system. Fire detection shall include a combination of CO monitors and carbon bed temperature monitors for fire detection. Refer to Figure 1 and 2 for additional information related to CO/COx monitors and temperature monitors specific to each HLW and LAW Activated Carbon Bed Adsorber. (For HLW, each fire detection system shall allow the isolation of one carbon bed upon detection of a fire, such that one Activated Carbon Bed Adsorber will not affect the fire detection capability in the other unit.) Refer to Figure 1 for HLW CO monitor and isolation valve configuration requirements. (For LAW, COx monitors shall be located on the inlet and outlet of the Activated Carbon Bed Adsorber unit.) LAW Activated Carbon Bed Adsorber shall only be isolated with pneumatic valves on the inlet as shown in Figure 2.
- 3.1.7 The Activated Carbon Bed Adsorbers shall be designed for carbon bed isolation as the primary means of fire suppression. Seller shall also design a water flood fire suppression system in accordance with applicable requirements of ASME AG-1, subarticle FE-4620, and MDSs in section 2 of the purchasing documents. Seller shall account for increased pressure inside the carbon bed vessel caused by activation of the fire suppression system and flooding of the carbon bed with water. (i.e. PSV valves with vent lines routed to offgas piping downstream of isolation.) Seller shall work closely with Buyer in determining required flow-rates for fire suppression water.
- 3.1.8 The Activated Carbon Bed Adsorber units and all permanently attached appurtenances (i.e. piping manifold, insulation, valves, and maintenance platforms) shall be designed to fit within the space envelope specified on the MDSs in section 2 of the purchasing documents.
- 3.1.9 Piping including supports shall be designed per the requirements of ASME B31.3 (Process Piping). Flanges used for connection to Buyer's piping shall be class 150 and meet the requirements of ASME B31.3.
- 3.1.10 The CFD model and analysis, thermal analysis, Activated Carbon Bed Adsorber analysis, and seismic analysis to be provided per this specification must verify that the final detailed design of the Activated Carbon Bed Adsorber and support frame meets the requirements set forth in this specification.
- 3.1.11 Each Activated Carbon Bed Adsorber Bed unit shall include all items listed or implied including, but not limited to, the following:
- Housing with inlet, outlet, support frame with anchorage provisions, platform supports, discharge filter receiver, piping connections and manifolds for testing and sampling, piping connections for pressure drop indication, insulation supports and hold-downs, lifting lugs, internal baffles, and mixing vanes (if mixing vanes required).
  - Fire suppression system, inlet and drain piping, shall be piped to equipment edge with flange.
  - Activated Carbon Bed Adsorbers, with pneumatic loading and gravity unloading of activated carbon.
  - Platform with grating and guardrails
- 3.1.12 All testing and sampling piping, connections, ports, and manifolds shall be permanently attached to the Activated Carbon Bed Adsorbers and easily accessible for shop and field testing. If required pipe length is not feasible within the space envelope or down stream of

carbon bed isolation valves, the Seller shall supply mixing vanes/diffusers to adequately mix test gases in accordance with applicable code requirements. Refer to Figures 1 and 2 for additional clarification on test port locations. The Seller shall work closely with the Buyer to determine best locations for testing and sampling piping, connections, ports, and manifolds.

- 3.1.13 The Activated Carbon Bed Adsorbers shall be designed for use with a bag-in/bag-out procedure to be developed by the Seller to facilitate adsorber removal and replacement operations. The Seller shall work closely with the Buyer on developing the bag-in/bag-out procedure.
- 3.1.14 The Activated Carbon Bed Adsorber shall be designed to attach insulation to the exterior of the pressure boundary. The design shall ensure the insulation is installed per the requirements of Buyer Specification 24590-WTP-3PS-NN00-T0001, *Thermal Insulation for Mechanical Systems* and section 4.3 of this specification.
- 3.1.15 Containment of melter offgas is an ITS function of the activated carbon bed adsorber units for both HLW and LAW. Design of the pressure boundary and support frame shall ensure containment of melter offgas during nominal, maximum, and design conditions. Pressure boundary must also be maintained during and post SC-III event. Refer to Tables 1 and 2 included in this specification for a detailed breakdown of ITS and Non-ITS equipment/components.

## 3.2 Basic Function

### 3.2.1 General

- 3.2.1.1 Each offgas stream consists of two (2) Activated Carbon Bed Adsorbers that can be operated in either series or parallel with the ability to isolate one unit for maintenance during operation. During normal operation, the Activated Carbon Bed Adsorbers will operate in a lead/lag series arrangement.
- 3.2.1.2 The Activated Carbon Bed Adsorber units are located downstream of HEPA filter banks operating with a minimum particulate removal efficiency of 99%.
- 3.2.1.3 Each Activated Carbon Bed Adsorber unit shall consist of a vessel, connecting piping, air actuated on/off control valves, adsorber bed(s), insulation, water fire suppression system, and a discharge filter.

### 3.2.2 HLW Activated Carbon Bed Adsorber

- 3.2.2.1 HLW Activated Carbon Bed Adsorbers shall be used to remove mercury (Hg) from the HLW melter secondary offgas HOP system.
- 3.2.2.2 Each Activated Carbon Bed Adsorber vessel shall be designed with a Seller specified activated carbon media and number of beds to meet performance criteria specified in section 3.4 of this specification and the MDSs in section 2 of the purchasing documents.

### 3.2.3 LAW Activated Carbon Bed Adsorber

- 3.2.3.1 LAW Activated Carbon Bed Adsorber shall be used to remove mercury (Hg), iodine (I<sub>2</sub>), HCl, and HF from the LAW melter secondary offgas LVP system.
- 3.2.3.2 Each Activated Carbon Bed Adsorber vessel shall be designed with a Seller specified activated carbon media and beds to meet performance criteria specified in section 3.4 of this specification and the MDSs in section 2 of the purchasing documents. The Seller may supply separate or mixed beds for acid gas removal.

### 3.3 Optional Electric Preheater

- 3.3.1 If determined necessary by Seller, to prevent condensate from forming in the activated carbon media during startup or after replacement, the Seller shall propose an electric preheater.
- 3.3.2 Electric preheater shall use an electric element and fan to preheat the carbon bed upon start-up or after media replacement.
- 3.3.3 The preheater shall be mounted on a 4 ft by 4 ft skid frame that must be located within the space envelope specified in the MDSs in section 2 of the purchasing documents.
- 3.3.4 Seller shall submit proposed control system and instrumentation for the preheater in accordance with Buyer specification 24590-WTP-3PS-JQ07-T0001 *Instrumentation for Package Systems*, and with the requirements of this specification.

### 3.4 Performance

#### 3.4.1 General

- 3.4.1.1 The Activated Carbon Bed Adsorber units shall be designed for a minimum service life of 40 years. Where specific components cannot meet the specified service requirement, they shall be identified, and a mechanism for their replacement and/or maintenance shall be incorporated into the design. Refer to section 10.1.12 of this specification for additional component design reliability requirements.
- 3.4.1.2 The Activated Carbon Bed Adsorbers shall be designed for a minimum adsorbent life expectancy as required by the MDSs when operating 8,760 hours per year.
- 3.4.1.3 As applicable to design, the root mean square of the velocities in a traverse shall be within  $\pm 20\%$  of the average velocity across the front face of the Activated Carbon Beds. If required, ports shall be provided on one foot intervals to confirm velocity distribution.
- 3.4.1.4 Instrumentation, valves, and related appurtenances shall meet the performance requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*.
- 3.4.1.5 Actuators for On/Off valves shall meet the performance requirements of Buyer specification 24590-WTP-3PS-JV15-T0001, *Actuators for On/Off Valves*.

### 3.4.2 HLW

- 3.4.2.1 Refer to MDSs in Section 2 of the purchasing documents for specified mercury decontamination factors (DF)/removal efficiencies and carbon media design life requirements.
- 3.4.2.2 Carbon media performance shall be affirmed by warranty testing specified in Appendix B of this specification.

### 3.4.3 LAW

- 3.4.3.1 Refer to MDS in Section 2 of the purchasing documents for specified mercury, iodine, HCl, and HF decontamination factors (DFs)/removal efficiencies and carbon media design life requirements.
- 3.4.3.2 Carbon media performance shall be affirmed by warranty testing specified in Appendix B of this specification.

## 3.5 Design Conditions

- 3.5.1 The Activated Carbon Bed Adsorber units shall be designed to meet design conditions specified in the MDSs in Section 2 of the purchasing documents.
- 3.5.2 The Activated Carbon Bed Adsorber units shall be considered non-ESF as defined in ASME AG-1, Article AA-1000.
- 3.5.3 The Activated Carbon Bed Adsorber units shall be designed to meet Level C service limits as defined in ASME AG-1, Paragraph AA-4214.

## 3.6 Environmental Conditions

- 3.6.1 The HLW Activated Carbon Bed Adsorber units will be installed indoors in an area maintained between 59 °F and 83 °F dry-bulb temperature during normal operation. The LAW Activated Carbon Bed Adsorber unit will be installed indoors in an area maintained between 59 °F and 95 °F dry-bulb temperature during normal operation. HLW and LAW Nominal radiation exposure is 10 mRad/hr. See Equipment Environmental Qualification data, located in the MDSs, for additional room environmental conditions.
- 3.6.2 Prior to installation, the Activated Carbon Bed Adsorber units may be stored outdoors at ambient temperature extremes ranging from (-)35 °F dry-bulb to 118 °F dry-bulb and a relative humidity of 0 to 100%.
- 3.6.3 Control and electrical equipment required to meet ITS functions of containment of melter offgas, bed isolation for fire suppression, and prevention of flooding of secondary offgas system on introduction of liquids (LAW only) shall be designed and fabricated to meet environmental qualifications in accordance with engineering specification 24590-WTP-3PS-IQ06-T0005, *Engineering Specification for Environmental Qualification of Control and*

*Electrical Systems and Components*, for a harsh environment. See Table 1 and 2 for list of ITS components.

- 3.6.4 *Control and electrical equipment shall be exposed to a maximum room temperature of 161 °F for LAW and 153 °F for HLW. See Equipment Environmental Qualification data, located in the MDSs, for additional room environmental conditions.*
- 3.6.5 Mechanical equipment/components required to meet ITS functions of containment of melter offgas, bed isolation for fire suppression, and prevention of flooding of secondary offgas system on introduction of liquids (LAW only) shall be designed and fabricated to meet environmental qualifications in accordance with engineering specification 24590-WTP-3PS-G000-T0015, *Engineering Specification for Environmental Qualification of Mechanical Equipment*, for a harsh environment. See Table 1 and 2 for list of ITS components.

### 3.7 Mechanical Requirements

#### 3.7.1 General

- 3.7.1.1 Sample ports shall be provided downstream of each bed for monitoring HCl and HF.
- 3.7.1.2 Each carbon bed shall be equipped with three (3) vertical and three (3) horizontal ports to obtain physical samples at three locations within the bed. The Seller shall provide special tools to physically retrieve samples. Seller may also propose the use of cylindrical media samples located external to the housing.
- 3.7.1.3 Valves and actuators shall meet the requirements of Buyer specification 24590-WTP-3PS-PV00-T0001, *Technical Supply Conditions for Valves*, and 24590-WTP-3PS-JV15-T0001, *Actuators for On/Off Valves*. Valve type, fail position, material, and flange requirements shall be as specified on the MDSs in section 2 of the purchasing documents. Refer to figures 1 and 2 for additional information.

#### 3.7.2 Loadings

- 3.7.2.1 Pneumatic loading shall lift activated carbon media to the fill chute. The carbon media shall be gravity loaded through the fill chute. If permissible in the equipment space envelope required on the MDSs, Seller may propose an alternative loading system using an integral jib crane to lift carbon media super sacks for bulk loading.
- 3.7.2.2 Pneumatic loading system shall be complete with hopper, piping, vacuum blower, mounting equipment, and air filters necessary to safely lift the activated carbon adsorbent media. If determined necessary by Seller, vibration equipment shall be designed and supplied for loading of the carbon media into the Activated Carbon Bed Adsorbers.
- 3.7.2.3 The loading equipment shall be transferable to other Activated Carbon Bed Adsorber units within that facility. Rate of loading shall be specified by the Seller to minimize possible damage or degradation of the Activated Carbon Media.

3.7.2.4 Transferable loading equipment may be located in maintenance aisle ways as shown in the MDSs in section 2 of the purchasing documents. Location shall be specified by the Seller. Seller shall work closely with the Buyer with respect to equipment size.

### 3.7.3 Unloading System

3.7.3.1 Spent carbon media shall be gravity unloaded directly into 55 gal drums for disposal. Seller shall allow for clearance of the 55 gal drum and bag-in/bag-out operations in accordance with applicable code requirements. If required to meet the space envelope specified in the MDSs, the Seller may propose the use an unloading system to elevate the carbon media into a 55 gal drum. Buyer prefers to use loading equipment for unloading.

3.7.3.2 If determined necessary by Seller, vibration equipment shall be designed and supplied for unloading of the carbon media.

3.7.3.3 Spent carbon is considered hazardous and potentially radioactive and must be contained during unloading through the use of a bag-out procedure as required in section 3.11 of this specification.

### 3.8 Discharge Filter Requirements

3.8.1 The discharge filters for the Activated Carbon Bed Adsorber units shall be rated for at least 300 °F with an efficiency of 99% at 5 microns and have a minimum capacity of two (2) times the design flowrate. Each discharge filter shall also be equipped with a differential pressure gage to measure pressure drop across the filter.

### 3.9 Lifting Requirements

3.9.1 Lifting lugs shall be installed on each Activated Carbon Bed Adsorber unit for balanced lifting and handling. Seller shall identify the weight and center of gravity of each unit and submit a report for Buyer review.

3.9.2 All lifting points shall be designed and tested in accordance with the requirements of Buyer specification 24590-WTP-3PS-G000-T0003, *Packaging, Handling, and Storage Requirements*. The allowable design stress shall equal the applicable code allowable design stress at ambient temperature.

3.9.3 The lifting lugs shall be designed to permit lifting of the Activated Carbon Bed Adsorber units without distortion or damage to the components or lifting lugs.

3.9.4 Lifting lugs shall be accessible without removal of covers and guardrails.

3.9.5 The lifting lugs must accept standard lifting equipment. Chain blocks or braiding shall not be permitted. If applicable, the lifting lugs shall be designed to accept Crosby shackles or equivalent meeting Federal Specification RR-C-271D.

3.9.6 Sampling and testing connections and ports shall not be used for lifting.

- 3.9.7 Seller shall provide any special designed equipment that is required to handle the component and is not available from a commercial source. Such equipment may include but is not limited to rigging devices such as spreader beams, structural lifting devices, strongbacks, and yokes. Rigging devices shall be designed, tested, and tagged in accordance with the applicable requirements of DOE-RL-92-36.
- 3.9.8 All lifting points on the Activated Carbon Bed Adsorber units shall be proof tested in shop. Test and examination certificates shall be provided to the Buyer for review.

### 3.10 Loadings

- 3.10.1 The Activated Carbon Bed Adsorber and support frames shall be self-supporting, capable of carrying the static loads of components, thermal expansion loads, seismic loads, full flood fire suppression water loads, and capable of handling the stresses imposed during shipment, installation, and operation.
- 3.10.2 Loads to be considered for the structural design of the Activated Carbon Bed Adsorbers and support frame shall be in accordance with applicable codes, standards, and reference documents listed in section 2 of this specification. As a minimum, loadings and stresses to be imposed shall meet Level C service limits as described in ASME AG-1, Paragraph AA-4214 and be in accordance with Buyer specification 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*.
- 3.10.3 Loads and stresses imposed for design of the vessel housings shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1.
- 3.10.4 Nozzle design shall consider seismic, thermal, and combination loads. Loads shall be in accordance with the requirements of the MDSs in section 2 of the purchasing documents.

### 3.11 Bag-in/Bag-out Procedure Requirements

- 3.11.1 Seller shall provide a detailed bag-in/bag-out procedure using a pneumatic loading system and gravity unloading of the Activated Carbon Bed Adsorber media and discharge filters using PPE, bags, a glovebag (if required), and special tools. Procedure shall assume carbon bed is isolated and not in operation. If unloading system is used, Seller's bag-out procedure shall include this additional equipment.
- 3.11.2 Bag-in/bag-out procedure shall note the necessary steps needed to safely bag-out media after a water deluge (i.e. additional drying of media, vibration, etc.).
- 3.11.3 Procedure shall include proposed means of activated carbon adsorbent media delivery (i.e. 40 lb bags, 55 gal drums, etc.).
- 3.11.4 Seller shall work with Buyer to determine PPE requirements to be included in the procedure for personnel conducting adsorbent and filter removal and replacement.
- 3.11.5 If a glovebag is required to perform the bag-in/ bag-out procedure, it shall conform to AGS-G001, and ERDA 76-21, Paragraph 2.2.1 and Chapter 7. Seller shall work with Buyer to determine whether or not a glovebag will be necessary.

- 3.11.6 Drawings of bags and glovebag (if glovebag is required) to be used shall be included in the bag-in/bag-out procedure. Drawings shall show configuration with dimensions and identify any equipment, filters, either/or apparatus to be an integral part of the bags and glovebag. Drawings shall also identify material, manufacturer, either/or model numbers of all bag and glovebag components.
- 3.11.7 The bag-in/bag-out procedure shall be written to ensure that confinement is not broken at any time.
- 3.11.8 Personnel shall not need to break the plane of the pressure boundary or discharge filter access openings at any time to perform the bag-in/bag-out procedure.

### 3.12 CFD Model and Analysis Requirements

- 3.12.1 The 3-D CFD model, required per section 1 of this specification, shall demonstrate the effects of internal structures and components on offgas flow distribution through the Activated Carbon Bed Adsorbers.
- 3.12.2 The 3-D CFD model shall include the following components of the Activated Carbon Bed Adsorber units:
- Housing including inlet (with transition fittings and necessary inlet piping to model turbulent flow entering the unit), outlet, inlet plenum, outlet plenum, discharge filter, manifolds for testing and sampling, and any required internal baffles, mixing vanes, and/or cross-venting holes.
  - Activated carbon bed(s).
- 3.12.3 The 3-D graphical results from the CFD model shall include:
- Analysis of changes to the Activated Carbon Bed Adsorber units to enhance offgas flow effectiveness.
  - Analysis of the effect of including additional baffles, mixing vanes, and/or cross-venting holes as required to study local offgas flow effects to achieve uniform offgas flow distribution through the adsorbers.
  - Analysis of changes to the Activated Carbon Bed Adsorber units to minimize the overall dimensions.
- 3.12.4 The 3-D graphical results from the CFD model shall demonstrate uniform offgas distribution through the adsorber beds at 75% of the design flowrate with  $\pm 10\%$  variation in flowrate.
- 3.12.5 Provide pressure drop to velocity relationship per adsorber bed(s) as part of the CFD analysis based on carbon media testing.
- 3.12.6 The Seller shall provide the documented results from the 3-D CFD analysis in report form to the Buyer. The CFD report shall provide a complete offgas flow analysis and shall include 3-D graphical results of the model and any calculations performed. The reports shall, at minimum, include:
- Definition of analysis objective
  - Identification of equipment for analysis

- General description of equipment supplemented by drawings and sketches
- Functional requirements per this specification
- Purpose of analysis
- Definition of design criteria and inputs with corresponding sources
- Results of literature searches and other applicable background data
- Applicable codes, standards, and reference documents per section 2 of this specification broken down by chapter, section, and paragraph, as applicable
- Analysis methodology
- Description of computer(s) used to conduct analysis
- Description of software/computer programs used for modeling and any calculations and limitations, justification for choice of program, and evidence and description of program validation method.
- Assumptions (indicate those that must be verified as the design proceeds)
- Analyses conducted with results
- Summary of analysis results
- Conclusions
- Location for Buyer review signatures

All assumptions shall be plainly identified and data present (including their uncertainty) with precise logic. Actual accomplishments of the work shall be clearly stated.

- 3.12.7 The final CFD report shall convey information to several disciplines, many of whom may be less familiar with the general subject than the authors. Care shall be taken to use simple statements and expressions and to make statements as concise as possible. If highly technical terms are necessary, they shall be adequately explained and defined.

### 3.13 Thermal Requirements

- 3.13.1 Refer to MDSs in section 2 of the purchasing documents for mechanical design data pertaining to thermal design information.
- 3.13.2 Thermal analyses shall include the effects of stresses resulting from potential variations in temperatures due to startup, normal operation, shutdowns, carbon bed fire, and thermal cycling of the Activated Carbon Bed Adsorber units. Analyses shall determine nozzle deflections in all directions per thermal expansion or other approved method. The calculations shall consider that the maintenance platforms shall be connected together with mechanical fasteners during normal operation.
- 3.13.3 Thermal analyses shall confirm the insulation temperature of Seller selected insulation and all exterior uninsulated portions of the Activated Carbon Bed Adsorber units with potential for personnel exposure, do not exceed 140 °F at maximum design temperature, in accordance with the requirements of Buyer specification 24590-WTP-3PS-NN00-T0001, *Thermal Insulation for Mechanical Systems*. Thermal calculations shall also confirm heat loss to the room is within the requirements of the MDSs. Refer to section 4.3 of this specification for addition insulation requirements.
- 3.13.4 The thermal analyses shall confirm the thickness and extent of insulation required on the bottom of the Activated Carbon Bed Adsorber units so that the average temperature of the

Buyer's concrete foundation directly under and within three feet of the skid boundary does not exceed 100 °F.

- 3.13.5 Seller shall perform a thermal analysis to determine and define the thermal conditions generated during a carbon bed fire. This analysis shall define the maximum and design temperatures for the carbon bed pressure boundary and isolation valves. Seller shall determine equilibrium design temperature for a carbon bed fire based on Seller specified CO/CO<sub>x</sub> analyzer set points and the carbon bed being isolated. This equilibrium design temperature shall be used in ASME Boiler and Pressure Vessel Code, Section VIII, Div.1 calculations for design of the Activated Carbon Bed Adsorber pressure boundary. If determined necessary, based on Seller operating procedures, operators shall have the option of activating the water deluge fire suppression system. Seller shall assume a minimum response time of one hour or any operator action. Design temperature determined by this thermal analysis shall confirm valve selection (valve material, seat material, leak tightness, etc.) for pressure boundary valves and process isolation valves.

### 3.14 Activated Carbon Bed Adsorber Design Analysis Requirements

- 3.14.1 The Seller shall conduct and submit separate Activated Carbon Bed Adsorber design analyses for LAW and HLW facilities. The design analysis of the Activated Carbon Bed Adsorber units shall be conducted by an Activated Carbon Bed Adsorber expert to determine the expected adsorbent changeout frequency for the final Activated Carbon Bed Adsorber design. Seller shall provide personnel qualifications to the Buyer for review prior to beginning adsorber design.
- 3.14.2 Analysis shall be conducted considering operation of the Activated Carbon Bed Adsorber units at design conditions outlined in this specification and MDSs.
- 3.14.3 Analysis shall determine expected adsorbent changeout frequency based on the gas composition and load information specified in the MDSs in Section 2 of the purchasing documents.
- 3.14.4 Assume that the offgas flow through the Activated Carbon Bed Adsorbers may vary as much as  $\pm 10\%$  from the design flowrate specified in the MDSs in section 2 of the purchasing documents.
- 3.14.5 Seller shall provide the documented results of the Activated Carbon Bed Adsorber analysis with any graphical results, as applicable, in report form to the Buyer prior to fabrication. Refer to section 3.12.6 and 3.12.7 for the minimum requirements of the report.
- 3.14.6 The final Activated Carbon Bed Adsorber design analysis report shall convey information to several disciplines, many of whom may be less familiar with the general subject than the authors. Care shall be taken to use simple statements and expressions and to make statements as concise as possible. If highly technical terms are necessary, they shall be adequately explained and defined.

### 3.15 Electrical Requirements

- 3.15.1 Electrical equipment necessary to meet the requirements of this specification and appendices shall be designed, fabricated, and tested in accordance with Buyer specification 24590-WTP-3PS-EKP0-T0001, *Electrical Requirements for Packaged Equipment*.
- 3.15.2 The Buyer will provide a single feed for each Activated Carbon Bed Adsorber unit. The Seller shall be responsible for determining electrical load and for the distribution of power within the Activated Carbon Bed Adsorber unit. The Seller shall provide a disconnect switch at the connection point for the Buyer's power feed for each Activated Carbon Bed Adsorber.
- 3.15.3 Delete
- 3.15.4 Motors shall operate continuously under running conditions at rated load and meet the requirements of Engineering Specification 24590-WTP-3PS-MUMI-T0002, *Low Voltage Induction Motors*.

### 3.16 Instrumentation and Control Requirements

#### 3.16.1 General

- 3.16.1.1 Instrumentation included in the Seller's scope of work shall meet the requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Refer to Figure 1 and 2 for general instrumentation layout and additional requirements for both HLW and LAW respectively. Buyer shall provide the appropriate ABB control system components (i.e. I/O modules, power supplies) to the Seller for fabrication into the Seller's control panel. Seller shall provide non-ABB manufactured equipment (fiber optic converters, fiber optic patch cables and plates, terminals, circuit breaker, wiring, etc.) and panel fabrication.

Seller shall design their control panel to utilize the ABB control system equipment and provide a General Arrangement drawing with a Bill of Materials identifying all parts to be provided by the Buyer. Seller shall provide I/O list for all instruments.

Seller shall provide control narrative, logic drawings, and related items as specified in 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Buyer shall provide programming according to Seller's specification of the monitoring and control requirements. Buyer shall provide controller, software, and attend and support the factory test of the equipment at the Seller's facility.

- 3.16.1.2 Analyzers and analyzer systems included in the Seller's scope of work shall meet the requirements of Buyer specification 24590-WTP-3PS-JA03-T0001, *Gas Analyzers*. Refer to Figure 1 and 2 for general analyzer layout and additional requirements. Seller shall work closely with the Buyer in establishing the performance criteria and location of the Hg analyzer(s). Enclosures for gas analyzers shall be NEMA 4. Analyzer cabinets shall be SC-III and designed in accordance with Buyer specification 24590-WTP-3PS-FB01-T0001, *Engineering specification for Structural Design Loads for Seismic Category III and IV Equipment and Tanks*.

### 3.16.2 Activated Carbon Bed Adsorber

3.16.2.1 The following instruments shall be included with the HLW Activated Carbon Bed Adsorber Units as a minimum, refer to section 1.6 of this specification for additional QA with subsequent testing requirements for these instruments:

- Inlet temperature elements, thermowell, and indicating transmitter on inlet to each Activated Carbon Bed.
- Inlet CO analyzer sample collection tap and return for Buyer supplied ITS CO analyzer.
- Differential pressure indicating transmitter on each Activated Carbon Bed Adsorber vessel.
- Carbon Bed temperature elements, thermowells, and indicating transmitter. (two for each guard media and two for each primary media).
- Radar level indicator for each Activated Carbon Bed Adsorber vessel.
- Differential pressure indicating transmitter on each discharge filter.
- Outlet CO analyzer sample collection tap and return for Buyer supplied ITS CO analyzer.
- Delete.
- Mercury monitor sample tap from each Activated Carbon Bed Adsorber with common return for Buyer supplied mercury analyzer. See Figure 3 for Mercury monitor sample tap requirements.

3.16.2.2 The following instruments shall be included with the LAW Activated Carbon Bed Adsorber Units as a minimum, refer to section 1.6 of this specification for additional QA with subsequent testing requirements for these instruments:

- Two (2) inlet temperature elements (ITS).
- Two (2) inlet COx analyzer sample collection taps and returns for Buyer supplied ITS COx analyzer.
- Differential pressure instrument on each Activated Carbon Bed Adsorber vessel (with ISA purges on each pressure leg).
- Carbon Bed temperature elements with thermowells and transmitters. (two for guard media, two for primary media).
- Two (2) radar level indicators for each Activated Carbon Bed Adsorber vessel (ITS).
- Differential pressure instrument on each discharge filter (with ISA purges on each pressure leg).
- One (1) outlet temperature elements.
- Two (2) outlet COx analyzer sample collection taps and returns for Buyer supplied ITS COx analyzer.
- Mercury monitor sample tap from each Activated Carbon Bed Adsorber with common return for Buyer supplied mercury analyzer. See Figure 3 for Mercury monitor sample tap requirements.
- HF/HCl monitor sample tap and return tap for Buyer supplied HF/HCl analyzer.

3.16.2.3 Deleted.

- 3.16.2.4 As listed in 3.16.2.1 and 3.16.2.2, each Activated Carbon Bed shall have at least four (4) temperature instruments and transmitters. Temperature elements shall be provided with thermowells that meet the inspection and testing requirements per the specified Q quality level and the requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Seller shall work closely with the Buyer in determining the location of the temperature instruments.
- 3.16.2.5 As listed in 3.16.2.1 and 3.16.2.2, each Activated Carbon Bed vessel shall have radar level indicator(s). Radar level indicators shall be Ohmart-Vega meeting Appendix B requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Seller proposed substitutions shall be well documented as to the relative technical advantages and exclude commercial considerations.
- 3.16.2.6 Seller shall provide control logic required to operate the Activated Carbon Bed Adsorber Units including the fire suppression system in accordance with the performance requirements of this specification and MDSs.
- 3.16.2.7 The Activated Carbon Bed Adsorber Units shall be designed with a single instrumentation tie-in point for connection to Buyer's Integrated Control Network (ICN) in accordance with the requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Design drawings shall show the location of instrumentation tie-in point. Instrumentation specified ITS shall have a separate tie-in point for connection to Buyer's Programmable Protection System (PPJ) in accordance with section 3.4.4 of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*, and the requirements of IEEE Std. 384.
- 3.16.2.8 The following instrumentation for LAW and HLW are specified ITS and shall have isolated hardwires to Buyer's programmable protection system (PPJ) in accordance with the requirements of section 3.4.4 of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems for ITS instrumentation*, and the requirements of IEEE Std. 384.
- Inlet temperature elements for LAW Activated Carbon Bed Adsorbers
  - Radar level indicators for LAW Activated Carbon Bed Adsorbers
  - Control and electrical components related to HLW and LAW Activated Carbon Bed Adsorber pneumatic isolation valves. (Instrument air supply shall have two solenoid valves in series, one solenoid valve is independently hardwired for connection to Buyer's PPJ, the second solenoid valve is wired to the Seller's control panel. All isolation valves are fail closed, refer to Figures 1 and 2 for additional information.)
  - Buyer supplied inlet and outlet CO analyzers for HLW. Buyer supplied inlet and outlet COx analyzers for LAW.
- 3.16.2.9 The following instrumentation shall meet the requirements of Buyer specification 24590-WTP-3PS-JQ06-T0005, *Environmental Qualification of Control and Electrical Systems and Components*.
- Inlet temperature elements for LAW Activated Carbon Bed Adsorbers
  - Radar level indicators for LAW Activated Carbon Bed Adsorbers

- Control and electrical components related to HLW and LAW Activated Carbon Bed Adsorber pneumatic isolation valves

3.16.2.10 LAW instrumentation shall be remote mounted in adjacent rooms. Seller shall design for remote mounting of the control system and related instrumentation. Instrumentation not mounted in Seller's control panel shall be mounted on Buyer procured instrument racks (i.e. transmitters, solenoid valves, etc.). Seller shall provide wiring schedule, junction boxes, tubing connections, connection diagrams, and documentation to facilitate installation of wiring from equipment to remote control panels and instrument racks. Instrumentation mounted on Buyer procured instrument racks shall be supplied with the necessary mounting brackets (universal). Installation of remote tubing and wiring is within Buyer's scope.

3.16.2.11 Delete.

### 3.16.3 Optional Preheater

3.16.3.1 Seller shall propose control system for electric pre-heater with over heat protection in accordance with section 3.3 of this specification.

3.16.3.2 Proposed control system shall be in accordance with the requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.

## 3.17 Accessibility and Maintenance

### 3.17.1 General

3.17.1.1 Accessibility and maintenance requirements shall be per this specification.

3.17.1.2 Seller's recommended accessibility and maintenance requirements for each piece of equipment shall be included in the Seller's applicable submittals.

3.17.1.3 Frequency of inspection and maintenance intervals shall be in accordance with Seller's recommendations.

3.17.1.4 All valves shall be accessible for maintenance and operation. Maintenance and replacement of valves shall be outlined in Seller's operation and maintenance procedures.

3.17.1.5 Seller shall design and supply any special tools required to perform maintenance activities and describe its use in applicable procedures.

3.17.1.6 If the equipment weight (i.e. valves, actuators, loading/unloading equipment, etc.) is in excess of 50 pounds the Seller shall design and supply jib cranes, lifting beams, or rigs in accordance with the requirements of DOE-RL-92-36.

### 3.17.2 Platform Requirements

3.17.2.1 Equipment, instrumentation, and electrical components that are 6 feet and over from ground level shall be provided with permanent work platforms with fixed ladders/stairs to perform maintenance.

- 3.17.2.2 The Activated Carbon Bed Adsorber unit maintenance platforms and ladders shall be designed to meet the requirements set forth in 29 CFR 1910, Occupational Safety and Health Standards (OSHA), Subpart D, Walking-Working Surfaces, and AISC 9<sup>th</sup> Edition.
- 3.17.2.3 The Activated Carbon Bed Adsorber unit maintenance platforms shall include guardrails. The guardrails shall be made out of piping.
- 3.17.2.4 The guardrails shall be designed per 29 CFR 1910.23.
- 3.17.2.5 The minimum live load for the column platforms shall be 100 psf. If platforms are to be used for laydown during maintenance, use a minimum live load of 250 psf.
- 3.17.2.6 The fixed ladder to be installed on the maintenance platforms shall meet the requirements set forth in 29 CFR 1910.27.
- 3.17.2.7 The maintenance platforms must be able to be attached to the Activated Carbon Bed Adsorber units without welding after the adsorbers are placed in the HLW and LAW facilities.
- 3.17.2.8 All openings in guardrails of each Activated Carbon Bed Adsorber unit maintenance platform shall have a safety gate or chain designed per the requirements of 29 CFR 1910.23.

## 4 Materials

### 4.1 General

- 4.1.1 Material used for the pressure boundary including control instrumentation shall comply with Buyer specification 24590-WTP-3PS-G000-T0002, *Positive Material Identification (PMI) for Shop Fabrication*. In accordance with the requirements of the PMI specification the Cr, Ni, Mo, content of the pressure boundary materials including weld consumables must be verified before and after fabrication.
- 4.1.2 Seller shall submit manufacturer cut sheets and MSDSs for all gaskets used for the pressure boundary. All gaskets, seal pads, caulks, and adhesives used must be certified for contact with austenitic stainless steel.
- 4.1.3 The Activated Carbon Bed Media shall have impurities less than 0.1 weight percent carbonate, oxide, or nitrate. Seller shall provide written certification that the amount of impurities in the carbon media is less than 0.1 weight percent carbonate, oxide, or nitrate.
- 4.1.4 Performance of the Activated Carbon Bed for removal of HCl, HF, and radioactive iodine ( $I^{129}$ ) associated with the LAW system is required, (an HCl, HF, and iodine guard bed is not required for the HLW offgas). The guard bed for HF, located upstream of the mercury removal bed, may contain adsorbent such as acid washed activated carbon or activated alumina. The activated alumina media is not required to be acid washed.
- 4.1.5 The Activated Carbon Bed Media shall meet applicable ASTM methods for particle size distribution.

## 4.2 Construction

- 4.2.1 Materials used in the construction of the Activated Carbon Bed Adsorber units shall conform to the requirements of ASME AG-1, Article AA-3000, ASME AG-1a, Article HA-3000, this specification, and the MDSs in section 2 of the purchasing documents. Material property and performance data for any materials not covered in ASME AG-1, ASME AG-1a or this specification shall be submitted to the Buyer for review prior to incorporation into the design of the Activated Carbon Bed Adsorber units. All materials in contact with the adsorber and process piping shall be 300 series stainless steel. Performance data shall indicate that material is acceptable for environmental and specific service conditions.
- 4.2.2 All materials used in the construction of the Activated Carbon Bed Adsorber units shall be resistant to radiation levels indicated in subsection 3.6 of this specification and be able to operate under environmental and design conditions described in ASME N509 (paragraph 4.4) and MDSs in section 2 of the purchasing documents.
- 4.2.3 Seller shall maintain a record of ASME or ASTM numbers, material test reports, and manufacturer material certifications for all materials used for construction of the Activated Carbon Bed Adsorber units. Seller shall provide copies to the Buyer.
- 4.2.4 All materials used in the manufacture of the Activated Carbon Bed Adsorber units, support frames, and shims shall be new and unused. Where specific criteria are not provided, material selection shall be determined by the Seller and have properties and composition suitable for the specific service conditions and consistent with this specification.
- 4.2.5 Dissimilar metal couples shall be avoided due to corrosion potential.
- 4.2.6 Activated Carbon Bed Adsorber housing material shall be in accordance with the requirement of the MDSs. Discharge filter covers shall be constructed of 316 L stainless steel.
- 4.2.7 The Activated Carbon Bed Adsorber support frames, pipe supports, and maintenance platforms shall be made of Carbon Steel. Special attention shall be placed on securing the stainless steel carbon bed adsorbers and piping to the carbon steel support structure to prevent galvanic corrosion.
- 4.2.8 The discharge filter frame shall be composed entirely of 316 L stainless steel.
- 4.2.9 Deleted.

## 4.3 Insulation

- 4.3.1 The Seller shall provide detailed insulation installation procedures complete with sketches showing methods and details for applying and securing external insulation, metal jacketing, etc., to the Activated Carbon Bed Adsorber Units and necessary piping. The insulation procedures shall be in accordance with PIP INIH 1000 and NACE Standard RP0198, Buyer specification 24590-WTP-3PS-NN00-T0001 *Thermal Insulation for Mechanical Systems*, and this specification.

- 4.3.2 Procedures for insulation thicknesses greater than three (3) inches shall be applied in multiple layers with staggered joints. Each layer of multiple layer and double insulation shall be held in place separately.
- 4.3.3 Procedures for insulation installation shall include jacketing the insulation with 304 L stainless steel following the requirements of Buyer specification 24590-WTP-3PS-NN00-T0001 *Thermal Insulation for Mechanical Systems*, and this specification. The stainless steel jacketing shall be 0.024 inches thick flat and smooth sheet. The jacketing shall be furnished in the annealed or soft condition with a regular 2B mill finish and have a factory applied moisture barrier.
- 4.3.4 Seller shall recommend cements, mastics, and adhesives that will be suitable for the maximum design temperature of the Activated Carbon Bed Adsorber units. The mixing of cements, mastics, etc., shall be done with deionized water. All recommended cements, mastics, adhesives must be certified for contact with austenitic stainless steel.
- 4.3.5 Procedures shall include cleaning instructions for surfaces to be insulated. Procedures should note that surfaces to be insulated must be dry and free of loose scale, dirt, and oil before the insulation is applied.
- 4.3.6 The design shall provide for removable/replaceable insulation on flanges, manholes, doors, and access openings.
- 4.3.7 All recommended insulation components, including facings, mastic, and adhesives, shall meet ASTM E84 fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed. Ratings used are determined by Underwriters Laboratories, Inc. (UL).

#### 4.4 Piping

- 4.4.1 All applicable materials used for piping and related appurtenances shall be in accordance with the requirements of the MDSs and Buyer specification 24590-WTP-3PB-P000-TS11V *Piping Material Classification Pipe Class S11V*, for HLW, and Buyer specification 24590-WTP-3PB-P000-TS11N *Piping Material Classification Pipe Class S11N*, for LAW.
- 4.4.2 Special attention shall be placed on securing stainless steel piping to the carbon steel support structure to prevent galvanic corrosion.

#### 4.5 Prohibited Materials

- 4.5.1 Mercury and other low melting point metals, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of the Activated Carbon Bed Adsorber units and shims.
- 4.5.2 Molybdenum and halides shall not be used in direct contact with stainless steel.
- 4.5.3 Asbestos shall not be included in any component of the Activated Carbon Bed Adsorber units.
- 4.5.4 Halide containing materials shall not be used in any component of the Activated Carbon Bed Adsorber units, unless otherwise noted in this specification.

#### 4.6 Storage of Special Materials (e.g., stainless steel) prior to work

- 4.6.1 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.
- 4.6.2 Storage of activated carbon and testing media shall be per the manufacturer's instructions to prevent contamination and degradation. Activated carbon and testing media storage requirements and instructions shall be provided by the Seller to the Buyer for review prior to purchase.

## 5 Fabrication

### 5.1 General Requirements

- 5.1.1 The Activated Carbon Bed Adsorber units shall be fabricated per this specification and the applicable documents listed in section 2 of this specification.
- 5.1.2 ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 shall only be applied to the fabrication of the housing pressure boundary of the Activated Carbon Bed Adsorber units. The housing pressure boundary shall be fabricated in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1. U-stamp and National Board Registration for the Activated Carbon Bed Adsorbers are not required.
- 5.1.3 Identification of fabrication methods shall be included in the detailed design of the Activated Carbon Bed Adsorber units.
- 5.1.4 All fabrication shall be performed by personnel qualified in accordance with this specification and applicable documents in section 2 of this specification.
- 5.1.5 Piping shall be fabricated in accordance with the requirements of ASME B31.3 and Buyer specification 24590-WTP-3PS-PS02-T0001, *Shop Fabrication of Piping*.

### 5.2 Assembly

- 5.2.1 Flatness of the completed Activated Carbon Bed Adsorbers and support frames shall be 1/8 inch per foot minimum, with no greater than 3/16 inch over the entire length, except for areas around cutouts. Areas around cutouts shall be flat within 1/16 inch per foot.
- 5.2.2 Cutout locations shall be within  $\pm 1/8$  inch and cutout size shall be within  $\pm 1/16$  inch.
- 5.2.3 The Activated Carbon Bed Adsorber units and shims shall have edges that are both smooth and not sharp to the touch.
- 5.2.4 The method of fabrication shall minimize the number and amount of seams, overlaps, or other discontinuities, which could trap radioactive contamination.

### 5.3 Tolerances

All tolerances, surface flatness, and finish requirements for assembly and fabrication shall be determined and specified by the Seller when completing the detailed design to meet performance requirements set forth in this specification. At a minimum, all tolerances, surface flatness, and finish requirements shall be per all applicable codes, standards, and reference documents in section 2 of this specification.

### 5.4 Welding

5.4.1 Seller shall develop detailed welding, weld inspection, NDE, and weld repair procedures for fabrication of the Activated Carbon Bed Adsorber units and submit them to the Buyer for review prior to fabrication. Procedures shall include acceptance criteria. The procedures shall conform to the following, as applicable:

- Buyer Specification 24590-WTP-3PS-SS00-T0001
- Buyer Specification 24590-WTP-3PS-SS00-T0002
- Buyer Specification 24590-WTP-3PS-NWPO-T0001
- Buyer Specification 24590-WTP-3PS-MVB2-T0001 (Pressure Boundary Only)
- ASME AG-1a, Article HA-6000
- ASME AG-1, Articles FE-6000
- ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 (Pressure Boundary Only)
- ASME B31.3
- AWS D1.6

5.4.2 Activated Carbon Bed Adsorber welding, weld inspection, NDE, and weld repair shall be carried out in accordance with the applicable procedures developed per the previous paragraph.

5.4.3 Activated Carbon Bed Adsorber welder qualifications shall be performed in accordance with requirements of the referenced specifications and codes listed in section 5.4.1 of this specification.

5.4.4 Welding or material manipulation shall be carried out indoors and only when the ambient, piping, or plate temperature is above 41°F, or higher where elevated temperatures are called for by a process.

5.4.5 Personnel performing Activated Carbon Bed Adsorber weld inspections shall be qualified in accordance with ASME AG-1, Paragraph AA-6335, ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1, Buyer specification 24590-WTP-3PS-SS00-T0002, *Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel* and 24590-WTP-3PS-SS00-T0001, *Specification for Welding of Structural Carbon Steel*.

5.4.6 Repairs required as a result of weld rejection by either the Seller's or Buyer's inspection shall be fully documented in accordance with Seller's Quality Assurance Program (QAP). Activated Carbon Bed Adsorber weld repairs shall be performed in accordance with ASME AG-1, subsubarticle AA-6330 and ASME Boiler and Pressure Vessel Code, Section VIII

(housing pressure boundary only). Weld repair records shall be included with Seller's quality verification document package to be submitted to Buyer.

- 5.4.7 Joints and seams shall be fabricated in accordance with ASME AG-1a, subsubarticle HA-4330 and ASME Boiler and Pressure Vessel Code, Section VIII (housing pressure boundary only).
- 5.4.8 Welding procedures and welder qualification records shall be submitted to Buyer for review and permission to proceed prior to start of fabrication. Each procedure shall be prepared and qualified in accordance with the requirements of the listed standards in section 5.4.1 of this specification.
- 5.4.9 Seller shall submit a weld verification report including a weld map which identifies the specific weld procedure and NDE procedure utilized for each weld joint.

## 5.5 Coating

- 5.5.1 Seller shall provide coating for carbon steel surfaces in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Appendix D, Item # 8.20. System code D applies.
- 5.5.2 Coating finish color shall be in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Appendix E, ANSI 70 Gray.
- 5.5.3 All carbon steel to stainless steel weld areas shall remain free of any zinc filled coatings, such as the P02 primer contained in system code D. Surfaces that were previously coated with zinc filled material, and subsequently ground off, are considered to be contaminated with zinc. Stainless steel shall not be welded to these surfaces.
- 5.5.4 Zinc filled coatings shall be held back from the carbon steel to stainless steel welds by 3 to 4 inches for shop welds and 4 to 5 inches for field welds. Coating hold back requirements are further defined in 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, section 2.2.1.
- 5.5.5 The following coating materials may be applied directly to stainless steel surfaces:
- Sherwin Williams Macropoxy 646
  - Carboline Carbogard 890
- 5.5.6 Insulated surfaces (applicable only to carbon steel in contact with stainless steel) with an operating temperature no greater than 200 °F shall be coated with system code H (see 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Appendix C, Table 2, limited to the coating materials listed in section 5.5.5 above). The coating shall be applied to all carbon steel surfaces overlapping 1 inch on to the stainless steel. Insulated surfaces (applicable only to carbon steel in contact with stainless steel) with an operating temperature from 200 °F to 300 °F shall be coated with system code G (see 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Appendix C, Table 2). The coating material specified for use in system code G is not acceptable for direct

application over stainless steel surfaces or stainless steel to carbon steel welds. Coat carbon steel surfaces with system code G to within 1-2 inches of the carbon steel-stainless steel weld. Do not overlap coating onto weld area or onto stainless steel material. Zinc primers without top-coating and hot dip galvanizing are not acceptable on surfaces that will be insulated.

- 5.5.7 Carbon steel components of gratings, platform assemblies, ladder assemblies, crane rail, and supports shall be hot dip galvanized in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, Appendix D, Note 15.
- 5.5.8 Components that are coated to manufacturer's standard shall be in accordance with 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment*, section 6.2.1.2.

## 6 Tests and Inspections

### 6.1 General Requirements

- 6.1.1 The Activated Carbon Bed Adsorber units shall be tested and inspected per this specification, applicable documents listed in section 2 of this specification, and all appendices, addenda, and attachments. Seller shall submit shop and field test plans for Buyer review.
- 6.1.2 Seller shall conduct and be responsible for all testing and inspections required per this specification, applicable codes, applicable standards, and reference documents.
- 6.1.3 Seller shall submit a detailed test and inspection plan identifying all the inspections and tests planned, including recommended witness and hold points. Buyer's inspector will advise the Seller of witness and hold points and identify the shop tests that the Buyer intends to witness.
- 6.1.4 Seller shall develop and submit to Buyer detailed test procedures for conducting all shop and field acceptance testing required per this specification, applicable codes, standards, and reference documents for review by the Buyer prior to Activated Carbon Bed Adsorber fabrication. Procedures shall include acceptance criteria and detailed drawings of the shop and field testing configurations. Seller shall identify on drawings location of taps, ports, piping connections, and/or manifolds made on housing and ductwork in order to take measurements during shop and field tests. These taps, ports, piping connections, and/or manifolds shall be temporarily capped for use in the field during acceptance testing. Seller shall provide instructions on permanently sealing these taps after field acceptance testing. Drawings shall be scalable and shall include plan and elevation views of the following:
- Activated Carbon Bed Adsorber
  - Any Seller furnished materials, fittings, and ductwork required to perform the tests
  - Seller furnished discharge filter(s)
  - All Seller furnished equipment, apparatus, and instrumentation
- 6.1.5 Seller shall develop and submit to Buyer detailed testing and inspection procedures for conducting all testing and inspections required per this specification, applicable codes,

standards, and reference documents for review by the Buyer prior to Activated Carbon Bed Adsorber fabrication.

- 6.1.6 Seller shall complete reports of all testing and inspections and submit them to Buyer. Reports shall identify the component tested, date performed, applicable test procedure, acceptance criteria, person performing the test or inspection, test results, and conclusions. Drawings of test setups shall be included. All testing and inspection results shall be certified.
- 6.1.7 Control and calibration of measuring and test equipment shall be in accordance with ASME AG-1, subarticle AA-5130.
- 6.1.8 All shop testing and inspection instruments used to conduct testing on the Activated Carbon Bed Adsorber units shall meet the requirements set forth in ASME AG-1, Article TA-3000. All testing and inspection instruments shall be in calibration and traceable to the appropriate national standard.
- 6.1.9 Any non-conforming work, in accordance with Seller's acceptance criteria, shall be redone by the Seller at Seller's cost.

## 6.2 Weld Testing and Inspection

- 6.2.1 Activated Carbon Bed Adsorber welds shall be inspected, examined, and tested in accordance with ASME AG-1, subarticle AA-6330, ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 (housing pressure boundary only), and Buyer specification 24590-WTP-3PS-MV00-T0001, *Pressure Vessel Design and Fabrication*.
- 6.2.2 Activated Carbon Bed Adsorber support frame welds shall be inspected, examined, and tested in accordance with Buyer specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel* and 24590-WTP-3PS-SS00-T0001, *Engineering Specification for Welding of Carbon Structural Steel*.
- 6.2.3 Piping shall be inspected, examined, and tested in accordance with ASME B31.3, Buyer specification 24590-WTP-3PS-PS02-T0001, *Shop Fabrication of Piping*, and Buyer specification 24590-WTP-3PS-NWPO-T0001, *General Welding and NDE Requirements for Supplier Fabricated Piping*.
- 6.2.4 As applicable, per code requirements, Seller shall submit Radiographic, Liquid Penetrant, and Ultrasonic Examination procedures for review, prior to fabrication.
- 6.2.5 Exposed radiograph film must be submitted along with technique and reader sheets. Film must be packaged in such a manner as to preclude moisture and handling damage.

## 6.3 Personnel Qualifications

- 6.3.1 All inspection and testing shall be performed by personnel qualified per the requirements set forth in this specification and all applicable documents in section 2 of this specification.

- 6.3.2 Seller shall submit personnel qualification documents, including years of experience for Seller's inspection and test personnel, for Buyer review.

#### 6.4 Laboratory Tests

- 6.4.1 Seller shall conduct and be responsible for laboratory testing of Activated Carbon Media in accordance with appendix A, B, and C of this specification. Laboratory tests shall be conducted in accordance with the applicable sections of NQA-1. The test plan shall include a matrix cross-referencing the QA requirements to implementing procedures for the work and justifying elements that are not applicable.
- 6.4.2 Seller shall submit laboratory test plan and procedures for Buyer review prior to the start of testing in accordance with the requirements of the G-321-E in section 3 of the purchasing documents.
- 6.4.3 A final report shall be submitted for Buyer review in accordance with the requirements of section 10.7 of this engineering specification. The final report shall support the engineering design of the Activated Carbon Bed Adsorber Units. In addition to the requirements of section 10.7, the final report shall show conformance with required DFs as outlined in section 3.4 of this specification and specified in the MDSs. Any effects related to the design of the Activated Carbon Bed Adsorber Units shall be identified in the final report.

#### 6.5 Shop Tests

- 6.5.1 Seller shall provide all materials, labor, tools, equipment, apparatus, instrumentation, testing media, and challenge gas to conduct all shop testing on the Activated Carbon Bed Adsorber units.
- 6.5.2 All shop tests requiring that adsorbent media be installed in the Activated Carbon Bed Adsorber units shall be conducted using activated carbon. The Seller shall ensure that the Activated Carbon Bed Adsorber does not become contaminated or degraded at any time before, during, or after completion of shop testing.
- 6.5.3 Testing media shall be loaded into adsorber cells and tested per applicable sections of ASME AG-1, Article FE-5000. Seller shall issue manufacturer's information for testing media to the Buyer for review prior to purchase.
- 6.5.4 Electrical and instrumentation tests shall be conducted in accordance with the requirements of Buyer specification 24590-WTP-3PS-EKP0-T0001, *Electrical Requirements for Packaged Equipment*, and 24590-WTP-3PS-JQ07-T0001, *Instrumentation for Package Systems*. Electrical and instrumentation test reports shall be submitted for Buyer review.
- 6.5.5 Seller shall conduct the following acceptance tests in the shop on each unit using air at ambient temperature, prior to shipment:
- Visual Inspection
  - Structural Capability Test

- System Bypass Test
- Mechanical Test
- Differential Pressure Test
- Airflow Distribution Test
- Electrical Air Heater Performance Test (per design)

All Activated Carbon Bed Adsorber shop acceptance testing procedures shall conform to ASME AG-1 (Section TA), N509 (Section 9), N510, and ERDA 76-21 (Chapter 8).

- 6.5.6 Deleted.
- 6.5.7 Pneumatic testing per ASME Boiler and Pressure Vessel Code, Section VIII, Div. 1 shall be conducted on the Activated Carbon Bed Adsorber housing pressure boundary. U-stamp and National Board Registration for the Activated Carbon Bed Adsorbers are not required.
- 6.5.8 Structural Capability Test: Conduct at pressure and conditions specified in the MDSs.
- 6.5.9 System Bypass Test: At  $\pm 10\%$  of design flowrate through the Activated Carbon Bed Adsorber, challenge gas leakage rate shall not exceed 0.1 % at 99.9 % efficiency.
- 6.5.10 All test results shall be documented, certified, and submitted to the Buyer for review.

## 6.6 Site Tests

All Activated Carbon Bed Adsorber field acceptance testing procedures shall conform to ASME AG-1 (Section TA), N509 (Section 9), N510, and ERDA 76-21 (Chapter 8).

## 6.7 Bag-in/Bag-out Procedure Demonstration

- 6.7.1 Demonstration shall be conducted in Seller's shop on one (1) of the fully assembled Activated Carbon Bed Adsorber units and witnessed by Buyer's Representatives. The Activated Carbon Bed Adsorber to be used for the demonstration shall be chosen by the Buyer.
- 6.7.2 Demonstration shall include removal and replacement of one (1) activated carbon adsorber bed adsorbent and the discharge filter(s) for one (1) Activated Carbon Bed Adsorber unit for each HLW and LAW facility. Actual adsorber bed adsorbent to be removed shall be chosen by the Buyer.
- 6.7.3 When conducting the demonstration, Seller personnel shall be wearing all PPE required per the final bag-in/bag-out procedure.
- 6.7.4 Field conditions shall be simulated in the shop when performing the bag-in/bag-out procedure demonstration, which will include pulling a vacuum on the Activated Carbon Bed Adsorber, room clearance, and lifting constraints.

## 7 Preparation for Shipment

### 7.1 General Requirements

- 7.1.1 The Activated Carbon Bed Adsorber units shall be packaged/prepared for shipment, handled, and stored in accordance with Buyer specification 24590-WTP-3PS-G000-T0003 *Engineering Specification for Packaging, Handling, and Storage Requirements*, and ASME AG-1a, Article HA-7000, (Level C).
- 7.1.2 The activated carbon media shall be packaged/prepared for shipment, handled, and stored in accordance with Buyer specification 24590-WTP-3PS-G000-T0003 *Engineering Specification for Packaging, Shipping, Handling and Storage Requirements*, ASME AG-1, Article FE-7000 and FF-7000, (Level B).
- 7.1.3 The Activated Carbon Bed Adsorber units, activated carbon media, and shims shall not be packaged for shipping until all shop tests and inspections have been performed and the Buyer's Representative reviews the results.

### 7.2 Cleanliness

- 7.2.1 Cleanliness shall be per the applicable documents in Paragraphs 7.1.1 and 7.1.2 of this specification.
- 7.2.2 Solvents and cleaning solutions used on stainless steel shall have a halogen content of less than 200 ppm.

### 7.3 Tagging

- 7.3.1 Tagging of the Activated Carbon Bed Adsorber units shall be as specified in ASME AG-1, Article FE-9000 and ASME AG-1a, Article HA-9000. Tagged information shall also include associated plant item number specified in the data sheets that are in Section 2 of the purchasing documents.
- 7.3.2 A stainless steel nameplate shall be rigidly attached to the Activated Carbon Bed Adsorber units in a prominent position for ease of visibility and include:
- manufacturer's name
  - shop location
  - date of manufacture
  - serial number
  - equipment ratings (pressure, flow, temperature)
  - plant item number
  - weight of assembly
  - purchase order number
- 7.3.3 Nameplates shall be visible after the insulation is installed, or a duplicate nameplate shall be provided on the top of the insulation. Nameplate shall be located for easy access and reading.
- 7.3.4 All field testing materials and filters shall be tagged as required for field testing.

7.3.5 Seller shall use Buyer supplied tag numbers for valves, instrumentation, junction boxes, racks, and panels.

#### 7.4 Documentation

7.4.1 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person(s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.

7.4.2 Seller shall ensure that appropriate documentation is prepared for the Activated Carbon Bed Adsorber units, activated carbon, and shims. At a minimum, documentation shall include the following information, as applicable:

- Manufacturer name, model number, and serial number
- Plant Item Number

#### 7.5 Shipment Preparation Instructions

7.5.1 Shipment of items shall be conducted in accordance with ASME AG-1a, Article HA-7300, Buyer specification 24590-WTP-3PS-G000-T0003 *Engineering Specification for Packaging, Handling, and Storage Requirements*.

7.5.2 The Activated Carbon Bed Adsorber units shall be shipped completely assembled except for activated carbon. Activated carbon shall be shipped separately.

7.5.3 Weatherproof shipping lists (two per packaged item) shall be prepared and submitted, and shall clearly identify the contents of each package sent to the Buyer. All submittals and shipping boxes shall be identified with the Buyer's purchase order number.

7.5.4 Seller shall provide a complete identification and location of temporary material contained within the equipment for shipment, handling, or storage that must be removed prior to commissioning (e.g., shipping blocks, desiccant bags, components shipped inside larger sections, etc.). In addition, the Seller shall provide instructions for removal of temporary materials, as required.

7.5.5 The Activated Carbon Bed Adsorber units and shims shall be mounted on skids, in crates, or in boxes as suited for the intended method of transport. Lifting weight and center of gravity shall be clearly marked on both the equipment and its shipping documents.

## 8 Quality Assurance

### 8.1 General Requirements

8.1.1 The Seller's QAP Requirements are included in Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

- 8.1.2 Seller's QAP Manual shall be submitted to Buyer for review in accordance with Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.
- 8.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheets listed in Section 2 of the purchasing documents.

## 8.2 Quality (Q) Related Components

- 8.2.1 Seller shall have in place a QAP meeting the requirements of ASME-NQA-1, marked as applicable in Supplier Quality Assurance Program Requirements Data Sheet attached to the purchasing documents, and Buyer specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.
- 8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Seller shall allow the Buyer, its agent, and DOE access to their facility and records pertaining to this purchase order for the purpose of Quality Assurance (QA) Audits and Surveillance at mutually agreed times.
- 8.2.3 All items shall be manufactured in accordance with the Seller's QAP that meets the requirements of ASME NQA-1, and has been previously evaluated and accepted by the WTP Quality Organization.
- 8.2.4 Seller shall submit their QAP and work plan to Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement the work and include a matrix of essential QA elements cross referenced with the documents/procedures.

## 8.3 Supplier Deviation

- 8.3.1 Each 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 RPP-WTP.

Supplier-proposed deviations from procurement documents shall be initiated by use of Supplier Deviation Disposition Request (SDDR) form in section 2 of the purchasing documents.

# 9 Configuration Management

Equipment and or components covered by this specification are identified with Plant Item numbers shown in the MDSs. Each item shall be identified in accordance with Tagging in section 7 of this specification.

## 10 Documentation and Submittals

### 10.1 General

- 10.1.1 Seller shall submit to Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, laboratory results, models, manufacturer data, inspection plans and reports, test plans and reports, certifications, certificates, qualification records, manuals, MSDSs, video tapes, and drawings required per this specification, the applicable codes, standards, and reference documents in section 2 of this specification, and the purchasing documents.
- 10.1.2 All detailed designs, drawings, shop drawings, supporting calculations, supporting analyses, support models, procedures, instructions, manufacturer data, operation manuals, and maintenance manuals shall be issued to the Buyer for review prior to manufacture of the Activated Carbon Bed Adsorber units, special tools, and/or the purchase of special tools, filters, and gaskets.
- 10.1.3 Seller shall submit storage requirements and instructions for Buyer's review.
- 10.1.4 Seller 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 purchasing documents.
- 10.1.5 Seller shall submit a report identifying any deviations and/or conflicts per Section 2 of the purchasing documents to the Buyer for review.
- 10.1.6 Each documentation transmittal package shall have a documentation inventory sheet attached listing all documents and the number of pages each.
- 10.1.7 MDSs in Section 2 of the purchasing documents and motor data sheets shall be marked-up by the Seller and submitted to the Buyer for review with the detailed design. Seller shall fill in all information that is marked with an asterisk (\*) and mark-up actual overall Activated Carbon Bed Adsorber dimensions based on the detailed design.
- 10.1.8 Seller shall provide all operation manuals (include media changeout operations and any media conditioning requirements), maintenance manuals, initial setup and startup instructions, special tools, and spare parts lists for Activated Carbon Bed Adsorber components, as applicable.
- 10.1.9 Provide nominal and maximum inlet and outlet nozzle loadings, deflections, and moments in all directions for Activated Carbon Bed Adsorber units per thermal and seismic analysis results.
- 10.1.10 Provide Activated Carbon Bed Adsorber unit support and anchorage design load analyses including seismic, thermal, and combination loads.
- 10.1.11 Provide MSDS for Seller's recommended challenge gas.
- 10.1.12 The Seller shall provide equipment reliability figures for all major components and sub-components of the Carbon Bed Adsorber system. The definition of components and sub-

components is at the vendor's discretion. The reliability figures shall include, as a minimum, the following:

- Failure rate, or mean time between failure (whichever is available)
- Estimated modes of failure (example, Drive gear failure, motor burnout, brake failure, etc.). This may be delineated in a FMEA. The method used to perform the FMEA (example, MIL-STD-1629) and the year shall be specified. In addition, all assumptions used to perform the FMEA shall be stated.
- Recommended maintenance and frequency, as applicable
- Estimated time to perform the recommended maintenance, as applicable

The data above shall be based on the physical and environmental conditions delineated in this specification. Where possible, the seller shall compare the figures for the equipment in this specification to similar equipment sold and serviced by the vendor. The source for all estimates and any underlying assumptions shall be stated. If software is used to perform the FMEA, the seller shall specify the software used and the version (example software, Relx, Isogen, Reliasoft, etc.)

- 10.1.13 Provide installation manual per the requirements of engineering specification 24590-WTP-3PS-G000-T0003, *Packaging, Handling, and Storage Requirements*.
- 10.1.14 Provide site handling and storage instructions per the requirements of section 3.9 and engineering specification 24590-WTP-3PS-G000-T0003, *Packaging, Handling, and Storage Requirements*.
- 10.1.15 All analyses shall be submitted in accordance with the requirements of 24590-WTP-3PS-G000-T0014, *Engineering Specification for Supplier Design Analyses*.

## 10.2 Drawings

- 10.2.1 Seller shall provide all drawings required per this specification and the applicable documents in section 2 of this specification.
- 10.2.2 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, *Engineering Drawing Practices*.
- 10.2.3 Seller shall submit drawings and diagrams for Buyer's review prior to fabrication, and/or purchase of appurtenance equipment. Drawing and diagram submittals shall include as a minimum, but are not limited to, the following:
  - Outline drawings showing dimensions, services, insulation, and foundation and mounting details.
  - Outline drawing showing electrical and instrumentation tie-in points.
  - Outline drawing showing locations of piping connections with nozzle schedule, including sizes of piping connections with nominal and maximum nozzle loadings, deflections, and moments in all directions.
  - Insulation detail drawing(s) mapping installation
  - Overall piping and instrumentation diagram (P&ID) for the Activated Carbon Bed Adsorber Units using Buyers supplied instrumentation and equipment tag numbers.

- Interconnection diagram showing details of all internal connections and Buyer external connections, including required location and sizes of wiring connections (including other connections to Buyer's control system).
- Overall single line diagram (wiring diagram) showing all electrical equipment and wiring in the Activated Carbon Bed Adsorber Unit.
- Control logic diagrams showing input signal paths required to accomplish a response.
- Assembly drawings with sufficient information and detail to facilitate assembly of the component parts of an equipment item.
- Shop detail drawings that provide information and detail to facilitate fabrication, manufacture, or installation.

### 10.3 30% Design Review

10.3.1 Seller shall conduct a 30 % design review with the Buyer. Seller shall submit all drawings, procedures, calculations, laboratory testing results, analyses, and information necessary to conduct the 30 % design review to the Buyer for review.

10.3.2 Finalized outline dimensions of the Activated Carbon Bed Adsorber units shall be included in the 30 % design review. Finalized dimensions shall, at a minimum, include the following:

- Overall dimensions and size for Activated Carbon Bed Adsorber units
- P&IDs
- Control logic diagrams
- Activated Carbon Bed Adsorber unit inlet and outlet nozzle locations
- Discharge filter location and size
- Testing port and manifold locations and size
- Adsorber cell overall dimensions
- Mounting details (anchor size, location, layout, etc.)
- Preliminary bag-in/bag-out plan
- Fire water inlet and drain locations and sizes

### 10.4 90% Design Review

Seller shall conduct a 90 % design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and information necessary to conduct the 90 % design review to the Buyer for review.

### 10.5 Calculations

All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- A concise statement of the purpose of the calculation
- Input data, applicable criteria, and stated assumptions
- A list of references used, including drawings, codes, standards, and computer programs (indicate the version or issue date)
- A discussion of rationale used for design assumption basis
- Equations used for all computations

- Numerical calculations including identification of units used
- A concise statement addressing the calculation results and/or recommendations
- A table of contents for complex calculations

## 10.6 Schedules

- 10.6.1 A detailed schedule of laboratory testing, engineering, document submittals, material purchases, fabrication, shop tests, and shipment shall be submitted.
- 10.6.2 All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to Activated Carbon Bed Adsorber shipment.

## 10.7 Reporting Appendix A, B, and C Test Results

A test plan and supporting documentation (operating procedures, materials and testing equipment control lists, analytical procedures) must provide a full record of the testing requirements, testing equipment configuration, operating conditions, assumptions, and any other relevant information. In addition to, or consistent with, the test plan content required by the Quality Assurance Project Plan for RPP-WTP, current revision, the test plan shall include directly or by reference (as appropriate) the following information:

- **Document Number** – Test plan number in the document header.
- **Document Hierarchy** – Statement in the test plan text referencing the governing test specification.
- **Background** – Summary level discussion of past results and current data needs that provide context and relevancy of the testing to the WTP Project.
- **Test Prerequisites** – Definition and/or reference of laboratory testing, engineering analyses, small-scale testing needed to support testing.
- **Test Conditions** – Test variables and operating conditions (e.g., duration of operations at steady state conditions, range of equipment operating conditions, process flows, pressures, temperatures, differential pressures, etc.) identified in tables or other efficient formats.
- **Sample Data Requirements** – A table listing the sample type, location, frequency, number of replicates, and planned analyses to be performed. Minimum data accuracy requirements shall be addressed.
- **Test Modifications** – Test Plan shall contain a statement defining how changes or modifications in operations or testing will be documented in the “desk copy” or similar controlling documentation during the test and who has the authority to authorize changes or modifications depending on the significance of the change.
- **Equipment Configuration Record** – The equipment configuration for the test or document reference where the configuration can be found. Statement defining where any changes or modifications to the baseline equipment will be recorded, e.g., laboratory record book.
- **M&TE** – A list identifying measuring and test equipment (M&TE) used to collect data to meet Test Specification requirements, data reported to the project in the summary report or other data reporting formats, and M&TE relied upon for control or modeling purposes. Accuracy and sensitivity achievable for each instrument.

- **Supporting Procedures** – A list of applicable technical and operating procedures or a referenced document that contains the list of documents required for operating the test equipment and associated support systems, sample preparation and analytical procedures, etc.
- **Unique Sample Identification** – Description of or document reference defining method to label, store and maintain samples.
- **Reporting and Analyses Requirements** – Process data that will be obtained and reported, Rate versus time, average temperature versus time, and analyses are required to satisfy each test objective. Planned data analyses, e.g., comparison to theoretical or published predictions, empirical fitting, etc., required to meet objectives.
- **Personnel Qualification** – List of any special training needs.
- **Quality Assurance** – Statement identifying applicable quality assurance requirements. Any exceptions to the approved quality assurance plan shall be described.

A final report shall be submitted within 60 days of completing testing and sample analyses. Test report content shall include (compatible with the individual test objectives):

- Approval sheet signed by the principal investigator, data validation peer reviewer, and project manager,
- Summarize the tests performed, including the date of the tests, and applicable test specification and test plan,
- Provide a clear description of the purpose of the test and state how the completed test met that purpose,
- Describe the unit operations in which the tests were performed and contrast test conditions with planned operating conditions of the RPP-WTP, as appropriate,
- Present and discuss test results and compare against the “success” criteria. Discuss whether or not the findings of the test performed are consistent with previous test reports, whether the expected WTP design or operational conditions are appropriate for the system, or have implications for safety, permitting, or operability,
- Data collected and its acceptability,
- Actions taken in connection with any nonconformances noted,
- Identification of the measuring and test equipment used during the test,
- Describe deviations from the approved test plan, or expected configuration conditions, that occurred during the conduct of the test,
- Comprehensive list of all samples providing the date/time of sampling, sample type, and sample label,
- Data tables listing monitored parameter values.
- A discussion of how the test results validate equipment sizing and performance.

## 11 References

### 11.1 Incorporated Design Changes

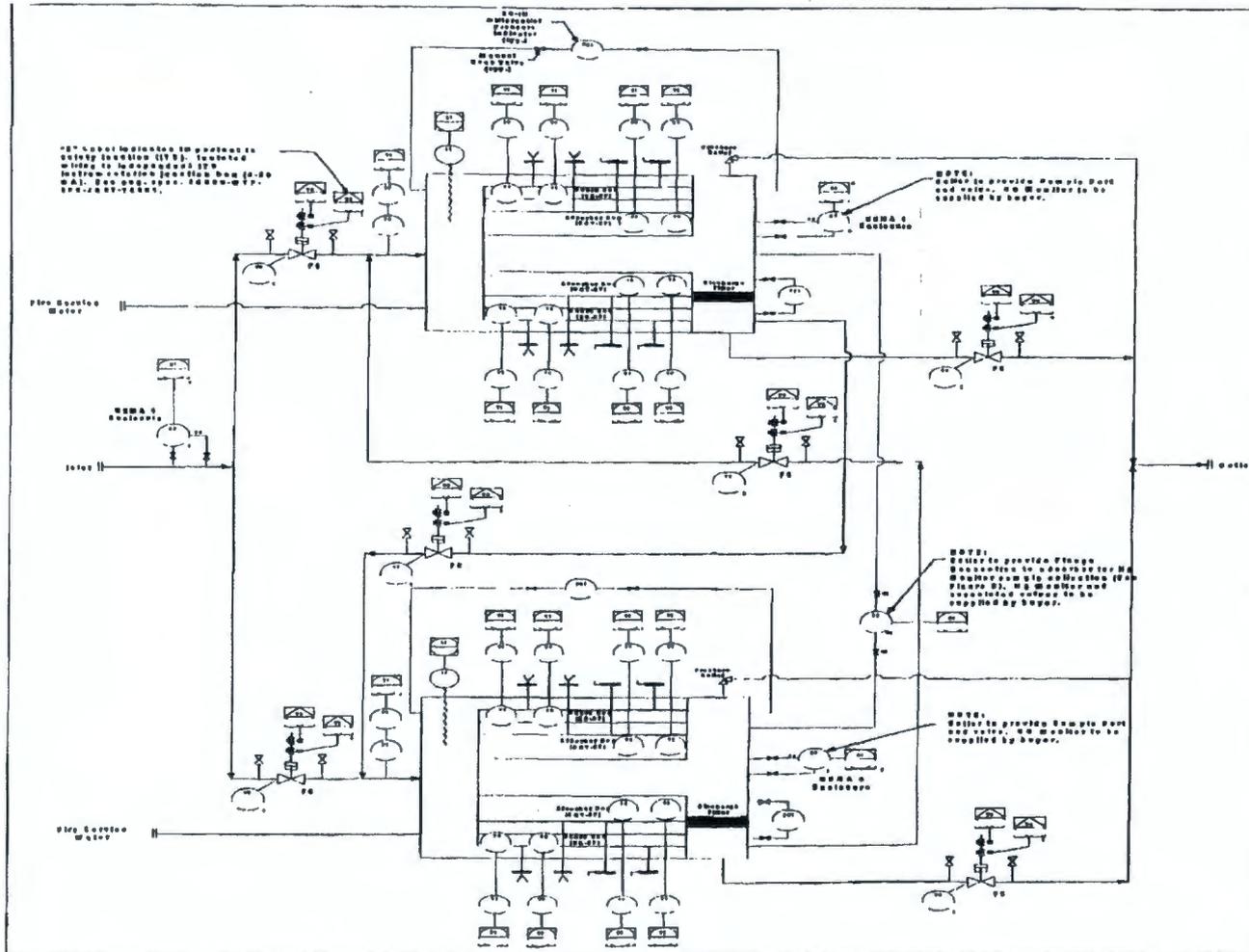
- 24590-WTP-3PN-MWK0-00001

- 24590-WTP-3PN-MWK0-00002
- 24590-WTP-SDDR-PROC-04-01020
- 24590-WTP-SDDR-PROC-04-01040
- 24590-WTP-SDDR-PROC-05-00392
- 24590-WTP-SDDR-PROC-05-00602
- 24590-WTP-SDDR-PROC-05-00652
- 24590-WTP-SDDR-PROC-05-00701
- 24590-WTP-SDDR-M-05-00018
- 24590-WTP-SDDR-MS-07-00051

## 11.2 Design Changes Incorporated by Reference

- 24590-WTP-SDDR-M-06-00286
- 24590-WTP-SDDR-M-06-00287

Figure 1 HLW Activated Carbon Bed Adsorber Schematic



Notes:

1. This figure is only intended to give a pictorial view of the offgas flow through the Activated Carbon Bed Adsorbers. Only the major components are shown. Refer to P&ID's 24590-HLW-M6-HOP-00011 and 24590-HLW-M6-HOP-20011 and the specification for all components to be included.
2. Deleted.
3. Pneumatic loading or manual system is not shown for clarity.
4. Buyer supplied mercury analyzer is pneumatically actuated to select Activated Carbon Bed Adsorber to be monitored.
5. Instrument air tubing is not shown. Instrument air shall be supplied on a common header, piped to equipment edge and flanged.
6. Seller shall supply a single electrical feed required for each Activated Carbon Bed Adsorber.
7. Except for ITS Instrumentation Interfaces, Seller shall supply a single Instrumentation Interface point for both Activated Carbon Bed Adsorbers in accordance with the requirements of Buyer specification 24590-WTP-3PS-JQ07-T0001.
8. Required PSV and vent lines for fire suppression system are not shown. System shall be per Seller's design.
9. Mercury analyzer is shown for clarity but is not included in the Seller's scope of supply. See figure 3 of this specification for Seller provided mercury probe connection flange requirements.
10. ITS solenoids identified for the isolation valves are part of actuators.
11. CO analyzers are shown for clarity but are not included in the Seller's scope of supply. Seller to provide 1/2" manual root valve for CO analyzer sample collection and return line.

Legend:

	Control Room Transmitter - Continuous Software (Operator Accessible)		Flange Connection
	Control Room Transmitter - Discrete Software (Operator Accessible)		Carbon Media Fill Chute
	Hardware - Field Mounted (Operator Accessible)		Radar or Sonic Signal (Not Guided)
	Actuated Butterfly Valve		Carbon Media Discharge
	Manual Valve		

Some information on page <sup>THIS</sup> may appear to be illegible, however, the information necessary for assuring adequate design is legible.  
Signature: \_\_\_\_\_ Date: //



Figure 3 Mercury Gas Monitor Probe Flange Connection

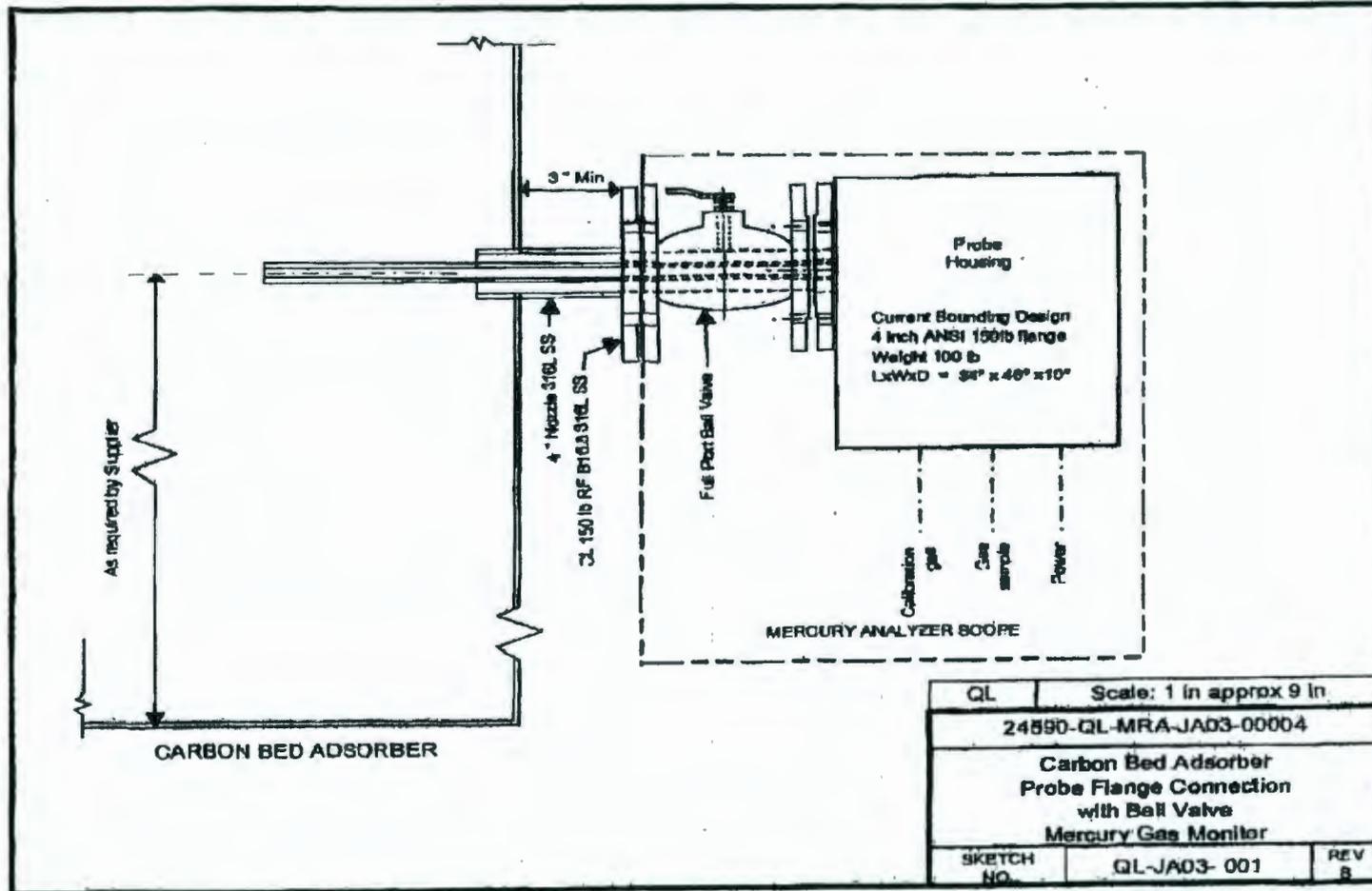


Table 1 Important to Safety Equipment List (HLW)

COMPONENT TAG NO.:  
24590-HLW-MV-HOP-ADBR-0001A/B  
24590-HLW-MV-HOP-ADBR-0002A/B

IMPORTANT TO SAFETY EQUIPMENT LIST

Important to Safety function for the activated carbon bed adsorber units for both HLW and LAW is defined in section 3.1.18 of engineering specification 24590-WTP-3PS-MWK0-T0001. This function is defined as containment of media effluents during normal, maximum, and design conditions. Pressure boundary must be maintained during and post SC-8 event.

Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CLASS	CGO	COMMENTS
08169 Inlet Air Slot	08169-1	Air Slot with Sample Holes	08169-1	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-2	Air Slot without Sample Holes	08169-2	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-3	Vertical Channel LH	12GA SHY 316L SS	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-4	Vertical Channel RH	12GA SHY 316L SS	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-5	Horizontal Channel	12GA SHY 316L SS	20	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-6	Lower Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-7	Upper Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-8	Vertical Flat Bar (118)	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-9	Vertical Flat Bar (125.53)	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-10	Backing Washer	12GA SHY 316L SS	3	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-11	Perforated Sheet (22.38)	20GA SHY 316L SS	10	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08169-12	Perforated Sheet (10.44)	20GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
08170 Outlet Air Slot	08170-1	Vertical Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-2	Horizontal Channel	12GA SHY 316L SS	10	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-3	Lower Channel	12GA SHY 316L SS	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-4	Upper Channel	12GA SHY 316L SS	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-5	Vertical Flat Bar	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-6	Perforated Sheet (22.38)	20GA SHY 316L SS	10	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08170-7	Perforated Sheet (10.44)	20GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
08171 Bed Air Slot	08171-1	Air Slot with Sample Holes	08169-1	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-2	Air Slot without Sample Holes	08169-2	1	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-3	Vertical Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-4	Horizontal Channel	12GA SHY 316L SS	20	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-5	Lower Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-6	Upper Channel	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-7	Backing Washer	12GA SHY 316L SS	6	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.
	08171-8	Perforated Sheet (22.38)	20GA SHY 316L SS	20	Non-ITS	CM	No	Does not function to contain media effluents. This part forms part of the carbon media screen.

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CL/CM	COO	COMMENTS
D8178 Adsorber Assembly	D8171-9	Perforated Steel (10.24)	20GA SHT 316L SS	4	Non-ITS	CM	No	Does not function to contain media offgas. This perforated part of the carbon media screen
	D8171-10	Vertical Channel VWHoles	12GA SHT 316L SS	2	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-1	Inlet Air Slot with Sample Holes	D8188-1	1	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-2	Inlet Air Slot without Sample Holes	D8188-2	1	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-3	Outlet Air Slot	D8170	1	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-4	Bed Air Slot with Sample Holes	D8171-1	1	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-5	Bed Air Slots without Sample Holes	D8171-2	1	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen
	D8179-6	Tubing	1 1/2 OD x 0.120 WT, 316L SS	3	Non-ITS	CM	No	Does not function to contain media offgas. This part forms part of the carbon media screen, used to fit the hole spaced used for the grain that sample.
	D8179-7	Pipe Coupling	1 1/4 x 5000F, 316L SS	3	ITS	CL	Yes	
	D8179-8	Inlet Plate	12GA SHT 316L SS	1	Non-ITS	CM	No	Does not function to contain media offgas. Plate is used to channel air into the air slots and through the carbon media.
	D8179-9	Outlet Plate	12GA SHT 316L SS	2	Non-ITS	CM	No	Does not function to contain media offgas. Plate is used in the top element of the carbon media beds to separate the different media and aid in media loading.
D8179-10	Divider Plate	12GA SHT 316L SS	2	Non-ITS	CM	No	Does not function to contain media offgas. Plate is used in the top element of the carbon media beds to separate the different media and aid in media loading.	
D8179-11	Cover Plate	12GA SHT 316L SS	2	Non-ITS	CM	No	Does not function to contain media offgas. Plate is used to channel air into the air slots and through the carbon media.	
D8183 Housing Weldment	D8183-1	Adsorber Assembly	D8178	1	ITS	CL	Yes	The pipe coupling called out on part of this assembly functions to contain media offgas, therefore, the whole assembly is designated ITS. * For item# D8183-1 should refer to drawing D8178 for the safety / quality designation and COO requirements.
	D8183-2	Back Panel	D8188-1	1	ITS	CL	Yes	
	D8183-3	Front Panel	D8188-2	1	ITS	CL	Yes	
	D8183-4	Bottom Panel	D8188-3	1	ITS	CL	Yes	
	D8183-5	Top Panel	D8188-4	1	ITS	CL	Yes	
	D8183-6	Top Panel VWHoles	D8188-5	1	ITS	CL	Yes	
	D8183-7	Top Panel	D8188-6	1	ITS	CL	Yes	
	D8183-8	Top End Panel	D8188-7	2	ITS	CL	Yes	
	D8183-9	Inlet End Panel	D8188-8	1	ITS	CL	Yes	
	D8183-10	Outlet End Panel	D8188-9	1	ITS	CL	Yes	
	D8183-11	Hopper Size Main Bed	D8188-10	8	ITS	CL	Yes	
	D8183-12	Hopper Size Guard Bed Panel	D8188-11	8	ITS	CL	Yes	
	D8183-13	Hopper End Main Bed Panel	D8188-12	8	ITS	CL	Yes	
	D8183-14	Hopper End Guard Bed Panel	D8188-13	8	ITS	CL	Yes	
	D8183-15	Hopper Bottom Panel	D8188-14	8	ITS	CL	Yes	
	D8183-16	Manway Flange	D8188-15	2	ITS	CL	Yes	
	D8183-17	Reinforcement Plate 18"	D8188-16	2	ITS	CL	Yes	
	D8183-18	Reinforcement Plate 14"	D8188-17	4	ITS	CL	Yes	
	D8183-19	Reinforcement Plate 8"	D8188-18	12	ITS	CL	Yes	
	D8183-20	Cylinder (R.L.D.)	D8188-19	2	ITS	CL	Yes	
	D8183-21	Discharge Filter MTG Plate	D8188-20	1	Non-ITS	CM	No	Does not function to contain media offgas. This is the internal rack used to hold the discharge filter.
	D8183-22	Slide Gate Assembly	D8215-2	8	ITS	CL	Yes	
	D8183-23	Lifting Lug	88218	4	Non-ITS	CM	No	Does not function to contain media offgas. Lifting lugs do not form part of the pressure boundary and are only used to handle the housing for transportation and installation.
	D8183-24	Plate (12x62)	1/4 PL 316L SS	8	ITS	CL	Yes	
	D8183-25	Plate (120)	1/4 PL 316L SS	8	ITS	CL	Yes	
	D8183-26	Plate (84)	1/4 PL 316L SS	2	ITS	CL	Yes	
D8183-27	Plate (8.25)	3/8 PL 316L SS	8	ITS	CL	Yes		
D8183-28	Plate (5.62)	3/8 PL 316L SS	20	ITS	CL	Yes		

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	GLCM	GGD	COMMENTS
	D8183-28	I-Beam (131.88)	6 X 12.3 # HR3	8	ITS	OL	Yes	
	D8183-30	I-Beam (120)	6 X 12.3 # HR3	8	ITS	OL	Yes	
	D8183-31	I-Beam (84.3)	6 X 12.3 # HR3	2	ITS	OL	Yes	
	D8183-32	Pipe Y.O.E. (4.5)	1/2 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-33	Pipe Y.O.E. (12)	3 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-34	Pipe (25.42)	3 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-35	Pipe (18.00)	2 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-36	Pipe (8.88)	2 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-37	Pipe (8.88)	2 SCH 40 316L SS	19	ITS	OL	Yes	
	D8183-38	Pipe (8.36)	8 SCH 40 316L SS	8	ITS	OL	Yes	
	D8183-39	Pipe (8.36)	14 SCH 40 316L SS	1	ITS	OL	Yes	
	D8183-40	Weld Neck Flange	2 X 180# 316L SS	2	ITS	OL	Yes	
	D8183-41	Slip-on Flange	6 X 150# 316L SS	12	ITS	OL	Yes	
	D8183-42	Weld Neck Flange	14 X 180# 316L SS	4	ITS	OL	Yes	
	D8183-43	90° Elbow	2 SCH 40 316L SS	2	ITS	OL	Yes	
	D8183-44	Hex HD Bolt	HEX HD BOLT (1.75)	24	ITS	OL	Yes	
	D8183-45	Bag-out Flange	D8188-22	2	ITS	OL	Yes	
	D8183-46	Door Flange	D8188-23	2	ITS	OL	Yes	
	D8183-47	Re-Bar Flange	D8188-24	2	ITS	OL	Yes	
	D8183-48	Round Bar	1/4 DIA ROUND BAR 316L SS	A/R	Non-ITS	CM	No	Does not function to contain meter or gas. This round bar is used to help hold a bag in place during a discharge filter bag-in-bag-out operation.
	D8183-49	Pipe Support Assy	D8228-1	1	ITS	OL	Yes	
	D8183-50	Pipe Support Assy	D8228-2	2	ITS	OL	Yes	
	D8183-51	Reinforcement PL (17.3 OD)	3/8 PL 316L SS	3	ITS	OL	Yes	
	D8183-52	Reinforcement PL (15.3 OD)	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8183-53	Reinforcement PL (18 OD)	3/8 PL 316L SS	2	ITS	OL	Yes	
	D8183-54	Reinforcement PL (4.88 OD)	3/8 PL 316L SS	3	ITS	OL	Yes	
	D8183-55	Pipe Support Assy	D8574	1	ITS	OL	Yes	
	D8183-56	Plug	3/8 PL 316L SS	1	ITS	OL	Yes	
D8188	D8188-1	Back Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
Housing W/DMT	D8188-2	Front Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
Details	D8188-3	Front Panel	3/8 PL 316L SS	2	ITS	OL	Yes	
	D8188-4	Bottom Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-5	Top Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-6	Top Panel w/ Hole	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-7	Top Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-8	Top End Panel	3/8 PL 316L SS	2	ITS	OL	Yes	
	D8188-9	Int End Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-10	Outlet End Panel	3/8 PL 316L SS	1	ITS	OL	Yes	
	D8188-11	Hopper Side Mesh Bed	3/8 PL 316L SS	6	ITS	OL	Yes	
	D8188-12	Hopper Side Guard Bed Panel	3/8 PL 316L SS	8	ITS	OL	Yes	
	D8188-13	Hopper End Mesh Bed Panel	3/8 PL 316L SS	6	ITS	OL	Yes	
	D8188-14	Hopper End Guard Bed Panel	3/8 PL 316L SS	6	ITS	OL	Yes	
	D8188-15	Hopper Bottom Panel	3/8 PL 316L SS	6	ITS	OL	Yes	
	D8188-16	Manway Flange	3/4 PL 316L SS	2	ITS	OL	Yes	
	D8188-17	Manway Cover	1/2 PL 316L SS	2	ITS	OL	Yes	
	D8188-18	Reinforcement Plate 16"	3/4 X 1 RECT BAR 316L SS	2	ITS	OL	Yes	
	D8188-19	Reinforcement Plate 14"	3/4 X 1 RECT BAR 316L SS	1	ITS	OL	Yes	
	D8188-20	Reinforcement Plate 8"	3/4 X 1 RECT BAR 316L SS	12	ITS	OL	Yes	
	D8188-21	Cylinder 18" I.D.	3/8 PL 316L SS	2	ITS	OL	Yes	
	D8188-22	Bag-out Flange	3/8 PL 316L SS	2	ITS	OL	Yes	
	D8188-23	Door Flange	3/4 X 5 RECT BAR 316L SS	2	ITS	OL	Yes	
	D8188-24	Re-Bar Flange	1 X 3 RECT BAR 316L SS	2	ITS	OL	Yes	
D8186	D8186-1	Plate (32.88)	1/4 PL 316L SS	1	Non-ITS	CM	No	Does not function to contain meter or gas. This is the internal rack used to hold the discharge filter.
Discharge Filter MTG	D8186-2	Plate (31.36)	1/4 PL 316L SS	1	Non-ITS	CM	No	Does not function to contain meter or gas. This is the internal rack used to hold the discharge filter.
Plate	D8186-3	Plate (23.75)	1/4 PL 316L SS	1	Non-ITS	CM	No	Does not function to contain meter or gas. This is the internal rack used to hold the discharge filter.
	D8186-4	Plate (21.75)	1/4 PL 316L SS	4	Non-ITS	CM	No	Does not function to contain meter or gas. This is the internal rack used to hold the discharge filter.

Drawing Number	Item No.	Description	Material or Vendor	QTY	IT/Non-ITS	CL/CM	CSB	COMMENTS
	D8186-3	2-Bar (8.18)	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain meter orfuge. This is the internal rack used to hold the discharge filter.
	D8186-6	2-Bar (8.68)	12GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain meter orfuge. This is the internal rack used to hold the discharge filter.
	D8186-7	Strip	30GA SHY 316L SS	4	Non-ITS	CM	No	Does not function to contain meter orfuge. This is the internal rack used to hold the discharge filter.
	D8186-8	Pull Rod	1/8GA SHY 316L SS	2	Non-ITS	CM	No	Does not function to contain meter orfuge. This is used to help remove the discharge filters during the bag-in/bag-out operation.
D8215 Side Gate Assembly	D8215-1	Pipe	8 SCH 40 316L SS	1	ITS	CL	Yes	
	D8215-2	Flange	1 PLATE 316L SS	1	ITS	CL	Yes	
	D8215-3	Flange	1 PLATE 316L SS	1	ITS	CL	Yes	
	D8215-4	Side	7GA SHY 316L SS	1	ITS	CL	Yes	
	D8215-6	O-Ring	1/4 DIA SOLID NEOPRENE	1	ITS	CL	Yes	
	D8215-8	Hex HD Bolt	3/4-10 UNC 316 SS	8	ITS	CL	Yes	
	D8215-7	Hex Nut	3/4-10 UNC 316 SS	8	ITS	CL	Yes	
D8215-9	Lock Washer	3/4 I.D. 316 SS	8	ITS	CL	Yes		
D8217 Housing Weldment	D8217-1	Adsorber Assembly	D8179	1	ITS	CL	Yes	The pipe coupling called out as part of this assembly functions to contain meter orfuge. Therefore, the whole assembly is designated ITB. * For Item D8217-1 should refer to drawing D8179 for the safety / quality designation and CSB requirements.
	D8217-2	Back Panel	D8188-1	1	ITS	CL	Yes	
	D8217-3	Front Panel	D8188-2	1	ITS	CL	Yes	
	D8217-4	Bottom Panel	D8188-3	1	ITS	CL	Yes	
	D8217-5	Top Panel	D8188-4	1	ITS	CL	Yes	
	D8217-6	Top Panel V-Holes	D8188-5	1	ITS	CL	Yes	
	D8217-7	Top Panel	D8188-6	1	ITS	CL	Yes	
	D8217-8	Top End Panel	D8188-7	2	ITS	CL	Yes	
	D8217-9	Inlet End Panel	D8188-8	1	ITS	CL	Yes	
	D8217-10	Outlet End Panel	D8188-10	1	ITS	CL	Yes	
	D8217-11	Hopper Side Guard Bed Panel	D8188-11	6	ITS	CL	Yes	
	D8217-12	Hopper Side Guard Bed Panel	D8188-12	6	ITS	CL	Yes	
	D8217-13	Hopper End Main Bed Panel	D8188-13	6	ITS	CL	Yes	
	D8217-14	Hopper End Guard Bed Panel	D8188-14	6	ITS	CL	Yes	
	D8217-15	Hopper Bottom Panel	D8188-15	6	ITS	CL	Yes	
	D8217-16	Manway Flange	D8188-16	2	ITS	CL	Yes	
	D8217-17	Reinforcement Plate 16"	D8188-18	2	ITS	CL	Yes	
	D8217-18	Reinforcement Plate 14"	D8188-19	4	ITS	CL	Yes	
	D8217-19	Reinforcement Plate 8"	D8188-20	12	ITS	CL	Yes	
	D8217-20	Cylinder 18" I.D.	D8188-21	2	ITS	CL	Yes	
	D8217-21	Discharge Filter MTG Plate	D8188	1	Non-ITS	CM	No	Does not function to contain meter orfuge. This is the internal rack used to hold the discharge filter.
	D8217-22	8166 Gage Assembly	D8218-3	6	ITS	CL	Yes	
	D8217-23	Lifting Lug	88216	4	Non-ITS	CM	No	Does not function to contain meter orfuge. Lifting lugs do not form part of the pressure boundary and are only used to handle the housings for transportation and installation.
	D8217-24	Plate (120.62)	1/4 PL 316L SS	6	ITS	CL	Yes	
	D8217-25	Plate (120)	1/4 PL 316L SS	6	ITS	CL	Yes	
	D8217-26	Plate (84)	1/4 PL 316L SS	2	ITS	CL	Yes	
	D8217-27	Plate (8.25)	3/8 PL 316L SS	6	ITS	CL	Yes	
D8217-28	Plate (8.82)	3/8 PL 316L SS	20	ITS	CL	Yes		
D8217-29	1-Beam (131.88)	6 X 12.5 # HRB	6	ITS	CL	Yes		
D8217-30	1-Beam (120)	6 X 12.5 # HRB	6	ITS	CL	Yes		
D8217-31	1-Beam (84.5)	6 X 12.5 # HRB	2	ITS	CL	Yes		
D8217-32	Pipe T.O.E. (4.5)	1/2 SCH 40 316L SS	1	ITS	CL	Yes		
D8217-33	Pipe T.O.E. (12)	3/8 SCH 40 316L SS	1	ITS	CL	Yes		
D8217-34	Pipe (23.62)	2 SCH 40 316L SS	1	ITS	CL	Yes		
D8217-35	Pipe (18.00)	2 SCH 40 316L SS	1	ITS	CL	Yes		
D8217-36	Pipe (3.00)	3/8 SCH 40 316L SS	1	ITS	CL	Yes		
D8217-37	Pipe (8.88)	8 SCH 40 316L SS	12	ITS	CL	Yes		
D8217-38	Pipe (8.38)	8 SCH 40 316L SS	6	ITS	CL	Yes		
D8217-39	Pipe (8.38)	1/4 SCH 40 316L SS	1	ITS	CL	Yes		

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Drawing Number	Item No.	Description	Material or Vendor	Qty	ITS/Non-ITS	CL/CM	CGD	COMMENTS
	D8217-40	Weld Neck Flange	2 X 1800 316L SS	2	ITS	CL	Yes	
	D8217-41	Blk-on Flange	8 X 1800 316L SS	12	ITS	CL	Yes	
	D8217-42	Weld Neck Flange	14 X 1800 316L SS	4	ITS	CL	Yes	
	D8217-43	90° Elbow	2 SCH 40 316L SS	2	ITS	CL	Yes	
	D8217-44	Hex HD Bolt	HEX HD BOLT (1.75)	24	ITS	CL	Yes	
	D8217-45	Bag-out Flange	D8188-22	2	ITS	CL	Yes	
	D8217-46	Door Flange	D8188-23	2	ITS	CL	Yes	
	D8217-47	Re-Bar Flange	D8188-24	2	ITS	CL	Yes	
	D8217-48	Round bar	1/4 DIA ROUND BAR 316L SS	A/R	Non-ITS	CM	No	Does not function to contain meter edges. This round bar is used to help hold a bag in place during a discharge then bag-in/bag-out operation.
	D8217-49	Pipe Support Assy	D8226-1	1	ITS	CL	Yes	
	D8217-50	Pipe Support Assy	D8226-2	2	ITS	CL	Yes	
	D8217-51	Reinforcement PL (17.0 OD)	3/8 PL 316L SS	3	ITS	CL	Yes	
	D8217-52	Reinforcement PL (18.5 OD)	3/8 PL 316L SS	1	ITS	CL	Yes	
	D8217-53	Reinforcement PL (18 OD)	3/8 PL 316L SS	2	ITS	CL	Yes	
	D8217-54	Reinforcement PL (4.00 OD)	3/8 PL 316L SS	3	ITS	CL	Yes	
D8217-55	Plug	3/8 PL 316L SS	1	ITS	CL	Yes		
D8218 Base Frame Assembly	D8218-1	W-Beam (276.60)	6 X 318 HRS ASTM A-36	2	ITS	CL	Yes	
	D8218-2	W-Beam (88.98)	6 X 318 HRS ASTM A-36	4	ITS	CL	Yes	
	D8218-3	W-Beam (48.80)	10 X 318 HRS ASTM A-36	8	ITS	CL	Yes	
	D8218-4	Plate	1/2 PL HRS ASTM A-36	8	ITS	CL	Yes	
D8220 Ladder Assembly	D8220-1	Channel (7.12)	4 X 8.46 HRS ASTM A-36	2	ITS	CL	Yes	
	D8220-2	Channel (81.28)	4 X 8.46 HRS ASTM A-36	1	ITS	CL	Yes	
	D8220-3	Flat Bar (191.3)	1/2 X 2 1/2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
	D8220-4	Flat Bar (95.5)	1/2 X 2 1/2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
D8220-5	D8220-5	Flat Bar (6.6)	1/2 X 2 1/2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
	D8220-6	Flat Bar (10.26)	1/4 X 2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
	D8220-7	Pipe	3/4 BAR CS	18	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
	D8220-8	Flat Bar (13.06)	1/4 X 2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
	D8220-9	Flat Bar (8.60)	1/4 X 2 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter edges. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.
D8222 Housing Assembly	D8222-1	Housing Weirment Upr A	D8182	1	ITS	CL	Yes	
	D8222-2	Narrowway Cover	D8181-17	2	ITS	CL	Yes	
	D8222-3	Side Gate Assembly	D8219	8	ITS	CL	Yes	
	D8222-4	Access Door Discharge Filter	D8224	2	ITS	CL	Yes	
	D8222-5	Carbon Sample Plug Assembly	D8284	3	ITS	CL	Yes	
	D8222-6	Electrical Enclosure/gauge panel Assy Unit A	D8285	1	ITS	CL	Yes*	PDI's contain a small amount of insulator oil/gas making the pressure boundary thicker of the PDI's an ITS function. This makes the assembly ITS. * For Item D8222-6, should refer to drawing D8264 for the safety / quality designation and CGD requirements.
	D8222-7	Blind Flange Modified	8 X 1800 316L SS	3	ITS	CL	Yes	
	D8222-8	Blind Flange	8 X 1800 316L SS	8	ITS	CL	Yes	
	D8222-9	Pipe Plug	1 1/4 X 1800 316L SS	3	ITS	CL	Yes	
	D8222-10	Pipe Coupling	1-1/4 X 3000 316L SS	3	ITS	CL	Yes	
	D8222-11	Pipe Coupling	1 1/2 X 3000 316L SS	1	ITS	CL	Yes	
	D8222-12	Pipe T.O.E. (8.38)	1/2 SCH 40 316L SS	5	ITS	CL	Yes	
D8222-13	Pipe T.O.E. (18.50)	1/2 SCH 40 316L SS	2	ITS	CL	Yes		

Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	QL/CM	CGD	COMMENTS	
	D8223-14	Thermowell (27")	88308-2	1	ITS	CL	Yes		
	D8223-16	Thermowell (48")	88308-3	4	ITS	CL	Yes		
	D8223-18	Thermowell (66")	88308-4	4	ITS	CL	Yes		
	D8223-17	Temperature Element (27")	2804100-015	1	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
	D8223-18	Temperature Element (48")	2804100-015	4	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
	D8223-19	Temperature Element (66")	2804100-015	1	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
	D8223-20	Radar Level Detector	2804100-017	1	ITS	CL	Yes		
	D8223-21	Manual Valve 1/2"	2804100-019	8	ITS	CL	Yes		
	D8223-22	Ball Valve 2"	2804100-020	1	ITS	CL	Yes		
	D8223-23	Gasket BIO Door 3/8THK x 1WD	Silicone Closed Cell Sponge	128	ITS	CL	Yes		
	D8223-24	Gasket B Flange		12	ITS	CL	Yes		
	D8223-25	Gasket Manway 3/8THK x 1WD		2	ITS	CL	Yes		
	D8223-26	Hex Nut	1/2-13UNC 316 SS	24	ITS	CL	Yes		
	D8223-27	Hex Nut	3/4-16UNC 316 SS	224	ITS	CL	Yes		
	D8223-28	Hex HD Bol (2.5)	3/4-16UNC 316 SS	32	ITS	CL	Yes		
	D8223-29	Hex HD Bol (3.5)	3/4-16UNC 316 SS	162	ITS	CL	Yes		
	D8223-30	Flat Washer	1/2 I.D. 316 SS	24	ITS	CL	Yes		
	D8223-31	Flat Washer	3/4 I.D. 316 SS	224	ITS	CL	Yes		
	D8223-32	DELETED							
	D8223-33	Special Valve 1/2"	2804100-022	1	ITS	CL	Yes		
	D8223 Housing Assembly	D8223-1	Housing Weldment Unit B	D8217	1	ITS	CL	Yes	
		D8223-2	Manway Cover	D8188-17	2	ITS	CL	Yes	
		D8223-3	Slide Gate Assembly	D8215	8	ITS	CL	Yes	
		D8223-4	Access Door Discharge Filter	D8224	2	ITS	CL	Yes	
		D8223-5	Carbon Sample Pkg Assembly	88384	5	ITS	CL	Yes	
		D8223-6	Electrical Enclosure/gauge panel assy Unit A	D8288	1	ITS	CL	Yes	PDYs contain a small amount of molten oil/gas making the pressure boundary function of the PDYs an ITS function. This makes the assembly ITS. * For Item# D8223-6 should refer to drawing D8283 for the safety / quality designation and CGD requirements.
		D8223-7	Blind Flange Modified	8 X 1508 316L SS	3	ITS	CL	Yes	
		D8223-8	Blind Flange	8 X 1508 316L SS	8	ITS	CL	Yes	
		D8223-9	Pipe Flang	1 1/4 X 1508 316L SS	3	ITS	CL	Yes	
		D8223-10	Pipe Coupling	1 1/4 X 3000A 316L SS	5	ITS	CL	Yes	
		D8223-11	Pipe Coupling	1 1/2 X 3000A 316L SS	1	ITS	CL	Yes	
		D8223-12	Pipe T.O.E. (8.38)	1/2 SCH 40 316L SS	5	ITS	CL	Yes	
D8223-13		Pipe T.O.E. (18.38)	1/2 SCH 40 316L SS	2	ITS	CL	Yes		
D8223-14		Thermowell (27")	88308-2	1	ITS	CL	Yes		
D8223-15		Thermowell (48")	88308-3	4	ITS	CL	Yes		
D8223-16		Thermowell (66")	88308-4	4	ITS	CL	Yes		
D8223-17		Temperature Element (27")	2804100-015	1	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
D8223-18		Temperature Element (48")	2804100-015	4	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
D8223-19		Temperature Element (66")	2804100-015	1	ITS	CM	No	Additional Protection Class (APC), may be purchased as commercial component.	
D8223-20		Radar Level Detector	2804100-017	1	ITS	CL	Yes		
D8223-21		Manual Valve 1/2"	2804100-019	8	ITS	CL	Yes		
D8223-22		Ball Valve 2"	2804100-020	1	ITS	CL	Yes		
D8223-23		Gasket BIO Door 3/8THK x 1WD	Silicone Closed Cell Sponge	128	ITS	CL	Yes		
D8223-24		Gasket B Flange		12	ITS	CL	Yes		
D8223-25		Gasket Manway 3/8THK x 1WD		2	ITS	CL	Yes		
D8223-26		Hex Nut	1/2-13UNC 316 SS	24	ITS	CL	Yes		
D8223-27		Hex Nut	3/4-16UNC 316 SS	224	ITS	CL	Yes		
D8223-28		Hex HD Bol (2.5)	3/4-16UNC 316 SS	32	ITS	CL	Yes		
D8223-29		Hex HD Bol (3.5)	3/4-16UNC 316 SS	162	ITS	CL	Yes		
D8223-30		Flat Washer	1/2 I.D. 316 SS	24	ITS	CL	Yes		
D8223-31		Flat Washer	3/4 I.D. 316 SS	224	ITS	CL	Yes		
D8223-32		DELETED							

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CLICH	COB	COMMENTS
	08224-33	Solenoid Valve, 1/2"	2804105-022	1	ITS	CL	Yes	
08224 Access Door Discharge Filter	08224-1	Plate-1	3/16 PL 316L SS	1	ITS	CL	Yes	
	08224-2	Plate-2	3/16 PL 316L SS	2	ITS	CL	Yes	
	08224-3	Plate-3	3/16 PL 316L SS	2	ITS	CL	Yes	
	08224-4	Flat bar-1	3/4 X 2 RECT BAR 316L SS	2	ITS	CL	Yes	
	08224-5	Flat bar-2	3/4 X 2 RECT BAR 316L SS	2	ITS	CL	Yes	
	08224-6	Flat bar-3	1/4 X 2 RECT BAR 316L SS	1	Non-ITS	CM	No	Does not function to contain meter orifices. This bar is used to make a sling loop for the access door.
08226 Crane Trolley Assembly	08226-1	I-Beam (26')	4 X 7.7# HBS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-2	Square Tube (61.35)	4 X 4 X 1/4 WT HRS	4	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-3	Square Tube (113.76)	4 X 4 X 1/4 WT HRS	6	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-4	Angle (8.00)	2 X 2 X 1/4 WT HRS	7	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-5	Angle (3.60)	2 X 2 X 1/4 WT HRS	2	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-6	Angle (3.60)	2 X 2 X 1/4 WT HRS	2	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-7	Flat Bar (6.00)	1/4 X 2 PL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-8	Flat Bar (67.36)	1/4 X 2 FL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-9	Plate (3.60 X 4.00)	1/4 PL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-10	Plate (6.00 X 6.00)	1/4 PL HRS ASTM A-36	5	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-11	Plate (6.00 X 6.00)	1/4 PL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-12	Plate (7.00 X 7.00)	1/4 PL HRS ASTM A-36	6	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-13	Hex HD Bolt (2.00)	1/2-13UNC GR 8 PL	20	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-14	Hex Nut	1/2-13UNC GR 8 PL	20	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-15	Lock Washer	1/2 NCM 13 GR 8 PL	20	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08226-16	Electric Hoist	HoMaster - Carr	1	Non-ITS	CM	No	Does not function to contain meter orifices. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
08228 Pipe Support Assembly	08228-1	Pipe Support with Gasket	08228-1	1	ITS	CL	Yes	
	08228-2	Pipe Support without Gasket	08228-2	1	ITS	CL	Yes	
	08228-3	I-Beam	6 X 12.5# HRS ASTM A-36	2	ITS	CL	Yes	
	08228-4	Angle	2 X 2 X 1/4 WT HRS ASTM A-36	1	ITS	CL	Yes	
	08228-5	Plate (1.50 X 7.00)	1/4 PL 316L SS	2	ITS	CL	Yes	
	08228-6	Plate (6.50 X 1.50)	1/4 PL 316L SS	4	ITS	CL	Yes	

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CL/CM	CL/CM	Yes/No	COMMENTS
	08225-7	Street	12GA BHT 316L SS	2	ITS	CL	CL	Yes	
	08225-8	Stud	1/2-13UNC X 3.0 LB, 316L SS	4	ITS	CL	CL	Yes	
	08225-9	SC Bolted Washer	1/2-13	4	ITS	CL	CL	Yes	
	08225-10	Hex Nut	1/2-13UNC 316L SS	4	ITS	CL	CL	Yes	
08250	08250-1	Channel (23.28 X 126.08)	3/16 PL HRS ASTM A-36	2	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
Platform Assembly	08250-2	Channel (11.4 X 272.80)	3/16 PL HRS ASTM A-36	3	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-3	Channel (8.9 X 28.26)	3/16 PL HRS ASTM A-36	3	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-4	Channel (8.9 X 28.26)	3/16 PL HRS ASTM A-36	10	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-5	Channel (11.4 X 8.00)	3/16 PL HRS ASTM A-36	6	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-6	Pipe (278.40)	1 1/2 SCH 40 CS	2	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-7	Pipe (30.40)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-8	Pipe (19.40)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-9	Pipe (71.80)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-10	Pipe (48.15)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-11	Pipe (40.50)	1 1/2 SCH 40 CS	6	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-12	Pipe (48.80)	1 1/2 SCH 40 CS	4	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-13	Pipe (41.98)	1 1/2 SCH 40 CS	4	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-14	Pipe (88.73)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-15	Pipe (88.10)	1 1/2 SCH 40 CS	8	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-16	Pipe (58.33)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-17	Pipe (49.53)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-18	Pipe (27.48)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-19	Pipe (18.48)	1 1/2 SCH 40 CS	1	Non-ITS	CM	CM	No	Does not function to contain molten or gas. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CR/CM	CGD	COMMENTS
	08250-20	Angle (6.00 X 7.70)	3/16 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-21	Plate (7.00 X 7.00)	1/4 PL HRS ASTM A-36	8	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-22	Plate (6.00 X 7.00)	1/4 PL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-23	Plate (3.5 X 7.00)	1/4 PL HRS ASTM A-36	8	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-24	Hook (3.00)	1/4 DIA BAR HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-25	Bracket (2.25)	1/4 X 1/2 PL HRS ASTM A-36	4	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-26	Plate (2.81 X 17.60)	3/16 PL HRS ASTM A-36	8	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-27	Plate (2.81 X 8.82)	3/16 PL HRS ASTM A-36	8	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-28	Flat Bar (278.50)	1/4 X 4 FL HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-29	Flat Bar (124.00)	1/4 X 4 FL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-30	Flat Bar (88.75)	1/4 X 4 FL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-31	Flat Bar (28.50)	1/4 X 4 FL HRS ASTM A-36	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-32	Chain (28.00)	3/16 304L SS	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-33	Chain (82.50)	3/16 304L SS	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-34	Grating (28.12 WD X 88.0 LG)	1 1/2 X 3/16 BEARING BAR	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-35	Grating (28.12 WD X 75.0 LG)	1 1/2 X 3/16 BEARING BAR	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-36	Grating (28.88 WD X 75.0 LG)	1 1/2 X 3/16 BEARING BAR	3	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-37	Grating (28.88 WD X 28.5 LG)	1 1/2 X 3/16 BEARING BAR	8	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-38	Angle (28.38)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	2	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	08250-39	Angle (85.25)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	1	Non-ITS	CM	No	Does not function to contain molten orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.

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Drawing Number	Item No.	Description	Material at Vendor	QTY	ITSP/MS-ITB	CL/CR	CRD	COMMENTS
08261 Platform Assembly	D8250-40	Angle (81.25)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8250-41	Channel (8.80 X 83.25)	3/16 PL HRS ASTM A-36	5	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8250-42	Grating Retainer Plate (8.80 X 4.00)	3/16 PL HRS ASTM A-36	12	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-1	Channel (23.28 X 178.00)	3/16 PL HRS ASTM A-36	2	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-2	Channel (11.4 X 272.50)	3/16 PL HRS ASTM A-36	3	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-3	Channel (8.8 X 81.25)	3/16 PL HRS ASTM A-36	3	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-4	Channel (8.8 X 26.50)	3/16 PL HRS ASTM A-36	10	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-5	Channel (11.4 X 8.00)	3/16 PL HRS ASTM A-36	6	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-6	Pipe (278.40)	1 1/2 SCH 40 CS	2	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-7	Pipe (50.40)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-8	Pipe (18.40)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-9	Pipe (71.60)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-10	Pipe (48.15)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-11	Pipe (40.80)	1 1/2 SCH 40 CS	6	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-12	Pipe (40.80)	1 1/2 SCH 40 CS	4	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-13	Pipe (41.90)	1 1/2 SCH 40 CS	4	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-14	Pipe (64.73)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
D8251-15	Pipe (68.10)	1 1/2 SCH 40 CS	6	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.	
D8251-16	Pipe (58.33)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.	
D8251-17	Pipe (45.23)	1 1/2 SCH 40 CS	1	Non-ITB	CM	No	Does not function to contain meter orifices. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.	

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/non-ITS	CLCM	ESD	COMMENTS
	D8251-38	Angle (28.56)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter effluents. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-39	Angle (83.26)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter effluents. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-40	Angle (91.25)	1 1/2 X 1 1/2 X 3/16 ASTM A-36	1	Non-ITS	CM	No	Does not function to contain meter effluents. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-41	Channel (6.00 X 63.25)	3/16 PL HRS ASTM A-36	3	Non-ITS	CM	No	Does not function to contain meter effluents. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
	D8251-42	Grating Retainer Plate (3.00 X 4.00)	3/16 PL HRS ASTM A-36	12	Non-ITS	CM	No	Does not function to contain meter effluents. Platform assembly and all associated parts are external to the pressure boundary and are used for maintenance operations.
D8282 Piping Assembly 14"	D8282-1	Inlet Pipe Assembly	D8282-1	1	ITS	CL	Yes	
	D8282-2	Crosscover Pipe Assembly	D8282-2	1	ITS	CL	Yes	
	D8282-3	Outlet Pipe Assembly	D8282-3	1	ITS	CL	Yes	
	D8282-4	Crosscover Pipe Assembly	D8282-4	1	ITS	CL	Yes	
	D8282-5	Ball Valve V4 Operator	2904100-008 W/ 2904100-011	8	ITS	CL	Yes	
	D8282-6	Weld Neck Flange	14 X 150# 316L SS	18	ITS	CL	Yes	
	D8282-7	Weld Neck Flange	2 X 150# 316L SS	1	ITS	CL	Yes	
	D8282-8	90° Elbow LR	14 SCH 40 316L SS	5	ITS	CL	Yes	
	D8282-9	Straight Tee	14 SCH 40 316L SS	2	ITS	CL	Yes	
	D8282-10	Pipe (Cut at Assembly)	14 SCH 18 316L SS	486 in	ITS	CL	Yes	
	D8282-11	Pipe (6.18)	2 SCH 40 316L SS	1	ITS	CL	Yes	
	D8282-12	Pipe T.O.E. (10.00)	1/2 SCH 40 316L SS	1	ITS	CL	Yes	
	D8282-13	Pipe T.O.E. (3.18)	1/2 SCH 40 316L SS	11	ITS	CL	Yes	
	D8282-14	DELETED						
D8285 Electrical Enclosure	D8282-15	Manual Valve 1/2"	2904100-019	12	ITS	CL	Yes	
	D8282-16	Thermowell	84509-1	1	ITS	CL	Yes	
	D8282-17	Hex HD Bolt	1-8UNC 316 SS	120	ITS	CL	Yes	
	D8282-18	Flat Washer	316 SS	120	ITS	CL	Yes	
	D8282-19	Belows Assy	2904100-021	4	ITS	CL	Yes	
	D8282-20	90° Elbow SR	14 SCH 40 316L SS	1	ITS	CL	Yes	
	D8285-1	Panel (12.00 X 62.80)	12GA SHT 316L SS	1	ITS	CL	Yes	Panel is used for mounting of the PDITs which have an ITS pressure boundary function.
	D8285-2	L-Bar 50"	7GA SHT 316L SS	1	ITS	CL	Yes	Used to mount the electrical enclosures with PDITs to the carbon bed adsorber units. PDITs have an ITS pressure boundary function.
	D8285-3	Enclosure	Hoffman	1	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.
	D8285-4	Sub-Panel	Hoffman	1	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.
	D8285-5	Temp. Transmitter	2904100-008	9	ITS	CM	No	Additional Protection Class (APC); may be purchased as commercial equipment.
D8285-6	DR. Press. X-Miner	2904100-016	2	ITS	CL	Yes		
D8285-7	5 Valve Manifold	Shagelok	2	ITS	CL	Yes		
D8285-8	Mounting Channel	Allen Bradley	ARR	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.	
D8285-9	End Plate	Allen Bradley	10	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.	
D8285-10	End Clamp	Allen Bradley	5	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.	
D8285-11	Marker Card	Allen Bradley	ARR	Non-ITS	CM	No	Does not function to contain meter effluents. Electrical enclosure internal component used for commercial instrumentation.	

Drawing Number	Item No.	Description	Material or Vendor	QTY	ITB/Non-ITB	Q/C/M	C&D	COMMENTS
	06285-12	Terminal	Allen Bradley	106	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-13	Circuit Breaker	Allen Bradley	5	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-14	Spur Block J.Box	Pepperl. Fuchs	2	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-15	Profibus DP Station	2804100-043	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-16	Fiber Optic Repeater	2804100-041	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-17	Fiber Optic Housing	2804100-042	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-18	Power Supply	Phoenix	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-19	Emergency GFCI Recept.	Greco	2	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-20	Wire Duct	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-21	Duct Cover	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-22	Wire Duct	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-23	Duct Cover	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-24	Duct Cover	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-25	Wire Duct	Panduit	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-26	Hex Nut	3/8-16UNC 316 SS	12	ITB	CL	Yes	
	06285-27	Hex HD Bolt 1.00 LG	3/8-16UNC 316 SS	6	ITB	CL	Yes	
	06285-28	Hex HD Bolt 2.00 LG	3/8-16UNC 316 SS	4	ITB	CL	Yes	
	06285-29	Lock Washer	3/8-16UNC 316 SS	12	ITB	CL	Yes	
	06286-30	TVSS	Farrar Shavemut	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-31	Enclosure	Hoffman	2	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06285-32	Circuit Breaker	Allen Bradley	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
06286	06286-1	Panel (12.00 X 62.50)	12GA SHT 316L SS	1	ITB	CL	Yes	Panel is used for mounting of the PDITs which have an ITB pressure boundary function.
Electrical Enclosure	06286-2	2-4x 60"	7GA SHT 316L SS	1	ITB	CL	Yes	Used to mount the electrical enclosures with PDITs to the carbon bed adsorber units. PDITs have an ITB pressure boundary function.
	06286-3	Enclosure	Hoffman	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-4	Sub-Panel	Hoffman	1	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-5	Temp. Transmitter	2804100-008	8	ITB	CM	No	Additional Protection Class (APC), may be purchased as commercial component.
	06286-6	Dir. Press. X-Miter	2804100-016	2	ITB	CL	Yes	
	06286-7	3 Valve Manifold	Swagelok	2	ITB	CL	Yes	
	06286-8	Mounting Channel	Allen Bradley	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-9	End Plate	Allen Bradley	10	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-10	End Clamp	Allen Bradley	5	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-11	Marker Card	Allen Bradley	A/R	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.
	06286-12	Terminal	Allen Bradley	106	Non-ITB	CM	No	Does not function to contain meter or gas. Electrical enclosure internal component used for commercial instrumentation.

Drawing Number	Item No.	Description	Material or Vendor	QTY	ITR-Non-ITS	CM	CR	COMMENTS	
	D8285-13	Circuit Breaker	AJian Bradley	3	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-14	Spur Block J-Box	Pepperl - Fuchs	2	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-15	Profibus DP Station	2804100-045	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-16	Fiber Optic Repeater	2804100-041	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-17	Fiber Optic Housing	2804100-042	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-18	Power Supply	Phoenix	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-19	External GFCI Recept.	Grace	2	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-20	Wire Duct	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-21	Duct Cover	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-22	Wire Duct	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-23	Duct Cover	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-24	Duct Cover	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-25	Wire Duct	Panduit	A/R	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-26	Hex Nut	3/8-18UNC 316 SS	12	ITS	OL	Yes		
	D8285-27	Hex HD Bolt 1.00 LG	3/8-18UNC 316 SS	6	ITS	OL	Yes		
	D8285-28	Hex HD Bolt 2.00 LG	3/8-18UNC 316 SS	4	ITS	OL	Yes		
	D8285-29	Lock Washer	3/8-18UNC 316 SS	12	ITS	OL	Yes		
	D8285-30	TVSS	Ferraz Shawmut	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-31	Enclosure	Hoffman	2	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8285-32	Circuit Breaker	AJian Bradley	1	Non-ITS	CM	No	Does not function to contain meter or gases. Electrical enclosure internal component used for commercial instrumentation.	
	D8287 Piping Assembly 2"	D8287-1	Pipe (Cut at Assembly)	2 SCH 40 316L SS	30R	ITS	OL	Yes	
		D8287-2	Weld Neck Flange	2 X 150R 316L SS	2	ITS	OL	Yes	
		D8287-3	90° Elbow	2 SCH 40 316L SS	6	ITS	OL	Yes	
		D8287-4	Tee	3 SCH 40 316L SS	1	ITS	OL	Yes	
		D8287-5	Gasket		7	ITS	OL	Yes	
		D8287-6	Radius Die		2	ITS	OL	Yes	
		D8287-7	Hex HD Bolt (3.4)	5/8-11UNC 316 SS	12	ITS	OL	Yes	
		D8287-8	Hex HD Bolt (3.00)	5/8-11UNC 316 SS	6	ITS	OL	Yes	
		D8287-9	Hex Nut	5/8-11UNC 316 SS	30	ITS	OL	Yes	
		D8304 Final Assembly	D8304-1	Base Frame Assembly (1A/B)	D8218	1	ITS	OL	Yes
D8304-2	Base Frame Assembly (2A/B)		D8218	1	ITS	OL	Yes		
D8304-3	Housing Assembly (1A)		D8222	1	ITS	OL	Yes		
D8304-4	Housing Assembly (2A)		D8222	1	ITS	OL	Yes		
D8304-5	Housing Assembly (1B)		D8222	1	ITS	OL	Yes		
D8304-6	Housing Assembly (2B)		D8222	1	ITS	OL	Yes		
D8304-7	Platform Assembly (1A/B)		D8250	1	ITS	OL	Yes		
D8304-8	Platform Assembly (2A/B)		D8251	1	ITS	OL	Yes		
D8304-9	Ladder Assembly (1A/B)		D8220	1	Non-ITS	CM	No	Does not function to contain meter or gases. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.	
D8304-10	Ladder Assembly (2A/B)		D8220	1	Non-ITS	CM	No	Does not function to contain meter or gases. Ladder and all associated parts are external to the pressure boundary and form part of the maintenance platform.	
D8304-11	Crane Trolley Assembly (1A/B)		D8226	1	Non-ITS	CM	No	Does not function to contain meter or gases. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.	

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITERATION-ITS	CLC/H	CSD	COMMENTS
	08304-12	Crane Trolley Assembly (2A/B)	D8228	1	Non-ITS	CM	No	Does not function to contain meter origas. Crane trolley and all associated parts are external to the pressure boundary and are used as part of the carbon media loading operation.
	08304-13	Inlet Pipe Assembly (1A/B)	D8282-1	1	ITS	CL	Yes	
	08304-14	Crossover Pipe Assembly (1A/B)	D8282-2	1	ITS	CL	Yes	
	08304-15	Outlet Pipe Assembly (1A/B)	D8282-3	1	ITS	CL	Yes	
	08304-16	Crossover Pipe Assembly (1A/B)	D8282-4	1	ITS	CL	Yes	
	08304-17	Inlet Pipe Assembly (2A/B)	D8282-1	1	ITS	CL	Yes	
	08304-18	Crossover Pipe Assembly (2A/B)	D8282-2	1	ITS	CL	Yes	
	08304-19	Outlet Pipe Assembly (2A/B)	D8282-3	1	ITS	CL	Yes	
	08304-20	Crossover Pipe Assembly (2A/B)	D8282-4	1	ITS	CL	Yes	
	08304-21	Pipe Assembly 2" (1A/B)	D8287	1	ITS	CL	Yes	
	08304-22	Pipe Assembly 2" (2A/B)	D8287	1	ITS	CL	Yes	
	08304-23	Spacer (1/8 THK 4.0 X 4.0)	Alumina Silicate Ceramic	100	ITS	CL	Yes	
	08304-24	Gasket 2"		10	ITS	CL	Yes	
	08304-25	Gasket 14"		20	ITS	CL	Yes	
	08304-26	Hex HD Bolt (1.50)	1/2-13UNC 316 SS	78	ITS	CL	Yes	
	08304-27	Hex HD Bolt (2.00)	1/2-13UNC 316 SS	260	ITS	CL	Yes	
	08304-28	Hex Nut	1/2-13UNC 316 SS	278	ITS	CL	Yes	
	08304-29	Lock Washer	1/2 ID 316 SS	278	ITS	CL	Yes	
	08304-30	Hex HD Bolt (2.50)	3/4-11UNC 316 SS	8	ITS	CL	Yes	
	08304-31	Hex HD Bolt (3.00)	3/4-11UNC 316 SS	16	ITS	CL	Yes	
	08304-32	Hex Nut	3/4-11UNC 316 SS	24	ITS	CL	Yes	
	08304-33	Hex HD Bolt (4.50)	1-8UNC 316 SS	144	ITS	CL	Yes	
	08304-34	Hex HD Bolt (2.50)	1-8UNC 316 SS	144	ITS	CL	Yes	
	08304-35	Hex Nut	1-8UNC 316 SS	144	ITS	CL	Yes	
	08304-36	Insulation	Castom-Silicate	2400 sq'	Non-ITS	CM	No	Does not function to contain meter origas. Insulation is not provided by ICNEX.
	08304-37	High Temperature Adhesive	Castbond R Gold	A/R	Non-ITS	CM	No	Does not function to contain meter origas. Insulation bonding material is not provided by ICNEX.
	08304-38	Sealing Caulk	PERMATYX HI-TEMP RED RTV	A/R	Non-ITS	CM	No	Does not function to contain meter origas. RTV is recommended for sealing the joints of the cladding and is not provided by ICNEX.
	08304-39	Flare Washer	1/2 ID X 1.25 OD 316 SS	842	ITS	CL	Yes	
	08304-40	Name Plate (S/Ns 01 THRU 08)	B8221	1	Non-ITS	CM	No	Does not function to contain meter origas. Nameplate is external to the pressure boundary and is only used to identify the equipment.
	08304-41	3-Way Solenoid Valve	Valcor	12	ITS	CL	No	Valcor solenoid valves have been procured from a qualified supplier. No CGO necessary.
	08304-42	3-Way Solenoid Valve	ASCO	12	Non-ITS	CM	No	Does not function to contain meter origas. This 3-way solenoid valve is used during normal operation to activate the 14 inch butterfly valve to either isolate the units for maintenance or adjust the flow of origas.
08317	08317-1	L-Beam	6 X 12.5# HRS ASTM A-36	2	Non-ITS	CM	No	Does not function to contain meter origas. External to the pressure boundary and is considered a non-pressure piece of plant equipment. Used only for handling the equipment during transportation and installation.
Spreader bar	08317-2	Plate	1.0 PLATE ASTM A-36	4	Non-ITS	CM	No	Does not function to contain meter origas. External to the pressure boundary and is considered a non-pressure piece of plant equipment. Used only for handling the equipment during transportation and installation.
	08317-3	Plate	1.0 PLATE ASTM A-36	4	Non-ITS	CM	No	Does not function to contain meter origas. External to the pressure boundary and is considered a non-pressure piece of plant equipment. Used only for handling the equipment during transportation and installation.

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Drawing Number	Item No.	Description	Material or Vendor	QTY	ITS/Non-ITS	CL/CM	CGD	COMMENTS
	D8317-4	Anchor Studs (25000)	McMaster - Car	12	Non-ITS	CM	No	Does not function to contain maker edges. External to the pressure boundary and is considered a non-permitable piece of plant equipment. Used only for handling the equipment during transportation and installation.
	D8317-5	Slings (11200)	McMaster - Car	4	Non-ITS	CM	No	Does not function to contain maker edges. External to the pressure boundary and is considered a non-permitable piece of plant equipment. Used only for handling the equipment during transportation and installation.
	D8317-8	Name Plate (4.00 X 7.00)	ITGA SHY 304L SS	3	Non-ITS	CM	No	Does not function to contain maker edges. External to the pressure boundary and is considered a non-permitable piece of plant equipment. Used only for handling the equipment during transportation and installation.
D8574 Inlet Pipe Support Assy	D8574-1	I-Beam	6 X 12.50 HAS ANYMASS	1	ITS	CL	Yes	
	D8574-2	Angle (54.85)	2 X 3 X 1/4 ANGLE A375 A-30	1	ITS	CL	Yes	
	D8574-3	Plate (22.38)	1/4 PL 316L SS	1	ITS	CL	Yes	
	D8574-4	Plate (21.38)	1/4 PL 316L SS	1	ITS	CL	Yes	
	D8574-5	Plate (4.00)	1/4 PL 316L SS	4	ITS	CL	Yes	
	D8574-6	Plate (7.00)	1/4 PL 316L SS	2	ITS	CL	Yes	
	D8574-7	Plate (2.75)	1/4 PL 316L SS	2	ITS	CL	Yes	
	D8574-8	Hex HD Bol (2.0)	1/2-13UNC 316 SS	4	ITS	CL	Yes	
	D8574-9	Lock Washer	1/2 I.D. 316 SS	4	ITS	CL	Yes	
	D8574-10	Hex Nut	1/2-13UNC 316 SS	4	ITS	CL	Yes	

NOTE:

Weld filler metal used for pressure boundary welds has been specified ITS. Refer to IONEX CGD plans for dedication requirements specified to stainless steel and carbon steel filler metal.

Table 2 Important to Safety Equipment List (LAW)

IMPORTANT TO SAFETY EQUIPMENT LIST

COMPONENT TAG NO:  
 24590-LAW-MV-LVP-ADBR-00001A/B

Important to Safety function for the activated carbon bed adsorber units for both HLY and LAW is defined in section 3.1.15 of engineering specification 24590-WTP-3PS-MWK0-T0001. This function is defined as containment of reactor effluent during normal, maximum, and design conditions. Pressure boundary must be maintained during and post BC-III event.

Drawing Number	Rev No.	Description	Material or Vendor	QTY	ITS/UNIT	U/LCM	CGD	COMMENTS

NOTE: ITS List shall be added to Table 2, as detailed design work is completed.

## **Appendix A**

### **Mandatory Ammonium Nitrate Test Requirements for LAW Carbon Bed Adsorbers**

# Appendix A

## Mandatory Ammonium Nitrate Test Requirements for LAW Carbon Bed Adsorbers

### 1.0 Purpose

The purpose of appendix A testing is to determine if sufficient amounts of ammonium nitrate can form in the LAW offgas pipeline, in the guard bed, and in the activated carbon bed adsorber media to increase the propagation rate of a bed fire.

### 2.0 Overview

The potential for ammonia and nitrous oxides to form ammonium nitrate within the LAW carbon bed adsorber media is unknown. A significant accumulation of ammonium nitrate within the bed media has been raised as a fire safety concern. It is postulated that ammonium nitrate may increase the rate a bed fire propagates, potentially modifying the current bed-fire mitigation strategy. It should be noted that VSL carbon bed testing has shown large temperature exotherms resulting from NO<sub>x</sub>. It may be necessary to condition the carbon media before testing with large NO<sub>x</sub> concentrations.

### 3.0 Objectives

1. Test 1 - Determine formation of NH<sub>4</sub>NO<sub>3</sub> in the proposed LAW activated carbon adsorber media(s) configuration if the inlet gas contains NO<sub>x</sub> and NH<sub>3</sub>.
2. Test 2 - Assess the hazards associated with NH<sub>4</sub>NO<sub>3</sub> adsorbed in the proposed LAW activated carbon adsorber media(s), (i.e. fire propagation).

### 4.0 Quality Assurance

Tests shall be performed in accordance with the applicable sections of NQA-1. The Test Plan will include a matrix cross-referencing the QA requirements to implementing procedures for the work, and justifying elements that are not applicable.

### 5.0 Test Conditions

Each of the tests in the following sections have been formulated to address the test objectives from Section 3.

The activated carbon beds proposed for the LAW off gas systems will operate under the conditions defined in mechanical data sheets. The appropriate media for each test will be selected and described in the Vendor Test Plan. The Test Plan will detail the test conditions and data collection for each test based on the media and operating conditions.

Testing will be done with a bench scale apparatus using air and water for humidity as the bulk gas.

Carbon test beds shall be insulated such that the temperature drop across the beds does not exceed 1.0 °C with dry hot air passing through the test beds at the test temperature.

- 5.1 Test 1 - Determine  $\text{NH}_4\text{NO}_3$  formation in the proposed LAW activated carbon adsorption system(s).
  - a. Test conditions
    - Sorbent - By vendor
    - Bed residence time - By vendor
    - Superficial gas velocity - by vendor
    - Inlet HEPA temperature - 50 °C (bounding case in exception with mechanical data sheets)
    - Relative humidity - 50 % (bounding case in exception with mechanical data sheets)
    - Gas composition:
      - a. Bulk gas - Air and water vapor
      - b. Other constituents -
        - i. Inlet  $\text{NH}_3$  concentration - 10 ppm
        - ii. Inlet CO concentration - 170 ppm
        - iii. Inlet NO concentration - 4000 ppm
        - iv. Inlet  $\text{NO}_2$  concentration - 4000 ppm
    - Inlet gas HEPA filtered to remove particulate ammonium nitrate formed prior to the carbon bed with two AG-1 certified HEPA filters operating in series.
    - Eight (8) seconds gas residence time to simulate ammonium nitrate formation, prior to HEPA filtration.
    - Residence time from the HEPA filters to the carbon bed is specified as 2.8 seconds.
  - b. Test duration
    - By vendor
  - c. Data to be obtained
    - Inlet and outlet NO,  $\text{NO}_2$ ,  $\text{NH}_3$  concentrations.
    - Quantity of  $\text{NH}_4\text{NO}_3$  - accumulated in the pipeline, HEPAs, and bed media at the end of test.
    - Temperature profile of bed during loading.
- 5.2 Test 2 - Perform standard calorimeter test (i.e., ASTM E 1623-04 or equivalent) to measure exotherm of new bed media compared to bed media containing two years of accumulated ammonium nitrate.
- 5.3 Test 3 - If a substantial quantity of ammonium nitrate or a substantial exotherm is determined, re-run Test 1 and Test 2 with the addition of offgas pre-heat to 70 °C just prior to HEPA filtration.
- 5.4 Test 4 - If a substantial (>140 °F) temperature change is measured in the bed, re-run Test 1 with 50% of the NO and  $\text{NO}_2$  concentrations.

## 6.0 Success Criteria

1. Quantization of ammonium nitrate formed in-situ on bed media, extrapolated to a two-year bed life.
2. Calorimeter test data of new bed media compared to bed media containing ammonium nitrate accumulated in two-years of bed life.
3. If Test 1 does not yield detectable levels of ammonium nitrate on the bed media, detection level shall be assumed and extrapolated to a two-year bed life. If Test 3 does not yield detectable levels of ammonium nitrate on the bed media, Test results shall take special note of this observation with no extrapolation to a two-year bed life.

## **Appendix B**

### **Warranty Testing**

## Appendix B

### Warranty Testing

#### 1.0 Purpose

The purpose of appendix B testing is to validate performance guarantees related to removal efficiencies and design life for the carbon bed adsorber media in a prototypic LAW and HLW offgas.

#### 2.0 Overview

Mercury is present in many of the DOE's mixed wastes including the high-level tank wastes, which will be processed in the WTP. When this waste is processed in the WTP Low-Activity Waste (LAW) and High-Level Waste (HLW) melter systems, the resulting offgas will contain mercury (Hg) and hydrogen fluoride (HF). Sulfur-activated carbon (S-AC) has been successfully used to remove mercury from offgas. However, it has generally been used with elemental mercury and under conditions that are not representative of WTP melter offgas. Concerns related to the adsorption behavior of elemental and oxidized forms of mercury, such as mercuric chloride, have been raised regarding mercury removal efficiency and breakthrough capacity, which could have a direct impact on sizing of the adsorption system and the frequency at which S-AC must be changed. Test apparatus will include two adsorbent columns (lead and lag adsorbers), each with guard and primary activated carbon media as described in the mechanical data sheets (24590-HLW-MVD-HOP-00011, 24590-HLW-MVD-HOP-20011, 24590-LAW-MVD-LVP-00004), representative of the WTP Lead and Lag Adsorbers.

VSL testing demonstrated that a rapid temperature rise resulted when water vapor was introduced to Kombisorb BAT-37. A temperature increase rapidly progressed through the VSL test bed. However, media temperatures quickly returned to normal as the bed became acclimated to water (except for heat losses). Introduction of NO<sub>x</sub> to the Kombisorb BAT 37 resulted in an initial temperature rise followed by a gradual temperature reduction as the media became acclimated to the NO<sub>x</sub> (elevated temperatures continued as long as NO<sub>x</sub> feed continued). Because virgin activated carbon media had a much greater sensitivity to NO<sub>x</sub>, it was necessary to establish a procedure for ramping feed of NO<sub>x</sub> to the bed (referred to as conditioning). The addition of Organics is very important, however acetonitrile (to be used in this phase of the testing) did not show much of a temperature effect. Nonetheless, the INL test plan should include a separate ramp procedure for NO<sub>x</sub> and organics.

VSL testing only evaluated the primary bed material, Kombisorb BAT 37. Because it may be possible that other important temperature effects may exist within the guard bed material, Kombisorb ZA-37, the testing shall also address the effects that the simulant offgas stream composition may have on the guard bed media temperature.

VSL testing identified the need to condition virgin Kombisorb BAT 37 to water, NO<sub>x</sub>, and organics. The Vendor Test Plan shall address conditioning of virgin activated carbon media, based on review of the following VSL steps:

- As NO<sub>x</sub> and organic ramping is initiated, actions should be taken to either stop ramps or reduce rates at a temperature threshold of 120°C.

- As NO<sub>x</sub> and organic approach full rates and during steady state operations, temperatures up to 130°C are permissible.
- Organic feed shall be stopped if activated carbon media temperature exceeds 130°C.
- If at any time the carbon media temperature reaches 140°C, both NO<sub>x</sub> and organic feed shall be stopped.

Steady-state for the activated carbon adsorbers will be reached when the gas outlet temperature for the lag bed operates at less than a 1°C change for one hour and monitoring of total hydrocarbons (THC) is maintained within a 1 to 3% variation for one hour. Once steady-state media temperatures and THC concentrations are reached, introduction of mercury to the test apparatus may be initiated.

### 3.0 Objectives

1. Test 1 - Determine removal efficiency and loading of mercury on the guard and primary beds for the lead and lag adsorbers with HLW simulated offgas. Confirm compliance with removal efficiency requirements and 12 month design life for the HLW lead adsorber. Confirm that the maximum media operating temperatures in the lead and lag adsorbers are below 130°C.
2. Test 2 - Determine removal efficiency and loading of mercury, hydrogen chloride, hydrogen fluoride, and iodine on the guard and primary beds for the lead and lag adsorber with LAW simulated offgas. Confirm compliance with removal efficiency requirements and 24 month design life for LAW lead adsorber. Confirm that the maximum media operating temperatures in the lead and lag adsorbers are below 130°C.

### 4.0 Quality Assurance

Tests shall be performed in accordance with the applicable sections of NQA-1. The Test Plan will include a matrix cross-referencing the QA requirements to implementing procedures for the work, and justifying elements that are not applicable.

### 5.0 Test Conditions

Each of the tests in the following sections have been formulated to address the test objectives from Section 3.

The activated carbon beds proposed for the HLW and LAW off gas systems will operate under the conditions defined in mechanical data sheets (24590-HLW-MVD-HOP-00011, 24590-HLW-MVD-HOP-20011, 24590-LAW-MVD-LVP-00004). The appropriate media for each test will be selected and described in the Vendor Test Plan. The Test Plan will detail the test conditions and data collection for each test based on the media and operating conditions, including steps for conditioning of virgin activated carbon media.

Testing will be done with a bench scale apparatus using air and water for humidity as the bulk gas.

Carbon test beds shall be insulated such that the temperature drop across the beds does not exceed 1.0°C with dry hot air passing through the test beds at test temperatures. Heat tracing may also be used in combination with the insulation as a means to compensate for differences between size of the test apparatus and the WTP activated carbon units. If heaters are used, the minimum number of zone controls shall be 4 (1 for the guard and 1 for the primary activated carbon media sections in both the lead and lag adsorbers).

5.1 Test 1 - Measure mercury removal efficiency and the mercury profile through the adsorbent bed using a simulated HLW offgas that includes acetonitrile.

A. Test conditions:

- Sorbent - Donau Kombisorb BAT 37 and ZA 37
- Residence time - by vendor, to match Mechanical Data Sheet
- Superficial gas velocity - by vendor, to match Mechanical Data Sheet
- Inlet temperature -  $94^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$
- Mercury concentration -  $52,600 \mu\text{g/dscm} \pm 50 \mu\text{g/dscm}$
- Relative humidity -  $18.6\% \pm 1\%$
- Gas composition (actual composition):
  - a. Bulk gas - Air and water vapor
  - b. Concentration of organic:
    - i. acetonitrile -  $2 \text{ ppm} \pm 0.05 \text{ ppm}$
  - c. Other components
    - i.  $\text{CO}_2$  -  $0.4\% \pm 0.03\%$
    - ii. CO -  $5.2 \text{ ppm} \pm 0.2 \text{ ppm}$
    - iii. NO -  $480 \text{ ppm} \pm 10 \text{ ppm}$
    - iv.  $\text{NO}_2$  -  $370 \text{ ppm} \pm 10 \text{ ppm}$
    - v. HF -  $6.2 \text{ ppm} \pm 0.2 \text{ ppm}$

B. Test duration:

- Initial period to condition the virgin sorbents with the test gases and to reach steady-state operations.
- 100 hours (continuous operation) or until breakthrough of mercury.

C. Data to be obtained:

- Measure Total Hydrocarbons at the outlet of the lead and lag adsorbers
- Measure inlet and outlet mercury concentrations for the lead and lag adsorbers.
- Measure mercury profile in the lead and lag adsorbers (guard and primary beds) at end of test.
- Measure inlet and outlet offgas temperatures of lead and lag adsorbers.
- Measure sulfur content of three representative samples of virgin primary media and three representative samples of primary media taken after completion of testing from the location where maximum bed temperature was reached.
- Media temperature at two equally spaced locations along the centerline of the guard bed and primary bed for both the lead and lag adsorbers (total of 4 per adsorber).
- Time at which breakthrough occurs (if realized) for any adsorbed constituents for the lead and lag adsorbers. Breakthrough is defined as the concentration at which emissions reaches 50% of the specified removal efficiency. For example, breakthrough for mercury would be  $26.3 \mu\text{g/dscm}$  using the DF of 1000 and maximum mercury loading of  $52,552 \mu\text{g/dscm}$  shown in the mechanical data sheets.
- Limits established for step changes to  $\text{NO}_x$  concentrations (and any other limiting gas stream components determined by testing).

D. Calculations:

- Hg removal efficiency and loading (mercury profile) for the lead and lag adsorbers.
- Estimated time for breakthrough of Hg for the lead and lag test adsorbers and for the WTP lead and lag adsorbers. (Mercury concentration specified in section A is the maximum concentration required for removal efficiency calculations. Design life shall be a ratio based on nominal mercury concentration 7,608 µg/dscm.)
- Correlation of lead and lag adsorber guard and primary bed temperatures and offgas constituents.
- Analysis of the impact of key gas components on sorbent temperatures during conditioning and operational phases.

E. Performance:

- Mercury removal efficiency - 99.9%
- Carbon media temperature maintained below maximum operating temperature (130°C)
- Media Design life - 12 months (WTP lead adsorber)

5.2 Test 2 - Measure mercury, hydrogen fluoride, and hydrogen chloride, and Iodine removal efficiencies through the adsorbent beds and organic removal using a simulated LAW offgas that also includes acetonitrile.

A. Test conditions

- Sorbents - Donau Kombisorb BAT 37 and ZA 37
- Residence time - by vendor to match mechanical data sheet
- Superficial gas velocity - by vendor to match mechanical data sheet
- Inlet temperature - 105 °C ± 0.5 °C (*Nominal Condition on Mechanical Data Sheet*)
- Mercury concentration - 24,000 µg/dscm ± 50 µg/dscm
  - i. Elemental mercury 85wt% ± 1 wt% Hg<sup>0</sup>
  - ii. Oxidized mercury 15wt% ± 1 wt% Hg<sup>+2</sup> (HgCl<sub>2</sub>)
- Relative humidity - 10.2 % ± 1% (*Nominal Condition on Mechanical Data Sheet*)
- Gas composition (actual composition):
  - a. Bulk gas - Air and water vapor
  - b. Concentration of organic:
    - i. acetonitrile - 50 ppm ± 1.5 ppm
  - c. Inlet hydrogen chloride (HCl) concentration - 46 ppm ± 1.5 ppm
  - d. Inlet hydrogen fluoride (HF) concentration - 2.8 ppm ± 0.1 ppm
  - e. Inlet iodine (I) concentration - 1.0 ppm ± 0.1 ppm
  - f. Other components:
    - i. Inlet CO concentration - 480 ppm ± 10 ppm
    - ii. Inlet NO concentration - 3800 ppm ± 50 ppm
    - iii. Inlet NO<sub>2</sub> concentration - 5600 ppm ± 50 ppm
    - iv. Inlet CO<sub>2</sub> concentration - 1.2% ± 0.5%
    - v. Inlet SO<sub>2</sub> concentration - 5.0 ppm ± 0.1 ppm

B. Test duration:

- Initial period to condition the virgin sorbent with the test gases and to reach steady-state operations.
- 100 hours or until breakthrough of mercury (Continuous).

C. Data to be obtained:

- Measure Total Hydrocarbons at the outlet of the lead and lag adsorbers
- Measure inlet and outlet mercury concentrations for the lead and lag adsorbers.
- Measure mercury profile in the lead and lag adsorbers (guard and primary beds) at end of test.
- Measure inlet and outlet hydrogen fluoride concentrations of the lead and lag adsorbers.
- Measure inlet and outlet hydrogen chloride concentrations of the lead and lag adsorbers.
- Measure inlet and outlet Iodine concentrations of the lead and lag adsorbers.
- Measure inlet and outlet organic concentrations of the lead and lag adsorbers.
- Measure inlet and outlet offgas temperatures of the lead and lag adsorbers.
- Measure sulfur content of three representative samples of virgin primary media and three representative samples of primary media taken after completion of testing from the location where maximum bed temperature was reached.
- Media temperature at two equally spaced locations along the centerline of the guard bed and primary bed for both the lead and lag adsorbers (total of 4 per adsorber).
- Time at which breakthrough occurs (if realized) for any adsorbed constituents for the lead and lag adsorbers.
- Limits established for step changes to NO<sub>x</sub> concentrations (and any other limiting gas stream components determined by testing).

D. Calculations:

- Mercury removal efficiency and loading (mercury profile) for the lead and lag adsorbers.
- Estimated time for breakthrough of mercury for the lead and lag test adsorbers and for the WTP lead and lag adsorbers. (Mercury concentration specified in Section A is the maximum concentration required for DRE. Design life shall be a ratio based on nominal mercury concentration 320 µg/dscm).
- Iodine removal efficiency and loading for the lead adsorber.
- Estimated time for breakthrough of iodine for the test lead and lag test adsorber and for the WTP lead and lag adsorbers.
- Hydrogen fluoride removal efficiency and loading for the lead adsorber.
- Estimated time for lead and lag adsorber breakthrough of hydrogen fluoride for the lead and lag test adsorbers and for the WTP adsorbers.
- Hydrogen chloride removal efficiency and loading for the lead and lag adsorbers.
- Estimated time for breakthrough of hydrogen chloride for the lead and lag test adsorber and for the WTP adsorbers.
- Correlation of lead and lag adsorber guard and primary bed temperatures and offgas constituents.
- Analysis of the impact of key gas components on sorbent temperatures during conditioning and operational phases.

E. Performance:

- Mercury removal efficiency - 99.8%
- Hydrogen chloride removal efficiency - 97%
- Hydrogen fluoride removal efficiency - 97%

- Iodine removal efficiency - 99%
- Carbon media temperature maintained below maximum operating temperature (130°C)
- Design life - 24 months (WTP lead adsorber)

## 6.0 Success Criteria

1. Verification that specified removal efficiencies for required offgas constituents are achieved.
2. Quantization of load profiles for required offgas constituents and verification of WTP bed life.
3. Verification that carbon media temperature controls maintain carbon media temperature below its maximum allowable operating temperature of 130°C.

# **Appendix C**

## **Permit Testing**

# Appendix C

## Permit Testing

### 1.0 Purpose

The purpose of appendix C testing is to determine removal efficiency and loading of spiked organics for WTP offgas permitting.

### 2.0 Overview

Test apparatus shall consist of two adsorbent columns (each with guard and primary activated carbon media) as described in mechanical data sheets (MDSs), representing the WTP Lead and Lag Adsorbers.

Permit requirements for the WTP melter offgas systems specify compliance with Maximum Achievable Control Technology (MACT) incinerator standards for mercury and organic (VOC and SVOC) destruction. The WTP project has conducted systems tests at the Vitreous State Laboratory (VSL) of the melter offgas systems, to determine if the offgas systems, as designed, will meet MACT requirements. However, the test carbon bed used at VSL did not contain a guard bed and in other respects (e.g., gas residence time) the VSL test bed was not representative of the WTP carbon bed design. VSL testing has also shown large temperature exotherms exist, resulting from NO<sub>x</sub> and organics (allyl alcohol and naphthalene) in the offgas stream.

VSL testing only evaluated the primary bed material, Kombisorb BAT 37. Because it may be possible that other important temperature effects may exist within the guard bed material, Kombisorb ZA 37, the testing shall also address the effects the simulant offgas stream composition may have on guard bed media temperature.

VSL testing identified the need to condition virgin Kombisorb BAT 37 to water, NO<sub>x</sub>, and organics. The Vendor Test Plan shall address conditioning of virgin activated carbon media, based on review of the following VSL steps:

- As NO<sub>x</sub> and organic ramping is initiated, actions should be taken to either stop ramps or reduce rates at a temperature threshold of 120°C.
- As NO<sub>x</sub> and organic approach full rates and during steady state operations, temperatures up to 130°C are permissible.
- Organic feed shall be stopped if activated carbon media temperature exceeds 130°C.
- If at any time the carbon media temperature reaches 140°C, both NO<sub>x</sub> and organic feed shall be stopped.

Steady-state for the activated carbon adsorbers will be reached when the gas outlet temperature for the lag bed operates at less than a 1°C change for one hour and monitoring of total hydrocarbons (THC) is maintained within a 1 to 3% variation for one hour. Once steady-state media temperatures and THC concentrations are reached, introduction of mercury to the test apparatus may be initiated.

### 3.0 Objectives

1. Test 1 - Determine removal efficiency and loading of mercury, allyl alcohol, and naphthalene on the guard and primary test beds for the lead and lag adsorbers with HLW simulated offgas. Measure

media temperatures and establish maximum allowable changes in NO<sub>x</sub> and allyl alcohol concentrations required to maintain control of bed temperatures due to adsorption and exothermic reactions. Confirm that the maximum media operating temperatures in the lead and lag adsorbers are below 130°C.

2. Test 2 - Determine removal efficiency and loading of mercury, hydrogen chloride, allyl alcohol, and naphthalene on the guard and primary test beds for both lead and lag adsorbers with LAW simulated offgas. Measure media temperatures and establish maximum allowable changes in NO<sub>x</sub> and allyl alcohol concentrations required to maintain control of bed temperatures due to adsorption and exothermic reactions. Confirm that the maximum media operating temperatures for the lead and lag adsorbers are below 130°C.

#### 4.0 Quality Assurance

Tests shall be performed in accordance with the applicable sections of NQA-1. The Test Plan will include a matrix cross-referencing the QA requirements to implementing procedures for the work, and justifying elements that are not applicable.

#### 5.0 Test Conditions

Each of the tests in the following sections have been formulated to address the test objectives from Section 3.

The activated carbon beds proposed for the HLW and LAW off gas systems will operate under the conditions defined in this section of Appendix C. The appropriate media for each test will be selected and described in the Vendor Test Plan. Test media shall be consistent with that proposed for the WTP carbon bed adsorbers. The Test Plan will detail the test conditions and data collection for each test based on the media and operating conditions, including steps for conditioning of virgin activated carbon media.

Testing will be done with a bench scale apparatus using air and water for humidity as the bulk gas. Carbon test beds shall be insulated such that the temperature drop across the beds does not exceed 1.0°C with dry hot air passing through the test beds at test temperatures. Heat tracing may also be used in combination with the insulation as a means to compensate for differences between size of the test apparatus and the WTP activated carbon units. If heaters are used, the minimum number of zone controls shall be 4 (1 for the guard and 1 for the primary activated carbon media sections in both the lead and lag adsorbers).

- 5.1 Test 1 - Measure mercury and allyl alcohol/naphthalene removal efficiencies, using a simulated HLW offgas.

##### A. Test conditions:

- Sorbent - Donau Kombisorb BAT-37 and ZA-37
- Residence time - by vendor, to match Mechanical Data Sheet
- Superficial gas velocity - by vendor, to Match Mechanical Data Sheet
- Inlet temperature - 94°C ± 0.5°C
- Mercury concentration - 52,600 µg/dscm ± 50 µg/dscm
- Relative humidity - 18.6 % ± 1%
- Gas composition:
  - a. Bulk gas - Air and water vapor
  - b. Concentrations of organics:

- i. Allyl alcohol – 1400 ppm  $\pm$  20 ppm (dry)
- ii. Naphthalene – 35 ppm  $\pm$  1 ppm (dry)
- c. Other components (actual composition):
  - i. CO<sub>2</sub> – 1.2%  $\pm$  0.03%
  - ii. CO – 900 ppm  $\pm$  20 ppm
  - iii. NO – 480 ppm  $\pm$  10 ppm
  - iv. NO<sub>2</sub> – 370 ppm  $\pm$  10 ppm
  - v. HF – 6.2 ppm  $\pm$  0.2 ppm

**B. Test duration:**

- Initial period to condition the virgin sorbent with the test gases and to reach steady-state operations.
- 100 hours (continuous operation) or until breakthrough of mercury.

**C. Data to be obtained:**

- Measure Total Hydrocarbons at the outlet of the lead and lag adsorbers
- Measure inlet and outlet mercury concentrations for the lead and lag adsorbers.
- Measure mercury profile in the lead adsorber (guard and primary beds) at end of test.
- Measure inlet and outlet offgas temperatures for the lead and lag adsorbers.
- Measure sulfur content of three representative samples of virgin primary media and three representative samples of primary media taken after completion of testing from the location where maximum bed temperature was reached.
- Measure inlet and outlet allyl alcohol and naphthalene concentrations in the lead and lag adsorbers.
- Media temperature at two equally spaced locations along the centerline of the guard bed and primary bed for both the the lead and lag adsorbers (total of 4 per adsorber).
- Time at which breakthrough occurs (if realized) for allyl alcohol and naphthalene for the lead and lag adsorbers.
- Limits established for step changes to NO<sub>x</sub> and allyl alcohol concentrations (and any other limiting gas stream components determined by testing).

**D. Calculations:**

- Mercury removal efficiency and loading (mercury profile) for the lead and lag adsorbers.
- Estimated time for breakthrough of mercury for the lead and lag test adsorbers and for the WTP lead and lag adsorbers.
- Allyl alcohol and naphthalene removal efficiency and loading for the lead and lag adsorbers.
- Estimated time for breakthrough of allyl alcohol and naphthalene for the lead and lag adsorbers.
- Correlation of guard and primary bed temperatures and offgas constituents for the lead and lag adsorber.
- Analysis of the impact of key gas components on sorbent temperatures during conditioning and operational phases.

E. Performance:

- Mercury removal efficiency - 99.9%
- Carbon media temperature maintained below maximum allowable operating temperature for the media (130°C)

5.2 Test 2 - Measure mercury, hydrogen chloride, allyl alcohol, and naphthalene removal efficiencies using a simulated LAW offgas.

A. Test conditions.

- Sorbents - Donau Kombisorb BAT-37 and ZA-37
- Residence time - by vendor, to match Mechanical Data Sheet
- Superficial gas velocity - by vendor, to Match Mechanical Data Sheet
- Inlet temperature - 105°C ± 0.5°C (*Nominal Condition on Mechanical Data Sheet*)
- Mercury concentration - 24,000 µg/dscm ± 50 µg/dscm
  - i. Elemental mercury 85wt% ± 1 wt% Hg<sup>0</sup>
  - ii. Oxidized mercury 15wt% ± 1 wt% Hg<sup>+2</sup> (HgCl<sub>2</sub>)
- Relative humidity - 10.2% ± 1% (*Nominal Condition on Mechanical Data Sheet*)
- Gas composition:
  - a. Bulk gas - Air and water vapor
  - b. Concentrations of organics:
    - i. Acetonitrile - 50 ppm ± 1.5 ppm
    - ii. Allyl alcohol - 100 ppm ± 3 ppm (dry)
    - iii. Naphthalene - 35 ppm ± 1 ppm (dry)
  - c. Inlet hydrogen chloride concentration - 46 ppm ± 1.5 ppm
  - d. Other components (actual composition):
    - i. Inlet CO concentration - 480 ppm ± 10 ppm
    - ii. Inlet NO concentration - 3800 ppm ± 50 ppm
    - iii. Inlet NO<sub>2</sub> concentration - 5600 ppm ± 50 ppm
    - iv. Inlet CO<sub>2</sub> concentration - 2% ± 0.5%v.
    - v. Inlet SO<sub>2</sub> concentration - 5.0 ppm ± 0.1 ppmB.

B. Test duration:

- Initial period to condition the virgin sorbent with the test gases and to reach steady-state operations.
- 100 hours (continuous operation) or until breakthrough of mercury.

C. Data to be obtained:

- Measure Total Hydrocarbons at the outlet of the lead and lag adsorbers
- Measure inlet and outlet mercury concentrations for the lead and lag adsorbers.
- Measure mercury profile in the lead adsorber (guard and primary beds) at end of test.
- Measure inlet and outlet hydrogen chloride concentrations of the lead and lag adsorbers.
- Measure inlet and outlet allyl alcohol and naphthalene concentrations of the lead and lag adsorbers.
- Measure inlet and outlet offgas temperatures of lead and lag adsorbers.
- Measure sulfur content of three representative samples of virgin primary media and three representative samples of primary media taken after completion of testing from the location where maximum bed temperature was reached.

- Media temperatures at two equally spaced locations along the centerline of the guard bed and primary bed for both the lead and lag adsorbers (total of 4 per adsorber).
- Time at which breakthrough occurs (if realized) for allyl alcohol and naphthalene for the lead and lag adsorbers.
- Limits established for step changes to NOx and allyl alcohol concentrations (and any other limiting gas stream components determined by testing).

D. Calculations:

- Mercury removal efficiency and loading (mercury profile) for the lead and lag adsorbers.
- Estimated time for breakthrough of mercury for the lead and lag test adsorbers and for the WTP lead and lag adsorbers.
- Hydrogen chloride removal efficiency and loading for the lead and lag adsorbers.
- Estimated time for breakthrough of hydrogen chloride for the lead and lag test adsorbers and for the WTP lead and lag adsorbers.
- Allyl alcohol and naphthalene removal efficiency and loading for the lead and lag adsorbers.
- Estimated time for breakthrough of allyl alcohol and naphthalene for the lead and lag adsorbers.
- Correlation of guard and primary bed temperatures and offgas constituents for the lead and lag adsorbers.
- Analysis of the impact of key gas components on sorbent temperatures during conditioning and operational phases.

E. Performance:

- Mercury removal efficiency - 99.8%
- Hydrogen chloride removal efficiency - 97%
- Carbon media temperature maintained below maximum allowable operating temperature for the media (130°C)

## 6.0 Success Criteria

1. Quantization of the removal efficiencies required offgas constituents.
2. Quantization of load profiles for required offgas constituents and determination of WTP bed life.
3. Quantization of carbon media temperature and controls to maintain carbon media below the maximum allowable operating temperature for the activated carbon media of 130°C.

Note that it is possible that the specified test conditions may result in activated carbon media temperatures that do not satisfy the success criteria. In that event, the testing will continue at the reduced allyl alcohol rate that is required to satisfy the success criteria. Because the reduced rate may not satisfy project needs, additional scope for addition of an optional testing may be required to be performed as follows:

Optional Test:

- Retest with the lead bed only on-line to demonstrate the maximum allyl alcohol and naphthalene rates that satisfy the success criteria.

## **Appendix D**

### **WTP Specific Tailoring of ASME AG-1-1997**

# Appendix D

## WTP Specific Tailoring of ASME AG-1-1997

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### 35.0 ASME AG-1, Code on Nuclear Air and Gas Treatment

Revision: 1997 (R2000)

Sponsoring Organization: The American Society of Mechanical Engineers

#### WTP Specific Tailoring

The following tailoring of ASME AG-1 is required for use by the RPP-WTP project as an implementing standard for the use of important-to-safety (ITS) radial HEPA filter systems and the use of ITS axial flow HEPA filters as inhaled units in the Laboratory CSV Exhaust System. Where not specifically identified herein, the remainder of the code requirements are invoked.

Section FK is added as an addendum to ASME AG-1-1997 with the ASME AG-1a-2000 Addenda AG-1 edition invoked on the project.

#### Page 228.9; Article HA-2000 Reference Documents

Revise Article HA-2000 as follows:

Change the code edition of ASME N509 as applied as a referenced (daughter) standard to AG-1 from 1989, reaffirmed December 6, 1996 to 2002.

**Justification:** The version of the ASME N509 Standard currently referenced as a daughter by AG-1 was issued in 1989 and Reaffirmed in 1996. At the time the N509-1989 (R1996) code was selected to be a daughter of AG-1, the ASME AG-1 code did not include requirements for HEPA filter housings. These requirements were later added in the 2000 Addenda to the AG-1 code. The ASME N509-2002 edition does not provide component requirements for HEPA filter housings and HEPA filters but instead refers the user to AG-1 for this information. Therefore, by making this change it will reduce potential redundancies and conflicts.

#### Page 228.16; Subsubarticle HA-4420 Access Doors and Panels

Revise Subsubarticle HA-4420 as follows for remote change housings:

Not applicable. The requirements of this article are not applicable to Remote Change Radial HEPA Filter Housings; the access doors and panels shall satisfy HA-4500, Pressure Boundary Leakage, and HA-5300, Pressure Boundary Leakage Testing.

**Justification:** Remote housings are not designed to "incorporate a means for adjusting compression forces, gasket compression..." There are not hinges or latches in the design and they are not designed for manual operation. Therefore, the requirements described in this code article are not applicable.

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The remote housing design requires remote access, using a grapple to manipulate doors in a cave environment that may become subject to contamination and high radiation fields. The design incorporates low maintenance features not subject to failure (i.e., vertical housings and heavy doors). The housing doors seal by virtue of their weight alone. Door guides are included. A bar placed across the tops of the doors (and pinned in position) is used to ensure the doors remain in place during seismic events.

**Page 228.18; Paragraph HA-4443 Clamping Mechanism**

Revise Paragraph HA-4443 as follows for remote change and safe change radial HEPA housings:

Replace the text with: The requirements of this article are not applicable to Safe Change and Remote Change Radial HEPA Filter Housings. For Safe Change and Remote Change Radial HEPA filter housings, the design shall ensure that the housing knife-edge is embedded into the pliable filter sealant and will provide a seal for the complete perimeter of each filter.

**Justification:** The remote change housings are not side access housings and are not designed for manual operation. There are no clamping mechanisms or filter indexing mechanisms. The weight of the remote filter and differential pressure across the filter is relied upon to ensure that the knife-edge is embedded into the fluid seal.

The safe change housings are front access and are not walk-in style. The filter is not accessed from its side. Therefore, filter retrieval features and filter indexing mechanisms do not apply. A clamping mechanism that is capable of moving the filter (e.g., for side access housings) is not required. The safe change housings are designed to allow a person to insert and remove each filter.

**Subarticle FK-4100 General Design**

Revise second paragraph of Subarticle FK-4100 as follows for remote change and safe change radial HEPA filter designs:

Replace the text with: For Remote Change and Safe Change Radial HEPA Filters, the total media area provided within the filter pack shall be such that maximum media velocity is 6.5 ft/min (2.0 m/min) at the rated flow.

**Justification:** The RPP-WTP radial filter design is based upon a UK Atomic Energy Standard Specification AESS 30/95100. This standard contains an equivalent requirement to that found in AG-1. It states: "The effective area of filter medium used for each insert shall be not less than 3.0 sq m for every 100 l/s rated airflow." The Project proposes to meet this criterion. Converting these metric units for a UK 950 l/s (~2,000 cfm) rated filter equates to approximately 6.5 ft/min media velocity or a minimum of 308 sq. ft of media.

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The DOE Nuclear Air Cleaning Handbook (Reference DOE-HDBK-1169-2003 Chapter 2.3.7 and Figure 2.8(a)) illustrates the importance and intent behind this code requirement. AG-1 Subsubarticle FK-1130 states that a HEPA filter shall have "a minimum efficiency of 99.97% (that is, a maximum particle penetration of 0.03%) for 0.3 micrometer diameter test aerosol particles." This defines the minimum performance of a HEPA type filter. The curves depicted in Figure 2.8(a) of the Handbook show that at 10.5 ft/min air velocity, the 0.30-micron particle size can be expected to penetrate a HEPA filter such that the AG-1 FK-1130 performance requirement would not be met.

Numerous aerosol penetration tests have been performed on the proposed filter design both inside prototype housings and on individual prototype radial filters designed with a media area of 236 sq. ft., or approximately 8.5 ft/min media velocity. Each test demonstrated that a filter design with media velocities of this magnitude would meet the qualification performance requirements as stated in AG-1 (e.g., 99.97% efficiency or better for penetration of 0.3-micron particles).

The proposed RPP-WTP design uses a filter with approximately 325 sq. ft. of effective media area, or a media velocity of approximately 6.1 ft/min. This represents a small improvement on the UK design and therefore continues to meet the UK Standard requirement.

Further addition of filter media to meet the more restrictive AG-1 Section FK requirement would possibly result in other undesirable design and performance characteristics (e.g., increased DP, reduced pleat spacing). The filter geometry is also limited by many other design restrictions including: available building space, personnel filter handling limitations, and waste disposal package limitations.

**Table FK-4000-1**

Revise Table FK-4000-1 rating information for the 2,000 acfm filter as follows for remote change and safe change HEPA radial filter designs:

**TABLE FK-4000-1 (TAILORED)  
TYPE 1 RADIAL FLOW HEPA FILTER - NOMINAL RATINGS**

Maximum Rated Air Flow		Maximum Resistance	
(acfm)	(m <sup>3</sup> /hr)	Inches WC	Pa
40	68	1.3	325
100	170	1.3	325
250	435	1.3	325
500	850	1.3	325

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1000	1700	1.3	325
1500	2550	1.3	325
2000	3400	1.6	400

**Justification:** A new filter design is being developed with the intent of qualifying it in accordance with the AG-1 code. The RPP-WTP radial flow HEPA filter design originated from UK Atomic Energy Standard Specification AESS 30/95100. The radial flow HEPA filters will be designed for a maximum initial pressure drop of approximately 1.55 inches WC at a rated flow of 2,000 cfm. This is just slightly greater than (~delta of 0.15 inches WC) the acceptance criterion stated in UK Atomic Energy Standard Specification AESS 30/95100. This increase in observed pressure drop is primarily due to small design differences between the UK design and the design proposed for use in the RPP-WTP. These differences include increases in filter pack depth, increases in inboard to media pack gaps (used to enhance protection of the media), and space to accommodate the filter gel seal channel. The UK filter pack depth is approximately 68mm or ~2.7 inches. The RPP-WTP filters are available in 1-inch increment pack depths with a 3-inch pack depth proposed for use on the RPP-WTP. The slightly deeper RPP-WTP media pack design will increase the filter media area and increase the removal efficiency for small particles. The benefits gained in the RPP-WTP radial filter design are viewed to outweigh the negligible increase in airflow resistance (~ 3 to 5% of typical filter loading at change-out of filter element).

**Paragraph RK-6211 Flatness and Squareness**

Revise Paragraph FK-6211 (a) as follows for remote change and safe change radial HEPA filter designs:

Type 1 filter flange and end cap tolerances shall meet the following criteria: parallel within  $\frac{1}{8}$  in., flat within  $\frac{1}{16}$  in.

**Justification: TAILORING OF PARALLELISM TOLERANCE:** The tailoring presented above changes the code requirement for flange to end cap parallelism from 1/16 in. to 1/8 in. For the Remote Change Filter, the inlet flange, which includes the gel channel with a nominal width of 3/4 in., creates the seal and supports the filter inside the housing. The outlet end cap is fully suspended inside the housing by the opposite inlet flange (i.e., outlet end cap does not touch the housing and is not used to form the seal). Parallelism to within 1/8 in. will ensure that an adequate housing-to-filter seal is created. For the Safe Change Filter, as with the remote filter, the seal is formed by insertion of a housing knife-edge into a filter gel filled channel with a nominal width of 3/4 in. The gel channel is located on the filter inlet flange. Parallelism to within 1/8 in. will ensure an adequate housing-to-filter seal is created.

**TAILORING OF SQUARENESS TOLERANCE:** The "squareness" tolerance from FK-6211 is being addressed with a tolerance for circular runout as stated in tailoring for FK-6212. Circular runout controls the cumulative variations that may be present in the positional relationship between the inlet flange and outlet end cap. Inspection for circular runout is equivalent to and meets the code requirement to maintain the squareness characteristic while taking into account the entire length of the filter. Maintaining radial

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filter circular runout to within the  $3/32$ " tolerance will ensure the filter forms an adequate seal within the filter housing.

**Paragraph FK-6212 Overall Dimensions**

Replace Paragraph FK-6212 as follows for the remote change and safe change radial HEPA filter design: Type 1 filter length shall be  $(\pm) / -1/4$  in., circular runout of filter flange with respect to the filter end cap shall be within  $3/32$  in., all other dimensions  $\pm 1/16$  in.

**Justification:** "Seal ring" and "seal face" are terms specific to Section FK radial filters with gaskets and therefore dimensions and tolerances associated with these terms are not applicable to the Type 1 gel seal radial filters to be used at the RPP-WTP.

**TAILORING OF CONCENTRICITY:** Concentricity is the condition in which the axes of all cross-sectional elements of a surface of revolution are common to the axis of a datum feature. Concentricity is being replaced with a tolerance for circular runout as a more practical method to verify roundness. Runout refers to the result of rotating a part about its central axis while measuring with a dial indicator its surface deviation from perfect roundness. With circular runout, the dial indicator is not moved along the direction of the axis of the part (as with "total runout"). Circular runout is therefore applied independently at each single circular element along the length of the part as the part is rotated through 360 degrees. The tolerance for circular runout provided in the tailored text controls the cumulative variations that may be present in the positional relationship between the inlet flange and outlet end cap. The  $3/32$  in. tolerance provided for circular runout will ensure the filter forms an adequate seal within the filter housing.

**TAILORING OF GENERAL DESIGN TOLERANCE OF  $\pm 1/16$  IN.:** REPLACE: "all other dimensions  $\pm 1/16$  in." WITH: "all other dimensions  $\pm 1/16$  in. with exception that design filter media to faceguard gap shall be  $\pm 1/8$  in. (i.e., to maintain a minimum media to faceguard gap of  $1/8$ ").

**Justification:** The proposed design is verified to be safe through end required filter qualification testing as described in Section FK-5100.

**Section FG Mounting Frames**

Not Applicable.

**Justification:** The ASME Committee on Nuclear Air and Gas Treatment (CONAGT) has stated that Section FG only applies to walk-in housings. None of the filter housings (i.e., radial or axial filter designs) to be installed on the RPP-WTP Project is a "walk in" design. Reference ASME Technical Interpretation File # 05-990, RPP-WTP CCM # 107935).

**Page 607; Paragraph TA-4632 Airflow Distribution Test (AD)**

Revise Paragraph TA-4632 as follows for remote change and safe change radial HEPA housings:

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Replace "downstream" with "upstream". Add for clarity: "For Remote Change and Sale Change Radial HEPA filter banks, flow measurement location is upstream vs. code required downstream."

**Justification:** The requirement for flow measurements to be taken downstream of each HEPA filter in a bank is in order to verify equal flow distribution between filters in a bank. In traditional axial flow systems, a measurement location downstream is preferred due to the improvements in the flow conditions (i.e., flow-straightening) inside the housing created by the filter itself. However, due to the difference in configuration created by the radial filter, the flow profile both entering and exiting the filter is extremely complex (i.e., not uniform over the filter face). Testing and analysis (computational fluid dynamic models) performed on prototype units to date have determined that taking the flow measurement upstream and inside the filter (inlet) using a hot wire anemometer provides the most repeatable measurement. Accuracy of the measurement is still hindered by flow conditions and anemometer placement; however, increased precision is obtained by taking an average of multiple measurements at multiple locations within each filter inlet. Predicted results from CFD modeling have agreed with actual field measurements using this technique. The project intends to design (based on the prototype tests) and use an anemometer instrument developed specifically for the radial filter design and place it at the inlet (i.e., upstream) side of the filter. Verification in the field, of acceptable air distribution between filters in a bank can then be accomplished, as the code requires.

Page 607; Paragraph TA-4633      **Air-Aerosol Mixing Test (AA)**

Revise Paragraph TA-4633 as follows for axial housings used as LAB CSV inbleeds:

This article is not applicable to LAB CSV inbleed axial filter housings.

**Justification:** The intent of this test is to verify that the test aerosol is uniformly mixed in the air stream when it reaches the filter in order to verify that each filter in a filter bank is being challenged. This test is concerned primarily with designs and layouts where a single point injection of aerosol in close proximity to the filter bank may result in non-uniform distribution of the test agent.

The Laboratory Facility CSV inbleed housing is designed such that each filter is assigned its own aerosol injection manifold. The manifold design and its proximity to the filters have been qualified to meet the aerosol mixing test criteria presented in AG-1. The housing is not designed to accommodate the air-aerosol mixing field-commissioning test per TA-4633. However, the housing design is not being modified for RPP-WTP use and aerosol mixing, by virtue of the manufacturer test-sections, will not be impacted by the installation in the RPP-WTP Laboratory Facility.

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# **Appendix E**

## **WTP Specific Tailoring of ASME B31.3-1996**

# Appendix E

## WTP Specific Tailoring of ASME B31.3-1996

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### 26.0 ASME B31.3-1996, Process Piping

Revision: 1996  
Sponsoring Organization: ASME

#### WTP Specific Tailoring

The following tailoring of ASME B31.3, *Process Piping*, is required for use by the WTP contractor as an implementing Standard for: (1) the fabrication and installation of those portions of the CSV ductwork that are being embedded in concrete, (2) the use of ASME B16.9 welding tees in accordance with ASME B31.3-2002, (3) use of vacuum box leak testing, and (4) the ASME B31.3-1996, paragraph 345.2.3(c) allowance for not leak testing closure welds outside of inaccessible areas.

- The tailored sections of ASME B31.3 applicable to embedded ductwork will only be utilized to the extent that it will cover the fabrication, installation, and inspection (and associated testing) of Category D fluid service piping being used as CS ductwork. Air testing requirements for this ductwork will be compliant with ASME AG-1. Below is a description of those portions of ASME B31.3 that apply to fabrication, installation, and inspection of Category D fluid service piping and the sections of the SRD that they will apply to.
- The tailored sections of ASME B31.3 applicable to welding tees will only be used for ASME B16.9 welding tees. As long as the stress intensification factors from ASME B31.3-2002 are used in the stress analysis for the welding tees, welding tees fabricated to either the 1996 or the 2002 edition of ASME B31.3 can be used. Below is a description of those portions of ASME B31.3, Appendix D, Table D300, that apply to welding tees and the section of the SRD to which they will apply.
- The tailored paragraphs of ASME B31.3 applicable to vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, will only be used to leak test full penetration circumferential piping field butt welds inside an inaccessible area (as defined in Appendix F, Section A.0) out to the first isolation component outside the inaccessible area. Further, if the 100 % volumetric inspection using ultrasonic examination per ASME B31.3 paragraph 344.6, is conducted for welds to be vacuum box tested, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction.
- The tailored paragraphs of ASME B31.3 adopting the provisions of ASME B31.3 (c) - 1996 Addendum paragraph 345.2.3(c) are applicable to all ASME B31.3 piping in all facilities except for closure welds in accessible areas.

Piping providing a confinement function in accordance with SRD 4.4-3 will comply with the following sections of ASME B31.3-1996, *Process Piping*. These sections of ASME B31.3 are applicable for embedded ductwork.

Chapter 3, Materials

Chapter 5, Fabrication

Table 341.3.2, Visual acceptance criteria for Category D fluid service piping

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**Justification:** Due to wall thickness requirements of duct embedded in concrete, piping materials are required. ASME B31.3 will apply to materials, fabrication, and inspection standards as appropriate. Testing requirements for nuclear air treatment systems will be consistent with ASME AG-1.

**Piping providing a confinement function in accordance with SRD 5.1-2 will comply with the following sections of ASME B31.3-1996, Process Piping. These sections of ASME B31.3 are applicable for embedded ductwork.**

Chapter 3, Materials

Chapter 5, Fabrication

Table 341.3.2, Visual acceptance criteria for Category D fluid service piping

**Justification:** Due to wall thickness requirements of duct embedded in concrete, piping materials are required. ASME B31.3 will apply to materials, fabrication, and inspection standards as appropriate. Testing requirements for nuclear air treatment systems will be consistent with ASME AG-1.

**Piping providing a confinement function in accordance with SRD 4.2-2 will comply with ASME B31.3-1996, Process Piping, with the following modification:**

In Table D300, the description of welding tee per ASME B16.9 shall be revised so it is consistent with that shown in Table D300 of ASME B31.3-2002:

Description	Flexibility Factor $k$	Stress Intensification Factor [Notes (2), (3)]		Flexibility Characteristic, $T_c$	Sketch
		Out-of-Plane, $i_o$	In-Plane $i_i$		
Welded tee per ASME B16.9 [Notes (2), (4), (6), (11), (13)]	1	$\frac{D_9}{h^{3/2}}$	$3/4 i_o + 1M$	$3.1 \frac{T_c}{r_2}$	Same as ASME B31.3-1996

This means that for welding tees per ASME B16.9, note 11 in Table D300 is also changed to:

(11) If  $r_2 \geq 1/8D$ , and  $T_c \geq 1.5T_c$ , a flexibility characteristic of  $4.4 \frac{T_c}{r_2}$  may be used.

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**Justification:** The use of a lower flexibility characteristic for welding toes per ASME B.16.9 in accordance with ASME B31.3-2002 will increase both the out-of-plane and in-plane stress intensification factors. The increased stress intensification factors will reduce the allowable out-of-plane and in-plane moments that can be applied to the welding toe and keep the calculated stress below the stresses allowable by ASME B31.3-1996.

Important to Safety piping within the scope of SRD 4.2-2 shall comply with ASME B31.3-1996, Chapter V, Paragraph 345, using the following approach for vacuum box leak testing. Vacuum box leak testing, in lieu of hydrostatic or pneumatic leak testing, may be used to leak test (a) penetration circumferential piping, field butt welds inside an inaccessible area (as defined in Appendix H, Section 6.0) out to the first isolation component outside the inaccessible area, only under the following conditions:

**Vacuum Box Leak Test Method** - The vacuum box leak test shall be in accordance with a Bubble Test - Vacuum Box Technique method specified in ASME B1V Code, Section V, Article 10, Appendix II, subject to the requirements listed below:

- (a) Sensitivity of the test shall be demonstrated to be not less than  $1E-3$  atm-ml/sec at 15 psig.
- (b) The test pressure shall be a partial vacuum of at least 7 psi below atmosphere, applied to the outside of the weld.
- (c) The required partial vacuum shall be maintained for at least 20 sec examination time.

In addition, the following limitations and restrictions shall apply to the application of vacuum box leak testing in lieu of a hydrostatic or a pneumatic leak test:

- Vacuum box leak testing will only be used to leak test circumferential piping field welds inside an inaccessible area (as defined in Appendix H, Section 6.0). This includes any welds in extensions of piping systems contained or originating in accessible areas between the inaccessible area boundary and the first isolation valve or device beyond the inaccessible area boundary;
- It shall only be used for piping field welds where required to avoid damage to components, ensure the safety to construction workers, perform leak tests of field welds where physical limitations prevent hydrostatic or pneumatic leak testing as prescribed in ASME B31.3-1996 paragraph 345.4 and paragraph 345.5 respectively;
- Pipe welds that are to be vacuum box leak tested will be assessed for suitability. The number of welds to be vacuum box leak tested shall be limited to a maximum of three welds between termination points (two termination or closure welds and one intermediate weld) on a given pipe system except where physical limitations prevent examination by hydrostatic or pneumatic leak testing. DOE will be informed of such exceptions, and may at its discretion and within 48 hours of being informed, respond to BNJ on the suitability of the use of vacuum box leak testing for such instances. Termination points may be tanks, vessels, valves, etc. (Specifically excluded from the definition of termination point are junctions where the piping changes design class). This could be either the last two closure welds in an inaccessible area or the last closure weld in the inaccessible area and the last closure weld outside the

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inaccessible area. In addition, vacuum box leak testing would be permitted for the connection welds between construction modules if this is limited to one module-to-module weld per piping run within the cells. This is in addition to termination welds on the piping run. A module is defined as a pre-leak-tested subassembly containing multiple pipe spools;

- Vacuum box leak testing shall be limited to full penetration girth butt welds, on straight pipe or between straight pipe and pipe components of the same nominal pipe size and same wall thickness on both sides of the weld at the weld location. The following configurations are candidates for vacuum box testing:
  - (a) Straight pipe to straight pipe connection butt welds
  - (b) Straight pipe to 90° elbow connection butt welds
  - (c) Straight pipe to 45° elbow connection butt welds
  - (d) Straight pipe to concentric reducer connection butt welds
  - (e) Straight pipe to eccentric reducer connection butt welds
  - (f) Straight pipe to butt welding tee connection butt welds
  - (g) Straight pipe to butt welding reduced outlet tee connection butt welds
  - (h) Straight pipe to valve nozzle connection butt welds
  - (i) Straight pipe to tank or vessel nozzle connection welds
  - (j) Straight pipe to safe-end of a weldolet connection butt welds - full penetration butt welded connection only
  - (k) Straight pipe to pipe-rap connection butt welds

Prior to the application of vacuum box testing using any of the candidate configurations on piping butt welds at the WTP, the Contractor must successfully demonstrate to the DOE, for the candidate configuration, that (1) all portions of the weld to be inspected are visible and can be inspected in accordance with the ASME Boiler and Pressure Vessel Code, Section V, Article 10, Appendix II - 1995; (2) the vacuum box can adequately maintain a partial vacuum of 7 psid; and (3) vacuum box leak testing can be accomplished in the time limits and other requirements established by this procedure. The DOE shall be advised at least 7 days in advance of any demonstration to qualify a new weld configuration so that they can witness the demonstration. The Contractor shall document any demonstration relied upon to justify the use of vacuum box leak testing on a new configuration. Further, vacuum box leak testing shall be conducted with a vacuum box that completely encapsulates the weld, at the test location;

- All welds shall be 100 % volumetrically inspected in accordance with ASME B31.3-1996, paragraphs 344.5 or 344.6. If the 100 % volumetric inspection is conducted using ultrasonic examination per ASME B31.3-1996 paragraph 344.6, then the ultrasonic examination shall be conducted using a method that creates and maintains a reproducible computerized image(s) of the entire weld in the axial and radial direction;
- It shall be limited to welds made using the Orbital welding machines. The only exception is that vacuum leak box testing may be used on manual welds if the 100 % volumetric inspection was conducted by radiography per ASME B31.3-1996 paragraph 344.5;
- The piping systems and or components on both sides of the weld to be vacuum box leak tested shall have been subjected to a hydrostatic leak test in accordance with ASME B31.3-1996

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paragraph 345.4, a pneumatic test in accordance with ASME B31.3-1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.6, or in the case of components, leak tested in accordance with the Code or Standard applicable to the design of the component;

- At a minimum, a flexibility analysis in accordance with ASME B31.3-1996 paragraphs 319.4.2 (a) and (b) shall be required on any piping systems that contain welds that are to be vacuum leak box tested. In addition, a comprehensive flexibility analysis in accordance with ASME B31.3-1996 paragraphs 319.4.2 (c) and (d) shall be performed on any piping systems that contain welds that are to be vacuum box leak tested when the piping systems have a design temperature greater than or equal to 150 °F;
- For manual welds, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a) through (g) shall be invoked on any weld to be vacuum box leak tested with the exception that the requirement of subparagraph 344.7.1 (c) "... aided by liquid penetrant or magnetic particle examination when specified in the engineering design" shall not be required. For welds made using Orbital welding machines, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a), (b), (c), (d), and (g) shall be invoked. The requirements of 344.7.1 (e) and (f) shall not be required. The implementation of these requirements shall be documented in the weld inspection report;
- Pipe welds and the associated line numbers that are to be vacuum leak box tested shall be identified in advance of the testing. This identification shall be documented in the controlled document Weld List, which must include this information prior to the initiation of any vacuum box leak testing associated with those welds and line numbers. It is understood that the controlled document Weld List may need to be revised and updated periodically through the construction phase of the WTP Project; and
- The following special requirements shall be placed on the training programs used to certify the technicians that will be conducting the vacuum box leak tests:
  1. The BNI Construction Manager shall pre-approve the technician qualifying examination(s) for vacuum box leak testing;
  2. The BNI Construction Manager shall pre-approve the qualifications of each Level III technician preparing or giving the examinations for vacuum box leak testing;
  3. DOE/ORP at their discretion shall reserve the right to observe any and/or all practical leak test examinations and review of the results of any and/or all written vacuum box leak test examinations;
  4. The minimum topical content of each Level II examination shall be specified by BNI and approved by DOE;
  5. The 80 % correct criteria for passing the examination shall apply to each part of the three part examinations that are to be given.
  6. BNI shall provide reasonable assurance that they will take adequate measures to assure the integrity of written examination is maintained; and
  7. There shall be several versions of each examination in use to assure Level II knowledge and ability concerning vacuum box leak testing is confirmed.

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**Justification:** The requirement for the vacuum box leak test sensitivity is consistent with the ASME B31.3 requirement for a sensitive leak test as given in ASME B31.3-1996 paragraph 345.8 and for at least 7 psi vacuum and an examination time of at least 30 seconds. The limitations in using vacuum box leak testing better define when this method can be used. DOE ORP may further change the definition and application of these special vacuum box leak testing criteria based on the Contractor's experience with their use, or the Contractor's request for a change.

**Piping system closure welds outside of inaccessible areas (as defined in SRD Appendix H, Section 6.0) shall comply with the requirements of ASME B31.3-1998, subparagraph 345.2.3(c). When ASME B31.3-1998, subparagraph 345.2.3(c) is invoked the following restrictions shall apply:**

- It shall not be invoked on any closure welds on piping systems in inaccessible areas as defined in Section 6.0 of Appendix H of the SRD. This includes any welds in extensions of piping systems contained or originating in inaccessible areas, between the inaccessible area boundary and the first isolation valve, or device beyond the inaccessible area boundary;
- It shall only be invoked on full penetration butt welds in straight pipe, full penetration butt welds at the safe-end of an equipment nozzle, or full penetration butt welds at the safe-end of branch connections. [The safe-end is defined as the piping to equipment nozzle connecting weld or the branch connection to branch piping connecting welds.];
- The requirements of ASME B31.3(c) - 1998, subparagraph 345.2.3 (c) shall be met;
- The piping systems and or components on both sides of the closure weld shall have been subjected to a hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.4, a parametric leak test in accordance with ASME B31.3-1996 paragraph 345.5, a combination pneumatic-hydrostatic leak test in accordance with ASME B31.3-1996 paragraph 345.6, or in the case of components leak tested in accordance with the Code or Standard applicable to the design of the component;
- For manual welds, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a) through (g) shall be invoked with the exception that the requirement of subparagraph 344.7.1 (e) "...aided by liquid penetrant or magnetic particle examination when specified in the engineering design" shall not be required. For welds made using the Orbital welding machines, the requirements of ASME B31.3-1996 paragraph 344.7.1 (a), (b), (c), (d), and (g) shall be invoked. The implementation of these requirements shall be documented in the weld inspection report;
- Piping welds and the associated line numbers for which the closure weld classification is invoked shall be documented in a controlled document Weld List;
- Piping components may include mechanical elements other than piping; and
- In addition, BNI shall incorporate these requirements into the appropriate specification. DOE-ORP may further change the definition and application on the use of closure welds based on the Contractor's experience with their use or the Contractor's request for a change.

**Justification:** This change does not change the safety function of any pressure boundary components. The requirement to leak test pressure boundary field welds is primarily to ensure the reliability of the welds in addition to the reliability provided by the other required examinations. The exception allowed by ASME B31.3-1998, paragraph 345.2.3 that the final weld connecting piping systems or components which have been successfully tested in accordance with

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paragraph 345 need not be leak tested provided the weld is examined in-process in accordance with paragraph 344.7 (a), (b), (c), (d), and (e) and passes with 100 % radiographic examination in accordance with paragraph 344.6 or 100 % ultrasonic examination in accordance with paragraph 344.6 provides adequate assurance that the weld is reliable and leak tight. The change continues to provide adequate safety since it requires that all piping closure welds that are not leak tested are in-process examined and 100 % volumetrically examined which exceeds the requirements of ASME B31.3-1986 for closure welds that are leak tested. The inability to hydrostatically or pneumatically leak test these closure welds does not affect the soundness of the welds.

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## **Appendix F**

### **WTP Specific Tailoring of AISC (ASD)**

# Appendix F

## WTP Specific Tailoring of AISC (ASD)

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#### 9.0 AISC M016, Manual of Steel Construction, Allowable Stress Design (ASD)

Revision: 9th Edition

Sponsoring Organization: American Institute of Steel Construction

##### WTP Specific Tailoring

The following tailoring of M016 is required for use by the WTP contractor as an implementing standard for design of structural steel for Seismic Category III SSCs.

##### No specific section

Load combinations for design of structural steel members utilize those identified in UBC 97, section 1612.3.

**Justification:** These load combinations represent the commercial requirements for allowable stress design of structural steel. Use of these load combinations will ensure compliance with the commercial design in accordance with the UBC.

##### No specific section

Seismic detailing requirements shall be in accordance with UBC 97, Chapter 22, Division V, section 221A, for moderate seismic risk structures.

**Justification:** The requirements contained in this section obtain accepted industry practice for design of important commercial steel structures. Use of this section will ensure compliance with the commercial design in accordance with the UBC.

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**Appendix G**  
**WTP Specific Tailoring of ASME NQA-1-1989**

# Appendix G

## WTP Specific Tailoring of ASME NQA-1-1989

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### C.37 ASME NQA-1-1989, Quality Assurance Program Requirements for Nuclear Facilities

Revision: 1989

Sponsoring Organization: The American Society of Mechanical Engineers

#### WTP Specific Tailoring

The following tailoring of ASME NQA-1-1989 is required for use by the WTP project as an implementing standard to perform Commercial Grade Dedication activities using ASME NQA-1-2004.

#### **NQA-1-1989, Supplement S-1 Terms and Definitions**

Replace the Commercial Grade Item definition with definition from NQA-1-2004, Part I, Section 400:

**Commercial Grade Item:** a safety class/safety significant structure, system, or component (SSC), or part thereof, that affects its safety function, that was not designed and manufactured in accordance with the requirements of this Standard.

**Justification:** By tailoring NQA-1-1989 to incorporate elements of NQA-1-2004, the Commercial Grade Item definition is broadened to reflect current industry practices related to Commercial Grade Dedication. Currently there are gaps among NQA-1 qualified suppliers and utilization of NQA-1-2004 will enable WTP to employ technically acceptable suppliers not available under the provision of NQA-1-1989. The NQA-1-1989 standard was established primarily to provide for the purchase of replacement parts for nuclear-related facilities and is not sufficient to support the purchase of commodities and equipment needed for a new facility.

Commercial Grade Items may be either off the shelf/catalog items or "engineered items", i.e., items for which some custom design effort is required by the supplier to meet purchaser requirements. If the critical characteristics of an "engineered item" cannot be verified solely based on material or performance attributes, verification of critical design characteristics should be based on NQA-1-2004, Section 704 (e.g., by design verification methods) or by application of alternate standards for qualification of suppliers of Safety Class/Safety Significant items.

#### **NQA-1-1989, Supplement S-3 Terms and Definitions**

Add to the reference section ASME NQA-1-1989, Supplement S-1, the following definitions from NQA-1-2004, Part I, Section 400:

**Commercial Grade Service:** a service that was not provided in accordance with the requirements of this standard.

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**Critical Characteristics:** important design, material, and performance characteristics of a commercial grade item or service that, once verified, will provide reasonable assurance that the item or service will perform its intended safety function.

**Dedication:** an acceptance process performed in accordance with this Standard to provide reasonable assurance that a commercial grade item or service will successfully perform its intended safety function and, in this respect, is deemed equivalent to an item or services provided under the requirements of this Standard.

**Dedicating Entity:** the organization that performs the dedication process.

**Justification:** The tailoring of the NQA-1-1989, by adding definitions of Commercial Grade Service, Critical Characteristic, Dedication, Dedicating Entity, and Safety Function to NQA-1-2004, allows for the use of the Commercial Grade Dedication process to procure equipment requiring design services by the supplier. This incorporates definitions consistent with NQA-1-2004 text.

**NQA-1-1989, Supplement 7S-1                      Supplementary Requirements for Control of  
Purchased Items and Services**

Replace NQA-1-1989 supplement 7S-1 Section 10, Titled Commercial Grade Items in its entirety with NQA-1-2004, Requirement 7, Section 700.

**Justification:** NQA-1-2004 provides greater flexibility for implementing the Commercial Grade Dedication process while assuring that equipment acquired under these processes will support their safety functions.

Modify new Section 701 General as follows:

**701 General**

When Commercial Grade Items or Services are utilized, the dedicating entity can utilize the requirements of this section for procurement and acceptance of items or services as an acceptable alternative to Sections 2 through 9 of this Supplement, except that Supplier evaluation and selection, where determined necessary by the Purchaser, shall be in accordance with Section 3.1 of this Supplement. The applicable requirements of this Standard shall apply to dedication activities for acceptance.

When a Commercial Grade Item has been delivered or installed, prior to the decision to dedicate, the dedicating entity can utilize the requirements of this section for acceptance of the item when the critical characteristics can be verified solely by inspections, tests, or analyses.

**Justification:** Corrects the section numbers to correspond to the appropriate section of NQA-1-1989 and provides for use of Commercial Grade Dedication for delivered and/or installed SSCs whose safety classification is subsequently upgraded.

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Modify (referenced section number only) new Section 704.2 Source Verification as follows:

**704.2 Source Verification**

Source verification is only applicable to the actual item(s) or service(s) that are verified at the Supplier's facility or other applicable location. Source verification shall be performed in accordance with Section 8.2.2 of this Supplement, including a checklist or plan with the documented evidence of the source verification furnished to the dedicating entity and shall include or address the following:

- (a) identification of the item(s) or service(s) included within the scope of the source verification
- (b) identification of the critical characteristics, including acceptance criteria, to be controlled by the Supplier
- (c) verification of the Supplier's processes and controls are effectively implemented for the identified critical characteristics
- (d) identification of the activities witnessed during the source verification and the results obtained
- (e) documentation of the adequacy of the Supplier's processes and controls.

**Justification:** Corrects the paragraph number to correspond to the appropriate section of NQA-1-1989.

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## **Appendix H**

### **WTP Specific Tailoring of IEEE Std. 384**

# Appendix H

## WTP Specific Tailoring of IEEE Std. 384

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#### 19.0 IEEE-384, IEEE Standard Criteria for Independence of Class 1E Equipment and Circuits

Revision: 1992

Sponsoring Organization: The Institute of Electrical and Electronics Engineers, Inc.

##### RPP-WTP Specific Tailoring

The following tailoring of IEEE-384 is required for use by the RPP-WTP project as an implementing standard for SDC, SC, SDS, or SS electrical equipment and circuit design.

##### All Sections Certification of Nuclear Power Generating Station Terminology

The term "Standby Generator" in the Standard is synonymous with "Emergency Generator" in the RPP-WTP.

**Justification:** As determined by the ISM review process, the Standby Generators on the RPP-WTP are not classified as SDC or SC while the Emergency Generators are classified as SDC or SC.

##### Section 2.6, Purpose

Replace with the following:

This standard establishes the criteria for implementation of the independence requirements of IEEE 603-1998 (as tailored in C.33) and IEEE 308-1991 (as tailored in C.16).

**Justification:** This section was revised to clarify that SRD implementing standards IEEE 603-1998 and IEEE 308-1991 are tailored in Appendix C.

##### Section 3.6, References

The following reference standards do not apply for the RPP-WTP.

- [1] ANSI/ANS-58.2-1988, Design Basis for Protection of Light Water Nuclear Power Plants Against the Effects of Postulated Pipe Rupture.

**Justification:** This document is applicable to the high pressure steam lines found in nuclear power generating stations and doesn't apply for the RPP-WTP.

- [4] ANSI/NFPA 801-1988, Fire Protection for Light Water Nuclear Power Plants.

**Justification:** This document specifically addresses nuclear power generating stations. Per section 4.5 of volume II of the SRD, the RPP-WTP will use NFPA 801-2003 as an implementing standard for fire protection.

- [11] IEEE Std 494-1974 (reaff 1990), IEEE Standard Method for Identification of Documents Related to Class 1B Equipment and Systems for Nuclear Power Generating Stations.

**Justification:** This standard has been withdrawn by the IEEE standards committee and no replacement standard has been recommended. This standard is not called out as an implementing standard in the SRD. Procedures for

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identification of documents related to SDC, SC, SDS, or SS equipment will be developed internally for the RPP-WTP project.

Replace the 1991 version of IEEE 603 with the following version.

IEEE Std 603-1998, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*.

**Justification:** SRD Safety Criterion 4.4-4 lists the 1998 version of IEEE 603 as an implementing standard for SDC and SC electrical power systems. The 1998 revision of IEEE 603 shall be used in place of the 1991 revision called out as a reference in the body of IEEE 384-1992 for SDC and SC electrical power systems only.

The following reference Standards shall be included:

- [16] DOE/RL-96-0006, Revision 1, *Top-level Radiological, Nuclear, and Process Safety Standards and Principles for TWRS Privatization Contractors*.

**Justification:** Called out as a regulatory basis in the SRD.

- [17] ANSI/ISA-S84.01-1996, *Application of Safety Instrumented Systems for the Process Industries*.

**Justification:** Replaces IEEE-603 for Control and Instrumentation Systems at the WTP, per 24590-WTP-ABCN-ESH-01-027.

- [18] NFPA 801-2003, *Standard for Fire Protection for Facilities Handling Radioactive Materials*.

**Justification:** Called out as an implementing standard under safety criteria 4.5-1 through 4.5-4.

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**Section 4.8, Definitions**

- The definition of design basis events shall be replaced with the following:

"Postulated events providing bounding conditions for establishing the performance requirements of structures, systems, and components that are necessary to: 1) ensure the integrity of the safety boundaries protecting the worker; 2) place and maintain the facility in a safe state indefinitely; or 3) prevent or mitigate the event consequences so that the radiological exposures to the general public or the workers would not exceed appropriate limits. The Design-Basis Events also establish the performance requirements of the structures, systems and components whose failure under Design-Basis Event conditions could adversely affect any of the above functions."

**Justification:** This definition is from DOE/RL-96-0006.

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**Section 5.3, Equipment and Circuits Requiring Independence**

Replace with the following sentence:

Equipment and circuits requiring independence shall be determined during the ISM review cycle and shall be identified on documents and drawings in a distinctive manner.

**Justification:** The reference to IEEE-494 is not applicable since this standard has been withdrawn by the IEEE standards committee and no replacement standard has been recommended. This standard is not called out as an

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implementing standard in the SRD. The ISM process will provide reliability requirements for each control strategy. These reliability requirements determine when control strategies require independence, redundancy, and seismic qualifications.

**Section 6.1.3.2, Area Boundaries**

Replace the reference to NFPA 803-1988[4] with NFPA 801-2003 [18].

**Justification:** Standard NFPA 803-1998 is not applicable for the RPP-WTP. Per section 4.5 of the SRD, NFPA 801-2003 shall be used for the RPP-WTP.

**Section 6.5, Containment Electrical Penetrations**

Not applicable for the RPP-WTP.

**Justification:** Containment electrical penetration assemblies are unique to the containment structure of Nuclear Power Generating Stations and have no equivalent in the RPP-WTP project.

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# **Appendix I**

## **WTP Specific Tailoring of IEEE Std. 323**

# Appendix I

## WTP Specific Tailoring of IEEE Std. 323

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### Appendix C: Implementing Standards

#### 23.0 IEEE-323, Qualifying Class 1E Equipment for Nuclear Power Generating Stations

Revision: 1983

Sponsoring Organization: The Institute of Electrical and Electronics Engineers, Inc.

##### RPP-WTP Specific Tailoring

The following tailoring of IEEE-323 is required for use by the RPP-WTP project as an implementing standard for ITS electrical and instrument system design.

##### Section 1.1, Scope

- This Standard applies to SSCs designated as SDC, SC, SDS, or SS (where the SS SSCs is required to perform a credited safety function in a harsh environment).

Justification: SS SSCs, which are required to perform a safety function in a harsh environment, have been included within the scope of this standard.

##### Section 2, References

The following reference Standard shall be included:

- [9] DOE/RL-96-0006, Revision 3, Top-level Radiological, Nuclear, and Process Safety Standards and Principles for the RPP Waste Treatment Plant Contractor.

Justification: The added references are applicable for the RPP-WTP project.

##### Section 3, Definitions

- Modify the definition of harsh environment to be: An environment expected as the result of the postulated service condition appropriate for the design basis event of the RPP-WTP. It is an environment that exceeds the conditions of a mild environment. Equipment that do not experience an environment beyond a mild environment during a design basis event can be considered to be in a mild environment.

Justification: A harsh environment, as defined by this standard, applies to a Nuclear Power Generating Station and are the result of a loss of cooling accident (LOCA)/high energy line break (HELB) inside the containment and post-LOCA or HELB outside containment. The modified definition applies to RPP-WTP.

This modified definition is further supported by 10 CFR 50.49, Environmental qualification of electric equipment important to safety for nuclear power plants, which states, in section C: "Requirements for (1) dynamic and seismic qualification of electric equipment important to safety, (2) protection of electric equipment important to safety against other natural phenomena and external events, and (3) environmental qualification of electric equipment important to safety located in a mild environment are not included within the scope of this section. A mild environment is an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences."

The definition of mild environment within the standard states:

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**"An environment expected as a result of normal service conditions and extremes (abnormal) in service conditions where seismic is the only design basis event (DBE) of consequences."**

Therefore the normal operating environment for a SSC is considered a "mild environment" by this definition.

The following definition is applicable for the RPP-WTP:

- The definition of design basis events shall be added with the definition from DOE/RL-96-0006, which states:  
"Postulated events providing bounding conditions for establishing the performance requirements of structures, systems, and components that are necessary to: 1) ensure the integrity of the safety boundaries protecting the worker; 2) place and maintain the facility in a safe state indefinitely; or 3) prevent or mitigate the event consequences so that the radiological exposures to the general public or the workers would not exceed appropriate limits. The Design-Basis Events also establish the performance requirements of the structures, systems and components whose failure under Design-Basis Event conditions could adversely affect any of the above functions."

**Justification:** The above listed definition was added to be applicable to the RPP-WTP project.

**Section 7, Simulated Test Profiles**

Delete this section.

**Justification:** This section is specific to Nuclear Power Generating Stations and describes profiles and margin for LOCA/HELB harsh environments.

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## **Appendix J**

### **WTP Specific Tailoring of IEEE Std. 344**

# Appendix J

## WTP Specific Tailoring of IEEE Std. 344

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#### 22.0 IEEE-344, IEEE Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations

Revision: 1987(R1993)

Sponsoring Organization: The Institute of Electrical and Electronics Engineers, Inc.

##### RPP-WTP Specific Tailoring

The following tailoring of IEEE-344 is required for use by the RPP-WTP project as an implementing standard for SDC/SDS or SCSS Seismic Class 1 electrical and instrument system design.

##### Pages 1-43, All Sections Clarification of Nuclear Power Generating Station Terminology

The term "Class 1E" in the Standard applies to "SC-1" in the RPP-WTP.

**Justification:** The Scope, section 1.0, of IEEE-344 applies to equipment that needs to function during and after an SSE for a Nuclear Power Generating Station. For RPP-WTP the equipment that needs to function during and after a design basis earthquake is SDC/SDS/SC/SS equipment which must be qualified to SC-1.

##### Page 1, Section 1.2 References

Delete reference [5] CFR (Code of Federal Regulations), Title 10: Energy, Part 100, Reactor Site Criteria, published by office of the Federal Register, 1992.

**Justification:** Reference [5] contains radiation dose criteria and seismic criteria for Nuclear Power Generating Stations and is not applicable to the RPP-WTP project. The applicable criteria for RPP-WTP is found in 24590-WTP-SRD-ESH-01-001-02, Safety Requirements Document (SRD) Volume II, Safety Criteria 2.0-1 for radiological dose and 2.0-2 for chemical hazards. The applicable seismic criteria is contained in 24590-WTP-SRD-ESH-01-001-02, Safety Requirements Document (SRD) Volume II, in section 4.1 General Design, Safety Criterion 4.1-3. This Safety Criterion defines Seismic Category (SC) I, II and III and provides seismic loads and source documents.

Delete reference [3] ANSI/IEEE Std 382-1985, *IEEE Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety-Related Functions for Nuclear Power Plants*.

**Justification:** This standard will be replaced with IEEE Std 382-1996. The IEEE Std 382-1996 includes a Required Input Motion (RIM) curve.

##### Pages 1-2, Section 2 Definitions

Delete the definitions for Operating basis earthquake (OBE) and safe shutdown earthquake (SSE).

Add a definition for design basis earthquake as: Earthquakes for RPP-WTP and the applicability to systems, structures and components (SSCs) is contained in 24590-WTP-SRD-ESH-01-001-02, Safety Requirements Document (SRD) Volume II, in section 4.1 General Design, Safety Criterion 4.1-3. This Safety Criterion defines Seismic Classes (SC) I, II and III and provide seismic loads and source documents.

**Justification:** The definition of OBE and SSE are applicable to Nuclear Power Generating Stations and the new definitions is applicable to the RPP-WTP project as defined in the SRD. This is consistent with the tailoring of AISC-N690 as documented in ABCN-013.

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**Pages 1-43, All Sections Clarification of OBE and SSE**

The term SSE in the standard is treated as a design basis earthquake. The requirement to apply and document the loads of a number of OBEs before an SSE is deleted from the standard.

**Justification:** The earthquake applicable to RPP-WTP is the design basis earthquake. The requirement to subject equipment to several OBEs prior to an SSE is not included in the requirements of the SRD for the RPP-WTP project. This is consistent with the tailoring of AISC N690 as documented in ABCN-013.

**Page 13, Section 7.1.3.2, Repairs**

In the fifth line delete the words, ", such as LOCA."

**Justification:** LOCA is a term specific to Nuclear Power Generating Stations and not to the RPP-WTP project.

**Page 15, Section 7.1.5, Vibrational Aging**

In the last paragraph change the first sentence to read, "The purpose of the vibrational aging is to show that the lower levels of normal and transient vibration associated with plant operation will not adversely affect an equipment's performance of its safety function nor cause any condition to exist that, if undetected, would cause failure of such performance during a subsequent design basis earthquake."

**Justification:** This sentence within the standard included additional vibration aging of an OBE, but used the terms "lower intensity earthquake" rather than OBE. The rewording is needed to clarify the meaning of the sentence. The requirement to subject equipment to several OBEs prior to an SSE is not included in the requirements of the SRD for the RPP-WTP project. The earthquake applicable to RPP-WTP is the design basis earthquake. This is consistent with the tailoring of AISC N690 as documented in ABCN-013.

**Page 16, Section 7.1.6.1, Hydrodynamic Loads**

Delete the words, "and the loss-of-coolant accident (LOCA)"

**Justification:** LOCA is a term specific to Nuclear Power Generating Stations and not to the RPP-WTP project.

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Quarter Ending June 30, 2008

24590-WTP-PCN-ENV-05-015

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Page 2 of 3:    Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Update Engineering Specification for Process Bulge Design and Fabrication in Appendix 7.7 of the  
Dangerous Waste Permit

Submitted by Co-Operator:

Reviewed by ORP Program Office:

*D. A. Klein*                      5/15/08  
D. A. Klein                                      Date

*SJA*                                      6/11/08  
S. J. Olinger                                      Date

Quarter Ending June 30, 2008

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<b>Hanford Facility RCRA Permit Modification Notification Form</b>			
Unit:		Permit Part & Chapter:	
<b>Waste Treatment and Immobilization Plant</b>		<b>Part III, Operating Unit 10</b>	
<b>Description of Modification:</b>			
The purpose of this Class 1 prime modification is to update the Engineering Specification for Process Bulge Design and Fabrication (24590-WTP-3PS-MX00-TP001) in Appendix 7.7 of the Dangerous Waste Permit. The following engineering specification is submitted to replace the permit specification currently in Appendix 7.7.			
<b>Appendix 7.7</b>			
<b>Replace:</b>	24590-WTP-3PS-MX00-TP001, Rev. 2	<b>With:</b>	24590-WTP-3PS-MX00-T0001, Rev. 6
<p>This modification requests Ecology approval and incorporation into the permit the specific changes to this specification that are identified by the revision history and revision bars shown on the specifications that have been issued since the last revision of the permit version. This PCN incorporates the changes documented in 24590-WTP-3PS-MX00-T0001 revisions 5 and 6. These revisions are the result of ongoing design. The following is a summary of the significant changes to the attached specification.</p> <p>Specification Scope (Section 1) was modified to require seller to provide P&amp;IDs and environmental qualification of equipment. The acronym list and definitions were also updated.</p> <p>Applicable Documents (Section 2)</p> <ul style="list-style-type: none"> <li>• Section 2.3 <i>Industry Standards</i> was deleted, standards which are still applicable were moved to Section 2.2 <i>Codes and Standards</i></li> <li>• Added requirement to use of the specific revision of a code or standard where specified, and the most current version when not specified</li> <li>• Codes and industry standards were updated including the addition of ASME Section VIII</li> <li>• Updated reference list</li> </ul> <p>Design Requirements (Section 3):</p> <ul style="list-style-type: none"> <li>• Clarified requirements relative to sellers purchase of valves, drive spindles, and actuators</li> <li>• Clarified requirement for ITS actuators to be hard wired in accordance with engineering specification</li> <li>• Provided specification for sellers purchase of instrumentation</li> <li>• Clarified system requirements for foundation field bus, cable products, and junction devices</li> <li>• Added requirement: where quality level and seismic categories for instruments are not specified they shall be qualified to the conditions where they are located internal or external to the bulge</li> <li>• Updated "environmental conditions" to include a requirement for the evaluation of bulge SSCs as suitable for continuous operations in specified environment, and added a description for harsh and mild environments</li> <li>• Updated general requirements for process bulge confinement to differentiate between design standards for SC-I/SC-II and SC-III/SC-IV enclosures</li> <li>• Added conceptual design information for weir including addition of figure 3</li> <li>• Clarified bulge design requirements relative to abnormal internal negative pressure</li> <li>• Added structural design requirements for bulge support frames; process bulge shielding; and bulge maintenance platforms in SC-I/SC-II and SC-III/SC-IV areas</li> <li>• Changed code requirement for fasteners from ASME B-18 to ASME B31.3</li> <li>• Clarified requirement for drainage through anchor washers including figure 4</li> <li>• Deleted sections 3.5.9.3 and 3.5.9.4 regarding welding of bulge skirt and foot plates</li> <li>• Added requirement for seismic analysis demonstrating compliance with specification</li> <li>• Updated requirements for nozzle loads including fatigue analysis</li> <li>• Deleted minimum design load tables (design loads are shown on appropriate data sheets)</li> </ul> <p>Materials (Section 4)</p> <ul style="list-style-type: none"> <li>• Added reference to appendix for selection of Radiation Resistant Materials</li> </ul>			

Quarter Ending June 30, 2008

24590-WTP-PCN-ENV-05-015

- Added Beryllium to list of prohibited materials

## Fabrication (Section 5)

- Added reference to code tailoring in appendices

## Tests and Inspections (Section 6)

- Added reference to code tailoring in appendices
- Added requirements for environmental qualification testing
- Added criteria for personnel qualifications
- Changed visual inspection requirement for non-piping welds from ASME Section V Article 9 to ASME Section VII Division I

## Documentation and Submittals (Section 10)

- Added requirement for certificate of compliance that components are qualified for their specific environment
- Updated requirements for calculations
- Added requirements for submittal of design stress reports

## References (Section 11)

- Updated references including design changes incorporated by reference

The following is a list of outstanding change documents that have not been incorporated into this modification

- 24590-WTP-3PN-MX00-00027 - Modification to Figure 2, Typical Representation of Process Pipework and Floor Penetrations
- 24590-WTP-SDDR-M-07-00042 - Deviation of the Bulge Specification's Pipe Sleeve Design for LCP 2&3, LFP 1&2, and RLD 4 Bulges

WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 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 <sup>1</sup>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 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:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

  
B. Becker-Khaleel

8/14/08  
Date

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 <sup>1</sup>1, if applicable.



ISSUED BY  
RPP/WTP PDC

**RIVER PROTECTION PROJECT - WASTE TREATMENT PLANT**

**ENGINEERING SPECIFICATION**

FOR

**PROCESS BULGE DESIGN AND FABRICATION**

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.

Content applicable to ALARA?  Yes  No

ADR No.  
24590-WTP-ADR-M-03-016

Rev  
1

Quality Level
Q
DOE Contract No. DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

6	3/26/07	<i>D. Harris</i> D. Harris	<i>L. Donovan</i> L. Donovan	<i>G. Goolsby</i> G. Goolsby	<i>K. Gibson</i> K. Gibson	<i>M. Ehlinger</i> M. Ehlinger	<i>R. Voke</i> R. Voke
5	1/31/06	W. Donigan	P. Pinto	C. Morley	J. Hinckley	S. Akerman	R. Voke
4	9/4/04	Sentanu	C. Dunstan	C. Morley	N/A	G. Warner	M. Hoffmann
3	7/22/04	Sentanu	C. Dunstan	C. Morley	N/A	G. Warner	G. Duncan
2	9/23/03	C. Dunstan	Sentanu	C. Morley	N/A	G. Warner	G. Duncan
1	7/11/02	C. Dunstan	C. Morley	B. Rao	N/A	G. Warner	G. Duncan
0	5/23/02	C. Dunstan	C. Morley	B. Posta	N/A	G. Warner	G. Duncan
A							
REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DFEM

SPECIFICATION No.  
24590-WTP-3PS-MX00-T0001

Rev  
6

Revision History

Revision	Reason for Revision
A	
0	Issued for Use
1	Document Revision
2	General Revision; Incorporated SDDR 24590-WTP-SDDR-PROC-03-0106 and SCNs 24590-WTP-3PN-MX00-00003 & 24590-WTP-3PN-MX00-00004
3	<b>Issued for use only for LAW bulges, not PTF bulges.</b> Incorporated SCN 24590-WTP-3PN-MX00-00006, add 24590-WTP-3PS-JQ06-T0003, 24590-WTP-3PS-JQ06-T0005, 24590-WTP-3PS-JR00-T0010, Implementing Standards for ANSI/AISC N690 in Appendix A, Implementing Standards for AISC M016 in Appendix B, Lifting Equipment Requirements and Nozzle Load Requirements.
4	Issued for Purchase, add column davit requirements
5	Issued for Purchase; incorporated SCNs 24590-WTP-3PN-MX00-00014, -00018, -00020, -00022, and -00023; Clarified Support for Actuator Assemblies; Clarified NDE Personnel Qualification Requirements; Included WTP Specific Tailoring of ASME B31.3-1996.
6	Issued for Purchase; Incorporated by Reference SDDR's 24590-WTP-M-06-00074 and 24590-WTP-M-06-00282; Incorporated changes resulting from CRPT-06-219 (formally CAR-06-250), removed nozzle load tables and place them on the appropriate Process Bulge Data Sheet, included Appendix D for load combinations to be used in analysis.

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# 1 Scope

## 1.1 Project Description and Location

- 1.1.1 The River Protection Project-Waste Treatment and Immobilization Plant (RPP-WTP) is a complex of waste treatment facilities where the U.S. Department of Energy Hanford Site tank waste will be put into stable glass form. The Waste Treatment and Immobilization Plant Contractor will design, build and start-up the RPP-WTP pretreatment and vitrification facilities for the DOE Office of River Protection. The waste treatment facilities will pretreat and immobilize the low-activity waste and high-level waste 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 RPP-WTP Facility will be constructed at the east end of the 200 East Area of the Hanford Site. The Counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

- 1.2.1 This specification establishes the requirements for the design, fabrication, project management, quality assurance, inspection, and testing of Process Bulges for use in the RPP-WTP Facilities.
- 1.2.2 The Seller shall provide fully detailed designs and all labor, materials, equipment, and services necessary to manufacture the Process Bulges in accordance with this specification, Piping and Instrumentation Diagrams (P&IDs), and Process Bulge Data Sheet. Any discrepancies between this specification, referenced specifications, P&IDs, and the Process Bulge Data Sheet shall be brought to the attention of the Buyer for resolution.
- 1.2.3 The scope of work includes, but is not limited to:
- Detail design of all pipework, confinement, support, maintenance platforms, column davits, and shielding systems as required.
  - Fabrication and/or assembly of all items and components.
  - Performance testing of equipment to verify and demonstrate functionality and conformance to the design and technical requirements described in this specification.
  - Leak/pressure testing of all process systems to demonstrate primary and secondary confinement.
  - Documentation of testing procedures, testing results, operation and maintenance procedures, and quality assurance procedures.

- Design document review in progressively complete package form. Delivery shall include 30%, 60%, 90%, and final design reviews.
- Preparation for shipping and packaging of all equipment.
- Environmental Qualification of equipment and/or components (as required) and determination of "Qualified Life".

1.2.4 The Seller shall also provide all special tools and/or equipment necessary for operation and maintenance of the Process Bulges and their components. The Seller shall prepare drawings of special tools and/or equipment and submit them to the Buyer for review. Special tools shall not include small hand tools available in the commercial market.

1.2.5 Specific activities excluded from the scope of this specification include:

- On site unloading
- Installation
- Commissioning

1.2.6 The Seller shall not be responsible for the supply of process pumps; the Buyer shall issue this equipment to the Seller as contractor furnished equipment for incorporation into the fabrication. Refer to the MR for the scope of procurement responsibilities for valves, actuators, and instrumentation.

### 1.3 Work by Others

1.3.1 The Seller may subcontract any portion of the work, provided the quality assurance requirements of this specification are maintained, and provided the Buyer approves the subcontractor and the scope of work.

1.3.2 The Seller will be ultimately responsible for the completeness and quality of all work covered in this specification.

### 1.4 Acronyms

AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
AP	Air Permit
APC	Additional Protection Class
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CM	Commercial Material
DBE	Design Basis Earthquake
DOE	U.S. Department of Energy
EQDS	Environmental Qualification Data Sheet
ECDS	Equipment Cyclic Data Sheets
ITS	Important to Safety
M&TE	Measurement and Test Equipment
MR	Material Requisition
MDS	Mechanical Data Sheet

MSDS	Material Safety Data Sheet
NRTL	Nationally Recognized Testing Laboratory
NQA	National Quality Assurance
OSHA	Occupational Safety & Health Administration
P&ID	Piping and Instrumentation Diagram
PCB	Polychlorinated Biphenyl
PMI	Positive Material identification
PO	Purchase Order
PT	Liquid Penetrant Test
QA	Quality Assurance
QAM	Quality Assurance Manual
QARD	Quality Assurance Requirements and Description
QL	Quality Level
RFQ	Request for Quote
RPP-WTP	River Protection Project-Waste Treatment Plant
RRC	Risk Reduction Class
SC	Safety Class
SC	Seismic Category
SDC	Safety Design Class
SDS	Safety Design Significant
SRD	Safety Requirements Document
SS	Safety Significant
SWL	Safe Working Load
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
UNC	Unified National Coarse
VT	Visual Test
WAC	Washington Administrative Code

## 1.5 Definitions

*Buyer:* Bechtel National Inc. for the RPP-WTP.

*Seller:* Manufacturer, assembler, fabricator, vendor, supplier, or equal who provides equipment, systems, components, services, or other products for delivery or direct benefit to the Buyer.

*Buyer's Representative(s):* The Buyer's designee(s), who shall witness onsite operations at the seller and sub-seller sites and perform onsite inspections and surveillance.

*HEPA Filter:* A high efficiency particulate air filter having a fibrous medium with a particle removal efficiency of 99.97% when tested with essentially mono-dispersed 0.3  $\mu\text{m}$  test aerosol particles.

*Important to Safety (ITS):* Systems, structures, and components (SSCs) that serve to provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the workers and the public. ITS encompasses the broad class of facility features addressed (not necessarily explicitly) in the top-level radiological, nuclear, and process safety standards and principles that contribute to the safe operation and protection of workers and the public during all phases and aspects of facility operations (e.g., normal operation as well as accident mitigation). ITS includes SSCs designed as Safety Design

Class (SDC)/ *Safety Class (SC)*, Safety Design Significant (SDS)/ *Safety Significant (SS)*, and Risk Reduction Class (RRC)/ *Additional Protection Class (APC)*.

*Paragraph*: When a paragraph of this specification, referenced document, referenced codes, or referenced standards is referenced in this specification, the paragraph referenced and all subparagraphs and sub-subparagraphs of the paragraph shall be considered inclusive.

*Quality Level (QL)*: The quality level identifies the quality requirements to be applied to items and activities. The identified quality levels are Q, and CM.

*Quality (Q)*: Q items and activities shall meet the applicable requirements of NQA-1 (1989).

*Commercial Material (CM)*: Those permanent plant SSCs not identified as Q, are CM (which includes both RRC/APC and Non-ITS).

*Risk Reduction Class (RRC) - Initial Safety Classification*: RRC Systems, Structures, and Components are Important to Safety Systems, Structures, and Components that are neither Safety Design Class nor Safety Design Significant.

*Additional Protection Class (APC) - Replacement Safety Classification*: Systems, Structures, and Components are Important to Safety Systems, Structures, and Components that are neither Safety Class (SC) nor Safety Significant (SS).

*Safety Design Class (SDC) - Initial Safety Classification*: an SSC whose safety function is to prevent a worker or maximally exposed member of the public from receiving a radiological or chemical exposure that exceeds the exposure standards defined in the Safety Requirements Document (SRD), or that is credited for the prevention of a critically event.

*Safety Class (SC) - Replacement Safety classification*: an SSC, including portions of process systems whose preventive or mitigative function is necessary to limit radioactive material exposure to the public, as determined from safety analyses.

*Safety Design Significant (SDS) - Initial Safety Classification*: an SSC that is required to ensure that exposure standards for normal operation are not exceeded; whose failure would directly prevent a SDC SSC from performing its safety function; or that implements the defense-in-depth requirements of the SRD Appendix B, section 3.0, Table 1.

*Safety Significant (SS) - Replacement Safety Classification*: an SSC that is not designated as SC, but whose preventive or mitigate function is a major contributor to defense-in-depth and/or worker safety as determined by safety analyses.

*Seismic Category (SC)*: RPP-WTP seismic classifications for SSCs based on their safety function. Seismic Categories are I (SC-I), II (SC-II), III (SC-III), IV (SC-IV), and V (SC-V).

*Seismic Category I (SC-I)*: ITS equipment/tanks that have a safety function. For the design of SC-I components, no credit for inelastic energy absorption is allowed. SC-I equipment/tanks shall be functional during and after a DBE.

*Seismic Category II (SC-II)*: ITS equipment/tanks whose failure during a seismic event could prevent a SC-I SSC from performing its seismic safety function. For the design of

SC-II equipment/tanks, credit for inelastic energy absorption is allowed. SC-II components shall maintain control and confinement of hazardous materials during and after a DBE, but do not need to be functional.

*Seismic Category III (SC-III):* (a) ITS SSC, but without SC-I or SC-II safety function, but with a chemical hazard. (b) Non-ITS SSC which has an inventory of radioactive or hazardous material in an amount less than ITS significant quantity.

*Seismic Category IV (SC-IV):* Non-ITS SSC without an inventory of radioactive or hazardous material, but must meet UBC 1997 loadings.

*Seismic Category V (SC-V):* Non-ITS SSC not requiring seismic design.

*Risk:* the product of probability and consequences of any event considered. These factors are, to the extent possible, assigned numeric values so that results of risk evaluations can be ordered using appropriate descriptions.

*Safety Classification:* categorized as SDC/SC, SDS/SS, or RRC/APC.

## 1.6 Safety/Quality Classifications

The Quality Level (QL) and Seismic Category (SC) of the Process Bulges are specified on the data sheets in section 2 of the MR.

# 2 Applicable Documents

## 2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards and documents listed below, which are an integral part of this specification.
- 2.1.2 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. If a date or revision is not identified, the latest issue, including addenda, at the time of quotation, shall apply. For material standards associated with CM equipment, the Seller shall ensure that the revision associated with currently available material is acceptable for the intended use of the material. The effective dates and revisions listed in section 2 shall apply to subsequent references to the codes and standards within this specification.

## 2.2 Codes and Standards

- |       |                   |  |
|-------|-------------------|--|
| 2.1.1 | WAC 296-24        | Washington Administrative Code General Safety and Health Standards   |
| 2.1.2 | ANSI/AISC N690-94 | Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities, as tailored in Appendix A of this specification |

2.1.3	AISC.M016-1989	Manual of Steel Construction, Allowable Stress Design, Ninth Edition, as tailored in Appendix B of this specification
2.1.4	ASME NQA-1-1989	Quality Assurance Program Requirements for Nuclear Facilities
2.1.5	NFPA 70-1999	National Electrical Code
2.1.6	SNT-TC-1A-1989	Society for Non-Destructive Testing
2.1.7	ASME B31.3-1996	Process Piping as tailored in Appendix C of this specification
2.1.8	ASME Section VIII Division 1	Boiler and Pressure Vessel Code, <i>Rules for Construction of Pressure Vessels</i>
2.1.9	ASME Section VIII Division 2	Boiler and Pressure Vessel Code, <i>Alternate Rules for Construction of Pressure Vessels</i>
2.1.10	ASME Y14.100	Engineering Drawing Practices
2.1.11	ASME B30.20	Below-the-Hook Lifting Devices

### 2.3 Engineering Standards

Any additional Engineering Specifications/Standards proposed for use by the Seller shall be reviewed by the Buyer prior to incorporation into the design.

### 2.4 Reference Documents

2.4.1	24590-WTP-3PS-SS90-T0001	Engineering Specification for Seismic Qualification of Seismic Category VIII Equipment and Tanks
2.4.2	24590-WTP-3PS-P000-T0001	Engineering Specification for Piping Material Classes General Description and Summary
2.4.3	24590-WTP-3PS-JQ06-T0003	Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components
2.4.4	24590-WTP-3PS-JQ06-T0005	Engineering Specification for Environmental Qualification of Control and Electrical Systems and Components
2.4.5	24590-WTP-3PS-JQ07-T0001	Engineering Specification for Instrumentation for Package Systems
2.4.6	24590-WTP-3PS-JR00-T0010	Engineering Specification for Liquid Effluent Gamma Monitor - QL
2.4.7	24590-WTP-3PS-JV15-T0001	Engineering Specification for Actuators for On/Off Valves
2.4.8	24590-WTP-3PS-EKP0-T0001	Engineering Specification for Electrical Requirements for Packaged Equipment
2.4.9	24590-WTP-3PS-PS02-T0001	Engineering Specification for Shop Fabrication of Piping
2.4.10	24590-WTP-3PS-G000-T0003	Engineering Specification for Packaging, Handling and Storage Requirements
2.4.11	24590-WTP-3PS-G000-T0001	General Specification for Supplier Quality Assurance Program Requirements
2.4.12	24590-WTP-3PS-G000-T0002	Engineering Specification for Positive Material Identification (PMI)

2.4.13	24590-WTP-3PS-PV00-T0001	Engineering Specification for Technical Supply Conditions for Valves
2.4.14	24590-WTP-3PS-AFPS-T0001	Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment
2.4.15	24590-WTP-PW-P30T-00001	WTP End Prep Detail for Field Butt Welds
2.4.16	24590-WTP-3PS-SS00-T0002	Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel
2.4.17	24590-WTP-3PS-FB01-T0001	Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks
2.4.18	RR-C-271D	Federal Specification Chains and Attachments, Welded and Weldless
2.4.19	DOE-RL-92-36	Hanford Site Hoisting and Rigging Manual - Hoists, Jib Cranes, and Monorail Systems
2.4.20	OSHA 29 CFR 1910.179	Occupational Safety and Health Standards Overhead and Gantry Cranes
2.4.21	24590-WTP-3PS-M000-T0002	Engineering Specification for Mechanical Handling Equipment Design & Manufacture
2.4.22	24590-WTP-3PS-MV00-T0003	Engineering Specification for Pressure Vessel Fatigue Analysis
2.4.23	24590-WTP-DC-ST-01-001	Structural Design Criteria

### 3 Design Requirements

#### 3.1 Basic Function

To support the use of 'hands on' maintainable equipment for process applications in out-cell areas, the Process Bulges are required to provide confinement structures for the safe operation and maintenance of process equipment such as pumps, valves, instruments and associated equipment. The Process Bulges shall have an expected working life of 40 years. Where specific components cannot meet this requirement they shall be identified and a mechanism for their replacement and/or maintenance shall be incorporated into the design.

##### 3.1.1 Process Pumps

- 3.1.1.1 The Buyer shall supply all process pumps. The process pumps are vertically mounted centrifugal canned motor type and facilitate top-access maintenance techniques.
- 3.1.1.2 The Seller shall be responsible for the installation of the pumps including all necessary services, supports, electrical and instrumentation requirements.
- 3.1.1.3 The pump impeller and motor assembly shall be removable vertically.
- 3.1.1.4 When indicated on the P&ID the Seller shall furnish the pumps with a cooling water flush line to the motor/bearing assembly. The water flush

shall be sacrificial and utilized only where the process fluid is unsuitable for use as the cooling medium.

- 3.1.1.5 Pump motor housings should be 'potted' to minimize internal fluid hold-up and should be oil free.
- 3.1.1.6 Power and instrumentation cabling to the pump/motor shall be run in sealed stainless steel conduit through the pump access plate to a terminal box mounted on the pump/motor access plate.
- 3.1.1.7 Pump supports shall be rigid to minimize pump vibration, deflection, and nozzle loadings.
- 3.1.1.8 If the pump includes a recirculation cooling water flush line, the line shall be hard piped to the pump, with a removable line from the top of the motor. If a cyclone solids separator is included, it shall be placed to allow an open vertical path for removal of the pump impeller and motor assembly. The cyclone solid separator shall be supported from the side of the Bulge containment.

### 3.1.2 Process Valve Assemblies

- 3.1.2.1 **The Seller shall purchase the valves, extended drive spindles and actuators from the Buyer's valve distributor. The Buyer will provide valve distributor upon issuance of the MR for the Bulges. Valves, extended drive spindles and actuators shall be purchased in accordance with specifications 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves* and 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuator On/Off Valves*.**
- 3.1.2.2 Valves located inside the Process Bulge shall be top accessible valves with extended drive spindles. They shall be operated with either a pneumatic actuator or manually, external to the Bulge confinement. Each drive spindle requires the ability to be locked in place, external to the Bulge.
- 3.1.2.3 Actuators are pneumatic piston types and supplied complete with solenoid pilot valve, position limit switches, and visual semaphore indication. Non-ITS Actuators shall be Fieldbus interface compatible in accordance with specification 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Control Valves*. ITS Actuators shall be hard wired classic I/O in accordance with specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.
- 3.1.2.4 All actuator/valve assemblies shall be 'fail closed' type unless otherwise stated on the P&ID.
- 3.1.2.5 All actuators shall be located externally on the top face of the Bulge. A nameplate shall be placed on top of each actuator to allow identification

of the valve from above. Refer to 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuator On/Off Valves*, section 7.1, Nameplate, for general mechanical nameplate requirements and attachment details.

- 3.1.2.6 Manual valves shall have a label attached to the top cap assembly. The label shall identify the valve number and position indication. Nameplate material shall be three-ply laminated plastic with white face, black core. The nameplate size shall be 2 1/2-inch length, 1 inch wide and 1/16-inch thickness. The letter size shall not be smaller than 1/4 inch; font shall be condensed gothic text, and engrave letters through the core with a round or square end cutter, V-shaped are not acceptable and shall be permanently affixed with by means of adhesive and 316 stainless steel screws.
- 3.1.2.7 Valve tags shall be removed from the valve bodies and attached to the top cap assemblies, external to the Bulge, to prevent them from becoming a sump plugging hazard if they become disconnected from the valve.
- 3.1.2.8 Extended Drive Shafts connecting the actuators to the valves shall be fitted with rotary seals to maintain confinement, and designed with double universal joints and a telescopic section to allow movement/misalignment of the valves in all three planes. In Bulges with shielding the Extended Drive Shaft shall be designed to prevent a vertical shine path.
- 3.1.2.9 The Seller shall furnish an air manifold (1" diameter minimum) on the top face of the Process Bulge to supply air to the valve actuators, complete with an air filter and pressure regulator. Each actuator shall be connected to the manifold using 3/8" 316 flexible stainless steel braided tubing and an isolation valve. The manifold and flexible connections shall be sized for the concurrent operation of all actuators. The location of the manifold should be routed so as to minimize the length of connections but must not prevent the removal of any access plate or plug.
- 3.1.2.10 Each air isolation valve requires a valve nameplate. The nameplate shall have the same number as its corresponding process valve.
- 3.1.2.11 The Seller shall provide a Valve Inspection Report detailing items inspected, dimensional inspections performed, verification of inspections required by section 5 and 11 of 24590-WTP-3PS-PV00-T0001, *Engineering Specification for Technical Supply Conditions for Valves*, as well as 8.3 of 24590-WTP-3PS-JV15-T0001, *Engineering Specifications for Actuators for On/Off Control Valves* by valve manufacturer (as a minimum). Results shall be documented and submitted in accordance with Section 3 (G-321-V Form) of the MR.

### 3.1.3 Instrumentation

- 3.1.3.1 The Seller shall purchase instrumentation in accordance with specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.

- 3.1.3.2 Instrumentation signal transmission shall be per the instrumentation Data Sheet.
- 3.1.3.3 When the instrument Data Sheet calls for Foundation Fieldbus, appropriate junction devices and compliant cable products shall be provided. Systems shall consist of:
- 1) Appropriate four or eight spur blocks with stainless steel receptacles Pepperl + Fuchs F2-JBSC-4.FF.7/8S.LED or F2-JBSC-8.FF.7/8S.LED or Buyer approved equal.
  - 2) Spur cable shall be armored type, Pepperl + Fuchs C-V9-G-OR-XXXM-PVC-V9-FF-S or Buyer approved equal.
  - 3) All unused spur block points shall be capped with a closure cap. Pepperl + Fuchs V9-R-F-COV or Buyer approved equal. The location of the junction should be on the side of the Bulge. Spur cable shall be routed so as to minimize the length, but should not prevent removal of any access plate.
  - 4) The Pepperl + Fuchs V9-R-M2-S, 2-wire connector shall be installed/pre-wired in the head of all Foundation Fieldbus instruments. The Turck RSFV 49-\*M/14.5 connector may be used if the ground lug (Terminal 4) is not connected (cut and tap green/yellow (ground)).
- 3.1.3.4 Each spurblock shall have a nameplate attached to the Bulge near the associated spurblock. These nameplates shall identify the spurblock tag number, spurblock terminals, and associated equipment/instrument by terminal connection.
- 3.1.3.5 Where Foundation Fieldbus is not used, terminals and junction boxes shall be provided for instrument signals in accordance with specification 24590-WTP-3PS-JQ07-T0001, *Engineering Specification for Instrumentation for Package Systems*.
- 3.1.3.6 ITS instrumentation systems and components qualification shall be in accordance with specification 24590-WTP-3PS-JQ06-T0005, *Engineering Specification for Environmental Qualification of Control and Electrical Systems and Components*. The Buyer will provide requirements to the Seller in specifications, Technical Notes of the Material Requisition, or Data Sheets, as needed.
- 3.1.3.7 Gamma Monitor design shall be in according with specification 24590-WTP-3PS-JR00-T0010, *Engineering Specification for Liquid Effluents Gamma Monitor - QL*.
- 3.1.3.8 If the Quality Level and Seismic Category for instruments inside the bulges are not specified on a datasheet they shall be the same as the Quality Level and Seismic Category specified for the Bulge they are contained in. Furthermore, for instruments that have components

internal and external to the bulge, the internal components shall be qualified to the conditions inside the bulge (e.g., radiation and contamination levels), and the external components shall be qualified to the room conditions as specified on the data sheets.

### 3.1.4 Electrical Equipment

- 3.1.4.1 All electrical equipment and material, including industrial control panels and cabinets that are assemblies of industrial control devices, shall be suitable for installation and use in conformity with the provisions of NFPA 70-1999. Suitability of equipment shall be evidenced by listing or labeling as a completed assembly by Underwriters Laboratories (UL). Equipment and assemblies not listed or labeled shall be required to bear a UL "Field Evaluated Product" mark. Equipment and materials listed, labeled or field evaluated by other nationally recognized testing laboratories (NRTLs) as recognized by OSHA, may be accepted only after receipt of prior written approval from the Buyer.
- 3.1.4.2 Refer to specification 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, for AC voltage requirements.
- 3.1.4.3 A motor starter and controller shall be integral to the 480V MCC, 13.8/4.16 kV - 480V AC Secondary Unit Substation (Load Center), or the 13.8 kV switchgear. A local controller shall be used if specified. Refer to specification 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, for general information.
- 3.1.4.4 Refer to specification 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, for cable and wiring requirements.
- 3.1.4.5 Refer to specification 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, Appendix A, for nameplate requirements for electrical enclosures, equipment, and devices.

### 3.1.5 Bulge Construction

- 3.1.5.1 Process Bulges shall generally be comprised of a pipework assembly including pumps, instruments, valves and fittings as required, a confinement assembly, a confinement support structure, and when required, a Maintenance Platform and/or a shielding assembly.
- 3.1.5.2 Process Bulges shall be furnished with 1" diameter removable inspection plugs to allow access for a 'video-scope'. The plugs shall be located to provide the best access for the viewing of all internal equipment. The number of inspection plugs shall be minimized.

### 3.2 Performance

- 3.2.1 Process Bulges shall be designed and fabricated to fulfill the mechanical and process requirements identified on the Data Sheets and drawings identified under section 2 of the MR.
- 3.2.2 The Seller shall demonstrate that air operated valves complete a full on-off cycle in less than 5 seconds. Refer to 24590-WTP-3PS-JV15-T0001, *Engineering Specification for Actuators for On/Off Valves*, for supplied plant air pressure.
- 3.2.3 Actuators shall be sized for 80-psig-supply pressure.

### 3.3 Design Conditions

- 3.3.1 Process Bulge pipework shall be designed in accordance with the Piping Class Sheets identified in the Process Bulge Data Sheet. Refer to specification 24590-WTP-3PS-P000-T0001, *Engineering Specification for Piping Material Classes General Description and Summary* for general requirements. Specifications for individual pipe classes will be provided, as needed, with the MR.
- 3.3.2 A recommended spare parts list shall be generated for all components requiring maintenance/replacement over a 40-year life.

### 3.4 Environmental Conditions

#### 3.4.1 Equipment Requirements

The Bulge SSCs shall be evaluated and accepted by the Seller as suitable for continuous operation in service conditions as specified in the Buyer's MDS.

#### 3.4.2 Outdoor Environment Conditions

Site ambient condition is an extreme temperature range of minus 23°F dry-bulb to 113°F dry-bulb, rain, wind, snow, ice, direct sunlight, and a relative humidity of 0% to 100%.

3.4.3 Ambient lighting levels for Process Bulge areas will be 30 Lumens/ft<sup>2</sup>

3.4.4 Radiation exposure will be as indicated on the Process Bulge Data Sheets and Instrument Data Sheets.

3.4.5 Bulges may be stored outdoors for 12 months prior to installation.

3.4.6 The Environmental Qualification classification will be specified as either "harsh", "mild", or "N/A" on the Buyer's Process Bulge Data Sheets. Environmental Qualification is not applicable to CM bulges or components. A mild environment is an environment expected as a result of normal service conditions and extremes (abnormal) in service conditions where seismic is the only design basis event (DBE) of consequences. Similarly, a harsh environment is an environment expected as the result of the postulated service condition appropriate for the design basis event of the RPP-WTP. It is an environment that exceeds the

conditions of a mild environment. In the event that a component is specified as having to be qualified for a harsh environment, the Buyer will indicate what the conditions are that the equipment shall be qualified to via the Buyer's MDS.

### 3.5 Mechanical Requirements

Process Bulges shall be designed and fabricated in accordance with the technical documents identified under section 2 of the MR. Variations to the design documents are permitted provided that the Seller's proposals meet the criteria stated herein, are communicated through drawings, and a general description of the proposed variation is reviewed and approved by the Buyer prior to fabrication.

#### 3.5.1 Process Bulge Confinement – General Requirements

##### 3.5.1.1 Applicable Bulge Enclosure Design Standards

- SC-I and SC-II Bulge Enclosure confinement systems shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.
- SC-III and SC-IV Bulge Enclosure confinement systems shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.

3.5.1.2 The Process Bulge confinement shall be fabricated using fully radiused (1" internal radius) corners along the side and bottom edges to assist decontamination. Confinement plate thickness shall be as specified on the Process Bulge Data Sheet.

3.5.1.3 The confinement shall incorporate removable roof plates bolted to a roof support structure using 3/8" UNC stainless steel welded stud bolts and 1/8" thick flat elastomer gaskets. The roof plates shall provide gross access to the Bulge internal systems.

3.5.1.4 The roof plates support structure shall be fabricated from 4"x3" stainless steel angle section as a minimum.

3.5.1.5 The confinement roof structure shall be designed to support the static and dynamic loads including seismic loads from the valve actuator assemblies if there is no shielding.

3.5.1.6 All confinement welds shall be continuous.

- 3.5.1.7 The base of the confinement shall slope in all directions to a fabricated drain. Minimum design requirements for the drain shall be a single strainer, designed to be manually removable from the exterior of the Bulge. When noted on the Process Bulge Data Sheet, the drain shall be fitted with a primary and a secondary strainer and level instrumentation. The primary strainer shall incorporate a weir (See Figure 3 for a conceptual design of a weir) in its design to enable leak detection and level instrument testing. The primary strainer assembly shall be operable from the outside of the Bulge via an extended drive spindle.
- 3.5.1.8 As a minimum, the floor of the Bulge shall have a fall of 1:100 and the drain shall be located at the lowest point.
- 3.5.1.9 The base shall be adequately supported externally to prevent liquid traps caused by distortion during welding.
- 3.5.1.10 The confinement's external and internal surface finish shall be equal or better than that specified on the Process Bulge Data Sheet. All proposed surface finishes must be to a standard approved by the Buyer's inspector.
- 3.5.1.11 The Bulge confinement shall be designed for an abnormal internal negative pressure as specified on the Buyer's MDS, and a positive internal pressure equal to that when completely filled with process fluid. The specific gravity of the process fluid can be found on the Buyer's MDS. There shall be no internal stiffeners unless approved by the Buyer.
- 3.5.1.12 Wash rings/spray nozzles shall be installed within the Bulge confinement at a high level to facilitate decontamination of the Bulge and pipework. The Seller shall determine the number and position of the wash rings. If spray nozzles are used, threaded connections are allowed at the connection of the nozzle and the pipe. Refer to the Process Bulge Data Sheet for pressure and flow limits supplied to the wash ring/spray nozzle.
- 3.5.1.13 A HEPA filter connection shall be located above the maximum height of the Bulge confinement.

### 3.5.2 Process Bulge Support Frame

- 3.5.2.1 The Bulge support frame shall be designed to support the confinement structure completely filled with process fluid and, when no shielding is required, a Maintenance Platform and column davits as required. The specific gravity of the process fluid can be found on the Buyer's MDS.
- 3.5.2.2 The confinement structure shall be installed within a Bulge support frame fabricated using a minimum of 4" x 2" heavy gauge stainless steel rectangular hollow section.
- 3.5.2.3 The confinement shall incorporate stiffening pads at all frame connection points and connection shall be accomplished using continuous fillet welds.

3.5.2.4 The support frame shall incorporate leveling and hold-down features to secure the Bulge to the building structure, and to satisfy the requirements noted in section 3.6.1. The leveling and hold-down features shall conform to the Buyer's embed plate location drawings, provided in section 2 of the MR.

3.5.2.5 The support frame shall be designed such as to eliminate open section ends or any open ends shall be closed with fully welded end plates.

3.5.2.6 The support frame will be welded to carbon steel interface pads by the Buyer as referenced in Section 3.5.2.8 of this specification. Seller shall specify weld details to satisfy the seismic requirements in section 3.6.1 of this specification.

**3.5.2.7 Applicable Bulge Support Frame Design Standards**

- SC-I and SC-II Bulge Support Frames shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D for exert of the appropriate load combinations and allowables from AISC N690 - 94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities*.
- SC-III and SC-IV Bulge Support Frames shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D for exert of the appropriate load combinations and allowables from AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*.

3.5.2.8 The Process Bulge Skirt or Support Frame, as appropriate, shall be designed to allow for 1/2" gap between skirt or frame and facility embed plates to allow for carbon steel interface pads and leveling features as indicated in Figure 2. Seller shall specify weld details to satisfy seismic requirements in Section 3.6.1 of this specification.

**3.5.3 Process Bulge Shielding**

3.5.3.1 Where indicated on the Process Bulge Data Sheets the Bulges shall be fitted with carbon steel shielding plates to the specified thickness.

3.5.3.2 Shielding structures shall be completely self-supporting and shall be constructed using a layered methodology, as required, with each layer of shielding being securely bolted and doweled to its predecessor. The initial layer of shielding plates shall be bolted to the Bulge support frame to ensure positional accuracy of shielding access plugs. 180° and 90° butt joints between adjacent shielding plates shall be alternately overlapped to maintain the required shielding thickness.

- 3.5.3.3 Shielding structures shall be designed to support the Maintenance Platform, valve actuator assemblies, and column davits, when required.
- 3.5.3.4 Access plugs shall be provided in the roof shielding plates with suitably engineered lifting points to facilitate pump/motor, valve and instrument access.
- 3.5.3.5 Access plugs shall be designed to be locked in position.
- 3.5.3.6 When specified on the Process Bulge Data Sheet internal shielding plates shall be provided between adjacent pumps (when more than one pump is installed) and between pump and valve sections of the Process Bulge.
- 3.5.3.7 The maximum weight for a single shielding plate or plug required to be removable for maintenance operations shall not exceed 500 pounds. The minimum thickness of the shielding plate shall not be less than 1".
- 3.5.3.8 The maximum weight for a single shielding plate not routinely removed for maintenance operations shall not exceed 2,500 pounds. The minimum thickness of the shielding plate shall not be less than 1".
- 3.5.3.9 Each plate shall be uniquely identified using 1/2" high stamped characters to assist assembly and have suitable attachment points for lifting eyes. A sequentially numbered assembly map shall also be provided to assist in installing the shielding plates on site.
- 3.5.3.10 Where extended drive spindles pass through shielding plates the drive spindles shall be designed such that shielding integrity is not compromised.
- 3.5.3.11 Shielding will be welded to the facility embeds by Buyer. Seller shall specify weld details to satisfy the seismic requirements in the section 3.6.1 of this specification.
- 3.5.3.12 **Applicable Structural Mounting Component Design Standards**
- **SC-I and SC-II Structural Mounting Components shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.**
  - **SC-III and SC-IV Bulge Structural Mounting Components shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.**

### 3.5.4 Maintenance Platforms

- 3.5.4.1 The Maintenance Platforms shall be designed to meet both the requirements set forth in WAC 296-24, and the following structural code requirements:
- SC-I and SC-II Bulge Maintenance Platforms shall be designed and fabricated in accordance with ANSI/AISC N690-1994, *Specification for the Design, Fabrication, and Erection of Steel Safety Related Structures for Nuclear Facilities*, as tailored by the Buyer and included as Appendix A of this specification. See Appendix D-1 for the required combined loadings and allowables for ANSI/AISC N690 - 94 designs.
  - SC-III and SC-IV Bulge Maintenance Platforms shall be designed and fabricated in accordance with AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design, Ninth Edition*, as tailored by the Buyer and included as Appendix B of this specification. See Appendix D-2 for the required combined loadings and allowables for AISC M016-1989 designs.
- 3.5.4.2 The Maintenance Platform shall have a grid of removable grating sections to allow access to the Bulge below. Each removable section shall be positioned to facilitate maintenance of the Bulge equipment.
- 3.5.4.3 The Maintenance Platforms shall include guardrails. The guardrails shall be designed per WAC 296-24-750.
- 3.5.4.4 All openings in the guardrail shall have a safety gate or chain designed per the requirements of WAC 296-24-750.
- 3.5.4.5 The Maintenance Platform shall be designed in sections and shall be removable. The maximum weight of one section shall not exceed 2,500 pounds. The sections shall be bolted together and bolted to the supporting frame or shielding.
- 3.5.4.6 The Maintenance Platform shall be bolted to either the external layer of shielding, or the Bulge support frame if no shielding is required.
- 3.5.4.7 A fixed ladder shall be provided to allow access onto the Maintenance Platform. The ladder shall meet the requirements set forth in WAC 296-24-810. Use a concentrated load of 300 pounds for the ladder design.

### 3.5.5 Lifting Points

- 3.5.5.1 Bulges shall not be lifted with the shielding structure attached.
- 3.5.5.2 External pipework and fittings shall not be used for lifting.

- 3.5.5.3 Lifting points shall accept standard lifting equipment; chain blocks, wire rope or braiding shall not be permitted. If applicable, the lifting lugs shall be designed to accept Crosby shackles or equivalent meeting Federal
- 3.5.5.4 All lifting attachments shall have either a safety factor of 3 based on the material yield strength, or 5 based on the material ultimate strength, whichever is most conservative. The lifting points shall have a label clearly identifying its unique number and SWL.
- 3.5.5.5 All lifting points shall be proof tested in situ and provided with test and examination certificates.
- 3.5.5.6 Items of equipment having eyebolts fitted, or having lifting points identified, shall be such that the point of lift is over the center of gravity of the equipment. Fitted eyebolts shall be removable for examination.
- 3.5.5.7 Seller shall provide any special designed lifting equipment not available from a commercial source. Such equipment may include, but is not limited to, rigging devices, such as spreader beams, structural lifting devices, strongbacks, and yokes. Rigging devices shall be designed, tested, and tagged in accordance with the applicable requirements of ASME B30.20.

### 3.5.6 Fasteners

- 3.5.6.1 UNC series threads shall be used for all screw fasteners and components with mating threads. This thread form shall be used throughout unless otherwise specified on equipment Data Sheets.
- 3.5.6.2 Steel bolts, screws, and nuts shall be in accordance with ASME B31.3-1996 as tailored in Appendix C of this specification .
- 3.5.6.3 Stainless steel bolts and cap screws shall be used except where repeated assembly and disassembly are required. In that case bolts and cap screws shall be fabricated from 'Nitronic 60' or equivalent to prevent galling. Stainless steel nuts shall be of type 300 stainless steel in accordance with ASTM F594, unless otherwise stated.
- 3.5.6.4 Welded Stud Connectors: Capacitor discharge stainless steel weld studs shall be ASTM F593, with the following minimum mechanical properties:
  - a. Tensile Strength: 95,000 psi
  - b. Yield Strength: 60,000 psi
  - c. Elongation: 20% in 4 diameters
- 3.5.6.5 The use of hexagon headed bolts with sufficient clearance for socket wrenches is preferred. The range of bolt sizes shall be kept to a minimum in order to limit the number of tools required.
- 3.5.6.6 High tensile steel fasteners shall not be employed in the construction of lifting equipment.

- 3.5.6.7 Bolts and set screws in rotating or reciprocating components, or where subject to vibration, shall be locked by a split pin, tab washer or wire, subject to prior approval of the method by the Buyer. Setscrews used for locking purposes do not require locking. Washers, plain or spring, shall not be used unless specifically called for on drawings.
- 3.5.6.8 Sufficient envelope clearances are required around the bolt head for sockets.

### 3.5.7 Pipework

- 3.5.7.1 All piping shall be designed to meet the requirements of ASME B31.3 1996, *Process Piping*, as tallored in Appendix C of this specification.
- 3.5.7.2 All pipework systems shall be self-draining with no liquid traps. Direction and magnitude (if specified) of slope shall be as indicated on the P&ID. Unless otherwise specified on the Process Bulge Data Sheet the minimum pipe slope shall be 1:120.
- 3.5.7.3 All materials for pumps, pipework, valves and fittings shall be in accordance with the P&ID and Process Bulge Data Sheet and fabricated using 100% butt-welded construction unless otherwise stated.
- 3.5.7.4 Radiographic examination shall be carried out on all primary confinement pipework butt-welds using 100% radiography for Q components or 20% radiography for all other quality levels.
- 3.5.7.5 Where pipework passes through shielding plates these penetrations shall be positioned such that shielding integrity is not compromised e.g. in areas that have no direct shine-path to the radiological source.

### 3.5.8 Wall Penetrations

- 3.5.8.1 All process pipework leaving the Bulge and penetrating a wall shall be contained within a sleeve pipe. This sleeve pipe will provide secondary containment for the primary pipe. Refer to Table 1 for associated sleeve sizes. The Bulge drain and ventilation line (when required) do not require a sleeve pipe.
- 3.5.8.2 For pipes sloping into the Bulges, the sleeve pipe shall penetrate the Bulge confinement. An anchor washer shall be welded to the high end of the sleeve. The low-end of the sleeve is open to the Bulge confinement, allowing the process pipe to move freely. **When the Bulge P&ID's indicate that the sleeve pipes continue beyond the Seller's scope of supply, then the design shall provide appropriate drainage through the anchor washer by incorporation of a drain hole or open slot on the bottom end of the anchor washer. See Figure 1 & 4.**
- 3.5.8.3 For pipe sloping away from the Bulge confinement, the sleeve pipe shall be welded to the external side of the Bulge confinement. The low-end of

the sleeve is open in the black cell, allowing the process pipe to move freely. See Figure 1.

- 3.5.8.4 The sleeve pipe and anchor washer material shall be same as that used for the Bulge confinement.

### 3.5.9 Floor Penetrations

- 3.5.9.1 All process pipework leaving the Bulge and penetrating a floor shall be contained within a sleeve pipe. The sleeve pipe will provide secondary confinement for the primary pipe. Refer to Table 1 for associated sleeve sizes. The Bulge drain and ventilation line (when required) do not require a sleeve pipe, See Figure 2.
- 3.5.9.2 The sleeve pipes shall be welded to the external side of Bulge confinement plate. The sleeve pipe material shall be equal to that used for the Bulge confinement.
- 3.5.9.3 Deleted
- 3.5.9.4 Deleted

### 3.5.10 Column Davits

- 3.5.10.1 All column davits shall be designed to operate in the space envelope indicated in the Process Bulge Data Sheet. The boom and mast dimensions shall be determined by the Seller.
- 3.5.10.2 The column davits shall meet the requirements of DOE-RL-92-36, *Hanford Site Hoisting and Rigging Manual Hoists, Jib Cranes, and Monorail Systems*, and OSHA 29 CFR 1910.179 *Occupational Safety and Health Standards Overhead and Gantry Cranes*.
- 3.5.10.3 The column davits shall meet the performance and material requirements identified in the Process Bulge Data Sheet.
- 3.5.10.4 The column davits shall be manufacture's standard products, having minimum capacity 500 lbs, unless otherwise specified in the Process Bulge Data Sheet.
- 3.5.10.5 Seller shall design the column davits to lift valves, actuators, pumps, top cover plates, shielding plugs, gratings, etc. for maintenance operations.
- 3.5.10.6 The column davits shall be supported by Process Bulge support frame. The thrust and pull forces under load shall be considered.
- 3.5.10.7 The column davits shall be design to be interchangeable between as many Process Bulges as reasonable. The quantity of the required column davits is specified in section 2 of the MR.

- 3.5.10.8 The location and the number of column davit supports shall be determined by the Seller, unless otherwise specified in Process Bulge Data Sheet.

### 3.6 Loadings

#### 3.6.1 Seismic

- 3.6.1.1 The Seismic Category is identified on the Process Bulge Data Sheet.
- 3.6.1.2 Seismic Category (SC) I & II Equipment design shall be in accordance with specification 24590-WTP-3PS-SS90-T0001, *Engineering Specification for Seismic Qualification of Seismic Category I/II Equipment and Tanks*.
- 3.6.1.3 For Seismic Category (SC) III & IV Equipment seismic design shall be in accordance with 24590-WTP-3PS-FB01-T0001, *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks*.
- 3.6.1.4 Where required, the Buyer will provide seismic data to enable the Seller to carry out a dynamic seismic analysis for each Process Bulge. Analyses shall be carried out for the pipework (including where applicable pumps with integral motors), confinement, support and shielding systems.
- 3.6.1.5 Where the ITS instrumentation system and component data sheets indicate SC-I for functional qualification, components shall be designed in accordance with specification 24590-WTP-3PS-JQ06-T0003, *Engineering Specification for Seismic Qualification of Control and Electrical Systems and Components*.
- 3.6.1.6 Seismic Detailing requirements for Seismic Category (SC) I & II Equipment shall be in accordance with UBC 1997, Chapter 22, Division V, Section 2213 per Table 1 of the *Structural Design Criteria*, 24590-WTP-DC-ST-01-0001.
- 3.6.1.7 Seismic Detailing requirements for Seismic Category (SC) III & IV Equipment shall be in accordance with UBC 1997, Chapter 22, Division V, Section 2214 per Table 1 of the *Structural Design Criteria*, 24590-WTP-DC-ST-01-0001.
- 3.6.1.8 Seller shall provide a Seismic Data Report/Analysis demonstrating the Bulge designs meet the requirements specified in sections 3.6.1.2 or 3.6.1.3 of this specification.

#### 3.6.2 Operation

- 3.6.2.1 All pumps, pipework, valves and fittings shall be adequately supported so as to minimize vibration, deflection and nozzle loadings.
- 3.6.2.2 Roof plate structures must be adequately supported to accommodate valve actuator static and dynamic loads.

### 3.6.3 Maintenance

- 3.6.3.1 During valve maintenance operations access will be required onto the shielding and roof plate structures. Therefore in addition to the normal operational loads these structures shall be designed to support personnel access loads of 500 lbs.

### 3.6.4 Nozzle Load

- 3.6.4.1 The Seller shall design the Bulge to withstand the nozzle loading from the Buyer's facility installed piping.

- For LAW & PTF bulges; the nozzle loads listed in the Process Bulge Data Sheets are the minimum design loads acting on the Bulges from facility installed piping at the juncture of the nozzle and shell (unless otherwise noted, see section 3.6.4.2 of this specification). Buyer external pipe nozzle loads for the LAW and PTF Bulges are listed in the Process Bulge Data Sheets in section 2.5 of this specification.

Seller shall apply these external loads, in the combined loading sections of Appendix D-1, D-2, and D-3 as applicable.

- 3.6.4.2 Nozzle load application for wall penetrating pipework shall be applied as follows:

- At the anchor washer for pipes sloping towards / into the Bulge confinement.
- At the Bulge confinement plate for pipes sloping away from the Bulge confinement.
- Seller shall calculate the deadweight and seismic loads for open-ended sleeves and apply them as an external load at the Bulge confinement plate.

Refer to Figure 1.

- 3.6.4.3 Nozzle loads for floor penetrating pipework shall be applied at the Bulge confinement plate. Refer to Figure 2.

- 3.6.4.4 When required, the Seller shall either design suitable reinforcement pads in the confinement plates or increase the confinement thickness.

- 3.6.4.5 For confinement shell to pipe nozzle connections, ASME Section VIII, Division 2, Appendix 4, Figure 4-130.1, *Stress Categories and Limits of Stress Intensity*, shall be used for establishing combined allowable stress limits, for pipe nozzle to confinement shell design, by analysis only. However, stress values from ASME Section II, Part D, Table 1A for ASME Section VIII, Division 1 shall be used as the allowable stress  $S$  in meeting the stress limits of ASME Section VIII, Division 2,

Appendix 4, Figure 4-130.1, in lieu of design stress intensity  $S_m$ . (See Appendix D-3 for combined loading and allowable requirements)

### 3.6.5 Fatigue Analysis

- 3.6.5.1 The Bulge transfer frequency consists of cycle of process fluid through the line followed shortly after by a flush transfer.
- 3.6.5.2 Seller shall analyze for fatigue per the requirements detailed in 24590-WTP-3PS-MV00-T0003, *Engineering Specification for Pressure Vessel Fatigue Analysis*.
- 3.6.5.3 The Process Bulge Data Sheets contain the cyclic information on each nozzle in the ECDS section of the Data Sheet.

### 3.7. Accessibility and Maintenance

- 3.7.1 Equipment that is expected to require maintenance, calibration or replacement e.g. pumps/motors, valves and instruments shall be located in areas of the Bulge that offer the best access; this will usually be the front and sides of the Bulge.
- 3.7.2 The location of equipment within the Bulge shall be such that any items requiring lifting during maintenance can be accessed with the column davits supplied by the Seller.
- 3.7.3 The Bulge roof plates and shielding top plates shall incorporate equipment access ports and shielding plugs respectively for the maintenance of pumps/motors, valves and instruments.
- 3.7.4 Each access port shall be contained within a bagging ring or tenting flange to facilitate bagging/tenting techniques to maintain confinement during maintenance.
- 3.7.5 Where indicated on the Process Bulge Data Sheet, pumps shall be fitted with extended casing bolts that shall pass through seals in the pump access plate. The bolts shall enable the pump motor/impeller unit to be unbolted from the pump casing without breaking confinement.
- 3.7.6 The centerline of the closest piece of internal equipment shall be a minimum of 15" from the cell wall.

## 4 Materials

### 4.1 Positive Material Identification

- 4.1.1 Refer to specification 24590-WTP-3PS-G000-T0002, *Engineering Specification for Positive Material Identification (PMI)* for Positive Material Identification requirements.

## 4.2 Construction

- 4.2.1 Seller shall provide Material Safety Data Sheets (MSDS) for all coatings and materials used in the construction of the Process Bulge.
- 4.2.2 Process fluids may contain caustic solutions (up to pH-14) but nitric acid solutions may also be used for decontamination of the pipework, pump, valves, and instruments/instrument tubing both inside and outside of the pipework assembly. All materials selected by the Seller shall be suitably corrosion and radiation resistant for the specified service.
- 4.2.3 Materials shall be as specified in the Process Bulge Data Sheet and Instrument Data Sheets. Any proposed substitutes or concessions shall be agreed with the Buyer prior to procurement or incorporation into the work.
- 4.2.4 All materials shall be new and comply with this specification and relevant standards.
- 4.2.5 All flanges and pipe fittings shall be welded-neck and long radius types respectively unless otherwise specified and shall conform to ANSI standards.
- 4.2.6 No threaded flanges or fittings shall be used for process pipework.
- 4.2.7 Material certificates shall be supplied for all stainless steel pipe, plate, sheet and sections. Materials without specified mill test certificates must be approved by the Buyer prior to ordering; however additional material analysis may be required, either by wet or dry methods, to verify compliance with test certification or to determine material composition. Where such testing is required, any additional costs shall be the responsibility of the Seller.
- 4.2.8 The Seller shall have and implement provisions to ensure that materials used or supplied are not counterfeit or of suspect origin. Particular attention should be given to high strength bolting material (grade 5 strength equivalent and higher) and pipe fittings.
- 4.2.9 **Appendix C, *Radiation Resistant Materials*, of Engineering Specification 24590-WTP-3PS-M000-T0002, *Engineering Specification for Mechanical Handling Equipment Design & Manufacture*, may be used when selecting non-metallic materials. All Non-metallic components shall be selected to resist the radiation levels specified on the data sheets. In particular this refers to items such as gaskets, seals, o-rings, and other similar items**

## 4.3 Prohibited Materials

- 4.3.1 No asbestos containing materials, bronze, copper, lead, Beryllium, zinc, mercury, tin, antimony, cadmium, or other low melting point metals, PCBs or compounds of lead base paints or lubricants containing lithium or boron shall be used. 'Teflon' or compounds thereof must be qualified for use with the radiation levels specified on the Process Bulge Data Sheet.

#### 4.4 Special Requirements

- 4.4.1 Where special requirements or restrictions are to be applied to the established items, these will be specified on the Process Bulge Data Sheets or in accompanying contractual documentation. In the absence of such instructions, the manufacturer's standard product shall be supplied as specified or as approved by the Buyer.

#### 4.5 Storage of Special Materials (e.g., stainless steel) prior to work

- 4.5.1 Stainless steel is susceptible to corrosion caused by the contact and interaction with incompatible materials. All stainless steel material shall be stored in separate areas away from other materials.
- 4.5.2 The Seller shall submit Material Control Procedures for controlling, handling, storage and trace ability of materials such as weld rods, production items or Government Owned materials.

## 5 Fabrication

The Seller shall obtain written Final Design approval from the Buyer prior to the start of fabrication activities.

### 5.1 General Requirements

- 5.1.1 For all piping, refer to Specification 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping*. All welding procedures must be pre-approved by the Buyer prior to the start of fabrication.
- 5.1.2 Structural welding procedures shall be carried out in accordance with ANSI/AISC N690 - 94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities as tailored in Appendix A of this specification*, and specification 24590-WTP-3PS-SS00-T0002, *Engineering Specification for Welding of Structural Stainless Steel and Welding of Structural Carbon Steel to Structural Stainless Steel*. All welding procedures must be pre-approved by the Buyer prior to start of fabrication.

### 5.2 Assembly

- 5.2.1 Flatness of the completed Bulge confinements shall be 1/8" per foot, with no greater than 3/16" over the entire length of the Bulge except for areas around cutouts. Areas around cutouts shall be flat within 1/16" per foot.
- 5.2.2 Cutout locations shall be within +/- 1/8" and cutout size shall be within +/- 1/16" except where noted on the Buyer sketches.
- 5.2.3 All Bulge confinement corners shall have a 1" +/- 1/16" internal radius.
- 5.2.4 The minimum material thickness for Bulge confinements shall be in accordance with the Process Bulge Data Sheet.

5.2.5 The Process Bulges shall have edges that are both smooth and not sharp to the touch.

5.2.6 The method of fabrication shall minimize the number and amount of seams, overlaps, or other discontinuities, which could trap radioactive contamination.

### 5.3 Tolerances

Manufacturing and fabrication tolerances for all equipment, accessories, and components shall conform to the following requirements:

#### 5.3.1 Machined Components:

5.3.1.1 Machined surfaces shall be aligned within +/- 0.5 degrees of design conditions.

5.3.1.2 **THICKNESS:** Thickness tolerances shall conform to the requirements of the referenced commercial standard. In the absence of such criteria, allowable thickness shall be plus 0.010 inches, minus 0.005 inches.

5.3.1.3 **DIMENSIONS:** Buyers preferred dimension scheme,

a) $0 \leq D < 4$ in	+/- 0.010 inch
b) $4 \text{ in} \leq D < 36$ in	+/- 0.020 inch
c) $3 \text{ ft} \leq D < 10$ ft	+/- 0.030 inch
d) $10 \text{ ft} \leq D < 20$ ft	+/- 0.060 inch
e) Over 20 feet	+/- 0.13 inch.

Note: D equals the desired dimension.

#### 5.3.2 Fabricated Components:

5.3.2.1 Nozzle and flange alignment shall be within +/- 0.5 degrees of design conditions.

5.3.2.2 Rotating shaft alignment shall be specified by the Seller to minimize valve-turning torque at the actuator.

5.3.2.3 Thickness tolerances shall conform to the requirements of the referenced commercial standard applicable to the material being fabricated. When plate thicknesses are specified herein or in other supporting documentation they shall be considered to mean minimum thickness.

5.3.2.4 **DIMENSIONS:** Buyers preferred dimension scheme,

a) $0 \leq D < 4$ in	+/- 0.020 inch
b) $4 \text{ in} \leq D < 36$ in	+/- 0.040 inch
c) $3 \text{ ft} \leq D < 10$ ft	+/- 0.060 inch
d) $10 \text{ ft} \leq D < 20$ ft	+/- 0.13 inch.
e) Over 20 feet	+/- 0.25 inch.

Note: D equals the desired dimension.

- 5.3.2.5 Weld joint preparation, for field welds, shall be in accordance with drawing 24590-WTP-PW-P30T-00001, *WTP End Prep Detail for Field Butt Welds*.

## 6 Tests and Inspections

### 6.1 Non-Destructive Examinations

- 6.1.1 Unless otherwise specified all welds shall be inspected in accordance with the requirements outlined in the reference 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping*. All primary pipework for Q components shall be inspected in accordance with Appendix A of 24590-WTP-3PS-PS02-T0001.
- 6.1.2 All welds performed on the Process Bulge Confinement, Support Frame, Shielding, or other structural/support components shall be inspected in accordance with the requirements of the appropriate standard as specified in Sections 3.5.1.1, 3.5.2.7, and 3.5.3.12 of this specification.

### 6.2 Personnel Qualifications

- 6.2.1 Non-Destructive Examinations of non-structural components shall be performed by an inspector certified to the requirements of SNT-TC-1A-1989. The interpretation of the results shall be by either Level II or Level III inspectors certified to SNT-TC-1A-1989.
- 6.2.2 For Personnel Qualification requirements for structural components, refer to ANSI/AISC N690-94, *Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities as tailored in Appendix A of this specification*, or AISC M016-1989, *Manual of Steel Construction, Allowable Stress Design*, Ninth Edition, as Tailored in Appendix B of this specification.
- 6.2.3 Personnel performing visual inspections of welds shall be either a Certified Weld Inspector (CWI) of the American Welding Society (AWS) or a SNT Level II or Level III inspector.

### 6.3 Shop Tests

#### 6.3.1 General Requirements

- 6.3.1.1 The Process Bulge piping shall be hydrostatically tested in accordance with ASME B31.3 1996 **as tailored in Appendix C of this specification**. The Seller shall submit hydrostatic test procedures to Buyer for review and permission to proceed, prior to commencement of testing. The pipework shall be dried after testing.

- 6.3.1.2 The Process Bulge confinement shall be flooded with test water. After a period of 12 hours there shall be no visible sign of leakage. The confinement shall be dried after testing.
- 6.3.1.3 Test water used for hydrostatic testing shall be tested for chlorides. The chloride content of the test medium shall not exceed 50 ppm and the water temperature shall not exceed 120°F.
- 6.3.1.4 Where installed, the Seller shall demonstrate a full removal and replacement operation for pumps, valves, and instruments utilizing the tent or bag-in/bag-out method. The Seller shall provide maintenance manual(s) detailing procedures for removal and replacement of valves, instrumentation, and pumps. Spare o-rings, valve seats, and seals shall be ordered to replace original maintainable parts used in the removal/replacement demonstration. The Seller shall demonstrate the assembly and disassembly of the shielding.
- 6.3.1.5 The Seller shall demonstrate the correct operation of all valves.
- 6.3.1.6 Seller shall submit procedures for and perform a wiring insulation test and continuity check. Refer to 24590-WTP-3PS-EKPO-T0001, *Engineering Specification for Electrical Requirements for Packaged Equipment*, section 7.1 for additional testing requirements. Results of the test and check shall be included in the required documentation packages.
- 6.3.1.7 Seller shall demonstrate all internal equipment and surfaces are thoroughly washed by the spray rings/nozzles.
- 6.3.1.8 Seller shall demonstrate operation, assembly and disassembly of the column davits.

### 6.3.2 Surface Finish Inspection

- 6.3.2.1 The Seller shall develop and implement a procedure for visually inspecting the surface finish of each manufactured item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging.
- 6.3.2.2 Inspection of weld surface finishes, shall confirm that design requirements listed on the Process Bulge Data Sheet have been met.
- 6.3.2.3 Following inspection, the Seller shall document acceptance of surface finishes.

### 6.3.3 Visual Weld Inspection

- 6.3.3.1 The Seller shall develop and implement a procedure to perform visual weld inspections (visual tests, VT) to inspect each weld. The inspection for piping shall be developed in accordance with ASME B31.3 - 1996 as tailored in Appendix C of this specification, and shall include inspection materials and acceptance criteria. The remaining VT shall be

developed in accordance with ASME Section VII, Div 1. The visual weld inspection procedure shall be submitted to the Buyer for review and approval, prior to the inspection. Surface porosity and undercutting is not allowed.

- 6.3.3.2 The Seller shall prepare a visual weld inspection report for each fabricated item, which records inspection results, the date and time of inspection, and signatures of certified inspection personnel performing the inspection.
- 6.3.3.3 The visual weld inspection reports shall be included in the required documentation packages.
- 6.3.3.4 The Seller shall summarize the VT results in the weld map report for each item.
- 6.3.3.5 The Seller shall notify the Buyer in advance of inspection. The Buyer may send representatives to witness or perform an independent inspection.

#### 6.3.4 Liquid Penetrant Test

- 6.3.4.1 The Seller shall develop and implement a procedure to perform a liquid penetrant test (PT) to inspect each weld, excluding handrails. PT testing for piping shall be in accordance with ASME B31.3 – 1996 as tailored in Appendix C of this specification. All Remaining PT shall be developed in accordance with ASME Section VII, Div 1, and shall include inspection materials, dwell time for dye and developer, and acceptance criteria. The liquid penetrant procedure shall be submitted to the Buyer for review and acceptance, prior to testing.
- 6.3.4.2 Acceptance criteria for PT inspection shall be in accordance with ASME B31.3 - 1996 as tailored in Appendix C of this specification. Surface porosity and undercutting is not allowed.
- 6.3.4.3 The Seller shall prepare a liquid penetrant test report for each weld connection on each fabricated item, which will record PT inspection results, the weld number, the date and time of inspection, and signatures of the certified inspection personnel performing the test.
- 6.3.4.4 The Seller shall include the liquid penetrant test reports in the required documentation packages.
- 6.3.4.5 The Seller shall summarize the PT results in the weld map report for each item.
- 6.3.4.6 The Seller shall notify the Buyer in advance of the test. The Buyer may send representatives to witness or perform an independent test.

#### 6.3.5 Radiography

- 6.3.5.1 The Seller shall develop and implement a procedure to perform radiographic weld examinations of piping butt-welds as specified in

3.5.7.4 and of structural welds. The inspection shall be in accordance with ANSI/AISC N690-94 as tailored in Appendix A of this specification, AISC M016-1989 as tailored in Appendix B of this specification, or ASME B31.3-1996 as tailored in Appendix C of this specification, as appropriate, and shall include inspection materials and acceptance criteria. The weld radiography procedure shall be submitted to the Buyer for review and approval, prior to performing the radiographic examinations.

- 6.3.5.2 The Seller shall prepare a weld inspection report for fabricated piping systems, which records inspection results, the date and time of the inspection, and signatures of certified personnel performing the inspection.
- 6.3.5.3 The weld inspection report shall be included in the required documentation packages along with the exposed film, a copy of the technique and the reader sheets. The film must be suitably packaged to preclude moisture and handling damage.
- 6.3.5.4 The Seller shall summarize the radiography results in the weld map report for each item.
- 6.3.5.5 The Seller shall notify the Buyer in advance of inspection. The Buyer may send representatives to witness or perform an independent inspection.

#### **6.3.6 Final Inspection**

- 6.3.6.1 The Seller shall develop and implement a procedure for final inspection of each fabricated item. The inspections shall be performed after completion of all fabrication, cleaning, and testing, and just prior to final packaging.
- 6.3.6.2 The Seller shall inspect all surfaces for contamination. Visible evidence of contamination is not acceptable.
- 6.3.6.3 The Seller shall prepare a final inspection report for each item, which documents the results of the final inspection. The Seller shall include the final inspection report in the documentation package for each piece.

#### **6.3.7 Environmental Qualification**

- 6.3.7.1 The Seller shall develop and implement a procedure to perform environmental qualification tests, or similar, when applicable to provide evidence that the equipment supplied is qualified for its environmental design conditions.

### **6.4 Control of Measurement and Test Equipment**

- 6.4.1 Testing shall be performed using calibrated equipment when required. The equipment shall be calibrated against certified measurement standards, having known valid relationships to national standards, at established intervals to ensure accuracy.

6.4.2 The Seller shall maintain records and mark equipment to show calibration status.

6.4.3 The Seller shall notify the Buyer when M&TE are found to be out of calibration after being used for inspection purposes, in compliance with this specification.

## 6.5 Inspection and Test Status

The Seller shall maintain a positive system for identifying inspection and testing status of items and systems.

## 6.6 Control of Nonconforming Items

The Seller shall provide a method of notifying the Buyer of fabrication items and activities, which do not conform to requirements.

# 7 Preparation for Shipment

## 7.1 General Requirements

7.1.1 Refer to section 7 of the Material Requisition for general requirements and Specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling, and Storage Requirements*.

## 7.2 Cleanliness

7.2.1 Refer to 24590-WTP-3PS-PS02-T0001, *Engineering Specification for Shop Fabrication of Piping* for general requirements.

## 7.3 Painting

7.3.1 All ferrous surfaces other than corrosion resistant steel and finished machined mating surfaces shall be prepared and painted by the Seller in accordance with the paint manufacturer's instructions. Refer to specification 24590-WTP-3PS-AFPS-T0001, *Engineering Specification for Shop Applied Special Protective Coatings for Steel Items and Equipment* for painting requirements.

## 7.4 Tagging

7.4.1 A stainless steel nameplate containing the following information shall be rigidly attached to each Bulge. The nameplate shall be located in a prominent position for ease of visibility. The information shall be stamped or etched using 1/2" high characters. The nameplate shall include the following information, minimum:

Seller's Name/Address/Phone Number  
Date of Manufacture  
Buyer's Purchase Order Number  
Seller's Contract Number  
Plant Item Number  
Weight of Assembly

- 7.4.2 When shipping loose bolting material, both Q and CM shall be placed in separate containers (box, bag). The container shall be marked with the Buyer Purchase Order Number, Plant Item Number, and Bill of Material item number to facilitate material control and assembly.
- 7.4.3 Each column davit shall be tagged with a permanent stainless steel tag indicating for which Bulges it was designed.

## 7.5 Packaging

- 7.5.1 Refer to 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements* for general requirements.

## 7.6 Documentation

- 7.6.1 Seller shall ensure that appropriate documentation is prepared and, if required, signed by the appropriate person(s). The shipping documentation shall accurately reflect specific traceability to the items being shipped.
- 7.6.2 Seller shall ensure that appropriate documentation is prepared for the Process Bulges. At a minimum, documentation shall include the following information, as applicable:
- Manufacturer name, model number, and serial number
  - Plant Item Number

## 7.7 Shipping Instructions

Shipping shall be conducted in accordance with Buyer specification 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*.

- 7.7.1 Process Bulges shall be shipped completely assembled. When required, shielding, Maintenance Platforms, and ladders shall be shipped separately.
- 7.7.2 Weatherproof shipping lists (two per packaged item) shall be prepared and submitted, and shall clearly identify the contents of each package sent to the Buyer. All submittals and shipping boxes shall be identified with the Buyer's PO number.
- 7.7.3 Seller shall provide a complete identification and location of temporary material contained within the equipment for shipment, handling, or storage that must be removed prior to commissioning (e.g., shipping blocks, glove bags, components shipped inside larger sections, etc.). In addition, the Seller shall provide instructions for the removal of temporary materials, as required.
- 7.7.4 The Process Bulges shall be mounted on skids, in crates, or in boxes, as suited for the intended method of transport. Lifting weight shall be clearly marked on both the equipment and its shipping documents.

## 8 Quality Assurance

### 8.1 General Requirements

The Quality Level will be identified on the Process Bulge Data Sheet and on the QA Data Sheet issued with the MR. Refer to section 9 of the Material Requisition for general requirements, and Specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.

### 8.2 Quality (Q) Related Components

- 8.2.1 Seller shall have in place a QA program meeting the requirements of NQA-1 (1989), marked as applicable in the Supplier Quality Assurance Program Requirements Data Sheet attached to the MR, and Specification 24590-WTP-3PS-G000-T0001, *General Specification for Supplier Quality Assurance Program Requirements*.
- 8.2.2 The successful bidder must pass a pre-award survey by the Buyer. Seller shall demonstrate that its quality program is in compliance with the procurement quality requirements listed in the Supplier Quality Assurance Program Requirements Data Sheet. The Seller shall allow the Buyer, Buyer's Representative, and DOE access to their facility and records pertaining to this PO for the purpose of QA audits and surveillance at mutually agreed times.
- 8.2.3 All items shall be manufactured in accordance with the Seller's Quality Assurance Program that meets the requirements of NQA-1 (1989), and has been previously evaluated and accepted by the RPP-WTP QA organization.
- 8.2.4 Seller shall submit their QA program and work plan to the Buyer for review prior to commencement of work. The plan shall include documents and procedures to implement work and include a matrix of essential QA elements cross-referenced with documents/procedures.

## 9 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item Numbers, shown on the data sheets included in section 2 of the MR. Bulges shall be identified in accordance with Tagging in section 7.4 of this specification.

## 10 Documentation and Submittals

### 10.1 General Requirements

- 10.1.1 Seller shall submit to the Buyer all detailed designs, documentation, procedures, instructions, calculations, analyses, manufacturer's data, inspection reports, test reports, certifications, certificates, manuals, MSDS, and drawings required per this specification, the applicable codes, standards, and reference documents in Section 2 of this specification, and the MR.

- 10.1.2 Seller 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 MR.
- 10.1.3 Seller shall submit a report identifying any deviations and/or conflicts per Section 2 of the MR to the Buyer for review.
- 10.1.4 All documentation submittal packages shall have a documentation inventory sheet attached, listing all documents and the number of pages.
- 10.1.5 All detailed designs, drawings, supporting calculations, supporting analysis, supporting models, procedures, instructions, manufacturer data, operations manuals, and maintenance manuals shall be issued to the Buyer for review prior to the manufacture of the Process Bulges, special tools, and/or purchase of special tools and gaskets.
- 10.1.6 Seller shall submit storage requirements and instructions for Buyer's review. Documentation shall include maintenance requirements for the equipment and its components while in storage.
- 10.1.7 Data sheets in section 2 of the MR shall be marked-up by the Seller and submitted to the Buyer for the review with the detailed design. Seller shall fill in all of the information that is marked as "To be determined by the vendor" and mark-up actual overall Process Bulge dimensions based on the detailed design.
- 10.1.8 Seller shall provide all operations manuals, maintenance manuals, and spare parts lists for Process Bulges and components, as applicable.
- 10.1.9 Seller shall provide a Certificate of Compliance to the Buyer, which certifies that any equipment or components requiring Environmental Qualification (as specified in Section 2 of the Material Requisition) are qualified for their specified environment. As a minimum, Environmental Qualification Documentation shall contain:
- Identification of each type of equipment, component, or sub-component subject to Environmental Qualification (e.g. solenoids, wire, pressure transmitters, etc.)
  - Equipment tag numbers, as applicable
  - Environmental Qualification Conditions in accordance with requirements as specified in the Technical Notes of the MR
  - Qualification method
  - Qualified Life under specified conditions

## 10.2 30% Design Review

- 10.2.1 Seller shall conduct a 30% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analysis, and supplementary information necessary to conduct the 30% design review to the Buyer for review.
- 10.2.2 Finalized outline dimensions for the Process Bulges shall be included in the 30% design review. Finalized dimensions shall, at a minimum, include the following:
- dimensioned layout drawings of the Process Bulge, shielding and Maintenance Platform
  - pipe slopes and nozzle locations
  - platform configuration and attachments, ladder location, and openings in the platform guardrails
  - penetration in walls/floor details
  - volume of the internal pipework
  - weight of the Process Bulge including shielding and Maintenance Platform, where required
  - anchor requirements (anchor size, location, layout, etc.)
  - completed Buyer supplied Mechanical Data Sheets, Electrical Data Sheets, and Instrument Data Sheets, as applicable
  - preliminary maintenance procedure, including bag-in/bag-out procedure.

## 10.3 60% Design Review

- 10.3.1 Seller shall conduct a 60% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and supplementary information necessary to conduct the 60% design review to the Buyer for review including as a minimum:
- equipment assembly/arrangement drawings
  - shop detail drawings with sufficient detail to facilitate fabrication, manufacture, or installation. This includes a complete Bill of Material (BOM), internal piping details, cross-sectional details, structural details, and anchor details
  - wiring diagrams including schematic diagrams and interconnecting wiring diagrams for electrical/instrumentation requirements
  - instrument air schematic diagrams
  - engineering calculations and analyses (seismic and nozzle loads)

#### 10.4 90% Design Review

- 10.4.1 Seller shall conduct a 90% design review with the Buyer. Seller shall submit all drawings, procedures, calculations, analyses, and information necessary to conduct a 90% design review to the Buyer for review.

#### 10.5 Final Design Review

- 10.5.1 The Seller shall provide a final design report including all design documents, manuals, and drawings that are required by this specification.

#### 10.6 Drawings

- 10.6.1 All drawings shall be produced per the drawing practices set forth in ASME Y14.100, *Engineering Drawing Practices*.
- 10.6.2 As-built drawings, with final dimensions, shall be developed and submitted after completion of the Bulge fabrication.

#### 10.7 Calculations

All calculations to be provided shall be orderly, complete, and sufficiently clear to permit verification. The body of the calculations shall include:

- The calculation shall be identifiable by: Subject (including component identifier), Originator, Reviewer, Approver, Revision and Date.
- Definition of the objective of the analysis (e.g; Purpose, Objective or Scope)
- Methodology
- Definition of design inputs and their sources
- References with identification of specific editions, revisions, dates
- Identification of assumptions and indication of those that require verification. If none of the assumptions require verification, the calculation shall state such.
- Identification of computer calculations including:
  - Computer Type
  - Identification of the program and revision/version
  - Evidence of or reference to the computer program verification
  - Bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. (See sections 10.7.1.1, 10.7.1.2 and 10.7.1.3 for design code requirements)
- Equations used for all computations
- Numerical calculations including identification of units used
- A concise statement addressing the calculation results and/or recommendations

- A table of contents for complex calculations

#### 10.7.1 Design Stress Reports

Design Stress Reports shall include, as a minimum, the following information

##### 10.7.1.1 ANSI/AISC N690 and AISC M016 for Bulge Enclosure Confinement Design

- All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.
- Compliance to the buckling requirements of ANSI/AISC N690 or AISC M016, as applicable, shall be provided. Note that the buckling formula in section Q1.5.9.1 of the ANSI/AISC N690-1994 code shall apply to AISC M016 for austenitic stainless steel buckling qualification.
- For each load case supply the resulting reaction loads at each of the embed interfaces.
- Weld sizing calculations, for all welds, shall be provided. Fillet welds are to be evaluated for shear stress on the basis of resultant loads on the throat along with considerations for the base metal.
- Bolt evaluation shall be performed in accordance with ANSI/AISC N690, section Q1.6.3 or AISC M016 requirements.
- For Finite Element Analysis (FEA) by Computer Program, submit the bases or reference to the bases that supports applicability of the computer program to the specific physical problem being solved. (e.g.; application /validation to steel code formulas and allowable stresses).
- For FEA, resultants must be cast in forms appropriate to code criteria being considered, e.g., column buckling with shell element models could be evaluated with axial stresses averaged over the member section to represent the appropriate axial compressive stress. The analysis must clearly identify the loads and criteria being addressed

##### 10.7.1.2 ASME VIII, Div 2, Appendix 4, Nozzle to Shell Design Only

- All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.
- Compliance to ASME VIII, Div 2, Appendix 4, sections 4-131, 4-132, 4-133 and 4-134 shall be provided for the nozzle to shell connections.
- Weld sizing calculations, for all welds, shall be provided.
- For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the

computer program to the specific physical problem being solved. (e.g.; application/validation to the ASME VIII, Div 2, Appendix 4, Maximum Shear Stress Theory.)

- Tresca (max shear) stress intensity outputs for each combined loading condition shall be compared with the allowable stress limit. Von Mises values are not acceptable.

#### 10.7.1.3 ASME B31.3 Piping Design

- All modeling inputs, applied loads, constraints, assumptions, etc., shall be provided for configuration compliance reviews.
- ASME B31.3 piping stress analysis shall show all pipe supports, guides and anchor points. Pipe support details shall be provided. All nozzle displacements, seismic anchor moments, component deadweights and nozzle flexibilities shall be applied in the analysis.
- For Bulges that are SC-I and SC-II, supply the resulting nozzle displacements (in the X, Y, Z directions) at the location where the Buyers nozzle loads are applied.
- All other structural qualifications, such as: pipe supports, lifting lugs/devices, platforms/ladders, etc.
- For FEA Computer Program analysis, submittal for the bases or reference to the bases supporting application of the computer program to the specific physical problem being solved. [e.g.; application/validity to the ASME B31.3 design requirements in accordance with B31.3-96, section 300(c)(3)].

## 10.8 Schedules

- 10.8.1 A detailed schedule of engineering, document submittal, material purchase, fabrication, shop tests, and shipment shall be submitted.
- 10.8.2 All procedures and instructions shall be completed and submitted to the Buyer a minimum of eight (8) weeks prior to Process Bulge shipment.

## 11 References

### 11.1 Incorporated Design Changes

- 24590-WTP-3PN-MX00-00003
- 24590-WTP-SDDR-PROC-03-0106
- 24590-WTP-3PN-MX00-00004
- 24590-WTP-3PN-MX00-00006
- 24590-WTP-3PN-MX00-00014
- 24590-WTP-3PN-MX00-00018
- 24590-WTP-3PN-MX00-00020

- 24590-WTP-3PN-MX00-00022
- 24590-WTP-3PN-MX00-00023

### 11.2 Design Changes Incorporated by Reference

- 24590-WTP-SDDR-PROC-03-0102
- 24590-WTP-SDDR-PROC-02-0063
- 24590-WTP-SDDR-PROC-05-00601
- 24590-WTP-SDDR-M-05-00332
- 24590-WTP-SDDR-M-05-00474
- 24590-WTP-SDDR-M-05-00685
- 24590-WTP-SDDR-M-06-00074
- 24590-WTP-SDDR-M-06-00282

Figure 1 Typical Representation of Process Pipework and Sleeve Pipes Penetrating the Cell Wall

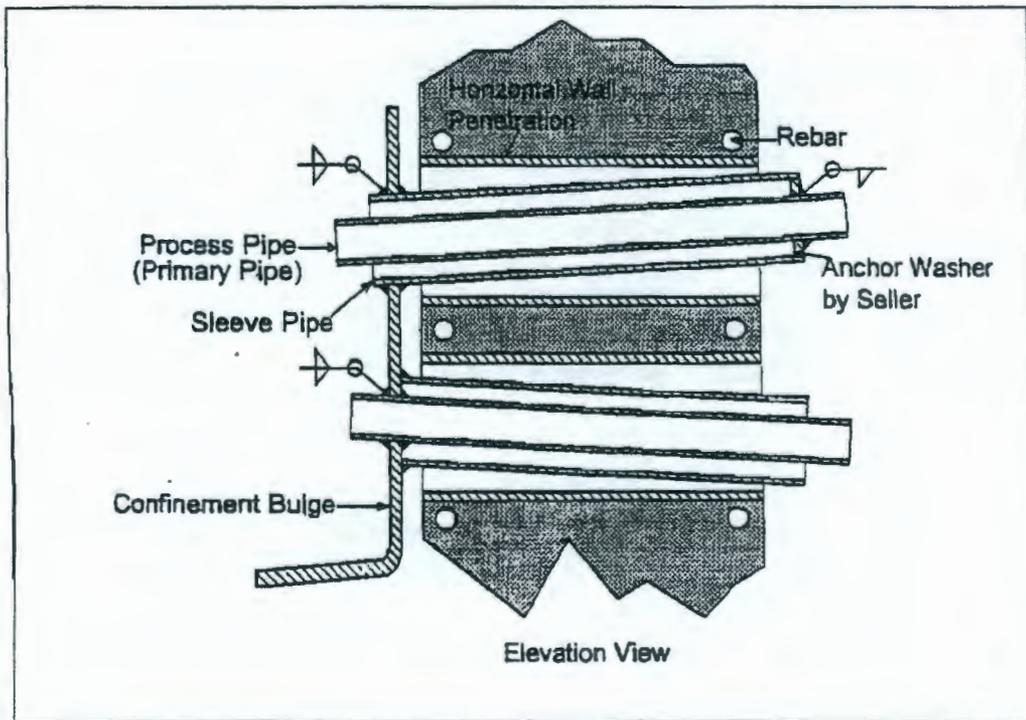


Figure 2 Typical Representations of Process Pipework and Floor Penetrations

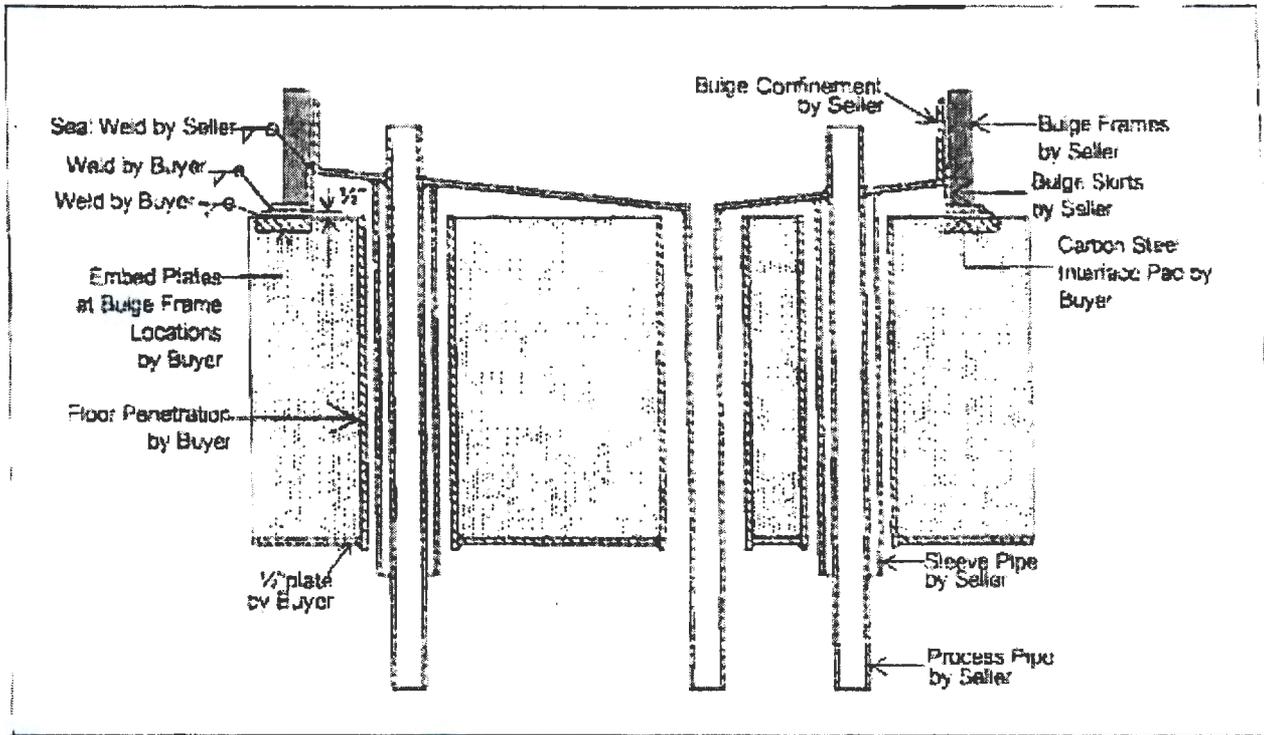


Figure 3 Conceptual Weir Design as a Primary and Secondary Strainer

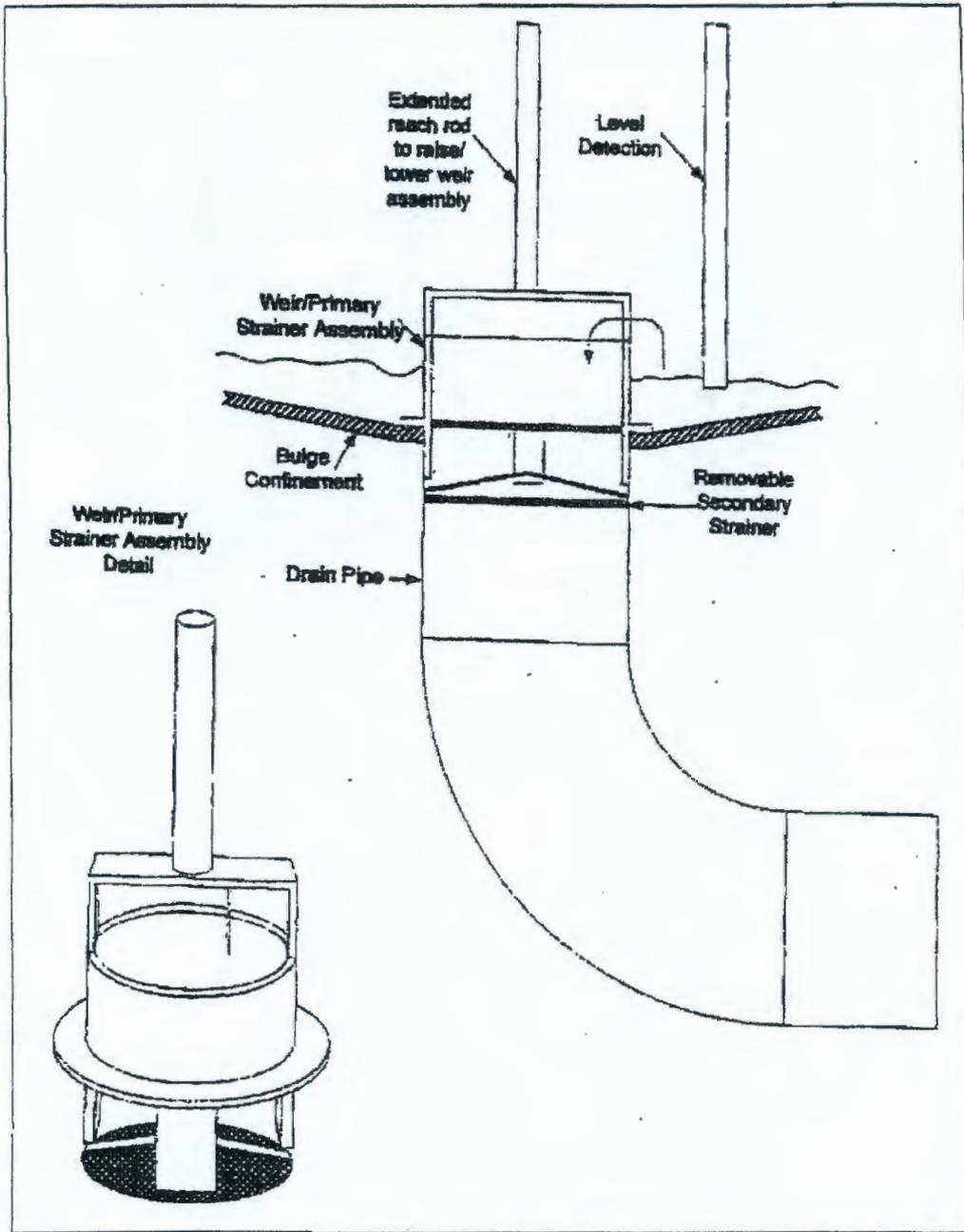




Table 1 Process Pipe and Sleeve Pipe Sizes

Process Pipe Size	Sleeve Pipe Size	Sleeve Pipe Schedule
1.0"	2.0"	40S
1.5"	3.0"	40S
2.0"	3.0"	40S
3.0"	4.0"	10S
4.0"	6.0"	10S
6.0"	8.0"	10S

**Table 2 Minimum Design Loads for PTF Bulges**

Deleted, PTF Bulge nozzle loads are located on appropriate PTF Bulge Data Sheet.

**Table 3 Minimum Design Loads for LAW Bulges**

**Deleted, LAW & UFP Bulge nozzle loads are located on appropriate LAW & UFP Bulge Data Sheet**

## Appendix A - ANSI /AISC N690 Tailoring

### Implementing Standards for ANSI/AISC N690, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities"

Revision: 1994

Sponsoring Organization: American National Standards Institute/American Institute of Steel Construction  
WTP Specific Tailoring

The following tailoring of ANSI/AISC N690 is required for use by the WTP contractor as an Implementing Standard for structural design.

---

#### Page 22, Section Q1.5.7.1 Primary Stresses

Revise the stress limit coefficients for compression in Table Q1.5.7.1 as follows:

- 1.3 instead of 1.5 [stated in footnote (c)] in load combinations 2, 5, and 6
- 1.4 instead of 1.6 in load combinations 7, 8, and 9
- 1.6 instead of 1.7 in load combination 11

**Justification:** These changes are made for consistency with the NRC requirements of Appendix F of section 3.8.4 of NUREG-0800 (Draft Rev. 2).

---

#### Page 22, Section Q1.5.7.1 Primary Stresses

Delete the following load combinations:

- 4.  $D + L + E_o$
- 6.  $D + L + R_o + T_o + E_o$

**Justification:** These load combinations are required for evaluation of an Operation Basis Earthquake (OBE). The WTP project has not identified an OBE event.

## Appendix B - AISC M016 Tailoring

### Implementing Standards for AISC M016, Manual of Steel Construction, Allowable Stress Design (ASD)

Revision: 9th Edition

Sponsoring Organization: American Institute of Steel Construction

#### WTP Specific Tailoring

The following tailoring of M016 is required for use by the WTP contractor as an implementing standard for design of structural steel for Seismic Category III SSCs.

---

#### **No specific section**

Load combinations for design of structural steel members utilize those identified in UBC 97, section 1612.3.

**Justification:** These load combinations represent the commercial requirements for allowable stress design of structural steel. Use of these load combinations will ensure compliance with the commercial design in accordance with the UBC.

---

#### **No specific section**

Seismic detailing requirements shall be in accordance with UBC 97, Chapter 22, Division V, section 2214, for moderate seismic risk structures.

**Justification:** The requirements contained in this section contain accepted industry practice for design of important commercial steel structures. Use of this section will ensure compliance with the commercial design in accordance with the UBC.

## Appendix C - ASME B31.3 Tailoring

### Implementing Standards for ASME B31.3, "Process Piping"

Revision: 1996

Sponsoring Organization: ASME

#### WTP Specific Tailoring

The following tailoring of ASME B31.3, *Process Piping*, is required for use by the WTP as an Implementing Standard for: (1) the fabrication and installation of those portions of the C5V ductwork that are being embedded in concrete, (2) the use of ASME B16.9 welding tees in accordance with ASME B31.3-2002, (3) use of vacuum box leak testing, and (4) the ASME B31.3-1998, paragraph 345.2.3(c), allowance for not leak testing closure welds outside of inaccessible areas.

- The tailored sections of ASME B31.3 applicable to welding tees will only be used for ASME B16.9 welding tees. As long as the stress intensification factors from ASME B31.3-2002 are used in the stress analysis for the welding tees, welding tees fabricated to either the 1996 or the 2002 edition of ASME B31.3 can be used. Below is a description of those portions of ASME B31.3, Appendix D, Table D300, that apply to welding tees and the section of the SRD to which they will apply.

Piping providing a confinement function in accordance with SRD 4.2-2 will comply with ASME B31.3-1996, *Process Piping*, with the following modifications:

In Table D300, the description of welding tee per ASME B16.9 shall be revised so it is consistent with that shown in Table D300 of ASME B31.3-2002

Stress Intensification					
Factor [Notes (2), (3)]					
Description	Flexibility Factor k	Out-of-Plane, $i_o$	In-Plane $i_i$	Flexibility Characteristic, h	Sketch
Welded tee per ASME B16.9	1	$\frac{0.9}{h^{2/3}}$	$3/4 i_o + 1/4$	$3.1 \frac{\bar{T}}{r_2}$	Same as ASME B31.3-1996
[Notes (2), (4), (6), (11), (13)]					

This means that for welding tees per ASME B16.9, note 11 in Table D300 is also changed to:

(11) If  $r_2 \geq 1/8D_b$  and  $T_c \geq 1.5\bar{T}$ , a flexibility characteristic of  $4.4 \frac{\bar{T}}{r_2}$  may be used.

**Justification:** The use of a lower flexibility characteristic for welding tees per ASME B16.9 in accordance with ASME B31.3-2002 will increase both the out-of-plane and in-plane stress intensification factors. The increased stress intensification factors will reduce the allowable out-of-plane and in-plane moments that can be applied to the welding tee and keep the calculated stress below the stress allowable by ASME B31.3-1996

---

## Appendix D - Combined Loadings

### D-1 Combined Loadings for ANSI/AISC N690 - Bulge Confinement, Frame Design, Structural Mounting Components, & Maintenance Platform

Combined Loading	Load Application	ANSI/AISC N690 Allowable Stress
$P_{Normal} + D - L + Noz(m)$	All	S
$P_{Normal} + D - L + R_c + T_r$	All	S (See note 5)
$P_{Normal} + D - L + R_c + S_{Bulge} + T_r$ $P_{Abnormal} - D - L + T_r + R_c + S_{Bulge}$	Load combination also applies except for the design of members in compression and shear or for bolted connections	1.6S
$P_{Normal} - D - L - R_c + T_r + S_{Bulge}$ $P_{Abnormal} - D + L + T_r - R_c$	Load combination also applies for the design of members in compression and shear and for bolted connections	1.4S
$P_{Abnormal} + D + L + T_r - R_c + S_{Bulge}$	Load combination applies for the design of members in compression.	1.6S
$P_{Abnormal} + D + L + T_r + R_c + S_{Bulge}$	Load combination applies for design of members in shear and for design of bolted connections	1.4S

\* S is the allowable stress per Allowable Stress Design Method

#### NOTES:

- For temperatures above 150 °F the minimum yield stress  $F_y$  and  $F_u$  shall be reduced by 5% for every 100 °F increase in temperature above 100 °F as required by AISC N690, section CQ 5 Ref: ANSI/AISC N690-1994, section CQ1.5.  
 The modulus of elasticity, E shall be reduced per Equation D-1 Ref: ASCE Manuals and Reports on Engineering Practice No. 78, Structural Fire Protection, Appendix A 1.2.2
- Where any load reduces the effects of other loads, the corresponding coefficient for that load shall be taken as 0.9 if it can be demonstrated that the load is always present or occurs simultaneously with other loads. Otherwise, the coefficient for that load shall be taken as zero.
- All load combinations shall be checked for zero live load condition.
- Pressure load  $P_{Normal}$  or  $P_{Abnormal}$  shall be based on worse case minimum or maximum values.
- For primary plus secondary stress, the allowable limits are increased by a factor of 1.3 per Appendix A above.
- In no instance shall the allowable stress exceed  $0.7F_u$  in axial tension nor  $0.7F_u$  times the ratio  $Z/S$  for tension plus bending.
- Secondary stresses which are used to limit primary stresses shall be treated as primary stresses. Excluded are the nozzle to shell connections.
- The Combined Loading equations are directly referenced from the *Structural Design Criteria*, 24590-WTP-DC-S7 01-0001.

Equation D-1

$$E_{Reduction} = 1 - \frac{(5.9) \ln(Temp - 32)}{200} \left[ \frac{(5.9) \ln(Temp - 32)}{1100} \right] \times (E)$$

#### Nomenclature:

$L_{np}$  = natural logarithm

$P_{Normal}$  = Maximum or Minimum Confinement Pressure for Normal Conditions

$P_{Abnormal}$  = Maximum or Minimum Confinement Pressure for Abnormal Conditions

- D = Deadweight  
 Noz (D) = Piping Nozzle Loads. Deadweight (D) from Vendor and Buyer Piping  
 L = Live Loads  
 R<sub>e</sub> = Piping Nozzle Reaction Loads: [Deadweight (D) + Thermal (T) + Seismic (S)] from Vendor and Buyer Piping  
 T<sub>n</sub> = Thermal Loads during Normal Operating Conditions  
 T<sub>a</sub> = Thermal Loads during Accident Conditions  
 S<sub>bulge</sub> = Seismic Bulge Load (24590-WTP-3PS 3590-T0001 for SC-III)

D-2 Combined Loadings for AISC M016 - Bulge Confinement, Frame Design, Structural Mounting Components, & Maintenance Platform

Combined Loading (see Note 2)	AISC M016 Allowable Stress (see Note 3)
D + L = Noz (D)	S
= P <sub>Normal</sub> = D + L = Noz (D)	S
= P <sub>Abnormal</sub> = D + L = Noz (D+T) + (0.714 x S <sub>bulge</sub> )	1.33S

\* S is the allowable stress per Allowable Stress Design Method

**NOTES:**

- 1) The buckling formula in section Q1.5.9.1 of the ANSI/AISC N690-1994 code shall apply to AISC M016 for austenitic stainless steel material buckling qualification (e.g., compression, compression and bending).
- 2) Pressure load P<sub>normal</sub> or P<sub>abnormal</sub> shall be based on worse case minimum or maximum values.
- 3) For temperatures above 150 °F the modulus of elasticity, E, and the minimum yield stress, F<sub>y</sub>, shall be reduced to the values of Equation 3-1 and Equation 3-2 respectively. Ref: ASCE Manuals and Reports on Engineering Practice No. 78, Structural Fire Protection, Appendix A 1.2.2
- 4) Where any load reduces the effect of other loads, the corresponding coefficient for that load shall be taken as 0.9 if it can be demonstrated that the load is always present or occurs simultaneously with other loads. Otherwise, the coefficient for that load shall be taken as zero.

Equation 3-1

$$E_{reduced} = \left[ 1 - \frac{(5.9 \times (Temp - 32))}{2000 L_n \left[ \frac{(5.9 \times (Temp - 32))}{1100} \right]} \right] \times (E)$$

Equation 3-2

$$F_{y, reduced} = \left[ 1 - \frac{(5.9 \times (Temp - 32))}{900 L_n \left[ \frac{(5.9 \times (Temp - 32))}{1750} \right]} \right] \times (F_y)$$

**Nomenclature:**

- L<sub>n</sub> = natural logarithm  
 P<sub>normal</sub> = Maximum or Minimum Confinement Pressure for Normal Conditions  
 P<sub>abnormal</sub> = Maximum or Minimum Confinement Pressure for Abnormal Conditions  
 D = Deadweight  
 L = Live Loads  
 Noz (D+T) = Piping Nozzle Loads: [Deadweight (D) + Thermal (T)] from Vendor and Buyer Piping  
 S<sub>bulge</sub> = Seismic Bulge Load (24590-WTP-3PS-FB01-T0001 for SC III/IV)

D-3 Combined Loadings for ASME VIII, Div 2, Appendix 4, Nozzle to Confinement Shell Design

Normal Loading	Stress Limits Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1 Allowable Stress Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1
$P_{Normal} = D + L + Noz(D+T)$	1.5S
$P_{Normal} = D + L + Noz(D+T) + \Delta T$	* $S_{T1} > 3S$ or $2S$ ,
Abnormal Loading	Stress Limits Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1 Allowable Stress Per ASME VIII, Div 2, Appendix 4, Fig. 4-130.1
$P_{Abnormal} = D + L + Noz(D+T) + S_{Seismic} + S_{Bulge}$	$1.5 \times 1.2S = 1.8S$
$P_{Abnormal} = D + L + Noz(D+T) + S_{Seismic} + S_{Bulge} + \Delta T$	* $S_{T2} > 3S$ or $2S$ ,

- \* Allowable yield stress  $S_y$  shall be per ASME II, Part D, Table Y-1
- \*\* Allowable stress  $S$  shall be per ASME VIII, Div 1 as specified in ASME II, Part D, Table 1A as follows:  
 Where two stress values are specified for the same material and related to deformation governed by a footnote:
  - Use the higher stress value for abnormal conditions
  - Use the lower stress value for normal conditions

**NOTES:**

- 1) Primary membrane stress shall be 1S for normal conditions and 1.2S for abnormal conditions
- 2) If applicable, peak stresses shall be evaluated per the stress limits and allowables of ASME VIII, Div 2, Appendix 4, Figure 4-130.1

**Nomenclature:**

- $P_{Normal}$  = Maximum or Minimum Confinement Pressure for Normal Conditions
- $P_{Abnormal}$  = Maximum or Minimum Confinement Pressure for Abnormal Conditions
- D = Deadweight
- L = Live Loads
- $Noz(D+T)$  = Piping Nozzle Loads [Deadweight (D) + Thermal (T)] from Vendor and Buyer Piping
- $S_{Seismic}$  = Piping Nozzle Loads Seismic (S) from Vendor and Buyer Piping
- $S_{Bulge}$  = Seismic Bulge Load (24590-WTP-3PS-SS90-T0001 for SC-I/T) or 24590-WTP-3PS-PB01-T0001 for SC-II/IV)
- $\Delta T$  = Minimum Shell to Maximum Pipe Differential Temperature: [(Pipe Nozzle Operating Temp) - (59°F)]

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Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-06-008

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Page 2 of 3: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Replace Permit Specification 24590-WTP-3PS-MPC0-TP008 (Engineering Specification for Vessel-Mounted  
Vertical Transfer Pumps - LAW Facility) in Appendix 7.7 of the Dangerous Waste Permit.

Submitted by Co-Operator:

D. A. Klein  
D. A. Klein

6/19/08  
Date

Reviewed by ORP Program Office:

S. J. Olinger  
S. J. Olinger

7/19/08  
Date

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-06-008

<b>Hanford Facility RCRA Permit Modification Notification Form</b>					
Unit: <b>Waste Treatment and Immobilization Plant</b>		Permit Part & Chapter: <b>Part III, Operating Unit 10</b>			
<u>Description of Modification:</u> The purpose of this Class 1 modification is to update 24590-WTP-3PS-MPC0-T0008 ( <i>Engineering Specification for Vessel-Mounted Vertical Transfer Pumps - LAW Facility</i> ).					
The following specification is being submitted to replace the specification currently in Appendix 7.7.					
<u>Appendix 7.7</u>					
Replace:		With:			
Replace:	24590-WTP-3PS-MPC0-TP008, Rev. 0	With:	24590-WTP-3PS-MPC0-T0008, Rev. 1		
Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design) and incorporate general criteria from a design verification review. The following identifies changes that have been revised on the attached specification.					
<ul style="list-style-type: none"> <li>• Section 6.3.2: Established acceptance criteria for net positive suction head (NPSH).</li> <li>• Appendix C, 2.0: Changed connector type for semi-remote process connectors.</li> <li>• Appendix C, Figure C3.1 deleted.</li> <li>• Minor editorial changes and clarifications (e.g., changed will to shall, replaced Seller with supplier, etc.).</li> </ul>					
The following is a list of outstanding change documents that have not been incorporated into this modification:					
<ul style="list-style-type: none"> <li>• 24590-WTP-3PN-MPC0-00023</li> <li>• 24590-WTP-3PN-MPC0-00030</li> <li>• 24590-WTP-SDDR-M-05-00603</li> <li>• 24590-WTP-SDDR-M-05-00607</li> <li>• 24590-WTP-SDDR-M-05-00608</li> <li>• 24590-WTP-SDDR-M-05-00613</li> <li>• 24590-WTP-SDDR-M-05-00782</li> <li>• 24590-WTP-SDDR-M-05-00809</li> </ul>					
WAC 173-303-830 Modification Class: <sup>1 2</sup>		Class 1	Class <sup>1</sup> 1	Class 2	Class 3
Please mark the Modification Class:		X			
Enter Relevant WAC 173-303-830, Appendix I Modification citation number:		A.1 & A.3			
Enter wording of WAC 173-303-830, Appendix I Modification citation:					
A.1 Administrative and informational changes.					
A.3 Equipment replacement of upgrading with functionally equivalent components.					

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-06-008

<p>Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) <u>Reason for denial:</u></p>	<p>Reviewed by Ecology:</p> <p><i>B. Becker-Khaleel</i> <u>8/26/08</u> B. Becker-Khaleel Date</p>
---	---



ISSUED BY  
RPP-WTP/PDC  
5/11/04  
INIT DATE

**RIVER PROTECTION PROJECT - WASTE TREATMENT PLANT**  
**ENGINEERING SPECIFICATION**  
**FOR**  
**Vessel-Mounted Vertical Transfer Pumps - LAW Facility**

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.

Content applicable to ALARA?  Yes  No

ADR No.  
24590-LAW-ADR-M-03-005

Rev  
0

Quality Designator
CM
DOE Contract No. DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	REASON FOR REVISION	BY	CHECK	REVIEW	QA	APEM/DEM
1	6/8/04	Re-issued for Purchase. Modified to incorporate SDDRs 24590-WTP-SDDR-PROC-00203 / 00251 / 00340, remove references to Hiltap connectors, and incorporate SCN 24590-WTP-3PN-MPC0-00009.	M. Nielsen	W. Honsaker	M. Hoffmann	G. Warner	G. Duncan
0	10/6/03	Issued for Purchase. Incorporates Addendums 01 through 13	M. Nielsen	W. Honsaker	M. Hoffmann	G. Warner	G. Duncan

SPECIFICATION No. 24590-WTP-3PS-MPC0-T0008 Rev 1

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# 1 Scope

## 1.1 Project Description and Location

The River Protection Project - Waste Treatment Plant (WTP) is a complex of waste treatment facilities where the US 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 DOE Office of River Protection (ORP). The waste treatment facilities will pretreat and immobilize the low-activity waste (LAW) and high level waste (HLW) at the Hanford Site. This specification covers only LAW Facility equipment.

The Hanford Site occupies an area of about 560 square miles 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. Benton, Franklin, and Grant counties surround the Hanford Site.

## 1.2 Scope Covered by this Specification

Design, furnish materials, fabricate, package, test and prepare for shipment of complete pump units and appurtenances in accordance with this specification, including the following:

- 1.2.1 Semi-remote vessel-mounted vertical transfer pumps, complete with motors, wiring and conduit, lifting lugs, eductor primer (if required), nozzle connections, all required piping from pump to nozzle connections, acquisition services documents, and attachments.
- 1.2.2 Deleted
- 1.2.3 Deleted
- 1.2.4 Special tools required for installation and maintenance.
- 1.2.5 Shop painting of exposed steel surfaces. Stainless steel surfaces shall not be painted.
- 1.2.6 Operations and maintenance manuals.
- 1.2.7 Lifting yokes designed to dimensions and configurations supplied by the Buyer.

## 1.3 Scope Not Covered by this Specification

- 1.3.1 Pump mounting flange bolt fasteners.
- 1.3.2 Semi-remote water, slurry, and power jumpers or instrumentation beyond first connection to factory assembled package.
- 1.3.3 Material unloading, unpacking, inspection, storage and installation labor at the job site.

## 1.4 Definitions

The equipment covered by this specification will be used in the WTP, where the definitions of terms are:

Cantilevered	Refers to a specific pump configuration where the bearings supporting the rotating pump shaft are positioned at one end of the shaft, leaving the remainder of the shaft unsupported.
Casing	Refers to the volute casing or the bowl assembly, depending on the pump used for these applications.
LAW	Refers to items associated with the Low Activity Waste (LAW) building.
Self-Priming	Refers to the process condition where the impeller will always be in fluid during pumping and the pumps for this application will be of the extended line-shaft bearing type
Semi-Remote	Equipment described as semi-remote in this specification refers to equipment located in the radioactive LAW cell that will normally be accessed from overhead protected levels and minimal human contact.
Vertical Pumps	Refers to equipment that is the subject of this specification, the semi-remote vessel-mounted vertical transfer pumps.

## 2 Applicable Documents

### 2.1 General

- 2.1.1 Work shall be performed in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification, and to the extent referenced herein.
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Proposal (RFP) shall apply. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent governing.
- 2.1.3 "Seller Surveillance Inspection" is defined in section 5 of the material requisition. Critical steps in manufacturing and testing, such as witness points and hold points, are also defined in section 5 of the material requisition.

## 2.2 Industry Standards

Unless otherwise specified herein or on drawings, work under this specification shall be performed in accordance with the codes, standards, and publications to the extent indicated by the references herein. The date of issue (or revision) indicated shall apply.

<u>Sponsor</u>	<u>Number</u>	<u>Subject</u>
ABMA	Std. 7	American Bearing Manufacturers Association - Shaft and Housing Fits for Metric Radial Ball and Roller Bearings
ABMA	Std. 9	American Bearing Manufacturers Association - Load Ratings and Fatigue Life for Ball Bearings
ABMA	Std. 20	American Bearing Manufacturers Association - Radial Bearings of Ball, Cylindrical Roller, and Spherical Roller Types Metric Design
ASME BPVC	Sec. IX	American Society of Mechanical Engineers - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASME/ANSI	Y14.5M	American Society of Mechanical Engineers - Dimensioning and Tolerancing
ASTM	A276	American Society for Testing and Materials - Specification for Stainless Steel Bars and Shapes
ASTM	A802	American Society for Testing and Materials - Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
HI	HI2.6, 2000	Hydraulic Institute Standards-American National Standard for Vertical Pump Tests
NEMA	MG-1	National Electrical Manufacturers Association - Motors and Generators

## 2.3 Safety/Quality/Seismic Classifications

Safety class, quality level, and seismic category of vertical pumps described in this specification are noted in the individual vertical pump data sheets issued with the material requisition.

## 2.4 Engineering Specifications

See section 2 of the material requisition for the referencing of engineering specifications.

## 2.5 Reference Documents and Drawings

See Figure 1 for LAW pump configuration.

### 3 Design Requirements

#### 3.1 General

The Seller shall control the quality of items and services to ensure that the requirements of this specification, applicable codes and standards, material requisitions, motor and vertical pump data sheets, and other acquisition services documents are met.

#### 3.2 Design Conditions

- 3.2.1 The equipment and appurtenances will be used in a plant that has a design life of 40 years. Vertical pumps shall be designed for a minimum service life of 20 years when subjected to normal periodic maintenance.
- 3.2.2 Pumps are generally categorized as semi-remote (as defined in section 1.4), depending on conditions of service as described in this section.
- 3.2.3 Plant location and environmental conditions are indicated on individual motor and vertical pump data sheets and other attachments to the material requisitions.
- 3.2.4 To simplify maintenance and spare parts inventory, it is desirable to have two semi-remote pump configurations for the LAW facility (one for cantilever and one for self-priming – described later in this section) for all service conditions shown in the vertical pump data sheets attached to the material requisitions. If one pump configuration for each category is not possible, the Seller shall minimize the number of pump configurations as much as possible. For general configurations see Figure 1 for LAW services.
- 3.2.5 The semi-remote LAW vertical pumps shall be designed for an exposure life of not less than five years at the specified conditions. Normal maintenance items shall be included, such as bearings, packing, seals, and gaskets, which, due to the semi-remote radioactive environment, shall function with no maintenance required within that period.

#### 3.3 Conditions of Service

##### 3.3.1 Semi-Remote Vertical Pumps

Vertical pumps shall be located in the LAW facility and exposed to a radioactive environment with expected radiation rates as follows.

##### Operating Dose Rates

##### Location

At vessel top mounting flange	0.50 rads/hr
At center of vessel	1.00 rads/hr

**Maximum Cumulative Yearly Dose**

**Location**

At vessel top mounting flange	$4.38 \times 10^3$ rads
At center of vessel	$8.76 \times 10^3$ rads

Note: These values are subject to change. Seller shall verify expected radiation levels with Buyer before commencing design.

**3.4 Environmental Conditions**

3.4.1 The vertical pumps will be located indoors in rooms maintained between 59 °F dry bulb minimum and 113 °F dry bulb maximum temperature during normal operation.

3.4.2 Vertical pumps and components shall not be stored outdoors.

**3.5 Pump Construction**

**3.5.1 General**

The vertical pumps are characterized into various groups and classifications for the purposes of design and construction. The following summary outlines the primary classifications, as defined in this specification.

<u>Location</u>	<u>Quality Level</u>	<u>Access</u>	<u>Preferred Design</u>
LAW	CM	Semi-remote	Cantilever
LAW	CM	Semi-remote	Self-priming

**Notes:**

Quality levels are detailed in section 8.

Semi-remote is defined in section 1.4.

Preferred pump designs are discussed further in the following sections.

**3.5.2 Pump Preferred Design Definitions:**

**3.5.2.1 Cantilever Pumps**

Pumps designated as cantilever pumps are defined for the purposes of this specification as pumps with a shaft and impeller that extends below the radial bearing (located above the mounting flange). Cantilever pumps shall have suction tailpipe and eductor priming assemblies. Cantilever pumps shall not have any bearings located within the interior volume of the vessel. See Appendix B, Pump Design Parameter Summary for individual pump designations.

**3.5.2.2 Self-Priming Pumps**

Self-priming pumps are defined, for the purposes of this specification, as pumps that have the capability of starting from a low liquid level without the use of a priming eductor or any other external priming

fluid. For all self-priming pumps, no external fluid, other than the main process stream, shall be added to the vessel or discharge piping for any purpose including priming or bearing lubrication (see section 3.5.4.4.3 for an exception for pumps using an extended line-shaft bearing configuration). See Appendix B, Pump Design Parameter Summary, for individual pump designations.

3.5.3 Design parameters are given on the vertical pump data sheets included in the material requisition. Additional parameters for pumps in slurry service are shown in Appendix B.

**Important:** Seller shall propose designs for all pumps considering vessel nozzle diameters as listed in Appendix B.

3.5.3.1 A pump lifting assembly shall be designed and fabricated by Seller to dimensions and configuration supplied by Buyer, with two lifting lugs located as shown in Figure 1. These lifting lugs shall facilitate a two-point lift by a compatible lift yoke that is in turn lifted by a single main crane hook. Lifting lugs shall be designed to lift 1.5 times the total dry pump weight and shall provide a straight plumb lift of a fully equipped dry pump.

3.5.3.2 A plumb lift test as well as a load test for 1.5 times the normal dry load shall be demonstrated on each unit in the Seller's shop, with Buyer to witness (see section 6.5). The pump shall be lifted off the shop floor and held for 10 minutes. Inspections shall be performed for any deformation or stress cracking at the lifting lugs and at the lifting lugs' attachments or reinforcements to the pump. Buyer will review design calculations related to lifting assembly design.

#### 3.5.4 Semi-Remote Vertical Pumps LAW

3.5.4.1 Semi-remote vertical pumps in the LAW building shall be designed in accordance with CM quality designation requirements as detailed in section 8.1.

3.5.4.2 The LAW pumps are designated as either cantilever or self-priming as defined in section 3.5.2.

#### 3.5.4.3 LAW Pumps - Cantilever

3.5.4.3.1 The preferred design for the LAW pumps designated as cantilever shall be as defined in section 3.5.2. Figure 1, LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps, illustrates the pump setting and vessel configuration with nominal and critical pump dimensions.

3.5.4.3.2 If the Seller proposes a design other than that described herein, the Seller shall include documentation of two or more successful applications, with contact information, in similar radioactive slurry service for the Buyer to review. Other pump designs may include any design with bearings located below the mounting flange and within the interior volume of the vessel such as vertical line-shaft pumps, submersible canned pumps, or any pump that differs fundamentally from a standard vertical cantilever and tailpipe design.

3.5.4.3.3 The Seller shall design all cantilevered pump components, including casing, impeller, tailpipe, eductor piping, and discharge piping, with the necessary structural supports to withstand all the operating forces, including those from slurry agitation, without incurring

plastic deformation or compromising the structural integrity of the pump. Such forces will be determined and quantified during detailed design.

3.5.4.4 LAW Pumps - Self-Priming

3.5.4.4.1 The preferred design for the LAW pumps designated as self-priming shall be as defined in section 3.5.2, Figure 1. LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps, illustrates the pump setting and vessel configuration with nominal and critical pump dimensions.

3.5.4.4.2 The Seller shall design all pump components, including casing, impeller, and discharge piping, with the necessary structural supports to withstand all the operating forces, including those from slurry agitation, without incurring plastic deformation or compromising the structural integrity of the pump. Such forces will be determined and quantified during detailed design.

3.5.4.4.3 Self-priming pumps using an extended line-shaft bearing configuration shall be designed with a pressurized support column to protect the shaft assembly from slurry intrusion. The pressurizing media shall be 15 psig of water or inert gas. The Seller shall also provide a method of monitoring the sustained pressure.

3.5.4.5 LAW vertical pumps shall be designed to minimize maintenance personnel radiation exposure time. The number of mounting bolts shall be minimized and designed to allow maintenance personnel to loosen the nuts from above with special wrenches supplied with the equipment. Figure 1 illustrates the desired pump configuration and mounting. Refer to 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, for more details on semi-remote handling issues.

3.5.4.6 Deleted (See 3.5.3.1, 3.5.3.2 and 6.5)

3.5.4.7 For LAW application, the main coupling between the drive motor shaft and the vertical pump shaft shall be radiation resistant and shall provide for misalignment (from fabrication and assembly) between the mating shafts at all conditions of service. To simplify pump construction, remote disassembly and re-assembly of coupling is not required for LAW pumps.

3.5.4.8 For LAW application, pumps shall be designed such that the motors can be removed from the pumps and stored in a separate place. Interfacing components on the motor and pump shall have tolerances suitable for motor replacement / interchangeability.

3.5.4.9 For all LAW pumps, the Seller is to provide the process connections (that is, discharge, column fluid pressure, and priming connections) located above the pump mounting flanges.

3.5.5 General Pump Requirements - LAW

3.5.5.1 Pump casings shall be hydrostatically tested in accordance with section 6.2. Castings shall be sound and free from cracks, pits, or nodules in accordance with section 5.1.1. Lined casings are not acceptable.

- 3.5.5.2 Two or more bearings shall support the vertical rotating pump shaft. In order to improve the stability of the rotating assembly, the bearings shall be preloaded, if necessary, according to bearing size. The load on the thrust bearing shall consist of the sum of the weight of the rotating assembly and the hydraulic thrust and moment from radial thrust and the preload. The load on the radial bearing shall consist of radial components and preload only.
- 3.5.5.3 All bearings shall be cartridge or standard width, single row radial ball, deep groove (Conrad type) or angular contact type, ABMA (Standard 20) Class 3 Internal Clearance, and selected to give 100,000 hours minimum  $L_{10}$  rating life in conformance with ABMA Standard 9.
- 3.5.5.4 Bearings and bearing seals shall withstand all conditions of service as stated in vertical pump data sheets and in section 3.2.5. Bearing seals shall be designed for the least possible drag on the inner race of the bearing to minimize heat build-up and premature failure. Shaft and housing fits shall be in accordance with ABMA Standard 7.
- Note: The Seller shall provide in-place re-greasing for the bearings to allow for re-lubrication of the bearings without removing any components of the motor from their installed positions. An in place grease connector would be located on the LAW vertical pumps for semi-remote access. Semi-remote access for LAW re-greasing applications is defined as an accessible, nonradioactive area for plant personnel to apply grease from a shielded platform, located 4 feet to 5 feet directly above the subject pump. It is imperative that the grease connector be located as close to the bearings as possible (that is, 6 inches or less) in order to minimize opportunities for the grease line to clog due to radiation hardening.
- 3.5.5.5 Bearings shall be lubricated with Chevron SRI Grease 2 (NLGI Grade 2), as detailed in Specification 24590-WTP-3PS-M000-T0002, *General Specification for Mechanical Handling Equipment Design & Manufacture*, or an approved equivalent radiation-resistant grease in an amount determined by bearing manufacturer. If an alternate grease is recommended, all appropriate technical information shall be submitted for Buyer acceptance.
- 3.5.5.6 Thrust bearings shall provide full load capabilities if the normal rotation direction of the pump is reversed.
- 3.5.5.7 Shafts of solid construction are preferred and shall be designed to carry their various loadings without exceeding their normal limits of combined stress, taking into account fatigue stress due to change in load or speed. The first lateral critical speed of shafts and impellers shall be at least 20 % above the maximum operating speed.
- 3.5.5.8 Special attention shall be given to ensure a smooth, even impeller finish, and care shall be taken to ensure uniformity of shape and finish on the vanes and the space between.
- 3.5.5.9 The bearing frame shall be constructed and bearing centers spaced so that the shaft and impeller assembly shall have proper support to be free of harmful vibration.
- 3.5.5.10 Maximum Allowable Vibration Limits

- 3.5.5.10.1 Motor, shaft, and impeller vibration amplitude shall not be more than 0.002 inches peak-to-peak, measured normal to pump shaft axis and not more than 10 inches above the impeller centerline, in air at motor speed, filtered to shaft speed.
- 3.5.5.10.2 The pump vibration amplitude shall not be more than 0.001 inches peak-to-peak, measured on the surface of the lower bearing housing normal to shaft axis, in air at motor speed, filtered to shaft speed.
- 3.5.5.10.3 The pump casing vibration amplitude shall not be more than 0.003 inches peak-to-peak measured outside the surface of the casing normal to shaft axis, pumping water at the design rate, filtered to shaft speed.
- 3.5.5.11 Shaft seals shall be installed to restrict air in-flow at the point of pump shaft entry to the vessel. A low pressure, non-lubricated stuffing box packed with Grafoil or approved equivalent split-ring, with a minimum compressed axial pitch length of 4 inches shall be furnished and installed by the Seller. Additionally, the Seller shall provide a temporary identification tag to caution against adjusting the Grafoil seal after delivery by Seller.
- 3.5.5.12 For cantilever pumps, an installed priming system is required to permit pump startup when vessel fluid level is below the pump casing. The priming system shall be a water eductor type of the general configuration shown on Figure 1 and shall be capable of starting the pump over the full range of conditions shown on the vertical pump data sheets and described in this specification. The priming system shall be able to start the pump from a vessel fluid level of 6 inches or more above the specified tailpipe intake height as shown on Figure 1. Available water pressure at the primer nozzle shall be as indicated on vertical pump data sheets. The priming system shall be capable of starting pumps without exceeding the maximum priming liquid volume as stated on the vertical pump data sheets. Priming capabilities will be tested and verified as detailed in section 6.3.5.
- 3.5.5.13 All pumps shall be provided with keyed impellers with separate threaded lock nuts and double (jam) nuts to positively secure the pump impeller.

### **3.6 Operational and Design Requirements**

- 3.6.1 The pump head capacity curve (see section 6.3.3) shall be continuously rising from maximum flow to shut-off.
- 3.6.2 Pump design pressure shall be not less than 25 % above the shut-off head at the specified suction pressure.
- 3.6.3 The pumps shall operate free of cavitation over the entire range of conditions shown on Appendix B, Pump Design Parameter Summary, and the vertical pump data sheets.
- 3.6.4 The Seller shall minimize rotational speed of shafts and impellers due to wear considerations and head losses encountered when pumping slurries at high speeds.
- 3.6.5 Frequency and length of operation for each pump is shown on Appendix A, Pump Operation Summary.

3.6.6 Vertical pumps in slurry service shall be designed to withstand sludge or slurry yield stresses of 300 dynes/cm<sup>2</sup> under normal operation. Startup torque shall be based on two times the normal running torque without priming water.

### 3.7 Drivers

#### 3.7.1 Motors

3.7.1.1 Drive motors shall conform to the requirements of Specification 24590-WTP-3PS-MUMI-T0002, *Low Voltage Induction Motors*. Adjustable speed drives shall conform to the requirements of Specification 24590-WTP-3PS-EVV1-T0001, *Engineering Specification for Low Voltage Adjustable Speed Drives*.

3.7.1.2 The Seller shall provide each pump with a totally enclosed fan-cooled (TEFC), washdown rated, chemical-type motor in accordance with the motor and vertical pump data sheets included with the material requisition.

3.7.1.3 Motor rated horsepower shall not be exceeded by any operating condition that can develop with the impellers.

3.7.1.4 Motors intended for use with adjustable speed drives shall be rated for inverter duty, with corresponding adjustable speed drives, as detailed on low voltage induction motor data sheets and adjustable speed drive data sheets, included with the material requisition package, in order to allow for varying rheologies and liquid levels of the slurries being pumped. The Seller shall make every effort to minimize the number of sizes and configurations of the motors. A single motor size with variable speed capability for all vertical pumps is preferable. Multiple motor configurations and constant speed motors will be considered if warranted.

3.7.1.5 All motors shall be NEMA design C type (in accordance with NEMA MG-1). The motor shall be the weakest link in a high torque event such that the shaft, impeller blades, and so forth do not fail in any event.

#### 3.7.2 Semi-Remote Service

3.7.2.1 Insulation for semi-remote motors in the LAW radioactive environment shall be radiation resistant to meet conditions of service described in section 3.3.

3.7.2.2 The Seller shall install all required conduit with proper wiring from the motor junction box to the electrical connectors. All electrical components shall be waterproof. Cable shall be radiation resistant for levels shown in section 3.3 (see section 6.3.9).

### 3.8 Seismic Requirements

3.8.1 The semi-remote vertical pump components, including the mounting plates, shall be designed in accordance with the methods and procedures described in Specification 24590-WTP-3PS-FB01-T0001, *Structural Design Loads for Seismic Category III and IV Equipment and Tanks*, attached to the material requisition.

### 3.9 Accessibility and Maintenance

- 3.9.1 The Buyer's layout allows for necessary access and space requirements to facilitate maintenance during normal plant operation or scheduled shutdown.
- 3.9.2 The Seller's recommended accessibility and maintenance requirements for each piece of equipment shall be included in the Seller's submittal.
- 3.9.3 For the LAW Facility pumps, frequency of inspection and maintenance intervals shall be in accordance with equipment Seller's recommendations and shall not be less than one year (excluding re-greasing of bearings.)

## 4 Materials

### 4.1 General

- 4.1.1 Pump materials situated above and fastened to the mounting plate (see Figure 1) shall be austenitic stainless steel type 316L. Exceptions will be the pump priming and discharge piping, which shall be constructed of the same material as the respective nozzle, and will extend down to the mounting plate. All piping shall be seamless or welded pipe with 100 % radiographic examination.

Note: The Seller may utilize standard materials of construction for the motor, bearings, and coupling components.

All other components (such as piping, nozzle assemblies, lifting assemblies, main shaft seals, nut retainer, and dutchman) shall be 316L stainless steel unless specified otherwise.

The materials of construction of special components not named herein shall be subject to the Buyer's review.

- 4.1.2 Pump materials below and including the mounting plate, with the exception of those designated as wet-end components (see section 4.1.4), shall be 316L stainless steel. Stainless steel material shall be in accordance with ASTM A276.
- 4.1.3 The Seller shall identify, on assembly drawings, all materials (including plate, forging, pipe, bolting) by ASTM material designation, class and UNS number, and shall submit material certificates for the Buyer's review and approval.
- 4.1.4 Wet-end components, which include the impeller, shaft sleeve, casing, and suction disc, shall be as indicated on vertical pump data sheets.
- 4.1.5 Gasket selection and configuration shall be based on specific application and performance requirements.
- 4.1.6 Fasteners shall be as shown on Figure 1.

## 4.2 Positive Material Identification

- 4.2.1 All pressure containing parts materials shall be in accordance with 24590-WTP-3PS-G000-T0002, *Specification for Positive Material Identification (PMI)*.

## 4.3 Prohibited Materials

- 4.3.1 Bronze, copper, lead, zinc, tin, antimony, cadmium, or other low melting point metals, their alloys, or materials containing such metals as their basic constituents or sulfur, and halogens shall not be used in direct contact with stainless steel. This prohibition applies to use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Seller in handling, assembly, and storage of stainless steel parts or components.
- 4.3.2 Asbestos, Teflon, and aluminum shall not be used in any component of the vertical pumps.

# 5 Fabrication

## 5.1 General

- 5.1.1 All casting surfaces shall meet severity level-1 visual examination acceptance standards contained in ASTM A-802. Castings shall be free from cracks, tears, voids, or other harmful defects indicative of substandard casting quality.
- 5.1.2 All vertical pumps shall be neatly finished and free of burrs and fins, and other harmful surface conditions.
- 5.1.3 Semi-remote vertical pumps shall be designed to minimize crevices that can trap contaminants for ease of decontamination. All surfaces are to be polished smooth (RMS 125 finish). Additionally, all non-machined plate, pipe surfaces, and welds shall be glass beaded to a 112 Ra finish (equivalent to 125 RMS machined finish) or better. Actual surface finishes shall be verified with a Profilometer and recorded in Ra format. Material hold-up points internal to the pump shall be minimized.

## 5.2 Welding Procedures

All welding on pump components shall be in accordance with ASME Section IX, *Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators*. The Seller shall submit all welding procedures for vertical pumps for review.

## 5.3 Repairs

The repair welding procedure shall include, as a minimum, the following:

- a Type and extent of repairable defects
- b Defects removal and nondestructive examination used to ensure complete defect removal
- c Weld preparation and treatment, including reference to welding procedures qualified in accordance with ASME Section IX

d Nondestructive examination methods

#### 5.4 Painting, Surface Preparation, and Cleaning

All painting, surface preparation, and cleaning for vertical pumps shall be in accordance with the Seller's standard practices unless superseded by additional requirements by the Buyer during design evaluation stage.

## 6 Inspection and Testing

### 6.1 General

The Seller shall supply the Buyer with all test data, certified by the Seller, whether witnessed or not. Pumps shall not be shipped until test data and curves have been reviewed by the Buyer.

### 6.2 Hydrostatic Tests

- 6.2.1 Each pressure part of the pump shall be hydrostatically tested at 150% of maximum allowable working pressure (MAWP). Hydrostatic tests shall be maintained for at least 30 minutes.
- 6.2.2 Before a hydrostatic test procedure is implemented, the Seller shall submit it to the Buyer for review.
- 6.2.3 Water used in hydrostatic testing shall be of potable quality or better. At no time shall it contain over 50 ppm chlorides.
- 6.2.4 Systems shall be thoroughly drained and dried by wiping or blotting all accessible areas within 24 hours after testing, rinsing, or flushing operations. Water shall not be left in the system before draining for more than 48 hours.

### 6.3 Performance Tests

- 6.3.1 A shop performance test shall be conducted with water on all pumps in accordance with Hydraulic Institute (HI2.6) standards at rated speed over the complete range of flow to maximum capacity to demonstrate fulfillment of efficiency and rating guarantees. Performance tests shall be run using the NPSH available to the pump at the site, including adjustments for all expected liquid levels in vessels (described in this specification and in data sheets) and corrected to shop test conditions.
- 6.3.2 An NPSH at incipient cavitation test shall be performed in accordance with HI standards on one pump of each type specified. At least three flow points shall be tested as a minimum: design point, run out, and minimum flow. At each point, five or more readings shall be taken at increasingly lowered suction pressure until a 3 % drop in head is noted. Acceptance criteria shall be: NPSH Available minus NPSH Required at normal design capacity shall be three (3) feet or greater.
- 6.3.3 Water test results shall be plotted, showing head, efficiency, and brake horsepower vs. capacity. Water temperatures shall be recorded, and test results corrected to a design average temperature. For pumps in slurry service, in addition to the water head curve above, the Seller

shall provide an estimated slurry head curve for comparison. The thickest slurry shown in Appendix B, Pump Design Parameter Summary, shall be used; specifically, the highest yield stress (if non-Newtonian) and highest viscosity shall be used.

- 6.3.4 Additional shop test results shall be plotted showing the eductor primer flow rate vs. pressure at the primer nozzle with an indication of minimum pressure, flow, and total quantity of priming water required to prime the pump at the low liquid level shown on Figure 1.
- 6.3.5 Shop test results must verify that all pumps are capable of starting from the minimum liquid level without exceeding the maximum priming liquid volume as listed in the vertical pump data sheets.
- 6.3.6 Unusual vibration and noise shall be corrected and documented for each test point. The cause of the noise as well as all corrective action taken shall also be noted. Shop tests must verify all pumps operate within maximum allowable vibration limits specified in section 3.5.5.10.
- 6.3.7 Witness tests shall be run after final trim has been calculated and applied to pumps. No final witness test shall be run without the Buyer's supplier quality representative (SQR) present. A satisfactory full-speed test shall be run at final impeller diameter before the Buyer's representative is called in to observe the test. A preliminary curve and test data shall be submitted to the Buyer's SQR immediately after each test. The amount of acceptable plus tolerance on head, capacity, and horsepower shall be within the range of tolerances suggested by the HI standards.
- 6.3.8 Shop tests must verify that the first lateral critical speed of all pump shafts and impellers is at least 20% above the maximum operating speed.
- 6.3.9 During testing, each pump tested shall be fully supplied with electrical power supplied by means of the electrical connectors per approved design (see section 3.7.2.2).
- 6.3.10 After tentative acceptance by the Buyer's SQR, the pumps may be readied for shipment but shall not be released until acceptance by the Buyer of formal submission of curves and data, which shall constitute the performance test report.

#### **6.4 Final Dimensional Checks - Semi-Remote Vertical Pumps**

- 6.4.1 After fabrication and testing, the Seller shall verify the dimensional requirements as given in Figure 1 in accordance with the procedures and precision measuring techniques described in Appendix D.
- 6.4.2 The Seller shall provide proof that the pump and pump appurtenances are dimensionally correct within the specified tolerances. This shall be accomplished by the completion of dimensional record drawings. These drawings, with details of the critical dimensions added by the Seller, shall be submitted to the Buyer for review prior to shipment.

Note: In addition to pump and pump appurtenances above, as-built shim dimensions of each individual shim required for precision placement of the pump shaft thrust and radial bearings shall be recorded on the dimensional record drawings for each pump.

6.4.3 All final dimensional measurements will be witnessed by the Buyer. No witness tests shall be performed without the Buyer's SQR present.

### 6.5 Plumb Lift Test

One complete pump of each type shall be tested for single point lift with Seller furnished lift yoke, designed to dimensions and configurations supplied by Buyer, connected to lifting lugs. Variation from vertical shall be 1-inch maximum from plumb. All plumb lift tests will be witnessed by Buyer. No witness tests shall be performed without the Buyer's SQR present.

## 7 Packaging, Handling, and Storage

### 7.1 General

Packaging, handling, and storage of the vertical pumps shall be in accordance with 24590-WTP-3PS-G000-T0003, *Engineering Specification for Packaging, Handling and Storage Requirements*.

### 7.2 Tagging

A stainless steel nameplate shall be attached to each vertical pump showing the manufacturer's name, shop location, date of manufacture, serial number, equipment rating, equipment tag numbers, weight of assembly, and material requisition number. Instruments shall be identified with Buyer-provided tag numbers on stainless steel tags using 1/4 inch tall characters.

## 8 Quality Assurance

### 8.1 CM Quality Designation - QA Requirements Specific to LAW Items or Service

8.1.1 The Seller's quality assurance program (QAP) requirements are included in 24590-WTP-3PS-G000-T0001.

8.1.2 The Seller's QAP manual shall be submitted to the Buyer for review in accordance with 24590-WTP-3PS-G000-T0001.

#### 8.1.3 Program QA Elements

The Seller's QAP, as a minimum, shall contain the requirements detailed in the supplier quality assurance program requirements data sheets listed in section 2 of the material requisition.

### 8.2 Seller Deviation

Each Seller shall be required to identify and promptly document all deviations from the requirements of the acquisition documents. Seller-proposed deviations from acquisition services documents shall be initiated by use of a supplier deviation disposition request (SDDR) form, listed in section 2 of the material requisition and attached thereto. In addition, the Seller shall be required to describe the recommended disposition based on appropriate analysis. Submittals of request for deviations from sub-Sellers shall be through the primary Seller to the Buyer.

## 9 Configuration Management

Equipment or components covered by this specification are identified with plant item numbers as shown in the motor and vertical pump data sheets. Each item shall be identified in accordance with section 7.2, Tagging.

## 10 Documentation and Submittals

### 10.1 General

The Seller shall submit to the 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 section 3 of the material requisition.

### 10.2 Submittals

The Seller shall submit the following:

#### 10.2.1 Drawings

Drawings shall show the following information:

- 10.2.1.1 The outline dimensions of the vertical pumps, including outline and detail drawings for each major component. These drawings shall reflect the "as-shipped" configuration of the equipment and instrumentation.
- 10.2.1.2 Details of construction
- 10.2.1.3 Mounting dimensions and information required for the design of supports and foundations
- 10.2.1.4 Operating weight of each vertical pump
- 10.2.1.5 Dynamic loading on mounting flange
- 10.2.1.6 The space required for the removal of components
- 10.2.1.7 The weight of individual components
- 10.2.1.8 The locations and identification of parts that are included in the parts list
- 10.2.1.9 Wiring, schematic diagrams, and connection. Diagrams shall include wire gauges and fuse sizes applicable to the supplied units only.
- 10.2.1.10 The ASTM or equivalent designation for materials
- 10.2.1.11 Nameplate lists
- 10.2.2 Procedures

Procedures shall include the following:

- 10.2.2.1 Welding procedures
- 10.2.2.2 Procedures for repairs of rejected items or parts
- 10.2.2.3 Electrical component performance test procedures
- 10.2.2.4 Seller's shipping preparation procedures, including initial startup and checkout procedures, instructions for final alignment checks and any other special instructions prior to initial start-up in facility.
- 10.2.2.5 Startup, shutdown, and idle procedures
- 10.2.2.6 Special instruction for installing and maintaining any packing and seals for shafts, bearings, or similar items. Include special instructions for extended (up to 3-years) storage or idle conditions prior to initial start-up in facility.
- 10.2.2.7 Procedure for all priming operations using an eductor or similar item, including special instructions and sequence for pump startup for all liquid level scenarios
- 10.2.2.8 For in-place re-greasing (see section 3.5.5.4), the Seller shall submit a full procedure for this re-lubrication process, including all materials needed, proper sequence, special remote crane operator instructions, and instructions for semi-remote access.
- 10.2.2.9 Seller shall submit a written tolerance control procedure to establish and verify horizontal and vertical centerlines, precise horizontal and vertical measurements, flatness, and datum planes for dimensional measurement of vertical pumps.
- 10.2.3 Inspection and Test Reports
  - 10.2.3.1 Records of repairs and rejected items or parts
  - 10.2.3.2 Electrical component performance test reports
  - 10.2.3.3 Bench test mechanical performance reports

10.2.4 Calculations

Calculations shall be submitted for the Buyer's review and permission to proceed.

- 10.2.4.1 Seismic analysis
- 10.2.4.2 Lifting lug stress analysis
- 10.2.5 Manuals

Manuals and instructions shall be supplied per the G-321-E form and shall include the following:

- 10.2.5.1 Erection and installation manuals that provide complete, detailed procedures for installing and placing equipment in initial operation. The manuals shall include all erection and installation drawings. A minimum of five (5) sets of each manual type shall be provided.
- 10.2.5.2 Operation and maintenance manuals that provide complete, detailed descriptions of components and accessories, including data sheets showing design, construction and performance data for equipment. Manuals shall include drawings required for operation, maintenance and repair, maintenance requirements, instructions, and operational troubleshooting guides. Motor to pump alignment criteria shall be provided by the Seller, including any special alignment criteria.
- 10.2.5.3 Instruction manuals shall cover every item purchased, including materials that the Seller has obtained from a subcontractor. The Seller shall obtain such manuals and lists, and submit them to the Buyer.
- 10.2.5.4 The Seller shall provide instructions regarding site storage and preparation and protection of equipment after installation and prior to operation.

10.2.6 Certificates of Conformance

- 10.2.6.1 The Seller shall provide certificates of conformance demonstrating compliance with all applicable standards, specifications, and drawings.
- 10.2.6.2 The Seller shall certify that lifting eyes or lugs and/or spreader bars are suitable for the safe, balanced lifting and handling of the equipment.

10.2.7 Lists and Schedules

Lists and schedules shall include the following:

- 10.2.7.1 Schedule of engineering and fabrication
- 10.2.7.2 Parts list, and cost for parts and items subject to deterioration and replacement
- 10.2.7.3 List of recommended spare parts

10.2.8 Materials Certificates/Statistics

Material certificates of compliance shall be submitted for components of the vertical pumps. The certificates shall include certified material test reports of chemical and physical properties for all stress components.

10.2.9 Data

Data shall include the following:

- 10.2.9.1 Buyer's Motor and Vertical Pump Data Sheets, completely filled out by the Seller, showing all information required to determine that the units are of the design and materials specified herein.
- 10.2.10 Design and Technology Selection Criteria

10.2.10.1 Bearing Grease Selection

If an alternative grease for bearings is recommended other than that specified herein (section 3.5.5.5), all appropriate technical information shall be submitted for Buyer acceptance.

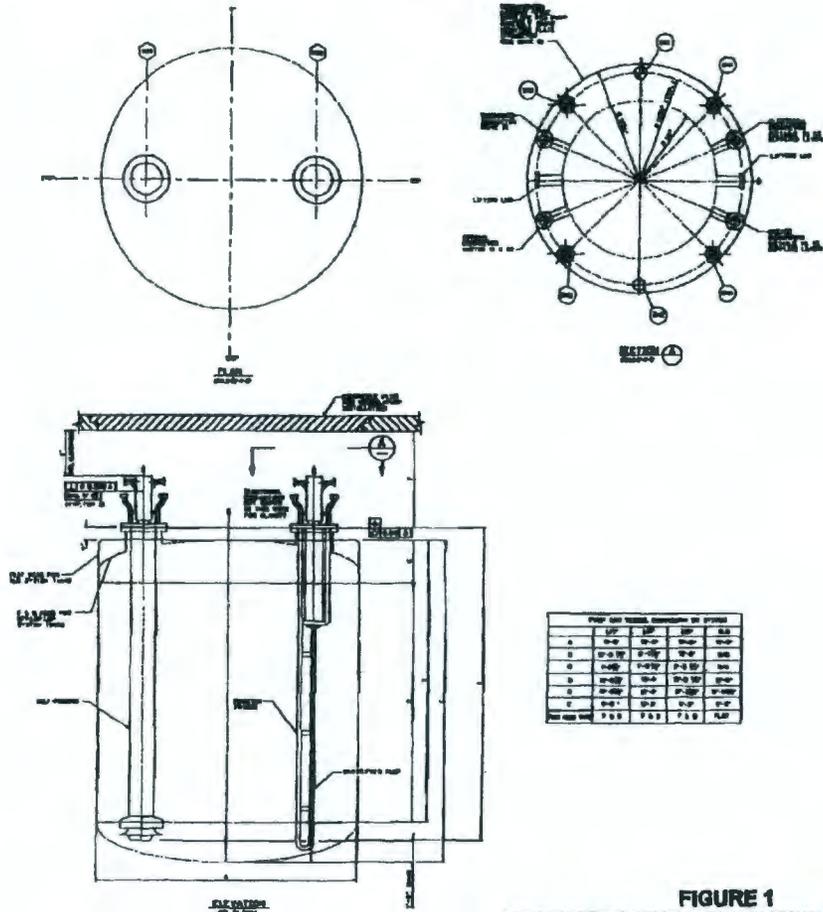
10.2.10.2 Deleted

10.2.11 Material Safety Data Sheets

Material Safety Data Sheets shall be provided for all oils, greases, paints, preservatives, and all other chemicals and chemical products that are shipped with the vertical pumps.

Figure 1 LAW Semi-Remote Vessel-Mounted Vertical Transfer Pumps

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- NOTES**
1. THE PUMP SHALL BE ASSEMBLED AND OPERATED IN ACCORDANCE WITH THE PUMP MANUFACTURER'S INSTRUCTIONS.
  2. THE PUMP SHALL BE OPERATED IN ACCORDANCE WITH THE PUMP MANUFACTURER'S INSTRUCTIONS.
  3. THE PUMP SHALL BE OPERATED IN ACCORDANCE WITH THE PUMP MANUFACTURER'S INSTRUCTIONS.
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  9. THE PUMP SHALL BE OPERATED IN ACCORDANCE WITH THE PUMP MANUFACTURER'S INSTRUCTIONS.
  10. THE PUMP SHALL BE OPERATED IN ACCORDANCE WITH THE PUMP MANUFACTURER'S INSTRUCTIONS.

TABLE 1: PUMP AND MOTOR SPECIFICATIONS BY MODEL

Model	Motor	Flow (GPM)	Head (ft)	Power (HP)
1	1/2 HP	100	10	1/2
2	1/2 HP	100	10	1/2
3	1/2 HP	100	10	1/2
4	1/2 HP	100	10	1/2
5	1/2 HP	100	10	1/2
6	1/2 HP	100	10	1/2
7	1/2 HP	100	10	1/2
8	1/2 HP	100	10	1/2
9	1/2 HP	100	10	1/2
10	1/2 HP	100	10	1/2

TABLE 2: PUMP AND MOTOR SPECIFICATIONS BY MODEL

Model	Motor	Flow (GPM)	Head (ft)	Power (HP)
1	1/2 HP	100	10	1/2
2	1/2 HP	100	10	1/2
3	1/2 HP	100	10	1/2
4	1/2 HP	100	10	1/2
5	1/2 HP	100	10	1/2
6	1/2 HP	100	10	1/2
7	1/2 HP	100	10	1/2
8	1/2 HP	100	10	1/2
9	1/2 HP	100	10	1/2
10	1/2 HP	100	10	1/2

**REVISIONS**

NO.	DATE	DESCRIPTION
1		
2		
3		
4		
5		

**FIGURE 1**  
**LAW SEMI-REMOTE VESSEL MOUNTED VERTICAL TRANSFER PUMPS**  
 ATTACHMENT TO SPECIFICATION 24590-WTP-3PS-MPC0-T0008  
 LAW VESSEL MOUNTED VERTICAL TRANSFER PUMPS FOR UPL, LOP, LOP, & RLP SYSTEMS

## Appendix A

### Pump Operation Summary

24590-WTP-3PS-MPC0-T0005, Rev 1  
 Vessel-Mounted Vertical Transfer Pumps - LAW Facility

#	Pump ID#	Vessel Description	Pump Frequency	Pump Duration
			(hours between batches)	(SEE NOTE 1) (minutes)
1	LCP-PMP-00001A	LAW Concentrate Receipt Pump	18	25
2	LCP-PMP-00001B	LAW Concentrate Receipt Pump	18	25
3	LCP-PMP-00002A	LAW Concentrate Receipt Pump	18	25
4	LCP-PMP-00002B	LAW Concentrate Receipt Pump	18	25
5	LFP-PMP-00001A	Melter 1 Feed Preparation Vessel Pump	18	60
6	LFP-PMP-00001B	Melter 1 Feed Preparation Vessel Pump	18	60
7	LFP-PMP-00002	Melter 1 Feed Vessel Pump	As Needed	60
8	LFP-PMP-00003A	Melter 2 Feed Preparation Vessel Pump	18	60
9	LFP-PMP-00003B	Melter 2 Feed Preparation Vessel Pump	18	60
10	LFP-PMP-00004	Melter 2 Feed Vessel Pump	As Needed	60
11	LOP-PMP-00001	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
12	LOP-PMP-00002	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
13	LOP-PMP-00004	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
14	LOP-PMP-00005	SBS Condensate Vessel Pump	24 / Continuous	107 (transfer) / recirc.
15	RLD-PMP-00001A	Plant Wash Vessel Pump	63	91
16	RLD-PMP-00001B	Plant Wash Vessel Pump	63	91
17	RLD-PMP-00003A	SBS Condensate Collection Vessel Pump	43	91
18	RLD-PMP-00003B	SBS Condensate Collection Vessel Pump	43	91

NOTE 1: Filter times shown in this column are for batch transfers only.  
 All pumps shown as recirc. should be designed for continuous service.  
 All other pumps should be designed for intermittent service in addition  
 to transfer durations shown (nom. 30 min. per day)

## **Appendix B**

### **Pump Design Parameter Summary**

#	UID	Sys	Pump ID	Quality Level	Access	Preferred Design	Height Elev (ft)	Vessel ID	Vessel Description	Site Building	Site Name	# Flow-Heads	Total Stress (dynes/cm <sup>2</sup> )		Conductivity (µS)		Density (g/cm <sup>3</sup> )		Sulfide Content			Part. Size (µm, Inherent)		Chem. Comp				
													Max	Min	Max	Min	Max	Min	Total	Max/Feed	Min/Inlet	Max	Average					
1	LAW	LCP	LCP-PMP-0001A	CM	Stand. Receipt	Std-010001	30	LCP-VB-0001	LCP Concentrate Receipt Vessel	Hermetic	Reception	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA		
2	LAW	LCP	LCP-PMP-0001B	CM	Stand. Receipt	Std-010001	30	LCP-VB-0002	LCP Concentrate Receipt Vessel	Hermetic	Reception	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
3	LAW	LCP	LCP-PMP-0002A	CM	Stand. Receipt	Std-010001	30	LCP-VB-0003	LCP Concentrate Receipt Vessel	Hermetic	Reception	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
4	LAW	LCP	LCP-PMP-0002B	CM	Stand. Receipt	Std-010001	30	LCP-VB-0004	LCP Concentrate Receipt Vessel	Hermetic	Reception	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
5	LAW	LFP	LFP-PMP-0001A	CM	Stand. Receipt	Std-010001	30	LFP-VB-0001	Melter #1 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
6	LAW	LFP	LFP-PMP-0001B	CM	Stand. Receipt	Std-010001	30	LFP-VB-0002	Melter #1 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
7	LAW	LFP	LFP-PMP-0002A	CM	Stand. Receipt	Std-010001	30	LFP-VB-0003	Melter #1 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
8	LAW	LFP	LFP-PMP-0002B	CM	Stand. Receipt	Std-010001	30	LFP-VB-0004	Melter #1 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
9	LAW	LFP	LFP-PMP-0003A	CM	Stand. Receipt	Std-010001	30	LFP-VB-0005	Melter #2 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
10	LAW	LFP	LFP-PMP-0003B	CM	Stand. Receipt	Std-010001	30	LFP-VB-0006	Melter #2 Feed Process Vessel	Self-Contained	Non-Hermetic	Throttled	180	0	80	-	0.4	1.80	1.87	33.4	33.4	30	343	48.7	NA	NA	NA	
11	LAW	LCP	LCP-PMP-0004	CM	Stand. Receipt	Std-010001	30	LCP-VB-0007	Wet Clarification Vessel	Hermetic	Reception	NA	NA	NA	-	0.80	-	1.00	-	0	0	0	0	0	0	0	0	
12	LAW	LCP	LCP-PMP-0005	CM	Stand. Receipt	Std-010001	30	LCP-VB-0008	Wet Clarification Vessel	Hermetic	Reception	NA	NA	NA	-	0.80	-	1.00	-	0	0	0	0	0	0	0	0	
13	LAW	LCP	LCP-PMP-0006	CM	Stand. Receipt	Std-010001	30	LCP-VB-0009	Wet Clarification Vessel	Hermetic	Reception	NA	NA	NA	-	0.80	-	1.00	-	0	0	0	0	0	0	0	0	
14	LAW	LCP	LCP-PMP-0007	CM	Stand. Receipt	Std-010001	30	LCP-VB-0010	Wet Clarification Vessel	Hermetic	Reception	NA	NA	NA	-	0.80	-	1.00	-	0	0	0	0	0	0	0	0	
15	LAW	PLD	PLD-PMP-0001A	CM	Stand. Receipt	Std-010001	30	PLD-VB-0001	Plant Wash Vessel	Hermetic	Reception	NA	NA	NA	-	1	-	1.00	-	0	0	0	0	0	0	0	<15 µm/ft, NA	
16	LAW	PLD	PLD-PMP-0001B	CM	Stand. Receipt	Std-010001	30	PLD-VB-0002	Plant Wash Vessel	Hermetic	Reception	NA	NA	NA	-	1	-	1.00	-	0	0	0	0	0	0	0	0	<15 µm/ft, NA
17	LAW	PLD	PLD-PMP-0002A	CM	Stand. Receipt	Std-010001	30	PLD-VB-0003	Plant Wash Vessel	Hermetic	Reception	NA	NA	NA	-	1	-	1.00	-	0	0	0	0	0	0	0	0	<15 µm/ft, NA
18	LAW	PLD	PLD-PMP-0002B	CM	Stand. Receipt	Std-010001	30	PLD-VB-0004	Plant Wash Vessel	Hermetic	Reception	NA	NA	NA	-	1	-	1.00	-	0	0	0	0	0	0	0	0	<15 µm/ft, NA

**Abbreviations for Systems**

- LCP LAW Concentrate Receipt Process System
- LFP LAW Melter Feed Process System
- LCP LAW Primary Offgas Process System
- RLD LAW Radioactive Liquid Waste Disposal System

**IMPORTANT:** These values are subject to change.

Information listed here will be updated as design progresses if required.  
 Seller shall verify values with Buyer before issuing detailed design.  
 In the event of a discrepancy between values shown here and the data sheets or elsewhere in this Bid package, Seller shall use the most conservative values.

### Typical Chemical Composition of Slurries

**LAW SLURRY LEGEND:**

- LCP** Refers to pretreated waste for LCP pumps.
- LFP-MFPV** Refers to Melter Feed for LFP-PMP-00001A/B, and 00003A/B
- LFP-GFC** Refers to Glass Forming Chemicals for LFP-PMP-00001A/B, and 00003A/B
- LFP-MFV** Refers to Melter Feed for LFP-PMP-00002, and 00004

<u>Compound</u>	<u>LCP</u> [wt%]	<u>LFP-MFPV</u> [wt%]	<u>LFP-GFC</u> [wt%]	<u>LFP-MFV</u> [wt%]
Al <sub>2</sub> O <sub>3</sub>	5.6%	5.3%	5.1%	5.3%
B <sub>2</sub> O <sub>3</sub>	0.6%	5.4%	8.3%	5.4%
Na <sub>2</sub> O	41.0%	17.0%	3.8%	17.0%
Fe <sub>2</sub> O <sub>3</sub>	0.1%	3.7%	5.7%	3.7%
SiO <sub>2</sub>	0.4%	33.1%	51.2%	33.1%
SO <sub>3</sub>	0.9%	0.3%	0.005%	0.3%
ZrO <sub>2</sub>	0.1%	1.5%	2.3%	1.5%
ZnO	0.1%	1.4%	2.1%	1.4%
Other	51.2%	32.3%	21.5%	32.3%

## **Appendix C**

### **Connectors**

## Appendix C

### Connectors

#### 1.0 General

Drawings and brief descriptions of the types of connectors proposed for the vertical pumps are detailed in section 3. Certain connectors shown here will be supplied by the Buyer, as described in this specification and in Appendix D, and the Seller shall be responsible for incorporating the proper interfaces and locations into their final designs. The final selection of connector size and type is subject to change and shall be approved by the Buyer prior to fabrication of the pumps.

#### 2.0 Connector Selection

##### 2.1 Semi-Remote Process Connectors - LAW

The semi-remote process connectors will be 150# Raised Face flanges.

##### Semi-Remote Electrical Connectors - LAW

The semi-remote electrical connectors shall be standard electrical connections sized appropriately for the specific power applications. Semi-remote electrical connectors shall be supplied by the Seller.

#### 3.0 Connector Technology

##### General

Figure C3.1 DELETED

**Appendix D**  
**Final Dimensional Measurements of Pumps by Seller**

## Appendix D

### Final Dimensional Measurements of Pumps by Seller

#### 1.0 Purpose

The Seller shall perform dimensional measurements for all vertical pumps, all nozzles, and all appurtenances at the Seller's shop. All as-built dimensions obtained thereby shall be recorded as required in Paragraph 6.4.1 of Specification 24590-WTP-3PS-MPC0-T00008. The Seller shall give the Buyer opportunity to witness all final dimensional measurements and review all dimensional records prior to shipment.

#### 2.0 Scope

##### 2.1 Items Included

The Seller shall furnish the following:

- Enclosed and/or partitioned separate temperature controlled area
- Level precision floor surface or surfaces
- Instrument supports, platforms, ladders, stairs, and guardrails
- Overhead crane access
- Lighting
- Facility and support drawings
- Vertical pump support stand
- Lifting yokes, fabricated to dimensions and configurations supplied by Buyer
- Optical instruments and scales

#### 3.0 Requirements - Shop Facilities

- 3.1 The Seller shall provide a measurement area for final dimensional verification. This will require approximately 30 feet of headroom to the bottom of the crane hook. A vertical pump stand with a level, flat surface matching the tolerances of the pump support plates is required for mounting pumps during dimensional check. The measurement area shall be temperature controlled to  $70\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$ . The Seller shall supply calibrated thermometers with traceable calibration sheets. This temperature shall be maintained during the dimensional measurement by the Seller.
- 3.2 The Seller shall make final dimensional measurements using their own equipment, such as calibrated jig transits, tilting levels, and calibrated and certified scales. Scales shall be graduated to 0.01 inch. The optical instruments shall be equipped with micrometers graduated to 0.001 inch.
- 3.3 The vertical pump support plate face shall be profiled at 15 degree intervals and plotted for record.

- 3.4 The Seller shall allow adequate time to perform final dimensional measurement of each pump in the presence of the Buyer's representative to witness/observe the Seller's inspection activity. The Seller shall also provide appropriate notification to the Buyer for each witnessed inspection activity. Note that the Seller has sole responsibility for quality control inspections of their products.
- 3.5 There shall be no visual interference with the optical measurements performed by the Seller. Examples of visual interference are arc welding and equipment movement.
- 3.6 The Seller shall provide rigid supports for optical transits and levels. These supports shall be freestanding and not touching the remote vertical pumps. Substantial platforms, ladders, stairs, and handrails shall be provided, all meeting OSHA requirements. The instrument supports shall be set up a minimum of 7 feet away from the vertical pump stand and at least 3 feet higher.
- 3.7 The Seller shall submit the following drawings for the Buyer's review:
  - a The measurement enclosure area
  - b The vertical pump stand
  - c The optical instrument supports
  - d Substantial platforms, ladders, and handrails
  - e The crane interface
- 3.8 The Seller shall furnish one balanced lifting yoke, or one for each lifting lug configuration as necessary, to the dimensions and configurations supplied by the Buyer, for the plumb lift testing of the vertical pumps.
- 3.9 The Seller shall provide adequate lighting to facilitate the optical dimensional measurements. Lighting should generally be 100-foot candle average where measurements will be made.

Quarter Ending June 30, 2008

24590-WTP-PCN-ENV-06-009

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 3:    Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Update the WTP Specification, General Centrifugal Pumps to Meet Requirements of ASME B73.2M-1991 for  
Commercial (CM) Components, located in Appendix 7.7 of the Dangerous Waste Permit.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein                      5/14/08  
D. A. Klein                      Date

S. J. Clinger                      6/9/08  
S. J. Clinger                      Date

Quarter Ending June 30, 2008

24590-WTP-PCN-ENV-06-009

<b>Hanford Facility RCRA Permit Modification Notification Form</b>														
Unit: <b>Waste Treatment and Immobilization Plant</b>	Permit Part & Chapter: <b>Part III, Operating Unit 10</b>													
<b>Description of Modification:</b>  The purpose of this Class 1 modification is to update the specification, General Centrifugal Pumps to Meet Requirements of ASME B73.2M-1991 for Commercial (CM) Components, located in Appendix 7.7 of the Dangerous Waste Permit. The following specification replaces the specification currently in Appendix 7.7.														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="5" style="padding: 2px;"><b>Appendix 7.7</b></td> </tr> <tr> <td style="width: 15%; padding: 2px;">Replace:</td> <td style="width: 35%; padding: 2px;">24590-WTP-3PS-MPC0-TP002, Rev. 1</td> <td style="width: 15%; padding: 2px;">With:</td> <td colspan="2" style="width: 35%; padding: 2px;">24590-WTP-3PS-MPC0-T0002, Rev. 3</td> </tr> </table>					<b>Appendix 7.7</b>					Replace:	24590-WTP-3PS-MPC0-TP002, Rev. 1	With:	24590-WTP-3PS-MPC0-T0002, Rev. 3	
<b>Appendix 7.7</b>														
Replace:	24590-WTP-3PS-MPC0-TP002, Rev. 1	With:	24590-WTP-3PS-MPC0-T0002, Rev. 3											
This modification requests Ecology approval and incorporation into the permit the specific changes to this specification that have been identified in revision note 2, <b>bolded text</b> , or revision bars since the last revision of the permitted version. Revisions are the result of ongoing design (changes from vendor preliminary data to vendor detailed design). The following identifies the significant changes that have been revised in the attached specification.														
<ul style="list-style-type: none"> <li>• Deleted requirement to have one lot of consumable spare parts per item for startup and one year of operation</li> <li>• Allows seller to use currently available materials if the material is acceptable for the intended use</li> <li>• Added DOE O 414.A as a Code and Industry Standard</li> <li>• Added requirement to obtain buyer approval if the head rise to shutoff is less than the 10% required</li> <li>• Added requirement to test with potable water containing a chloride content of no more than 50 ppm</li> <li>• Specified a noise level of 85 dBa which is the maximum noise limit to avoid having a hearing conservation program per 29 CFR 1910.95. This is a more stringent requirement than complying with minimum requirements specified in 29 CFR 1910.95.</li> <li>• Added requirement to plug or cover openings</li> <li>• Added a reference of SDDR design changes</li> <li>• Identified specific pump requirements for drawings</li> <li>• Other miscellaneous minor clarifications</li> </ul>														
The following is a list of outstanding change documents that have not been incorporated into this modification:														
<ul style="list-style-type: none"> <li>• None</li> </ul>														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 45%; padding: 2px;">WAC 173-303-830 Modification Class: <sup>1 2</sup></td> <td style="width: 10%; padding: 2px; text-align: center;">Class 1</td> <td style="width: 10%; padding: 2px; text-align: center;">Class <sup>1</sup>1</td> <td style="width: 10%; padding: 2px; text-align: center;">Class 2</td> <td style="width: 15%; padding: 2px; text-align: center;">Class 3</td> </tr> <tr> <td style="padding: 2px;">Please mark the Modification Class:</td> <td style="text-align: center; padding: 2px;">X</td> <td></td> <td></td> <td></td> </tr> </table>					WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 1	Class 2	Class 3	Please mark the Modification Class:	X			
WAC 173-303-830 Modification Class: <sup>1 2</sup>	Class 1	Class <sup>1</sup> 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														

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 applicable.

Quarter Ending June 30, 2008

24590-WTP-PCN-ENV-06-009

<p>Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) <u>Reason for denial:</u></p>	<p>Reviewed by Ecology:</p> <p><i>B. Becker-Khaleel</i> 8/20/08 B. Becker-Khaleel Date</p>
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ISSUED BY  
RPP/WTP PDC

R10902453

**RIVER PROTECTION PROJECT - WASTE TREATMENT PLANT**

**ENGINEERING SPECIFICATION**

FOR

**General Centrifugal Pumps to Meet Requirements of ASME B73.1M-2001 and ASME B73.2M-2003 for Commercial (CM) 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.

Content applicable to ALARA?  Yes  No

ADR No.  
24590-WTP-ADR-M-03-007

Rev  
0

Quality Level

CM

DOE Contract No.  
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPEM
3	5/5/08	U. Sen <i>[Signature]</i>	B. Foster <i>[Signature]</i>	G. Goolsby <i>[Signature]</i>	M. Rosenfeld <i>[Signature]</i>	M. Sheridan <i>[Signature]</i>	John Julyk <i>[Signature]</i>
2	2/13/05	T. Henry	G. Goolsby / Chris Morley	M. Hoffmann		G. Warner	G. Duncan
1	4/08/03	W. Honsaker	G. Goolsby	M. Hoffmann		G. Warner	G. Duncan
0	6/4/02	G. Goolsby	GEC/WGH	SK for BR		G. Warner	G. Duncan

SPECIFICATION No.  
24590-WTP-3PS-MPC0-T0002

Rev  
3

**Revision History**

Revision	Reason for Revision
0	Issued for Use
1	Reissued for Use with General Revisions
2	Incorporate the following SCNs: 24590-WTP-3PN-MPCD-00007, -00010, -00012, -00014, -00015, -00020, & 00021 Incorporate the following SDDRs: 24590-WTP-SDDR-PROC-05-00097, 24590-WTP-SDDR-PROC-04-00614, -04-00659, -04-00660, -04-00804, -04-00895, -04-00928, -04-01117, & -05-00039 and 24590-WTP-SDDR-PROC-05-00096
3	Used current templates for specification cover sheet and specification; Revised sections 1.1, 1.2.5, 2.2, 3.2.1, 3.2.2, 3.5.5, 4.2.1, 5.2.1, 10.1.1, 10.2.9, 10.2.11; 10.2.12; Added section 2.4; Deleted sections 6.6.3, 7.4.3

## 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.

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# 1 Scope

## 1.1 Project Description and Location

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is a complex of waste treatment facilities where the U.S. Department of Energy (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 DOE Office of River Protection. The waste treatment facilities will pretreat and immobilize the low-activity waste and high-level waste 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. The Counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

Seller shall design, fabricate and test, centrifugal pumps and accessories in accordance with ANSI/ASME Standards B73.1M & B73.2M including:

- 1.2.1 Horizontal centrifugal pumps complete with electric motor, baseplate, and accessories as specified in individual Pump Data Sheets.
- 1.2.2 Vertical in-line centrifugal pumps complete with electric motor and accessories as specified in individual Pump Data Sheets.
- 1.2.3 Specific modifications to pump, attachments, baseplate, baseplate attachments, electric motor, and/or electric motor attachments are detailed in individual Pump Data Sheets.
- 1.2.4 Deleted
- 1.2.5 Stainless steel (SS) shim packs for each foot mounting position for each pump and driver. The shims shall be cut and slotted to match each support baseplate. Unless otherwise agreed to by the Buyer, each shim pack shall contain the following:

- 1 each SS shim 0.250" in thickness
- 2 each SS shim 0.125" in thickness
- 2 each SS shim 0.0625" in thickness
- 2 each SS shim 0.040" in thickness
- 2 each SS shim 0.010" in thickness
- 2 each SS shim 0.005" in thickness

## 1.3 Work by Others

- 1.3.1 Material unloading and storage at job site

- 1.3.2 Installation labor
- 1.3.3 External piping
- 1.3.4 Electrical power supply
- 1.3.5 Wiring external to the pump
- 1.3.6 Motor starters (except adjustable speed drive motors)

#### 1.4 Definitions and Acronyms

- 1.4.1 Definitions – See ANSI/ASME B73.1M and ANSI/ASME B73.2M and:

**Buyer**

Bechtel National Inc. for the WTP.

**Seller**

Designer, manufacturer, fabricator, vendor, supplier, bidder who provides equipment, components, services or other products for delivery or direct benefit to the Buyer.

- 1.4.2 Acronyms of Organizations and Terms

ABMA	American Bearing Manufacturers Association
AIHA	American Industrial Hygiene Association
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
BEP	Best Efficiency Point
NEMA	National Electrical Manufacturers Association
NPSH	Net Positive Suction Head
PIP	Process Industry Practices

## 2 Applicable Documents

### 2.1 General

- 2.1.1 Work shall be done in accordance with the applicable referenced codes, standards and documents listed below, which are an integral part of this specification.
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue including addenda at the time of Request for Quote (RFQ) shall apply, **except for material standards where the Seller ensures that the revision associated with currently available material is acceptable for the intended use of the material.** When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent combination of requirements.

### 2.2 Codes and Industry Standards

ANSI/ASME B73.1M	<i>Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process - 2001</i>
ANSI/ASME B73.2M	<i>Specification for Vertical In-Line Centrifugal Pumps for Chemical Process - 2003</i>
ANSI/ASME B16.1	<i>Cast Iron Pipe Flanges and Flanged Fittings</i>
ANSI/ASME B16.5	<i>Pipe Flanges and Flanged Fittings</i>
ANSI/ABMA 9	<i>Load Ratings and Fatigue Life for Ball Bearings</i>
ANSI/ABMA 11	<i>Load Ratings and Fatigue Life for Roller Bearings</i>
ANSI/ASME B15.1	<i>Safety Standard for Mechanical Power Transmission Apparatus</i>
ASME B1.1	<i>Unified Inch Screw Threads</i>
ASME Section VIII, Division 1	<i>American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section VIII, Division 1, "Rules for Construction of Pressure Vessels"</i>
ASME Section IX	<i>BPVC Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators</i> <i>Deleted</i>
PIP RESP002	<i>Design of ASME B73.1 and General Purpose Pump Baseplates</i> <i>Deleted</i> <i>Deleted</i>
UBC	<i>Uniform Building Code - 1997</i> <i>Deleted</i>

HIS Deleted  
Hydraulic Institute Standards  
Deleted

## 2.3 Reference Documents

24590-WTP-3PS-G000-T0001	<i>General Specification for Supplier Quality Assurance Program Requirements</i>
24590-WTP-3PS-G000-T0002	<i>Specification for Positive Material Identification (PMI)</i>
24590-WTP-3PS-G000-T0003	<i>General Specification for Packaging, Shipping, Handling and Storage Requirements</i>
24590-WTP-3PS-EVV1-T0001	<i>Engineering Specification for Low Voltage Adjustable Speed Drives</i>
24590-WTP-3PS-MUMI-T0001	<i>Specification for Medium Voltage Induction Motors</i>
24590-WTP-3PS-MUMI-T0002	<i>Specification for Low Voltage Induction Motors</i>
24590-WTP-3PS-FB01-T0001	<i>Engineering Specification for Structural Design Loads for Seismic Category III &amp; IV Equipment and Tanks</i>

## 2.4 Government Documents

40 CFR 264	<i>Code of Federal Regulations Part 264—Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities</i>
29 CFR 1910	<i>Code of Federal Regulations Part 1910—Occupational Safety and Health Standards (OSHA) - 1995</i>

# 3 Design Requirements

## 3.1 Basic Function

- 3.1.1 The centrifugal pumps shall provide motive force required to move various process liquids (defined in individual Pump Data Sheets) in the facilities that make up the WTP Project.

## 3.2 Performance

- 3.2.1 Pump head capacity characteristic curves shall be selected to rise continuously as flow is reduced to shutoff. Head rise to shut-off shall be at least 10 % of the head at the rated capacity.

- 3.2.2 Pump shall be capable of a minimum head increase of 5 % at the rated flow by installing a new impeller, up to the maximum allowable shown on the Seller's typical pump curves.
- 3.2.3 The net positive suction head (NPSH) available shall exceed the NPSH required by at least 3 ft from minimum continuous flow to 110 % of rated operating point.
- 3.2.4 Pumps with suction Specific Speeds ( $N_s$ ) greater than 11,000 require approval from the Buyer.
- 3.2.5 Both the normal and rated flow rates shall be within the acceptable and preferred flow rate ranges established in Figure 1. Buyer approval is required before deviating from this chart.

### 3.3 Design Conditions

- 3.3.1 Equipment and accessories are to be used in a plant with a design life of 40 years. The design objective for pumps purchased to this Specification shall be 40 years of useful life with periodic maintenance as recommended by the Seller. Maintainable items will be specified for cost-effective design lives taking into account current technology and standards.
- 3.3.2 Specific design conditions shall be detailed in individual Pump Data Sheets for each pump.

### 3.4 Environmental Conditions

- 3.4.1 Pumps shall be subjected to the operating conditions specified in individual Pump Data Sheets.
- 3.4.2 When noted in individual Pump Data Sheets, the seal elastomer components shall use radiation-tolerant materials.

When noted in individual Pump Data Sheets, bearings may require special radiation resistant lubricants.

### 3.5 Mechanical Requirements

- 3.5.1 See individual Pump Data Sheets.
- 3.5.2 Suction and discharge nozzles shall be flanged in accordance with ANSI/ASME B73.1M, [paragraph 4.2] and/or ANSI/ASME B73.2M, [paragraph 4.2]. See individual Pump Data Sheets for additional requirements.
- 3.5.3 Modifications and/or special nozzle configurations are specified in individual Pump Data Sheets.
- 3.5.4 Seal gland shall be as specified in ANSI/ASME B73.1M, [paragraph 4.6.6] or ANSI/ASME B73.2M, [paragraph 4.6.6]. For services where the pump case is a higher grade alloy, the seal gland shall be of the same material as the pump case or an alloy of greater corrosion resistance. See paragraph 6.5 of this specification for positive material identification requirements.

3.5.5 Unless otherwise specified, horizontal end suction centrifugal pumps shall be supplied with suitable baseplates designed for grouting in accordance with reference PIP RESP002 [section 4].

3.5.6 The underside of fabricated baseplates, beneath pump and driver supports, shall have reinforcing cross members welded to full depth. The members shall be shaped to be held in position by the grout. All welding shall be continuous. Stitch welding, top or bottom, is unacceptable.

### 3.6 Loadings

3.6.1 Seller shall submit allowable flange loadings to Buyer for review.

3.6.2 Pumps shall be designed for seismic loads as specified in the individual Pump Data Sheets. Design loads shall be calculated in accordance with *Engineering Specification for Structural Design Loads for Seismic Category III & IV Equipment and Tanks (24590-WTP-3PS-FB01-T0001)*.

### 3.7 Electric Motors

3.7.1 Medium and Low Voltage Induction Motors shall conform to specifications *Specification for Medium Voltage Motors (24590-WTP-3PS-MUMI-T0001)* and *Specification for Low Voltage Motors (24590-WTP-3PS-MUMI-T0002)* respectively.

3.7.2 Adjustable speed drives shall be in accordance with *Engineering Specification for Low Voltage Adjustable Speed Drives (24590-WTP-3PS-EVV1-T0001)*.

3.7.3 Electric Motors shall be sized so that they are not overloaded at any point on the performance curve.

3.7.4 For other requirements see individual motor data sheets, if provided; otherwise see additional motor specifications listed in the individual pump data sheets.

### 3.8 Instrumentation and Control Requirements

3.8.1 Barrier fluid systems, when specified in individual Pump Data Sheets, shall be equipped with seal failure detection as required by 40 CFR 264. Switch supplied shall be a single pole double throw (SPDT), hermetically sealed dry contact design suitable for the environmental conditions where it is located.

3.8.2 Seal failure detection on barrier fluid systems, shall include discreet contacts for Buyer's external alarm as required by 40 CFR 264.

### 3.9 Accessibility and Maintenance

3.9.1 Frequency of inspection and maintenance intervals shall be in accordance with equipment Seller's recommendations or as required by plant maintenance.

- 3.9.2 Buyer's layout specifies access and space requirements to facilitate maintenance during normal plant operation or scheduled shutdown.
- 3.9.3 Detailed drawings of facility specific maintenance equipment requirements, if any, are referenced in individual pump data sheets.
- 3.9.4 Seller shall advise recommended screen size or perforation size in startup strainers for each pump application.

## 4 Materials

### 4.1 Construction

- 4.1.1 See individual Pump Data Sheets.
- 4.1.2 Horizontal end suction centrifugal pump construction shall be in accordance with ANSI/ASME B73.1M.
- 4.1.3 Vertical in-line centrifugal pump construction shall be in accordance with ANSI/ASME B73.2M.
- 4.1.4 Restrictions to repair of pressure containing or wetted parts shall be in accordance with ANSI/ASME B73.1M [paragraph 4.8] and/or ANSI/ASME B73.2M [paragraph 4.8].

### 4.2 Prohibited Materials

- 4.2.1 Bronze, copper, lead, zinc, tin, antimony, cadmium, their alloys or materials containing such metals as their basic constituents, or molybdenum and halogens, shall not be used in direct contact with stainless steel, with the exception of oil impregnated bronze bearings. This prohibition applies to the use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Seller in handling, assembly and storage of stainless steel parts or components.
- 4.2.2 The use of asbestos is prohibited.

### 4.3 Special Requirements

Special conditions and requirements, if any, are detailed in individual pump data sheets.

### 4.4 Storage of Special Materials (e.g., Stainless Steel) Prior to Work

Storage of Special Materials (Seller's Location) shall be in accordance with the Seller's QAP and *General Specification for Packaging, Shipping, Handling and Storage Requirements* (24590-WTP-3PS-G000-T0003).

## 5 Fabrication

### 5.1 Welding

- 5.1.1 Weld repairs required to certify pressure containing parts shall be performed and inspected by qualified operators using procedures which are qualified in accordance with Section VIII, Division 1 and Section IX of the ASME Code.
- 5.1.2 Weld repair records shall be included with document submittal package.

### 5.2 Assembly

- 5.2.1 Pump and driver mounted by the Seller shall be properly aligned prior to shipment. To ensure final alignment can be achieved in the field, the equipment Seller shall align the pump and driver within 0.002 inch parallel offset. The driver shall not be bolt bound in any direction and hold down bolts shall not be undercut or undersized to relieve this condition.
- 5.2.2 Each pump, motor and baseplate assembly shall include all components and accessories fully assembled, piped and wired, requiring only setting on the foundation and connecting Buyer's piping, electrical, and control systems.

## 6 Tests and Inspections

### 6.1 Personnel Qualifications

Seller's inspection and test personnel qualifications shall be verified by Buyer's supplier quality representative.

### 6.2 Non-Destructive Examinations

Hydrostatic tests on machined parts shall be in accordance with ANSI/ASME B73.1M, [paragraph 5.2.1] or ANSI/ASME B73.2M, [paragraph 5.2.1]. See individual pump data sheets for additional tests.

### 6.3 Shop Tests

- 6.3.1 Buyer's inspection plan shall indicate tests and inspections to be witnessed. The individual Pump Data Sheets may further define inspection, test requirements, and pump media type.
- 6.3.2 Pump performance tests shall be performed per Hydraulic Institute Standards (HIS) as required by ANSI/ASME B73.1M [paragraph 5.2] or ANSI/ASME B73.2M [paragraph 5.2].
- 6.3.3 Hydrostatic testing of equipment shall be performed using potable water with chlorine content of no more than 50 ppm.

## 6.4 Site Tests

Buyer's startup personnel shall perform field tests after installation. Buyer may request Seller's assistance during startup at no additional cost.

## 6.5 Positive Material Identification

Positive material identification (PMI) shall be performed in accordance with *Specification for Positive Material Identification (PMI)* (24590-WTP-3PS-G000-T0002).

## 6.6 Safety Requirements

6.6.1 See individual pump data sheets for specific safety requirements.

6.6.2 Safety guards shall be furnished in accordance with ANSI/ASME B73.1M, [paragraph 4.12.1] or ANSI/ASME B73.2M [paragraph 4.12.1].

6.6.3 Deleted

# 7 Preparation for Shipment

## 7.1 Cleanliness

All dirt, oil, grease, loose mill scale, weld splatter and other foreign matter shall be removed from all surfaces in accordance with *General Specification for Packaging, Handling and Storage Requirements*.

## 7.2 Painting

Manufacturer's standard procedures shall be submitted for Buyer's review.

## 7.3 Tagging

7.3.1 Nameplate shall be provided and attached as specified in of ANSI/ASME B73.1M [paragraph 5.3] or ANSI/ASME B73.2M [paragraph 5.3].

7.3.2 Buyer's equipment number listed on the individual pump data sheets shall be included on nameplate.

7.3.3 Buyer's instrument tag numbers listed on the individual instrument data sheets shall be included on name tags affixed to instruments. Seller shall supply stainless steel wired instrument tags engraved with Buyer's purchase order number, item number, and instrument tag number.

## 7.4 Packaging

- 7.4.1 All equipment shall be packed, securely anchored, and protected for shipment in accordance with *General Specification for Packaging, Handling, and Storage Requirements*. Non-mounted drivers (if approved by Buyer) shall be shipped along with the main pump assembly unless otherwise agreed by Buyer or specified on individual pump data sheets.
- 7.4.2 Pumps, drive motors, and all furnished auxiliaries shall be shipped fully assembled on their specific baseplates. Special applications requiring different shipping instructions are detailed in individual pump data sheets.
- 7.4.3 Deleted

## 8 Quality Assurance

### 8.1 QA Requirements Specific to Item(s) or Service

- 8.1.1 The Seller's quality assurance program (QAP) requirements are included in *General Specification for Supplier Quality Assurance Program Requirements (24590-WTP-3PS-G000-T0001)*.
- 8.1.2 Seller's QAP manual shall be submitted to Buyer for review in accordance with *General Specification for Supplier Quality Assurance Program Requirement*.

### 8.2 Program QA Elements

Seller's QAP, at a minimum shall contain the requirements detailed in the Supplier QAP requirements data sheets listed in Section 2 of the material requisition.

## 9 Configuration Management

Equipment covered by this Specification is identified with equipment numbers listed in individual pump data sheets. Each item is identified in accordance with Tagging in Paragraph 7.3 of this specification.

## 10 Documentation and Submittals

### 10.1 General

- 10.1.1 Documents required by Buyer shall be made available in as prescribed in Appendix A of ANSI/ASME B73.1M and/or ANSI/ASME B73.2M. See section 3 of the Material Requisition for submittal format requirements.

10.1.2 Submittals and document quantities including drawings, installation procedures, inspection and test reports, calculations, manuals, certificates of conformance, schedules and material certificates are detailed in section 3 (G-321-E Form) of the material requisition.

## 10.2 Submittals

### 10.2.1 Drawings

Drawings shall be inclusive of all following requirements:

10.2.2 Outline drawings of pump assembly, including outline and detail drawings for each component as follows:

- Pump
- Motor
- Seal
- Coupling

10.2.3 Mounting dimensions and information required for the design of supports and foundations

10.2.4 Locations and identification of parts included in the parts list

10.2.5 Wiring, schematic diagrams and data; diagrams including wire gauges applicable to the supplied units only; external connections for power and measurement shown on these diagrams; submittals to meeting requirements specified in *Specification for Medium Voltage Motors* (24590-WTP-3PS-MUMI-T0001, paragraph 10.1) or *Specification for Low Voltage Motors* (24590-WTP-3PS-MUMI-T0002, paragraph 10.1) as applicable

10.2.6 Pump performance curve showing NPSH required, horsepower, efficiency, flow vs. head at applicable speeds

10.2.7 Drawing submittal requirements as shown on G-321-E form of the material requisition

10.2.8 Mechanical seal drawing for pumps specified in individual pump data sheets

### 10.2.9 Parts List

A list of all pump parts for start-up and 1-year operation shall be provided by Seller as prescribed in ANSI/ASME B73.1M or ANSI/ASME B73.2M. Seller shall identify useful shelf life and storage requirements of parts anticipated to have functional life spans shorter than the pump design life.

### 10.2.10 Inspection and Test Reports

Seller shall provide test reports in accordance with ANSI/ASME B73.1M [paragraph 5.2] or ANSI/ASME B73.2M [paragraph 5.2]. See section 5 and section 3 of the material requisition.

#### 10.2.11 Forces and Moments

Allowable external forces and moments on pump nozzles shall be provided as prescribed in ANSI/ASME B73.1M [paragraph 5.1.2] and/or ANSI/ASME B73.2M [paragraph 5.1.2].

#### 10.2.12 Manuals

Manuals shall be supplied to provide information on the correct installation, operation, and maintenance of the pump assembly. Manuals shall be as prescribed in ANSI/ASME B73.1M [paragraph 7.3.8] or ANSI/ASME B73.2M [paragraph 7.3.8].

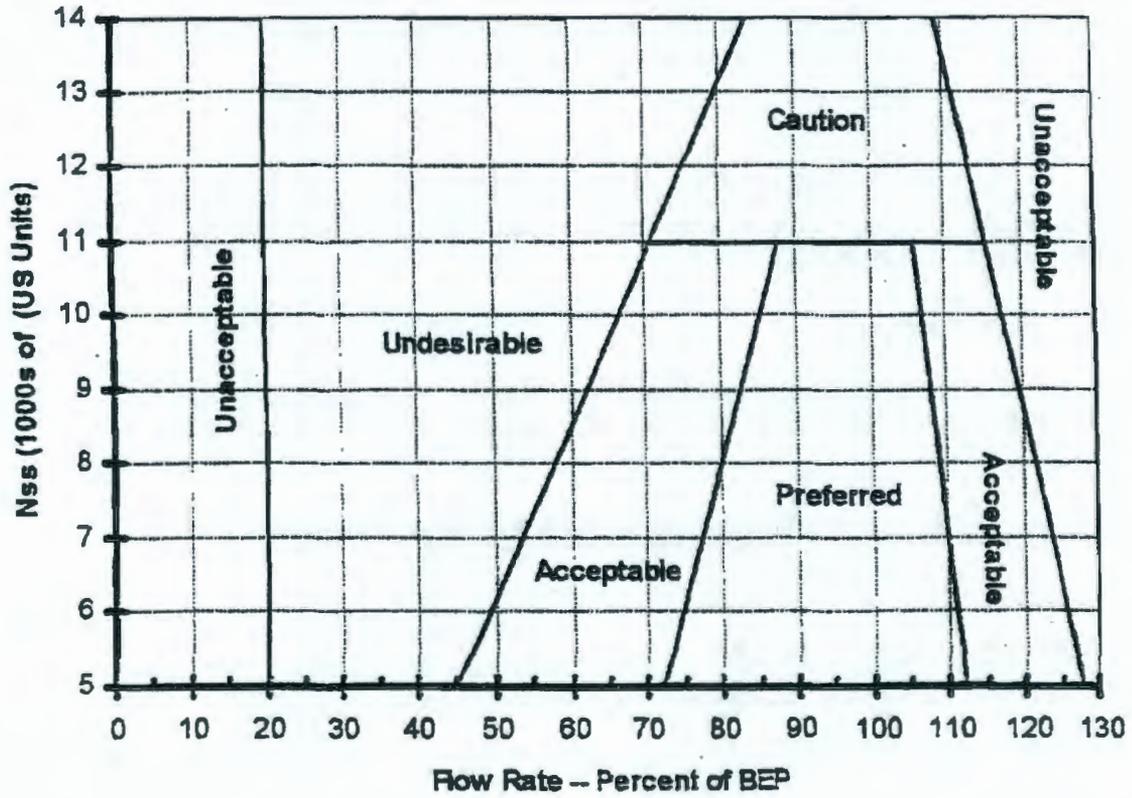
#### 10.2.13 Schedules

Seller shall provide fabrication and delivery schedule and progress reports for pumps described in individual pump data sheets. See section 3 of the material requisition for submittal requirements.

## 11 Design Changes Incorporated by Reference

24590-WTP-SDDR-PROC-04-00614  
24590-WTP-SDDR-PROC-04-00659  
24590-WTP-SDDR-PROC-04-00660  
24590-WTP-SDDR-PROC-04-00804  
24590-WTP-SDDR-PROC-04-00895  
24590-WTP-SDDR-PROC-04-00928  
24590-WTP-SDDR-PROC-04-01117  
24590-WTP-SDDR-PROC-05-00039  
24590-WTP-SDDR-PROC-05-00097

Figure 1 Pump Operating Range



Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-08-002

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**Hanford Facility RCRA Permit Modification Notification Form**  
**Part III, Operating Unit 10**  
**Waste Treatment and Immobilization Plant**

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Index

Page 2 of 2: Hanford Facility RCRA Permit, Part III, Operating Unit 10, Waste Treatment and Immobilization Plant  
Delete Permit Specification 24590-WTP-3PS-MPC0-TP001 (*Engineering Specification for Centrifugal Pumps to Meet Requirements of API Standard 610, Eighth Edition, and for Quality Level QL-1 and QL-2*) in Appendix 7.7 of the Dangerous Waste Permit and adds four new pump specifications that cover pumps in contact with dangerous waste.

Submitted by Co-Operator:

Reviewed by ORP Program Office:

D. A. Klein

6/16/08

D. A. Klein

Date

S. J. Otinger

S. J. Otinger

6/30/08

Date

Quarter Ending September 30,  
2008

24590-WTP-PCN-ENV-08-002

**Hanford Facility RCRA Permit Modification Notification Form**

Unit

**Waste Treatment and Immobilization Plant**

Permit Part &amp; Chapter:

**Part III, Operating Unit 10****Description of Modification:**

The purpose of this Class 1 prime modification is to delete the obsolete specification 24590-WTP-3PS-MPC0-TP001, *Engineering Specification for Centrifugal Pumps to Meet Requirements of API Standard 610, Eighth Edition, and for Quality Level QL-1 and QL-2*, and add four new pump specifications that cover pumps in contact with dangerous waste.

Delete the specification, 24590-WTP-3PS-MPC0-TP001, Rev. 0, currently in Appendix 7.7.

Add the following specifications to the indicated Appendix Number of the permit:

Specification	Appendix Location
24590-WTP-3PS-MPPD-T0001, Rev. 3	7.7
24590-LAW-3PS-RLD-T0001, Rev. 1	9.7
24590-QL-HC4-W000-00011-04-00266, Rev. 00B	10.7
24590-QL-HC4-W000-00011-03-00590, Rev. 00A	9.7

This modification requests Ecology approve and incorporate into the permit the four identified specifications. The source specification for permit specification, 24590-WTP-3PS-MPC0-TP001, was cancelled in October 2003.

The following is a list of outstanding change documents that have not been incorporated into this modification:

- None

WAC 173-303-830 Modification Class: <sup>1 2</sup>

Please mark the Modification Class:

Class 1

Class <sup>1</sup>1

Class 2

Class 3

X

Enter Relevant WAC 173-303-830, Appendix I Modification citation number:

Not Applicable

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 <sup>1</sup>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:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*B. Becker-Khaleel*  
B. Becker-Khaleel

8/20/08  
Date

<sup>1</sup> Class 1 modifications requiring prior Agency approval.

<sup>2</sup> 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 <sup>1</sup>1, if applicable.



ISSUED BY  
RPP-WTP PDC

**RIVER PROTECTION PROJECT – WASTE TREATMENT PLANT**

**ENGINEERING SPECIFICATION**

FOR

**Air-Operated Diaphragm Pumps**

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.

Content applicable to ALARA?  Yes  No

ADR No.

Rev

Quality Level

CM

DOE Contract No.  
DE-AC27-01RV14136

NOTE: Contents of this document are Dangerous Waste Permit affecting.

REV	DATE	BY	CHECK	REVIEW	E&NS	QA	DPFM
3	2/14/07	J. Sen	W. Knauss		N/A	M. Ehinger	J. Julyk
2	1/21/03	J. Albretsen	W. Honsaker		-	G. Warner	G. Duncan
1	12/11/02	J. Albretsen	W. Honsaker		-	G. Warner	G. Duncan
0	10/10/02	J. Albretsen	W. Honsaker			G. Warner	B. Rao for G. Duncan
SPECIFICATION No. 24590-WTP-3PS-MPPD-T0001						Rev 3	

**Revision History**

<b>Revision</b>	<b>Reason for Revision</b>
0	Issue for Use
1	Reissue with new ALARA Coversheet
2	Corrected Project Number on Coversheet
3	Incorporated SCNs 24590-WTP-3PN-MPPD-00001, 00002, 00003 and 00005; Incorporated by Reference 24590-WTP-SDDR-PROC-04-00987, 00988, 00991 and 01123, 24590-WTP-SDDR- M-05-00110, Rev 1; Revised to current project format

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# 1 Scope

## 1.1 Project Description and Location

The River Protection Project-Waste Treatment Plant (WTP) is a complex of waste treatment facilities where the US Department of Energy (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 DOE 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. The counties of Benton, Franklin, and Grant surround the Hanford Site.

## 1.2 Equipment, Material, and Services Required

The Seller shall design, furnish materials, fabricate, shop test, and deliver air-operated diaphragm pumps in accordance with this specification and the requirements contained in the Material Requisition. Each pump assembly shall include all components and accessories required to develop the performance described in this specification and the Pump Data Sheets. The Seller shall provide the following as a minimum:

- 1.2.1 Air-powered double-diaphragm pumps, each complete with non-lubricated air distribution valve, relief valve, air filter, regulator, air exhaust muffler and the accessories specified on individual Pump Data Sheets for Air-Operated Diaphragm Pumps.
- 1.2.2 Pumps shall be fully assembled, piped and wired, requiring only setting on the foundation and connecting to the Buyer's pipe, air supply and control systems.
- 1.2.3 Sets of any special tools required for installation and maintenance. The number of tool sets will be specified in the Material Requisition.
- 1.2.4 One lot of consumable spare parts per item for start-up and one year of operation.

## 1.3 Work by Others

- 1.3.1 Material unloading and storage at jobsite
- 1.3.2 Installation labor
- 1.3.3 Foundation and anchor bolts
- 1.3.4 Interconnecting pipework external to unit
- 1.3.5 Plant Service Air supply

1.3.6 Wiring external to pump

1.4 Definitions and Acronyms

1.4.1 Definitions

Quality Level	WTP Project's quality classifications of structures, systems, and components based on their importance to safety. See Supplier Quality Assurance Program Requirements Datasheet and individual Pump Data Sheets for quality requirements.
Commercial Quality	Structures, systems, components, and associated services that are required to meet the requirements of DOE Order 414.1A. See Supplier Quality Assurance Program Requirements Datasheet and individual Pump Data Sheets for Quality Requirements.
Seismic Category	WTP Project's seismic classifications of structures, systems, and components based on their safety function. See 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Qualification of Seismic Category III & IV Equipment and Tanks, and individual Pump Data Sheets for seismic requirements.

1.4.2 Acronyms of organizations and terms

ASME	American Society of Mechanical Engineers
HI	Hydraulic Institute
MSS	Manufacturing Standardization Society of the Valve and Fittings Industry
OSHA	Occupational Safety and Health Administration

1.5 Quality/Seismic Classifications

Quality Level and Seismic Category of each pump described in this specification will be listed on the individual Pump Data Sheets.

## 2 Applicable Documents

2.1 General

- 2.1.1 Work shall be done in accordance with the referenced codes, standards, and documents listed below, which are an integral part of this specification.
- 2.1.2 When specific chapters, sections, parts, or paragraphs are listed following a code, industry standard, or reference document, only those chapters, sections, parts, or paragraphs of the document are applicable and shall be applied. If a date or revision is not listed, the latest issue, including addenda, at the time of Request for Quote (RFQ) shall apply, *except for*

*material standards where the Seller ensures that the revision associated with currently available material is acceptable for the intended use of the material. When more than one code, standard, or referenced document covers the same topic, the requirements for all must be met with the most stringent combination of requirements.*

## 2.2 Codes and Industry Standards

Sponsor	Number	Subject
ASME	B1.1	Unified Inch Screw Threads
ASME	B1.20.1	Pipe threads, General Purpose (Inch)
ASME	B16.5	Pipe Flanges and Flanged Fittings
ASME	B16.11	Forged Fittings, Socket-Welding and Threaded
MSS	SP-55	Quality Standard for Steel Castings for Valves, Flanges and Fittings and other Piping Components
OSHA	1910.95	Occupation Noise Exposure

## 2.3 Engineering Specifications

- 2.3.1 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements
- 2.3.2 24590-WTP-3PS-G000-T0002, Specification for Positive Material Identification (PMI)
- 2.3.3 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping, Handling and Storage Requirements
- 2.3.4 24590-WTP-3PS-FB01 -T0001, Engineering Specification for Structural Design Loads for Seismic Qualification of Seismic Category III & IV Equipment and Tanks

# 3 Design Requirements

## 3.1 Basic Function

These air-operated diaphragm pumps will transfer liquids that may have high solids content and/or be radioactive and/or hazardous.

## 3.2 Performance

See the individual Pump Data Sheets.

## 3.3 Design Conditions

3.3.1 See the individual Pump Data Sheets.

3.3.2 Air-powered pumps shall be of double-diaphragm, double-acting type complete with enclosure, diaphragms, check valves, and air distribution valve. The pump design shall allow access for adjustment or replacement of liquid components, including seals, check valves,

other wetted parts that require maintenance. Equipment shall be designed to run safely to the relief-valve setting. The check valves shall be removable from the liquid end for servicing or replacement. The diaphragms shall be connected by means of a solid steel shaft. The pump flow rate shall be adjustable, by means of the furnished regulator, over the specific turndown ratio, no less than 10:1, while the pump is running.

- 3.3.2.1 The design of the equipment shall be no less than utility grade suitable for continuous operation at the minimum and maximum capabilities of the furnished pump.
- 3.3.2.2 Maximum interchangeability of pump components is desired among similar pump designs. Parts in identical pump designs shall be completely interchangeable.

### 3.3.3 Diaphragms

- 3.3.3.1 Pumps shall be provided with diaphragms rated for no less than 110% of the duty conditions.
- 3.3.3.2 Diaphragms shall be used to provide isolation and transmit pressure from air to pumped fluid. Diaphragm materials shall be compatible with fluids contacted at all specified temperatures. Diaphragms shall be of sufficient thickness and density to prevent permeation.
- 3.3.3.3 Deleted.

### 3.3.4 Pump Check Valves

The suction and discharge check valve cartridges or seats and elements shall be replaceable in the field. Proper guiding of check valve elements shall be provided for quick seating action and maximum seal life.

### 3.3.5 Pressure-Containing Parts

- 3.3.5.1 Pressure-containing parts shall be positively bolted together (wing bolts, set screws, and clamps shall not be used) and shall be designed to prevent damaging distortion caused by temperature, pressure, torque, and allowable external forces and moments.
- 3.3.5.2 Through bolting is preferred. Tapped holes in pressure retaining parts shall be kept to a minimum. Studs shall be used in preference to cap screws. Sufficient metal (in addition to the metal allowance for corrosion) shall be left around the bottom of drilled and tapped holes to prevent leakage.
- 3.3.5.3 Threading shall conform to ASME B1.1.
- 3.3.5.4 Clearances shall be provided to bolt locations to permit ease of access and the use of socket or box-type wrenches.

### 3.3.6 Nozzles and Miscellaneous Connections

- 3.3.6.1 Process and air connections shall be flanged. Flanges shall conform to ASME B16.5 standards except that marking requirements are not applicable. Flanges shall have through bolting. The back surface of all flanges shall be full or spot-faced at the bolt circle. The

suction nozzle flanges (ratings) shall be designed for the same pressure as the discharge flange.

- 3.3.6.2 Pipe threads shall be taper pipe threads in conformance with ASME B1.20.1. Tapped openings not used shall be plugged with a solid metal plug of material equal to the material of the tapped components and furnished in accordance with ASME B16.11. Plugs shall be of corrosion resistant material. Threads shall be lubricated.
- 3.3.6.3 Auxiliary piping and tubing, and/or conduit or cable for instrumentation, when furnished by the pump manufacturer, shall be securely supported to resist vibration and damage in the field. Auxiliary tubing shall be heavy-wall stainless steel suitable for the service conditions. Connection for auxiliary systems shall be as specified. A means for disassembly (unions, flanges, connections, etc.) shall be provided.
- 3.3.7 Pump unit shall have a noise level less than 85 dBA when measured 3 feet in any direction from pump unit. (OSHA 1910.95) Seller shall furnish expected noise data.

#### 3.4 Environmental Conditions

- 3.4.1 See individual Pump Data Sheets.
- 3.4.2 Pumps and auxiliaries shall be suitable for outdoor installation in the climatic zone specified on the data sheets, but will be normally located indoors. Indoor and outdoor environmental conditions will be specified on the individual Pump Data Sheets.

#### 3.5 Mechanical Requirements

- 3.5.1 See the individual Pump Data Sheets.
- 3.5.2 Assuming normal maintenance practices are performed by Buyer as recommended by Seller and based on information provided in individual Pump Data Sheets, Seller shall provide data similar to the following for the pump:
- estimated service life
  - common modes of failure (i.e., diaphragm failure, etc.) and the estimated hours until such an event occurs
  - maintenance time for replacement of major maintenance items (such as diaphragms), assuming normal work environments

#### 3.6 Loadings

- 3.6.1 See the individual Pump Data Sheets for Seismic Classification. Equipment shall be designed for the seismic forces corresponding to that defined in 24590-WTP-3PS-FB01-T0001, Engineering Specification for Structural Design Loads for Seismic Qualification of Seismic Category III & IV Equipment and Tanks as applicable.
- 3.6.2 Seller shall advise maximum allowable nozzle forces and moments.

### **3.7 Instrumentation and Control Requirements**

- 3.7.1 See individual Pump Data Sheets.
- 3.7.2 If noted in individual Pump Data Sheets, pumps shall be provided with electronic diaphragm failure/ leak detection system. Seller shall submit output signal specifications for Buyer review.

## **4 Materials**

### **4.1 General**

Materials used in constructing the equipment shall be suitable for the specified service and subject to review and acceptance by Buyer. Where specific materials are identified in the individual Pump Data Sheets, the base bid shall be based on their use. However, the Seller may additionally offer the option of utilizing alternative materials of equal or superior properties for Buyer's consideration.

### **4.2 Prohibited Materials**

- 4.2.1 Mercury and other low melting point metals, their alloys, or materials containing such metals as their basic constituents shall not be used in the construction of pumps.
- 4.2.2 Products which contain asbestos are prohibited. This prohibition includes items such as gaskets even though the item is encapsulated or the asbestos fibers are impregnated with binder material.

## **5 Fabrication**

### **5.1 General**

- 5.1.1 Use Seller's standard procedures and those of sub-suppliers for fabrication and manufacture of items covered by this specification provided they do not render these items unsuitable for service and conditions specified herein. Where Seller's (or sub-suppliers) standard procedures conflict with applicable specifications, codes or other standards, apply the most stringent requirements to fabricate and manufacture equipment specified.
- 5.1.2 All equipment shall be furnished neatly finished and free of burrs and fins.
- 5.1.3 Conform to MSS-SP-55 for visual examination acceptance standards of all casting surfaces. Impregnated castings shall not be furnished.

### **5.2 Welding**

Fabricated sections and repairs shall be welded using Weld Procedure Specifications (WPSs), Procedure Qualification Records (PQRs), Weld Filler Materials, Preheat, Post Weld Heat Treatment, and Welder Performance Tests in accordance with Seller's Quality Assurance Program and related Procedures.

### 5.3 Assembly

All components furnished under this specification shall be preassembled in Seller's shop to maximum extent consistent with shipping, handling, and erection constraints.

## 6 Tests

Specified tests shall be conducted in accordance with applicable HI Standards, except as noted in this section. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 parts per million. To prevent deposition of chlorides as a result of evaporative drying, all residual liquid shall be removed from tested parts at the conclusion of the test.

### 6.1 General

- 6.1.1 Seller shall conduct and be responsible for all shop tests listed in the individual Pump Data Sheets and other applicable standards and reference documents. Tests may be witnessed by the Buyer's Supplier Quality Representative.
- 6.1.2 As a minimum, every pump shall have a hydrostatic and a performance test. Seller shall submit testing procedures for Buyer review and acceptance.
- 6.1.3 Seller shall furnish all facilities necessary for the performance of such tests. In the event Seller's own facilities are not suitable for such tests, Seller shall advise Buyer and obtain advanced written permission for using alternative facilities.
- 6.1.4 The Seller shall supply Buyer with all certified test data whether witnessed or not.

### 6.2 Hydrostatic Tests

Pressure retaining casings shall be hydrostatically tested at not less than 125 percent of design (shutoff) pressure or 150 percent of head at specified rated condition, whichever is greater. Hydrostatic test pressure shall be maintained for at least 10 minutes and checked for leaks.

### 6.3 Positive Material Identification

If specified on individual Pump Data Sheets, Positive Material Identification (PMI) will be required for pressure retaining casings, see 24590-WTP-3PS-G000-T0002, Specification for Positive Material Identification (PMI). Seller shall submit their PMI Procedures and PMI Verification Reports to the Buyer as required in this specification.

## 7 Preparation for Shipment

### 7.1 Cleanliness

All dirt, oil, grease, loose mill scale, cuttings, weld spatter, and other foreign matter shall be removed from all interior and exterior surfaces per 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping, Handling and Storage Requirements.

## 7.2 Painting

- 7.2.1 After visual examination, all exposed ferrous surfaces shall be primed and coated in accordance with Seller's standard procedures. Color, if specified, shall be advised later.
- 7.2.2 Machined faces and fittings, preparations for field welding, parts to be embedded in concrete, nonferrous parts, nameplates, and instruction plates shall not be painted. Rust preventative means, such as coating with a preservative, shall be employed to provide protection of ferrous surfaces during shipment and storage.
- 7.2.3 Seller shall submit their cleaning and coating procedure for Buyer's review prior to performing the work.

## 7.3 Tagging

- 7.3.1 Each pump shall be provided with a permanent corrosion-resistant nameplate(s) securely attached at a readily visible location on the equipment and on any other major piece of auxiliary equipment.
- 7.3.2 The nameplate(s) shall be stamped with the following information in units consistent with the datasheet:
  - 7.3.2.1 Plant item (equipment tag) number.
  - 7.3.2.2 Purchase order number.
  - 7.3.2.3 Seller's size and model number.
  - 7.3.2.4 Pump serial number.
  - 7.3.2.5 Capacity.
  - 7.3.2.6 Minimum and maximum inlet air pressure.
  - 7.3.2.7 Maximum pump discharge pressure @ maximum inlet air pressure.
  - 7.3.2.8 Casing hydrostatic test pressure.
  - 7.3.2.9 Maximum allowable working pressure (MAWP).
- 7.3.3 In addition to being stamped on the nameplate(s), the pump serial number shall be plainly and permanently marked on the pump casing(s).
- 7.3.4 Nameplate(s) shall be of austenitic stainless steel or of nickel-copper alloy (Monel or its equivalent). Attachment pins shall be of the same material. Welding is not permitted.

## 7.4 Packaging and Shipping Instructions

- 7.4.1 All equipment shall be packed, securely anchored, and protected for shipment in accordance with 24590-WTP-3PS-G000-T0003, General Specification for Packaging, Shipping,

Handling, and Storage Requirements. The Seller shall submit his Shipping Preparation Procedures for Buyer's Review.

- 7.4.2 All lifting points shall be clearly marked. Lifting lugs shall be provided for pump assemblies.
- 7.4.3 All openings shall be covered or plugged with substantial one piece plywood, metal or plastic closures, securely fastened and suitable for prolonged exposure prior to final installation.
- 7.4.4 Packaging shall provide protection for equipment during transit and storage. Equipment may be stored outdoors at jobsite for as long as one year before it is installed.

## 8 Quality Assurance

### 8.1 General Requirements

- 8.1.1 The Seller's Quality Assurance Program (QAP) Requirements are included in 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program.
- 8.1.2 Seller's QAP Manual shall be submitted to Buyer for review in accordance with 24590-WTP-3PS-G000-T0001, Supplier Quality Assurance Program.
- 8.1.3 Seller's QAP, as a minimum, shall contain the requirements detailed in the Supplier Quality Assurance Program Requirements Data Sheet(s) listed in Section 2 of the Material Requisition.

## 9 Configuration Management

Equipment and/or components covered by this specification are identified with Plant Item (equipment tag) numbers as given in the individual Data Sheets. Each item shall be tagged per Paragraph 7.3.

## 10 Documentation and Submittals

### 10.1 General

Submittals and document quantities shall be submitted as summarized on Forms G-321-E, for Engineering Documents, and G-321-V for Quality Documents. See Material Requisition Section 3.

### 10.2 Drawings

Drawings shall be inclusive of all following requirements:

- 10.2.1 Outline drawings of pump assembly, including outline and detail drawings, for each component.
- 10.2.2 Mounting dimensions and information required for the design of supports and/or foundations.

- 10.2.3 Dimensions and details for process flanges and other connections.
- 10.2.4 Locations and identification of parts included in the parts list.
- 10.2.5 Wiring schematic diagrams and data. Diagrams shall include wire gauges applicable to the supplied units only. External connections for measurement shall be shown on these diagrams.
- 10.2.6 Gasket, seal, and diaphragm drawings.

### 10.3 Parts List

Recommended spare parts lists for start-up and one (1) year's operation along with complete lists of prices and equipment parts with drawings showing sectional view of identified parts and assembly locations shall be provided. Seller shall identify limits to shelf-life and storage requirements of parts anticipated to have functional life spans shorter than the equipment design life.

### 10.4 Test Reports

- 10.4.1 Completed Data Sheets, as applicable, incorporating required information
- 10.4.2 Performance curves showing NPSH required, air consumption, efficiency, flow vs. pressure at applicable inlet air pressures.
- 10.4.3 Hydrostatic test results

### 10.5 Forces and Moments

Maximum allowable external forces and moments on pump nozzles shall be provided.

### 10.6 Manuals

Manuals shall be furnished to provide information on the correct storage, installation, operation, and maintenance of the equipment assembly.

### 10.7 Other

Noise data per paragraph 3.3.7.

### 10.8 Records

The following Documents shall be submitted for review and maintained on file at Seller's shop and be accessible for Buyer's review:

- 10.8.1 Hydrostatic test procedures
- 10.8.2 Performance test procedures
- 10.8.3 Cleaning and painting procedures
- 10.8.4 Shipping preparation procedures

## 11 Design Changes Incorporated by Reference

1. 24590-WTP-SDDR-PROC-04-00987 - Allows Impregnation of casting components for air motor
2. 24590-WTP-SDDR-PROC-04-00988 - Allows attachment of nameplates with stainless steel wire
3. 24590-WTP-SDDR-PROC-04-00991 - Allows reduction of hydrotest duration from 10 minutes to 9 minutes
4. 24590-WTP-SDDR-PROC-04-01123 - Allows Material Test Reports with ASTM year not matching specification requirements
5. 24590-WTP-SDDR-M-05-00110, Rev 1 - Item IV, Allows exceptions to specification sections 3.3.7, 7.3.3, 7.4.2, and 10.4.2



ISSUED BY  
 RPL/STP/POC  
 MB 4-22-02  
 INT DATE

# RIVER PROTECTION PROJECT - WASTE TREATMENT PLANT SPECIFICATION

FOR

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.

## Centrifugal Canned Motor Pumps to be Located In-Bulge

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**TECHNICAL SPECIFICATION  
FOR  
CENTRIFUGAL CANNED MOTOR PUMPS  
LOCATED IN-BULGE**

# **1 Scope**

## **1.1 Project Description and Location**

The River Protection Project –Waste Treatment and Immobilization Plant (RPP-WTP) is a complex of waste treatment facilities where the U.S. Department of Energy (DOE) Hanford Site tank waste will be put into stable glass form. The WTP Contractor will design, build and startup the RPP-WTP pretreatment and vitrification facilities for the DOE 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 RPP-WTP Facility will be constructed at the east-end of the 200 East Area of the Hanford Site. The Counties of Benton, Franklin and Grant surround the Hanford Site.

## **1.2 Equipment, Material, and Services Required**

Design, furnish materials, fabricate, assemble, test and deliver the centrifugal canned motor pumps and accessories in accordance with this specification, including:

- 1.2.1 Centrifugal canned motor pumps, each complete with electric motor and accessories specified on individual Pump Data Sheets and in this Specification.
- 1.2.2 Services of an installation supervisor when required.
- 1.2.3 One lot of any special tools required for installation and maintenance.
- 1.2.4 One lot of startup and commissioning spare parts, and list of recommended spare parts.
- 1.2.5 Installation, Operation and Maintenance Manuals.
- 1.2.6 Each pump and motor assembly shall include all components and accessories fully assembled, aligned, piped and wired, requiring only connecting to Buyer's pipe, electrical and control systems.

## **1.3 Work by Others**

- 1.3.1 Material unloading and storage at jobsite
- 1.3.2 Installation labor

- 1.3.3 Interconnecting pipework external to the equipment
- 1.3.4 Electric power supply
- 1.3.5 Wiring external to the pump and driver
- 1.3.6 Motor starters.

#### 1.4 Definitions and Abbreviations

- 1.4.1 Definitions – See API-610 and:

**Bulge** A fabricated steel, floor mounted enclosure to house items, such as pumps and valves, which is located adjacent to a room that contains radioactive material. Top covers will be removable to permit access to equipment.

**Important to Safety (ITS)** Project classification of Structures, Systems and Components (SSCs) based on their importance to safety controlling normal radiographic/chemical releases, accident prevention and mitigation. ITS safety classifications are 1) Safety Design Class (SDC), 2) Safety Design Significant (SDS), 3) Other SSCs and 4) Commercial Grade SSCs.

**SDC** Safety Design Class SSCs includes those that, by performing their specified safety function, prevent workers or the maximally exposed member of the public from receiving a radiological exposure that exceeds the accident exposure standards defined in the Safety Requirements Document. SDC also applies to those features that, by functioning, prevent the worker or maximally exposed member of the public from receiving a chemical exposure that exceeds the Emergency Response Planning Guidelines (ERPG)-2 (AIHA 1988) chemical release standard. Those features credited for the prevention of a criticality event are also designated as SDC.

**SDS** Safety classification for Important to Safety SSCs needed to achieve compliance with the radiological or chemical exposure standards for the public and workers during normal operation; and SSCs that can, if they fail or malfunction, place frequent demands on or adversely affect the function of SDC SSCs.

**Other SSCs** Those SSCs that are neither SDC nor SDS.

**QL-1** SDC items. This level is based on the safety classification identified in the Standard Identification Process Database (SIPD).

**QL-2** SDS items. This level is based on the safety classification identified in the SIPD. QL-2 shall also be used to identify other items and activities for which Nuclear Quality Assurance (NQA)-1 (1989) compliance is required.

**QL-3** Quality Level 3 based on Immobilized High Level Waste (IHLW) Acceptance Items and Activity List for IHLW product quality-affecting items and associated services that affect the functionality of an SSC item that is not designated as SDC or SDS.

Non-Quality Related Remaining SSC items and associated services (those that are not designated as SDC or SDS) that are manufactured using standard commercial practices. For designed items, quality requirements will be defined in applicable design documents.

Seismic Category RPP-WTP Project's seismic classifications of SSCs based on their safety function. Seismic Categories are I (SC-I), II (SC-II), III (SC-III), IV (SC-IV) and V (SC-V).

SC-I SSC important to safety and which has a seismic safety function.

SC-II SSC important to safety, whose failure during a seismic event could prevent a Seismic Category I SSC from performing its seismic safety function.

SC-III (a) SSC important to safety, but without seismic safety function.  
(b) SSC not important to safety, but has an inventory of radioactive or hazardous material in an amount less than an important-to-safety significant quantity.

SC-IV SSC not important to safety and without an inventory of radioactive or hazardous material, but requiring seismic protection.

SC-V SSC not important to safety and does not require seismic design.

#### 1.4.2 Abbreviations of Organizations

ABMA	American Bearing Manufacturers Association
AGMA	American Gear Manufacturers Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASTM	American Society for Testing and Materials
HI	Hydraulics Institute
ISO	International Organization for Standardization
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association

### 1.5 Safety/Quality Classifications

Safety Classification, Quality Level and Seismic Category, if any, of each pump described in this specification will be on the individual Pump Data Sheets, included in Section 2 of the Material Requisition.

## 2 Applicable Documents

### 2.1 Codes and Industry Standards

- 2.1.1 API-610, Centrifugal Pumps for Petroleum, Heavy Duty Chemical and Eighth Edition Gas Industry Service. (See its Appendix A for additional Referenced Publications and International Standards)
- 2.1.2 ASNT SNT-TC-1A, Recommended Practice (including Non-Destructive August 1984 Examination [NDE] personnel certification)
- 2.1.3 NEMA MG 1-98 Motors and Generators

### 2.2 Engineering Standards

- 2.2.1 24590-WTP-3PS-G000-T0001, General Specification for Supplier Quality Assurance Program Requirements
- 2.2.2 24590-WTP-3PS-G000-T0002, Specification for Positive Material Identification (PMI)
- 2.2.3 24590-WTP-3PS-G000-T0003, RPP-WTP General Specification for Packaging, Shipping, Handling and Storage Requirements

### 2.3 Reference Documents/Drawings

- 2.3.1 24590-LAW-MX-RLD-00001001, General Arrangement LAW-RLD C3/C5 Pump Bulge RLD-BULGE-00001
- 2.3.2 24590-LAW-MX-RLD-00001002, Piping Assembly LAW-RLD C3/C5 Pump Bulge RLD-BULGE-00001

## 3 Design Requirements

### 3.1 Basic Function

- 3.1.1 These centrifugal canned motor pumps will be located in a bulge in the Low Activity Waste Facility. They will transfer liquid to meet conditions as shown on the Pump Data Sheets.
- 3.1.2 The pumps shall have design refinements to extend the normal time between maintenance, and to allow removal of the canned motor/pump rotating element assemblies using semi-remote handling devices. Bidders shall include descriptions and sketches, as appropriate, of these design refinements in the proposal.

### 3.2 Performance

See the individual Pump Data Sheets.

### 3.3 Design Conditions

- 3.3.1 See the individual Pump Data Sheets.
- 3.3.2 These pumps will be designed to be mounted in a vertical position with the suction and discharge connections butt-welded to the piping. The bolts connecting the back cover to the pump casing shall be designed to permit removal from some distance above with a specially designed tool(s) to be furnished by the Supplier.
- 3.3.3 The equipment and appurtenances will be used in a plant that has a design life of 40 years. The design objective for these canned motor pumps shall also be based on a 40 year life. If the design life can not be met, the maintenance items shall be easily accessible once the motor and rotating element have been removed from the case.
- 3.3.4 All components of the pump and motor shall be self-draining. Pockets or voids that could entrain process fluid are not allowed.
- 3.3.5 The canned motor pumps shall be manufactured so that oil is not used for lubricant or cooling purposes. The motor windings shall be potted to reduce size as much as possible.
- 3.3.6 The Supplier shall include recommendations for safety monitoring devices, such as bearing wear detection and motor winding thermostats, to help avoid unexpected outages.
- 3.3.7 The pumps shall meet API Standard 610 as much as possible. **Paragraphs which do not match the type of pump and/or required modifications, will not apply.** The following Purchaser modifications to API 610, using the paragraph numbers found in API-610, apply:

#### API 610 Paragraph No.

- 1.1.1 This specification covers the minimum requirements for centrifugal pumps designed in accordance with API 610, Eighth Edition, "Centrifugal Pumps for Petroleum, Heavy Duty Chemical, and Gas Industry Services" as modified by this section. The paragraph numbers in this section correspond to those in API 610 and each of the paragraphs denotes an "Addition", "Decision" or "Modification" to the API requirements. Bulleted items not addressed in this specification shall have the decisions noted on the individual pump data sheets.
- 1.2.2 (Decision) Dimensions shall be U.S. Standard.
- 1.3 Conflicting Requirements (Modification)

In case of conflict between this specification and other referenced documents, the following order of precedence shall govern:

- Purchase Order
  - Data Sheets
  - This Specification
  - API 610
  - Other referenced specifications and standards
- 2.1.9 (Decision) Pump Suction Specific Speed (S) shall not exceed 12,000 (calculated using rotative speed in rev/min, BEP flow at the maximum diameter impeller in GPM and NPSH in feet). Pumps offered with suction specific speeds > 12,000 may be accepted subject to purchaser's written approval.
- 2.1.11 (Addition) Pumps for parallel operation shall have equal head rise (within  $\pm 1\%$  as measured on the performance test) to shutoff.
- 2.1.14 (Addition) Noise level shall not exceed 85 dBA measured 3 ft from the edge of the baseplate.
- 2.1.29 (Decision) Pumps and auxiliaries shall be suitable for outdoor installation in the climatic zone specified on the data sheets.
- 2.2.4 (Modification) The maximum allowable working pressure shall apply to all parts referred to in the definition of "pressure casing" (See API paragraph 1.4.40), except for double-casing pumps. Components and sections of double-casing pumps which are normally subjected to suction pressure shall be designed to permit, as a minimum, a hydrostatic test pressure equal to the casing maximum allowable working pressure.
- 2.3.2.1 (Modification) ~~All pumps, except double-casing designs, shall have suction and discharge flanges of equal rating.~~ The pumps shall have weld ends at suction and discharge suitable to be butt welded to Purchaser's suction and discharge piping.
- 2.3.3.3 (Decision) Cylindrical threads shall not be used.
- 2.3.3.10 (Addition) Casings shall be provided with flanged vents and drains. Flanges shall be the same rating as the pump discharge nozzle capability.
- 2.3.3.11 (Decision) Pressure gauge connections shall not be provided.
- 2.6.4.1 (Addition) The wear ring running clearance (adjusted for temperature) and diameter, shall be provided for each service. Pump efficiencies shall be based on the corrected clearances.
- 3.2.12 (Addition) Coupling guards are not used due to canned motor, close-coupled design.
- 3.3.3 (Addition) Centers of the mounting pads shall be at the correct relative elevation with 0.002 inch per foot of separation between the pads. Each pad shall be machined flat to within 0.002 inch total variation across the surfaces. NOT APPLICABLE
- 3.3.4 (Modification) Pump pads are not to be machined to allow for the installation of shims. Pump feet will not be shimmed. NOT APPLICABLE
- 3.3.14 (Addition) Transverse alignment positioning jackscrews shall be provided for all components, except the pump. NOT APPLICABLE

- 3.3.21 (New) To insure that final alignment can be achieved in the field, the equipment manufacturer shall align the pump and driver to within 0.010 inch parallel offset and 0.002 inch/inch angular in the shop. The bolts shall be centered in their holes after the preliminary alignment. Undercutting of hold-down bolts is not acceptable. NOT APPLICABLE

Note : Hold down bolts shall not be bolt bound after final alignment in the field. The hold-down bolt shall be reasonably centered, based on visual inspection after the final field alignment.

- 4.2.3.3 (New) The following in process items shall be verified by the Supplier Quality Representative:  
NOT APPLICABLE
- Flatness of the mounting feet at the machining process
  - Initial alignment of the drive train
  - Vertical NEMA frame motors with thrust bearings comply with paragraph 3.1.8 of API-610
  - Shaft runout of horizontal motors

- 4.3.2.1a (Modification) Double-casing pumps and other special-design pumps, as approved by the purchaser, may be segmentally tested at the appropriate section pressure. Segmental hydro testing of horizontal multistage pumps is not acceptable. Hydrostatic testing, whether on a component basis or assembled pump, shall be done after all machining and welding (such as piping connections, drain, vents, seal welding) has been completed. NOT APPLICABLE

- 4.3.4.1.1 (Addition) NPSHR test shall be performed if the NPSH required by the pump differs from the specified available NPSH by 3 feet or less. The NPSH test will be a vacuum tank suppression test unless a suction valve throttling test has been approved by the purchaser.

SECTION 6 - SUPPLIER'S DATA The requirements of Section 3 of the Material Requisition shall be applicable in addition to the API-610 requirements.

END OF COMMENTS TO API-610.

### 3.4 Environmental Conditions

- 3.4.1 See individual Pump Data Sheets.
- 3.4.2 When noted on the Data Sheets, motors will require radiation shielding. It is preferred that this be designed and furnished by the motor Supplier so they consider motor cooling air flow.
- 3.4.3 When noted on the Data Sheets, all bearings may require special radiation resistant lubricants.
- 3.4.4 When noted on the Data Sheets, the seal elastomer components shall use high radiation-tolerance materials.

### 3.5 Mechanical Requirements

- 3.5.1 See individual Pump Data Sheets.

- 3.5.2 If an external clean water supply is required to avoid problems due to the pumped liquid, ie. slurry content, or cooling, the Supplier shall advise the expected minimum flow and pressure required.

### 3.6 Loading

- 3.6.1 Suction and Discharge pipe ends, which will be butt welded to Project piping, shall meet the API 610 load capability requirements.
- 3.6.2 After initial installation, the motor and the pump rotating element will be removed through an opening in the bulge. Any maintenance tools, or devices shall be provided by the Supplier, and must be designed to allow for removal of the motor and rotating element from above.
- 3.6.3 See the individual Pump Data Sheets for Seismic Classification, if any.

### 3.7 Electrical Requirements

- 3.7.1 See individual Motor Data Sheets.
- 3.7.2 Electric motors shall meet the requirements of NEMA MG 1-98, Motors and Generators.
- 3.7.3 Motors shall be furnished with 30 foot long power cable to facilitate power hookup. The power cable shall be three (3) wire, No. 12 size plus ground wire, with standard insulation. The motor power leads shall be tagged with line phase designations to permit for proper motor and pump rotation.

### 3.8 Instrumentation and Control Requirements

See individual Pump Data Sheets.

### 3.9 Accessibility and Maintenance

- 3.9.1 These pumps will require semi-remote removal capability, and the following modifications must be furnished with clear information on how to perform maintenance:
- 3.9.1.1 Bolts holding the back cover to the pump casing shall be removable with a tool(s) used through a removable cover plate on top of the bulge.
- 3.9.1.2 Any other electrical / cooling liquid connections shall be removable from outside the bulge with manually handled tools.
- 3.9.1.3 Lifting eye(s) / lugs to be used by the maintenance crane to lift the canned motor and pump rotating element must be easily accessible and take into account balance points to prevent swinging of the unit.
- 3.9.2 As the pumps may not operate for some period of time after installation, the Supplier shall provide clear pre-operation maintenance and preservation instructions to keep the equipment like-new.

## 4 Materials

### 4.1 Construction

See individual Pump Data Sheets for materials of construction.

### 4.2 Prohibited Materials

Bronze, copper, lead, zinc, tin, antimony, cadmium, or other low melting point metals, their alloys, or materials containing such metals as their basic constituents, or molybdenum and halogens, shall not be used in direct contact with stainless steel, with the exception of oil impregnated bronze bearings. This prohibition applies to the use of tools, fixtures, paints, coatings and sealing compounds, and any other equipment or materials used by the Supplier in handling, assembly and storage of stainless steel parts or components.

### 4.3 Special Requirements

See individual Pump Data Sheets. Note the requirement in Specification for Positive Material Identification of casings of 316 SS and better.

### 4.4 Storage of Special Materials (e.g., stainless steel) prior to work

The Supplier shall advise any special storage and preservation requirements.

## 5 Fabrication

### 5.1 Welding

- 5.1.1 Welding and weld repairs shall follow requirements of API-610.
- 5.1.2 Weld repair records shall be available for shop inspection and be submitted with documentation package.
- 5.1.3 Weld procedures and procedure qualification records shall be submitted to Buyer for review and acceptance prior to start of fabrication.

### 5.2 Assembly

No special comments.

### 5.2 Heat Treatment

Heat treatment shall be conducted as required by Supplier and/or welding procedures.

### 5.4 Other Processes (as required)

No special comments.

## 6 Tests and Inspections

### 6.1 Personnel Qualifications

Qualification of Supplier's inspection and test personnel shall be verified.

### 6.2 Non-Destructive Examinations

Personnel performing non-destructive examinations or reviewing such test results shall be certified to ASNT Standard SNT-TC-1A.

### 6.3 Shop Tests

6.3.1 Supplier shall conduct and be responsible for all shop tests listed in the individual Pump Data Sheets, API-610 and other applicable standards and reference documents.

6.3.2 Supplier shall furnish all facilities necessary for the performance of such tests. In the event Supplier's own facilities are not suitable for such tests, Supplier shall advise Buyer and obtain permission for using alternative facilities.

### 6.4 Site Tests

Buyer's startup personnel will run field performance tests after installation. Buyer may request Supplier's assistance during startup. Supplier shall be responsible for after-installation performance of the pumps.

## 7 Preparation for Shipment

See instructions in the Material Requisition, Section 7 and General Specification for Packaging, Shipping, Handling and Storage.

### 7.1 Cleanliness

Remove all dirt, oil, grease, loose mill scale, weld spatter and other foreign matter from all surfaces, with special attention to surfaces to be painted in accordance with Buyer's cleaning and coating procedures.

### 7.2 Painting

After visual examination, all exposed surfaces, except if stainless steel, shall be primed and coated in accordance with Buyer's cleaning and coating procedures. Supplier shall submit their conforming procedures as part of the documentation package. Color shall be advised later.

### 7.3 Tagging

See Paragraph 2.12 of API-610.

#### **7.4 Packaging**

See Material Requisition, Section 7, and General Specification for Packaging, Shipping, Handling and Storage.

#### **7.5 Documentation**

See API 610 and Material Requisition, Section 3.

#### **7.6 Shipping Instructions**

See Material Requisition, Section 7.

### **8 Quality Assurance**

See Material Requisition, Section 9.

#### **8.1 QA requirements specific to item(s) or service**

- 8.1.1 The Supplier Quality Assurance Program (QAP) Requirements are included in Reference Document 2.2.1.
- 8.1.2 Supplier's QAP Manual shall be submitted to Buyer for review in accordance with Reference 2.2.1.

#### **8.2 Program QA elements**

Supplier's Quality Assurance Program, as a minimum, shall contain the requirements detailed in the Material Requisition.

### **9 Configuration Management**

Equipment and/or components covered by this specification are identified with Plant Item (equipment tag) Numbers as given on the individual Data Sheets. Each item to be tagged per Section 7.3.

### **10 Documentation and Submittals**

See Section 3 of the Material Requisition, which includes Forms G-321-E and G-321-V with their associated instructions, for the required documents and submittals.

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P0/SCT	Submittal	Rev
		Job No. 24590
Bechtel National, Inc.		
<b>SUPPLIER REQUIREMENT STATUS</b>		
1. <input checked="" type="checkbox"/> Work may proceed.		
2. <input type="checkbox"/> Review and resubmit. Work may proceed subject to resolution of indicated comments.		
3. <input type="checkbox"/> Review and resubmit. Work may not proceed.		
4. <input type="checkbox"/> Review not required. Work may proceed.		
<small>Permission to proceed does not constitute acceptance or approval of design details, calculations, analysis, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.</small>		
REVIEWED	NA MS	
G-321 Document Category <u>8.0</u>		
<small>[From Supplement A to G-321-B (B) or G-321-V (V), as applicable, or "N/A" if SSRS is used]</small>		
Supervisor BNI Document No. <u>N/A</u>	Rev.	
<small>[When applicable]</small>		
Accepted by <u>ROBERT VANCE</u>	<u>Robert Vance</u>	<u>11/30/04</u>
<small>Print Name</small>	<small>Signature</small>	<small>Date</small>
Revised by <u>N/A</u>		
<small>[When applicable]</small>		
<small>Print Name</small>	<small>Signature</small>	<small>Date</small>

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.

# SUBCONTRACT SUBMITTAL



HLW ADS Pump Procurement Specification

Approvals Page



River Protection Project – Waste Treatment Plant

HLW ADS Pump Procurement Specification

Originator: Theresa A Bontl 10-7-04  
Date

Reviewed by: JF Bauer 10/7/04  
Date

Approved by: R. Barrow 10/11/04  
QA Manager Date

Approved by: Theresa A Bontl for R. Meigs 10-7-04  
Design Authority Date

Approved by: RW Martin 10/7/04  
Engineering Manager Date



Revision History

Revision	Date	Comments/Description
0	4/28/03	Original Release.
1	8/4/03	Incorporate customer's 90% design review comments.
2	8/25/04	Incorporate customer's final design review comments.
3	10/7/04	Incorporated customer's comments



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## **1. SCOPE**

### **1.1. Project Description and Location**

The River Protection Project-Waste Treatment Plant (RPP-WTP) is a facility located on the Department of Energy's Hanford Reservation in southeast Washington State. The facility's purpose is to vitrify radioactive tank waste for permanent disposal.

### **1.2. Equipment, Material, and Services Required**

- 1.2.1.** The purpose of this specification is to provide information for the Vendor to fabricate the Air Displacement Slurry (ADS) pump for the HLW melter feed system. This specification, used along with the attached design drawings, will provide all necessary information for the vendor to procure all required materials, fabricate parts and provide assemblies. Guidance will be given for non-vendor specific materials such as fasteners and piping.
- 1.2.2.** The Vendor is not responsible for the design of these components.
- 1.2.3.** This specification covers the supply of materials for fabrication, inspection, assembly, disassembly, packing, and delivery to the site.
- 1.2.4.** The Vendor shall be responsible to perform all activities necessary to provide a complete product as specified herein and in the design drawings. If any information contained on the drawings or other contractual documents conflicts with the information contained in this specification, then it must be resolved with the Buyer in writing before commencing work.
- 1.2.5.** The quantity of assemblies shall be identified on the purchase order.
- 1.2.6.** The vendor may subcontract any portion of the fabrication, manufacturing, or inspections provided it meets the quality assurance requirements of this specification.
- 1.2.7.** The Vendor shall provide any special tools required for assembly, disassembly and reassembly of the components. The latest revision of the drawings shall be listed and controlled by the Buyer documents.

### **1.3. Work by Others**

Vendor's responsibility will terminate with shipment of the assemblies, unless otherwise specified.

**1.4. Definitions****HLW Melter  
Vitrification****High Level Waste Melter****The process of joining a waste stream with glass formers at high temperature to produce a stable waste form.****Buyer****Bechtel National, Inc.****Vendor****Company selected by Buyer to fabricate the HLW ADS Pump.****ADS****Air Displacement Slurry****2. REFERENCES****2.1. Codes**

**The items covered by this specification shall be fabricated in accordance with this specification, the codes and standards listed below and the drawings. The applicable edition of each code and standard shall be the edition in effect at the time of contract. Vendor shall submit a list of codes and standards including year of edition four weeks after contract award.**

- 2.1.1. ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination.**
- 2.1.2. ASME Boiler and Pressure Vessel Code, Section VIII, Design & Fabrication of Pressure Vessels.**
- 2.1.3. ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standard For Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.**
- 2.1.4. ASME B31.3-1996, Process Piping.**

**2.2. Industry Standards**

- 2.2.1. SSPC-SP NO. 10 NACE NO.2, Joint Surface Preparation Standard Near-White Blast Cleaning.**
- 2.2.2. ANSI/ASME B46.1, Surface Texture.**
- 2.2.3. ANSI/ASME Y14.5M**
- 2.2.4. ASNT SMT-TC-1A**
- 2.2.5. AWS A2.4, Symbols for Welding and Nondestructive Testing.**

- 2.2.6. AWS A3.0, Standard Welding Terms and Definitions.
- 2.2.7. ASTM A-380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- 2.2.8. AWS D1.6, Structural Welding Code, Stainless Steel, 1999.
- 2.3. Engineering Standards  
N/A
- 2.4. Reference Documents/Drawings
  - 2.4.1. 24590-WTP-3PS-NW00-T0002, Chemical Requirements for Materials Used in Contact with Austenitic Stainless Steel and Nickel-Base Alloys

### 3. DESIGN REQUIREMENTS

N/A

### 4. MATERIALS

- 4.1. Construction
  - 4.1.1. All materials shall be as specified on the relevant drawings and shall be provided by the vendor. Any proposed substitutes or concessions shall be agreed to by the Buyer prior to procurement or incorporation into the work. Materials shall be standard products of established manufacturers who have produced the type specified.
  - 4.1.2. If no references are made in the drawings, provide all materials to complete the work.
  - 4.1.3. All materials provided by the Vendor shall be new and free of defects or mechanical damage.
  - 4.1.4. The Vendor shall submit Certified Material Test Reports (CMTRs) for all base metals and filler materials, and shall certify that the test results and materials conform to the applicable specification.
  - 4.1.5. Traceability must be maintained to assure material compatibility.

- 4.1.6. The Vendor shall submit Certificates of Compliance (COC) certifying that the materials conform to the applicable specification.
- 4.1.7. The Vendor shall submit shop detail drawings for review and approval.
- 4.1.8. Stainless steel and similar corrosion resistance materials not suitable for standard thermal cutting means may be cut by plasma arc, water jet, laser, mechanical, or equivalent methods. All flame cut and rough edges shall be dressed by grinding or other mechanical methods to remove oxidized materials, burrs, scale, and other impurities that could affect weld quality or subsequent manufacturing operations and/or painting. Stainless steel tooling shall be new or not have been used on carbon steel.
- 4.1.9. The limits of size and form, including surface texture requirements, of mill stock material (plate, sheet, pipe, tube, etc.) shall, either directly or indirectly, be in accordance with the national standards identified on the drawings. Where stock materials are specified without condition, finish, or temper, the Vendor shall select a commercial grade that is readily available.

#### 4.2. Prohibited Materials

- 4.2.1. Materials use in contact with Austenitic stainless steel and nickel-based alloys shall meet the requirements of 24590-WTP-3PS-NW00-T0002, Ref. 2.4.1.

#### 4.3. Special Requirements

N/A

#### 4.4. Storage of Special Materials Prior to Work

- 4.4.1. The Vendor shall handle and store materials indoors in a locked controlled area to prevent misappropriation and damage or deterioration of the materials. The Vendor shall protect shipping tags and other identifying objects on delivered material for establishing identification and traceability. Heat numbers removed by cutting material shall be transferred to the unused material to maintain traceability.

### 5. FABRICATION

#### 5.1. Welding

- 5.1.1. The Vendor shall identify each weld with a unique weld number, providing the following information. In addition the Vendor shall provide weld map format

for Buyer approval. A system of control such as "weld travelers" or packages shall be established by the Vendor to control welding activities.

- Purchase Order number
- Weld number
- Welder's name
- Filler metal heat number
- Weld and NDE symbols
- Applicable weld procedure
- Applicable weld inspection procedure(s)

5.1.2. Weld inspection to include:

- Inspector's name
- Accept/Reject statement
- Non-conforming conditions, if any
- Date of Inspection

5.1.3. Welders, Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR), Qualification of Base Metal, Welding, Inspection, and Inspection Personnel shall be in accordance with AWS D1.6 or ASME BPVC, Section IX. The Vendor shall submit Welding Procedure Specifications and Procedure Qualification Records for Buyer approval.

5.1.4. The Vendor shall be responsible for all welds meeting the requirements of the applicable code, including proper filler metal selection.

5.1.4.1. All structural welds shall be in accordance with AWS D1.6.

5.1.4.2. All pipe welds shall be in accordance with ASME B31.3.

5.1.5. The Vendor shall also have available for review Welder Qualification Records for all welders who will perform welding.

5.1.6. The Vendor shall maintain a record of welds employed at each weld joint, the filler metal heat number and applicable WPS utilized on a weld map, and include in Vendor's data package.

- 5.1.7. The Vendor shall be responsible for conducting the examination and tests required to qualify the performance of the welders and welding operations and procedures. Welding machines and welding operators shall be currently certified before welding.
- 5.1.8. Vendor shall use controlled welding techniques to meet final product dimensions and tolerances as provided in the drawings.
- 5.1.9. Welders shall be requalified when the Buyer determines their work does not meet the performance qualification requirements. Requalification tests shall be the Vendor's responsibility. Welders failing a requalification test shall be removed from work under this specification.
- 5.1.10. Weld joint symbols shall be interpreted in accordance with AWS A2.4 and AWS A3.0.
- 5.1.11. Temporary tack-welded attachments: All areas of material where temporary welded attachments have been removed shall be repaired with weld overlay, ground flush, and penetrant inspected to the same acceptance criteria as for VT on welds.

## 5.2. Assembly

- 5.2.1. The Vendor shall submit the fabrication plan for Buyer approval. As a minimum the Vendor's fabrication plan shall include the following information.
- Purchase order number
  - Sequence of Operation
  - Fabrication Techniques
  - In-process Inspection
  - Handling Techniques
- 5.2.2. A suggested assembly procedure has been provided as Attachment 1 that has been used to fabricate previous ADS pumps. The Vendor should use this as a basis for the fabrication plan listed in 5.2.1 above.
- 5.2.3. The Vendor shall inform the Buyer if any aspect of the drawing or specification content is incorrect, or if the application could have an adverse effect on ADS pump life or reliability.
- 5.2.4. Controls are to be exercised during all stages of fabrication to minimize exposure of stainless steel to contaminants and in particular any chlorides that

might cause stress-corrosive cracking. Chloride and halide bearing compounds shall be avoided, however, if used, they must be completely removed by thorough cleaning. Furnace atmosphere for open heating should be slightly reducing to prevent excessive oxidation of material.

- 5.2.5. All materials used shall be assembled in a clean condition and provisions to maintain this condition shall be outlined as a part of the fabrication plan.
- 5.2.6. The Vendor shall assemble components of the ADS pump at the vendor's facility. The Vendor shall ship the components to the Hanford site in approved shipping containers.
- 5.2.7. When equipment must be disassembled into multiple pieces for shipment, the components shall be initially assembled at the Vendor's shop to ensure compatibility. As many components as possible should be fit checked at the Vendor's location first to assure that potential interference and fit up problems are resolved prior to shipment. All items that have been disassembled for shipment should be clearly labeled and tagged.
- 5.2.8. Where sub-assemblies erected at the shop have to be dismantled for transport to site, then the fasteners holding them together shall be inspected. Fasteners exhibiting distortion, galling, permanent set, or other damage shall, at the discretion of the Buyer, be replaced.
- 5.2.9. Fasteners shall be tightened in accordance with the torque values in the following table titled "Schedule of Un-Lubricated Bolt Torque" unless otherwise stated on the drawings. ACME nuts and studs shall be lubricated with Bostik Pure Nickel Never-Seez<sup>®</sup>, Nuclear Grade unless otherwise approved by the Buyer. Torque values for this application are per the drawing requirement. Anti galling compound shall be applied to mating stainless steel threads prior to assembly.

### Schedule of Un-Lubricated Bolt Torque

Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	1288	5
3/8	16	UNC	0.0775	3137	20
½	13	UNC	0.1418	5744	48
5/8	11	UNC	0.2259	9148	95
¾	10	UNC	0.3343	13539	169
1	8	UNC	0.6054	24520	409
1-1/8	7	UNC	0.7629	30897	579
1-1/4	7	UNC	0.9686	39229	817
Yield Strength 81000 PSI, Nut Factor - 0.2					
Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	477	2
3/8	16	UNC	0.0775	1162	7
½	13	UNC	0.1418	2127	18
5/8	11	UNC	0.2259	3388	35
¾	10	UNC	0.3343	5014	63
1	8	UNC	0.6054	9082	151
1-1/8	7	UNC	0.7629	11443	215
1-1/4	7	UNC	0.9686	14529	303
Yield Strength 30000 PSI, Nut Factor -0.2					
Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	2385	10
3/8	16	UNC	0.0775	5809	36
½	13	UNC	0.1418	10637	89
5/8	11	UNC	0.2259	16942	176
¾	10	UNC	0.3343	25072	313
1	8	UNC	0.6054	45408	757
1-1/8	7	UNC	0.7629	57216	1073
1-1/4	7	UNC	0.9686	72646	1513
Yield Strength 150000 PSI, Nut Factor -0.2					

**5.3. Fabrication Hold Points**

- 5.3.1. The Vendor shall provide necessary access to facilities, equipment, records, and personnel to allow performance of required Buyer verifications/inspections. Accomplishment of Buyer source verifications/inspections does not indicate Buyer's final acceptance of the supplied item.

**5.4. Heat Treatment**

- 5.4.1. The Vendor shall develop and implement a procedure for heat treatment.

- 5.4.2. The following components listed in WTP-M-23502 shall be heat treated either before or after machining to meet condition H900 in accordance with ASTM A-564:

5.4.2.1. Item 12, nipple

5.4.2.2. Item 14, poppet

5.4.2.3. Item 21, rocker arm

5.4.2.4. Item 22, pivot pin

5.4.2.5. Item 23, lift rod pin

5.4.2.6. Item 33, housing

5.4.2.7. Item 36, lift rod assembly comprising of upper (Item 35) and lower lift rods (Item 11)

- 5.4.3. The following components listed in WTP-M-23502 also shall be heat-treated.

5.4.3.1. Item 15, actuator magnet target

5.4.3.2. Item 20, lift rod magnet target

- 5.4.4. The heat treatment process shall include annealing in a wet hydrogen atmosphere at a temperature of 1,550 to 1,600 degrees Fahrenheit for two to four hours and cooled at a rate of 100 to 200 degrees Fahrenheit per hour down to 1,000 degrees Fahrenheit and any rate thereafter.

- 5.4.5. The Vendor shall maintain heat treatment reports and furnace charts. These shall include the procedure used for heat treatment and annealing, serial numbers of the temperature measuring devices used to control temperature, and the name of the person responsible for heat treatment and annealing.
- 5.4.6. The Vendor shall include the heat treatment reports and furnace charts in the documentation package.

### 5.5. Other Processes

#### 5.5.1. Handling, Cleaning and Maintaining Cleanliness:

- 5.5.1.1. The Vendor shall submit the procedures for handling, cleaning, and maintaining cleanliness throughout the entire course of this project. Methods and precautions presented in ASTM A380 shall be followed as applicable.
- 5.5.1.2. Surfaces of each component and its appurtenances shall be visually examined for cleanliness in accordance with ASTM A380, Paragraph 7.2.1. Surfaces not readily accessible to visual examination may be examined by other methods provided in Paragraph 7.2 of ASTM A380 subject to Buyer approval.

#### 5.5.2. Painting:

- 5.5.2.1. The Vendor shall prepare a painting and inspection procedure for Buyer review.
- 5.5.2.2. Surfaces shall be prepared for coating in accordance with SSPC-SP-10 and the coating manufacturer's recommendations.
- 5.5.2.3. Surface finish shall be inspected prior to painting to assure compliance with SSPC-SP-10.

#### 5.5.3. Jigs, Fixtures and Special Tools:

- 5.5.3.1. Any special tools, jigs, fixtures, tapes, patterns, and tooling prepared for fabrication of the components per this procurement specification

for guaranteeing interchangeability or facilitating quantity production shall become the property of the Buyer.

5.5.3.2. For certifications, implement provisions to ensure that all components used or supplied are not counterfeit or of other suspect origin.

5.5.3.3. Materials and forms of fasteners shall comply with drawings. Any substitutes shall be agreed upon with the Buyer prior to use.

5.5.4. Pipe Thread Sealant:

5.5.4.1. The Vendor shall submit the proposed pipe thread sealant, activator (if necessary) and the applicable Material Safety Data Sheet (MSDS) for each, to the Buyer for review prior to procuring materials.

5.5.4.2. Pipe thread sealant shall be as specified on drawing.

5.5.4.3. The Vendor shall be responsible for submitting materials with properties that meet or exceed those specified. The Vendor shall be responsible for using compatible systems and application methods that are appropriate for the intended service.

5.5.4.4. Pipe thread sealant shall be used as required during assembly of parts in accordance with manufacturer-recommended instructions.

5.5.4.5. All parts to be bonded shall be visually examined for cleanliness in accordance with approved procedures. A report of the inspection results shall be included in the documentation package.

5.5.4.6. Confirm compatibility of sealant with parts to be bonded.

5.5.4.7. If aqueous washing systems are used to clean the surfaces before bonding, check for compatibility of washing solution with the adhesive.

5.5.4.8. A determination shall be made as to whether the parts to be bonded are made from an *active* or an *inactive* material.

5.5.4.9. Specific pipe thread sealants will react faster with *active* metals while *inactive* metals will require the use of an activator.

5.5.4.10. If metal is unknown, use activator. See pipe thread sealant manufacturer technical data sheet for list of *active* and *inactive* metals.

5.5.4.11. Apply sealant to threads of parts to be bonded following directions for use listed in pipe thread sealant technical data sheet.

## 6. TESTS AND INSPECTIONS

### 6.1. General Requirements:

6.1.1. Buyer's representative shall have reasonable access to Vendor's fabrication facilities during normal working hours for source inspection, audit, or surveillance to verify conformance to the specified requirements.

### 6.2. Personnel Qualifications

6.2.1. Test and inspection personnel qualifications shall be in accordance with National Standards as shown herein.

6.2.2. NDE Personnel Certification: Nondestructive Examination (NDE) personnel performing leak testing and liquid penetrate testing operations shall be certified per the requirements of ASNT SNT-TC-1A. All test reports shall be signed by personnel holding either Level II or Level III certifications that either performed, or witnessed the test. A copy of the individual's current certification(s) shall be provided.

### 6.3. Non-Destructive Examinations

6.3.1. Visual testing (VT): All welds will be visually inspected to check for absence of cracks, fissures and other surface defects. The Vendor shall submit a VT test procedure for review and approval.

6.3.2. Liquid penetrant testing (PT): Liquid penetrant examination shall be performed on welds as specified in the design drawings and in accordance with ASME BPVC, Section V and accepted to criteria of ASME BPVC, Section VIII, Appendix 8. The Vendor shall submit a PT test procedure for review and approval.

**6.4. Shop Tests**

- 6.4.1. The Vendor shall conduct tests in accordance with written procedures approved by the Buyer.
- 6.4.2. Established (standard/commercial manufacture) items such as fasteners and actuators shall be inspected and tested against manufacturers specifications and industry standards. It shall be supplied with a Certificate of Conformance or test or type certification, unless specified otherwise on drawings or in accompanying contractual documentation.
- 6.4.3. Prior to acceptance, equipment shall be inspected for leaks of Lubricant and shall be rectified at source.
- 6.4.4. **Hydrostatic Test**  
The 3/4" and 1/2" pipes including the 6" pipe chamber shall be hydrostatically tested to 225 psi per ASME B31.3-1996, Process Piping (Reference 2.1.4). This can be accomplished by following the steps for hydrostatic test in Attachment 1.
- 6.4.5. **Leak Test**  
The pump chamber and poppet seat shall be pressure leak tested with the poppet in the lower most position. The test medium shall be potable water and shall be supplied through the quick connect fitting (item 36 on WTP-M-23500) to pressurize the chamber. Pressure shall be 35 to 40 psig and held for a minimum of 10 minutes. Repeat the test 3 times and average the leak rate. The acceptable leak rate shall be less than 2 gal/hr. If the leak rate is in excess of this value the vendor shall consult with Buyer to determine if there is a design or a manufacturing problem that needs correction.
- 6.4.6. **Functional Test**  
Functionally test the pump actuator assembly by activating the mechanism by hand. All moving parts of the pump and actuator shall work smoothly without binding.
- 6.4.7. **Pump Vertical Balance While Suspended**  
While suspended vertically by two lift trunnions, the pump shall hang vertically within 5 degree as measured from the side of the upper tube assembly. The reference location of the lift trunnions is shown on WTP-M-23500, sht. 2 and is the best estimate of the required location. The vendor shall verify the 5-degree requirement and position the trunnions as required prior to final welding of the trunnions. Refer to note 21 on WTP-M-23500.
- 6.4.8. **Vent Valve Vertical Balance While Suspended**

After completion of assembly, position the hoses and balance per notes 16 and 20 on WTP-M-23508.

6.4.9. Actuator Vertical Balance While Suspended

After completion of assembly, position the hoses and balance per notes 16 and 17 on WTP-M-23504.

6.4.10. Load Test of Lifting Bails

All lifting bails and trunnions shall be load tested to 125% of the respective component's assembled weight. The bail and connecting hardware shall show no signs of plastic deformation.

6.5. Site Tests

N/A

6.6. Interpretation of Requirements/Tolerances and Acceptance Criteria

6.6.1. Unless otherwise specifically stated in the detailed drawings, manufacturing and fabrication tolerances for all equipment, accessories, and components shall conform to ASME/ANSI Y14.5M.

6.6.2. Thickness tolerances shall conform to the requirements of the referenced commercial standard. In the absence of such criteria, allowable thickness shall be plus .010 inches, minus .005 inches or as defined on the drawings.

6.6.3. Finishes, thread classes, and edge provisions:

6.6.3.1. Unless otherwise noted, all machined surfaces shall be 125 rms or finer in accordance with ASME/ANSI B46.1.

6.6.3.2. Sharp edges and burrs shall be removed from all components, including manufactured assemblies.

6.6.3.3. Internal machined UNC threads shall be class 2B, unless otherwise noted.

6.6.3.4. External machined UNC threads shall be class 2A, unless otherwise noted.

6.6.3.5. All machined thread surface finishes shall be 63 or finer in accordance with ANSI B46.1. Burrs shall be removed from the threads.

**6.6.4. Fabricated Components**

6.6.4.1. Thickness tolerances shall conform to the requirements of the referenced commercial standard applicable to the material being fabricated. When plate thickness is specified herein or in the detailed drawings, it shall be considered to mean minimum thickness.

**6.7. Equipment Data Package**

On completion of fabrication the Seller shall assemble an equipment data package, which consists of all quality verification documents including but not limited to:

- Welding qualifications verification reports.
- Major repair verification reports (as required).
- Cleaning and coating verification reports.
- Heat-treating reports.
- Material test reports.
- Material certificates of compliance.
- Liquid penetrant examination and verification reports.
- Pressure test reports – hydrostatic and leak tests.
- Visual weld inspection reports.
- Mechanical test reports – functional test.
- Load testing reports

The data package shall be in a three ring binder and include an index of the information contained within. Each pump shall have a separate data package assembled and identified as such. The data package shall be shipped with the applicable pump.

## 7. ATTACHMENT 1

### 7.1. Suggested Assembly ADS Feed Pump

1. Fabricate lower tube assembly (WTP-M-23502-4). NDE and document welds.
2. Check ease of insertion of  $\frac{3}{4}$ " feed pipe (WTP-M-23502-13) into socket on cover (WTP-M-23502-6).
3. Weld lower tube assembly to cover. See View H on WTP-M-23500, sheet 2. NDE and document weld.
4. Fabricate tube assembly (WTP-M-23502-3). NDE and document welds.
5. Insert tube assembly into lower tube assembly and ensure that  $\frac{3}{4}$ " feed pipe seats in socket on cover assembly. Rotate tube assembly such that, in plan view, the centerline of the  $\frac{1}{2}$ " vent pipe (WTP-M-23502-24) is centered between two bolt holes (any two) on the cover. Scribe a line on the cover between these two bolt holes. **Verify  $\frac{3}{4}$ " feed pipe is still seated in cover socket before welding.** Weld tube assembly to lower tube assembly. See View H on WTP-M-23500, sheet 3. NDE and document weld.

#### Hydrostatic Test

6. Cut a  $\frac{1}{8}$ " thick rubber disk gasket to  $2 \frac{7}{8}$ " ID x  $4 \frac{15}{16}$ " OD. Position on cover and transfer bolt hole pattern to gasket. Cut  $\frac{7}{16}$ " holes in gasket. Note: holes will cut through the outer edge of the gasket; this is ok.
7. Cut a 12 gauge thick stainless steel disk to  $4 \frac{1}{8}$ " OD.
8. Insert rubber gasket into recess in cover, followed by stainless steel disk. Install housing (WTP-M-23502-33) onto cover and bolt together using studs, lock washers, flat washers and nuts (WTP-M-23500-25, 26, 27 & 28). Uniformly torque in a cross pattern to 7 ft-lb. Note that poppet (WTP-M-23502-14) and screen (WTP-M-23502-10) do not need to be installed at this time.
9. Provide temporary supports for positioning the assembly on an angle with the  $\frac{3}{4}$ " and  $\frac{1}{2}$ " pipes as high as possible. The  $\frac{1}{2}$ " pipe should be on top. Fit the  $\frac{3}{4}$ " pipe for water inlet and  $\frac{1}{2}$ " pipe for air vent and pressure gauge.
10. Connect the pressure pump and fill with potable water through the  $\frac{3}{4}$ " pipe. Continue until all air escapes through the  $\frac{1}{2}$ " pipe.
11. Install a calibrated 0-250 psig pressure gauge to the  $\frac{1}{2}$ " pipe.

12. Raise the pressure slowly to 225 psig. Hold the test pressure for at least 10 minutes and view for any areas of deformation. After 10 minutes, visually examine all the pressure containing welds for leaks. (See reference 2.1.4) Note: leaks around the gasket/disk area are acceptable as long as the test pressure is maintained throughout the test duration.
13. Upon successful completion of the test (including retest after repairs, if applicable) document the test results, disassemble and drain the assembly.
14. Fabricate upper tube assembly (WTP-M-23502-31). NDE and document welds.
15. Weld upper tube assembly to lower tube assembly. See elevation view on WTP-M-23500, sheet 2. NDE and document weld.
16. Install nipple (WTP-M-23502-12) into recess in cover.
17. Attach rocker arm (WTP-M-23502-21) to housing (capturing poppet) using pivot pin (WTP-M-23502-22) and setscrews (WTP-M-23500-19 and WTP-M-23500-41) per section D-D, WTP-M-23500, sht. 4. Attach screen (WTP-M-23502-10) to housing using machine screws and flat washers (WTP-M-23500-23 & 24).
18. Orient housing with cover such that the free end of the rocker arm aligns with the scribe line between the bolt holes on the cover. Attach housing to cover with studs, lock washers, flat washers and nuts (WTP-M-23500-25, 26, 27 & 28).
19. Fabricate flange assembly (WTP-M-23502-1). NDE and document welds.
20. Attach flange assembly to upper tube assembly, sliding the ¾" and ½" pipes through their respective holes in the flange assembly. Seat flange on upper tube assembly. Note: the flange assembly will have to be shifted over about 1" to mate with the upper tube assembly. This will cause the ¾" and ½" pipes to bend slightly. This is ok. However, make sure not to twist the flange assembly relative to the pipes. See Section C-C on WTP-M-23500, sheet 2. TACK WELD ONLY flange assembly to upper tube assembly. (Full welding will be done after lift rod operation is verified).
21. Install bushing (WTP-M-23500-35) in flange assembly.
22. Assemble lift rod assembly (WTP-M-23502-36).
23. Install lift rod assembly through bushing in flange assembly. Slide lift rod guide assembly (WTP-M-23502-30) over lift rod assembly.
24. Attach lift rod assembly to rocker arm using lift rod pin (WTP-M-23502-23), flat washers (WTP-M-23500-20) and roll pin (WTP-M-23500-22). Lift rod pin is a press fit into lift rod.

**Functional Test**

25. Manually operate the lift rod assembly to check for smooth operation. There should be no binding. Binding will be eliminated with proper orientation of the flange assembly relative to the upper tube assembly.
26. Locate the lift rod guide assembly at the proper elevation and weld to upper tube assembly. NDE and document welds.
27. Weld flange assembly to upper tube assembly. Weld  $\frac{3}{4}$ " and  $\frac{1}{2}$ " pipes to flange assembly. NDE and document welds.
28. Attach the lift rod magnet target (WTP-M-23502-20) to the lift rod assembly.
29. Attach the actuator magnet targets (WTP-M-23502-15) to the flange assembly using the threaded studs (WTP-M-23500-11).
30. Attach the vent pipe boot (WTP-M-23502-19) and boot retainer (WTP-M-23502-17) to the flange assembly using the flat washers, lock washers and machine screws (WTP-M-23500-29 & 32).
31. Fabricate the lift trunnion assemblies (WTP-M-23502-7). NDE and document welds.
32. Check balance of pump then tack lift trunnion assemblies to flange assembly. Verify pump hangs within 1 degree of vertical, then complete the lift trunnion to flange welds. NDE and document welds.
33. Fabricate the actuator assembly (WTP-M-23504-1).
34. Place hoses in clips on actuator and check level. Adjust by bending bail as required.
35. Fabricate the vent valve assembly (WTP-M-23508-1).
36. Place hoses in clips on vent valve and check level. Adjust by bending bail as required or sliding laterally in the slots provided.

**Leak Test**

37. Attach actuator assembly to magnets on flange assembly.
38. Provide for filling the lower chamber with potable water through the  $\frac{1}{2}$ " pipe complete with a calibrated pressure gauge 0-60 psig and a valve to regulate pressure up to 40 psig.
39. Cap the  $\frac{3}{4}$ " pipe with a stainless steel cap.
40. Position the ADS pump assembly in the vertical position with room at the bottom for a 5-gallon bucket.



41. Pressurize the air cylinder on the actuator assembly with 35 psig air to push the lift rod into the "down" position (poppet valve in the down position) and pressurize the lower chamber with water to 40 psig.
42. Place the 5 gallon bucket under the pump assembly and begin timing for the leak test per section 6.4.5 of this specification.
43. Drain the test water and disconnect the test apparatus.
44. If leak test is acceptable, tack weld roll pin item (WTP-M-23500-22) to lift rod pin (WTP-M-23502-23).

24590-QL-HC4-W000-00011

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PO/SCT

Submittal

Rev



Job No. 24590

Rectel National, Inc.

**SUPPLIER DOCUMENT STATUS**

- 1.  Work may proceed.
- 2.  Revise and resubmit. Work may proceed subject to resolution of indicated comments.
- 3.  Revise and resubmit. Work may not proceed.
- 4.  Review not required. Work may proceed.

Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the supplier and does not relieve supplier from full compliance with contractual obligations.

REVIEWED	M																		
	MS																		

G-321 Document Category B.0

[From Supplement A to G-321-E (E) or G-321-V (V), as applicable, or "N/A" if SSRS is used]

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Released by N/A [Signature] [Date]

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**PURCHASE ORDER SUBMITTAL**



Approvals Page



RPP-WTP

LAW ADS Pump Procurement Specification

Originator: R. P. J. 08.25.04  
Date

Reviewed by: [Signature] 8/25/04  
Date

Approved by: [Signature] 8/25/04  
QA Manager Date

Approved by: [Signature] 8/25/04  
Design Authority Date

Approved by: [Signature] 8/25/04  
Engineering Manager Date



Revision History

Revision	Date	Comments/Description
0	3/28/03	Original Release.
1	8/25/03	Incorporate customer's 90% design review comments.
2	9/25/04	Incorporate customer's final design review comments

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## 1. SCOPE

### 1.1. Project Description and Location

The River Protection Project-Waste Treatment Plant (RPP-WTP) is a facility located on the Department of Energy's Hanford Reservation in southeast Washington State. The facility's purpose is to vitrify radioactive tank waste for permanent disposal.

### 1.2. Equipment, Material, and Services Required

- 1.2.1. The purpose of this specification is to provide information for the Vendor to fabricate the Air Displacement Slurry (ADS) pump for the LAW melter feed system. This specification, used along with the attached design drawings, will provide all necessary information for the Vendor to procure all required materials, fabricate parts and provide assemblies. Guidance will be given for non-vendor specific materials such as fasteners and piping.
- 1.2.2. The Vendor is not responsible for the design of these components.
- 1.2.3. This specification covers the supply of materials, fabrication, inspection, assembly, disassembly, packing, and delivery to the site.
- 1.2.4. The Vendor shall be responsible to perform all activities necessary to provide a complete product as specified herein and in the design drawings. If any information contained on the drawings or other contractual documents conflicts with the information contained in this specification, then it must be resolved with the Buyer in writing before commencing work.
- 1.2.5. The quantity of assemblies shall be identified on the purchase order.
- 1.2.6. The Vendor may subcontract any portion of the fabrication, manufacturing, or inspections provided it meets the quality assurance requirements of this specification.
- 1.2.7. The Vendor shall provide any special tools required for assembly, disassembly and reassembly of the components. The latest revision of the drawings shall be listed and controlled by the Buyer documents.

### 1.3. Work by Others

Vendor's responsibility will terminate with shipment of the assemblies, unless otherwise specified.

**1.4. Definitions****LAW Melter  
Vitrification**

Low Active Waste Melter

The process of joining a waste stream with glass formers at high temperature to produce a stable waste form.

**Buyer  
Vendor**

Bechtel National, Inc.

Company selected by Buyer to fabricate the LAW melter components.

**ADS**

Air Displacement Slurry

**2. REFERENCES****2.1. Codes**

The items covered by this specification shall be fabricated in accordance with this specification, the codes and standards listed below and the drawings. The applicable edition of each code and standard shall be the edition in effect at the time of contract. Vendor shall submit a list of codes and standards including year of edition four weeks after contract award.

2.1.1. ASME Boiler and Pressure Vessel Code, Section II, Material Specification.

2.1.2. ASME Boiler and Pressure Vessel Code, Section V, Nondestructive Examination.

2.1.3. ASME Boiler and Pressure Vessel Code, Section VIII, Design & Fabrication of Pressure Vessels.

2.1.4. ASME Boiler and Pressure Vessel Code, Section IX, Qualification Standard For Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

2.1.5. ASME B31.3-1996, Process Piping.

**2.2. Industry Standards**

2.2.1. SSPC-SP NO. 10 NACE NO.2, Joint Surface Preparation Standard Near-White Blast Cleaning.

2.2.2. ANSI/ASME B46.1, Surface Texture.

2.2.3. ANSI/ASME Y14.5M.

- 2.2.4. AWS A2.4, Symbols for Welding and Nondestructive Testing.
- 2.2.5. AWS A3.0, Standard Welding Terms and Definitions.
- 2.2.6. ASTM A-380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
- 2.2.7. AWS D1.6, Structural Welding Code, Stainless Steel, 1999.

### 2.3. Engineering Standards

N/A

### 2.4. Reference Documents/Drawings

- 2.4.1. 24590-WTP-3PS-NW00-T0002, Chemical Requirements for Materials Used in Contact with Austenitic Stainless Steel and Nickel-Based Alloys

## 3. DESIGN REQUIREMENTS

N/A

## 4. MATERIALS

### 4.1. Construction

- 4.1.1. All materials shall be as specified on the relevant drawings and purchased by the Vendor. Any proposed substitutes or concessions shall be agreed to by the Buyer prior to procurement or incorporation into the work. Materials shall be standard products of established manufacturers who have produced the type specified.
- 4.1.2. Certified Material Test Reports (CMTRs) will be provided to the Vendor for all Buyer Furnished Materials. The test reports will certify that the materials conform to the applicable specification.
- 4.1.3. Layout and Record Keeping of Buyer Furnished Materials:
  - 4.1.3.1. The Vendor shall keep a record of Buyer Furnished Materials used in fabricating components.

- 4.1.3.2. The Buyer will supply layout drawings for each supplied item, if uncut plate is supplied.
- 4.1.3.3. Surplus from the Buyer Furnished Materials shall be returned to the Buyer after completion of the job.
- 4.1.4. If no references are made in the drawings, provide all materials to complete the work.
- 4.1.5. All materials provided by the Vendor shall be new and free of defects or mechanical damage.
- 4.1.6. The Vendor shall submit Certified Material Test Reports (CMTRs) for the following items and shall certify that the test results and materials conform to the applicable specification.
- All base materials.
  - All weld filler materials.
- 4.1.7. Traceability must be maintained to assure material compatibility.
- 4.1.8. The Vendor shall submit Certificates of Compliance (COC) certifying that the materials conform to the applicable specification.
- 4.1.9. Carbon steel materials may be cut by thermal or mechanical means. Stainless steel and similar corrosion resistance materials not suitable for standard thermal cutting means may be cut by plasma arc, water jet, laser, mechanical, or equivalent methods. All flame cut and rough edges shall be dressed by grinding or other mechanical methods to remove oxidized materials, burrs, scale, and other impurities that could affect weld quality or subsequent manufacturing operations and/or painting. Stainless steel tooling shall be new or not have been used on carbon steel.
- 4.1.10. The limits of size and form, including surface texture requirements, of mill stock material (plate, sheet, pipe, tube, etc.) shall, either directly or indirectly, be in accordance with the national standards identified on the drawings. Where stock materials are specified without condition, finish, or temper, the Vendor shall select a commercial grade that is readily available.
- 4.1.11. Vendor shall submit shop detail drawings for review and approval.

**4.2. Prohibited Materials**

- 4.2.1. **Materials used in contact with Austenitic stainless steel and nickel-based alloys shall meet the requirements of 24590-WTP-3PS-NW00-T0002, Ref. 2.4.1.**

**4.3. Special Requirements**

N/A

**4.4. Storage of Special Materials Prior to Work**

- 4.4.1. **The Vendor shall handle and store materials indoors in a locked controlled area to prevent misappropriation and damage or deterioration of the materials. The Vendor shall protect shipping tags and other identifying objects on delivered material for establishing identification and traceability. Heat numbers removed by cutting material shall be transferred to the unused material to maintain traceability.**

**5. FABRICATION****5.1. Welding**

- 5.1.1. **The Vendor shall identify each weld with a unique weld number, providing the following information. In addition the Vendor shall provide weld map format for Buyer approval. A system of control such as "weld travelers" or packages shall be established by the Vendor to control welding activities.**

- **Purchase Order number**
- **Weld number**
- **Welder's name**
- **Filler metal heat number**
- **Weld and NDE symbols**
- **Applicable weld procedure**
- **Applicable weld inspection procedure(s)**

- 5.1.2. **Weld inspection to include:**

- **Inspector's name**
- **Accept/Reject statement**
- **Non-conforming conditions, if any**
- **Date of Inspection**

- 5.1.3. **Welders, Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR), Qualification of Base Metal, Welding, Inspection, and Inspection Personnel shall be in accordance with AWS D1.6 or ASME BPVC, Section IX. The Vendor shall submit Welding Procedure Specifications and Procedure Qualification Records for Buyer approval.**
- 5.1.4. **The Vendor shall be responsible for all welds meeting the requirements of the applicable code, including proper filler metal selection.**
- 5.1.4.1. **All structural welds shall be in accordance with AWS D1.6.**
- 5.1.4.2. **All pipe welds shall be in accordance with ASME B31.3.**
- 5.1.5. **The Vendor shall also have available for review Welder Qualification Records for all welders who will perform welding.**
- 5.1.6. **The Vendor shall maintain a record of welds employed at each weld joint, the filler metal heat number and applicable WPS utilized on a weld map, and include in Vendor's data package.**
- 5.1.7. **The Vendor shall be responsible for conducting the examination and tests required to qualify the performance of the welders and welding operations and procedures. Welding machines and welding operators shall be currently certified before welding.**
- 5.1.8. **Vendor shall use controlled welding techniques to meet final product dimensions and tolerances as provided in the drawings.**
- 5.1.9. **Welders shall be requalified when the Buyer determines their work does not meet the performance qualification requirements. Requalification tests shall be the Vendor's responsibility. Welders failing a requalification test shall be removed from work under this specification.**
- 5.1.10. **Weld joint symbols shall be interpreted in accordance with AWS A2.4 and AWS A3.0.**
- 5.1.11. **Temporary tack-welded attachments: All areas of material where temporary welded attachments have been removed shall be repaired with weld overlay, ground flush, and penetrant inspected to the same acceptance criteria as for VT on welds.**

**5.2. Assembly**

- 5.2.1. The Vendor shall submit the fabrication plan for Buyer approval. As a minimum the Vendor's fabrication plan shall include the following information.
- Purchase order number
  - Sequence of Operation
  - Fabrication Techniques
  - In-process Inspection
  - Handling Techniques
- 5.2.2. A suggested assembly procedure has been provided as Attachment 1 that has been used to fabricate previous ADS pumps. The Vendor should use this as a basis for the fabrication plan listed in 5.2.1 above.
- 5.2.3. The Vendor shall inform the Buyer if any aspect of the drawing or specification content is incorrect, or if the application could have an adverse effect on ADS pump life or reliability.
- 5.2.4. Controls are to be exercised during all stages of fabrication to minimize exposure of stainless steel to contaminants and in particular any chlorides that might cause stress-corrosive cracking. Chloride and halide bearing compounds shall be avoided, however, if used, they must be completely removed by thorough cleaning.
- 5.2.5. All materials used shall be assembled in a clean condition and provisions to maintain this condition shall be outlined as a part of the fabrication plan.
- 5.2.6. The Vendor shall assemble components of the ADS pump at the factory. The Vendor shall ship the components to the Hanford site in approved shipping containers.
- 5.2.7. When equipment must be disassembled into multiple pieces for shipment, the components shall be initially assembled at the Vendor's shop to ensure compatibility. As many components as possible should be fit checked at the Vendor's location first to assure that potential interference and fit up problems are resolved prior to shipment. All items that have been disassembled for shipment should be clearly labeled and tagged.
- 5.2.8. Where sub-assemblies erected at the shop have to be dismantled for transport to site, then the fasteners holding them together shall be inspected. Fasteners exhibiting distortion, galling, permanent set, or other damage shall, at the discretion of the Buyer, be replaced.

- 5.2.9. Fasteners shall be tightened in accordance with the torque values in the following table titled "Schedule of Un-Lubricated Bolt Torque" unless otherwise stated on the drawings. ACME nuts and studs shall be lubricated with Bostik Pure Nickel Never-Seez<sup>®</sup>, Nuclear Grade unless otherwise approved by the Buyer. Torque values for this application are per the drawing requirement. Anti galling compound shall be applied to mating stainless steel threads prior to assembly.

### Schedule of Un-Lubricated Bolt Torque

Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	1288	5
3/8	16	UNC	0.0775	3137	20
½	13	UNC	0.1418	5744	48
5/8	11	UNC	0.2259	9148	95
¾	10	UNC	0.3343	13539	169
1	8	UNC	0.6054	24520	409
1-1/8	7	UNC	0.7629	30897	579
1-1/4	7	UNC	0.9686	39229	817
Yield Strength 81000 PSI, Nut Factor - 0.2					
Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	477	2
3/8	16	UNC	0.0776	1162	7
½	13	UNC	0.1418	2127	18
5/8	11	UNC	0.2259	3388	35
¾	10	UNC	0.3343	5014	63
1	8	UNC	0.6054	9082	151
1-1/8	7	UNC	0.7629	11443	215
1-1/4	7	UNC	0.9686	14529	303
Yield Strength 30000 PSI, Nut Factor -0.2					
Size	Thds/In		Tensile Stress Area (in <sup>2</sup> )	50% Yield Load (lbs.)	Torque (ft-lbs)
¼	20	UNC	0.0318	2385	10
3/8	16	UNC	0.0775	5809	36
½	13	UNC	0.1418	10637	89
5/8	11	UNC	0.2259	16942	176
¾	10	UNC	0.3343	25072	313
1	8	UNC	0.6054	45408	757
1-1/8	7	UNC	0.7629	57216	1073
1-1/4	7	UNC	0.9686	72646	1513
Yield Strength 150000 PSI, Nut Factor -0.2					

**5.3. Fabrication Hold Points**

- 5.3.1. The Vendor shall provide necessary access to facilities, equipment, records, and personnel to allow performance of required Buyer verifications/inspections. Accomplishment of Buyer source verifications/inspections does not indicate Buyer's final acceptance of the supplied item.

**5.4. Heat Treatment**

- 5.4.1. The Vendor shall develop and implement a procedure for heat treatment.

- 5.4.2. The following components listed in WTP-M-13505 shall be heat treated per AMS 5670:

5.4.2.1. Item 12, nipple

5.4.2.2. Item 14, poppet

5.4.2.3. Item 21, rocker arm

5.4.2.4. Item 22, pivot pin

5.4.2.5. Item 23, lift rod pin

5.4.2.6. Item 33, housing

5.4.2.7. Item 36, lift rod assembly comprising of upper and lower lift rods

- 5.4.3. The heat treatment process shall include solution annealing at an initial temperature of 1,800 degrees Fahrenheit, held at 1,350 degrees Fahrenheit for 8 hours and furnace cooled to 1,150 degrees Fahrenheit for a total time of 18 hours.

- 5.4.4. The following components listed in WTP-M-13505 also shall be heat-treated.

5.4.4.1. Item 15, actuator magnet target

5.4.4.2. Item 20, lift rod magnet target

- 5.4.5. The heat treatment process shall include annealing in a wet hydrogen atmosphere at a temperature of 1,550 to 1,600 degrees Fahrenheit for two to four hours and cooled at a rate of 100 to 200 degrees Fahrenheit per hour down to 1,000 degrees Fahrenheit and any rate thereafter.
- 5.4.6. The Vendor shall maintain heat treatment reports and furnace charts. These shall include the procedure used for heat treatment and annealing, serial numbers of the temperature measuring devices used to control temperature, and the name of the person responsible for heat treatment and annealing.
- 5.4.7. The Vendor shall include the heat treatment reports and furnace charts in the documentation package.
- 5.5. Other Processes
- 5.5.1. Handling, Cleaning and Maintaining Cleanliness:
- 5.5.1.1. The Vendor shall submit the procedures for handling, cleaning, and maintaining cleanliness throughout the entire course of this project. Methods and precautions presented in ASTM A380 shall be followed as applicable.
- 5.5.1.2. Surfaces of each component and its appurtenances shall be visually examined for cleanliness in accordance with ASTM A380, Paragraph 7.2.1. Surfaces not readily accessible to visual examination may be examined by other methods provided in Paragraph 7.2 of ASTM A380 subject to Buyer approval.
- 5.5.2. Painting:
- 5.5.2.1. The Vendor shall prepare a painting and inspection procedure for Buyer review.
- 5.5.2.2. Surfaces shall be prepared for coating in accordance with SSPC-SP-10 and the coating manufacturer's recommendations.
- 5.5.2.3. Surface finish shall be inspected prior to painting to assure compliance with SSPC-SP-10.

**5.5.3. Jigs, Fixtures and Special Tools:**

- 5.5.3.1. Any special tools, jigs, fixtures, tapes, patterns, and tooling prepared for fabrication of the components per this procurement specification for guaranteeing interchangeability or facilitating quantity production shall become the property of the Buyer.
- 5.5.3.2. The Vendor shall make available to the Buyer during installation and commissioning of the LAW ADS pump, the jigs, fixtures, and special tools used during fabrication and manufacturing of the components.
- 5.5.3.3. For certifications, implement provisions to ensure that all components used or supplied are not counterfeit or of other suspect origin.
- 5.5.3.4. Materials and forms of fasteners shall comply with drawings. Any substitutes shall be agreed upon with the Buyer prior to use.

**5.5.4. Pipe Thread Sealant:**

- 5.5.4.1. The Vendor shall submit the proposed pipe thread sealant, activator (if necessary) and the applicable Material Safety Data Sheet (MSDS) for each, to the Buyer for review prior to procuring materials.
- 5.5.4.2. Pipe thread sealant shall be as specified on drawing.
- 5.5.4.3. The Vendor shall be responsible for submitting materials with properties that meet or exceed those specified. The Vendor shall be responsible for using compatible systems and application methods that are appropriate for the intended service.
- 5.5.4.4. Pipe thread sealant shall be used as required during assembly of parts in accordance with manufacturer-recommended instructions.
- 5.5.4.5. All parts to be bonded shall be visually examined for cleanliness in accordance with approved procedures. A report of the inspection results shall be included in the documentation package.
- 5.5.4.6. Confirm compatibility of sealant with parts to be bonded

- 5.5.4.7. If aqueous washing systems are used to clean the surfaces before bonding, check for compatibility of washing solution with the adhesive.
- 5.5.4.8. A determination shall be made as to whether the parts to be bonded are made from an *active* or an *inactive* material.
- 5.5.4.9. Specific pipe thread sealants will react faster with *active* metals while *inactive* metals will require the use of an activator.
- 5.5.4.10. If metal is unknown use activator. See pipe thread sealant manufacturer technical data sheet for list of *active* and *inactive* metals.
- 5.5.4.11. Apply sealant to threads of parts to be bonded following directions for use listed in pipe thread sealant technical data sheet.

## 6. TESTS AND INSPECTIONS

### 6.1. General Requirements:

- 6.1.1. Buyer's representative shall have reasonable access to Vendor's fabrication facilities during normal working hours for source inspection, audit, or surveillance to verify conformance to the specified requirements.

### 6.2. Personnel Qualifications

- 6.2.1. Test and inspection personnel qualifications shall be in accordance with National Standards as shown herein.
- 6.2.2. NDE Personnel Certification: Nondestructive Examination (NDE) personnel performing leak testing and liquid penetrate testing operations shall be certified per the requirements of ASNT SNT-TC-1A. All test reports shall be signed by personnel holding either Level II or Level III certifications that either performed, or witnessed the test. A copy of the individual's current certification(s) shall be provided.

### 6.3. Non-Destructive Examinations

- 6.3.1. Visual testing (VT): All welds will be visually inspected to check for absence of cracks, fissures and other surface defects. The Vendor shall submit a VT test procedure for review and approval.

- 6.3.2. **Liquid penetrant testing (PT):** Liquid penetrant examination shall be performed on welds as specified in the design drawings and in accordance with ASME BPVC, Section V and accepted to criteria of ASME BPVC, Section VIII, Appendix 8. The Vendor shall submit a PT test procedure for review and approval.

#### 6.4. Shop Tests

- 6.4.1. The Vendor shall conduct tests in accordance with written procedures approved by the Buyer.

- 6.4.2. Established (standard/commercial manufacture) items such as fasteners, gearboxes, actuators, and electric motors shall be inspected and tested against manufacturers specifications and industry standards. It shall be supplied with a Certificate of Conformance or test or type certification, unless specified otherwise on drawings or in accompanying contractual documentation.

- 6.4.3. Prior to acceptance, equipment shall be inspected for leaks of Lubricant and shall be rectified at source.

#### 6.4.4. Hydrostatic Test

The ¾" and ½" pipes including the 6" pipe chamber (items WTP-M-13505-3, -4 and -2) shall be hydrostatically tested to 225 psi per Reference 2.1.5. This can be accomplished by following the steps for hydrostatic test in Attachment 1.

#### 6.4.5. Leak Test

The pump chamber and poppet seat shall be pressure leak tested with the poppet in the lower most position. The test medium shall be potable water and shall be supplied through the quick disconnect fitting to pressurize the chamber. Pressure shall be 35-40 psig and held for a minimum of 10 minutes. Repeat test 3 times and average the leak rate. The acceptable leak rate shall be less than 2 gal/hr. If the leak rate is in excess of this value the Vendor shall consult with Buyer to determine if there is a design or a manufacturing problem that needs correction.

#### 6.4.6. Functional Test

Functionally test the pump actuator assembly by activating the mechanism by hand. All moving parts of the pump and actuator shall work smoothly without binding.

#### 6.4.7. Vertical Balance While Suspended

While suspended vertically by the main bail, the pump shall hang vertically within 5 degrees as measured from the side of the upper tube assembly. The Vendor shall consult with Buyer if counterweights or some other design change is required to meet this requirement.

**6.4.8. Load Test of Lifting Bails**

Each lifting bail shall be load tested to 125% of the respective component's assembled weight. The bail and connecting hardware shall show no signs of plastic deformation. The Vendor shall consult with Buyer if design changes are required to meet this requirement.

**6.5. Site Tests**

N/A

**6.6. Interpretation of Requirements/Tolerances and Acceptance Criteria**

**6.6.1. Unless otherwise specifically stated in the detailed drawings, manufacturing and fabrication tolerances for all equipment, accessories, and components shall conform to ASME/ANSI Y14.5M-1994.**

**6.6.2. Thickness tolerances shall conform to the requirements of the referenced commercial standard. In the absence of such criteria, allowable thickness shall be plus .010 inches, minus .005 inches or as defined on the drawings.**

**6.6.3. Finishes, thread classes, and edge provisions:**

**6.6.3.1. Unless otherwise noted, all machined surfaces shall be 125 rms or better in accordance with ASME/ANSI B46.1.**

**6.6.3.2. Sharp edges and burrs shall be removed from all components, including manufactured assemblies.**

**6.6.3.3. Internal machined UNC threads shall be class 2B, unless otherwise noted.**

**6.6.3.4. External machined UNC threads shall be class 2A, unless otherwise noted.**

**6.6.3.5. All machined thread surface finishes shall be 63 or better in accordance with ANSI B46.1. Burrs shall be removed from the threads.**

**6.6.4. Fabricated Components**

6.6.4.1. Thickness tolerances shall conform to the requirements of the referenced commercial standard applicable to the material being fabricated. When plate thickness is specified herein or in the detailed drawings, it shall be considered to mean minimum thickness.

**6.7. Equipment Data Package**

On completion of fabrication the Seller shall assemble an equipment data package, which consists of all quality verification documents including but not limited to:

- Welding qualifications verification reports.
- Major repair verification reports (as required).
- Cleaning and coating verification reports.
- Heat-treating reports.
- Material test reports.
- Material certificates of compliance.
- Liquid penetrant examination and verification reports.
- Pressure test reports – hydrostatic and leak tests.
- Visual weld inspection reports.
- Mechanical test reports – functional test.
- Load testing reports

The data package shall be in a three ring binder and include an index of the information contained within. Each pump shall have a separate data package assembled and identified as such. The data package shall be shipped with the applicable pump.

## 7. ATTACHMENT

### 7.1. Suggested Assembly ADS Feed Pump

1. Fabricate lower tube assembly (WTP-M-13505-4). NDE and document welds.
2. Check ease of insertion of  $\frac{3}{4}$ " feed pipe (WTP-M-13505-13) into socket on cover (WTP-M-13505-6).
3. Weld lower tube assembly to cover. See View H on WTP-M-13500, sheet 3. NDE and document weld.
4. Fabricate tube assembly (WTP-M-13505-3). NDE and document welds.
5. Insert tube assembly into lower tube assembly and ensure that  $\frac{3}{4}$ " feed pipe seats in socket on cover assembly. Rotate tube assembly such that, in plan view, the centerline of the  $\frac{1}{2}$ " vent pipe (WTP-M-13505-24) is centered between two bolt holes (any two) on the cover. Scribe a line on the cover between these two bolt holes. **Verify  $\frac{3}{4}$ " feed pipe is still seated in cover socket before welding.** Weld tube assembly to lower tube assembly. See View H on WTP-M-13500, sheet 3. NDE and document weld.

#### Hydrostatic Test

6. Cut a  $\frac{1}{8}$ " thick rubber disk gasket to 2  $\frac{7}{8}$ " ID x 4  $\frac{15}{16}$ " OD. Position on cover and transfer bolt hole pattern to gasket. Cut  $\frac{7}{16}$ " holes in gasket. Note: holes will cut through the outer edge of the gasket; this is ok.
7. Cut a 12 gauge thick stainless steel disk to 4  $\frac{1}{8}$ " OD.
8. Insert rubber gasket into recess in cover, followed by stainless steel disk. Install housing (WTP-M-13505-33) onto cover and bolt together using studs, lock washers, flat washers and nuts (WTP-M-13500-25, 26, 27 & 28). Uniformly torque in a cross pattern to 7 ft-lb. Note that poppet (WTP-M-13505-14) and screen (WTP-M-13505-10) do not need to be installed at this time.
9. Provide temporary supports for positioning the assembly on an angle with the  $\frac{3}{4}$ " and  $\frac{1}{2}$ " pipes as high as possible. The  $\frac{1}{2}$ " pipe should be on top. Fit the  $\frac{3}{4}$ " pipe for water inlet and  $\frac{1}{2}$ " pipe for air vent and pressure gauge.
10. Connect the pressure pump and fill with potable water through the  $\frac{3}{4}$ " pipe. Continue until all air escapes through the  $\frac{1}{2}$ " pipe.
11. Install a calibrated 0-250 psig pressure gauge to the  $\frac{1}{2}$ " pipe.

12. Raise the pressure slowly to 225 psig. Hold the test pressure for at least 10 minutes and view for any areas of deformation. After 10 minutes, visually examine all the pressure containing welds for leaks. (See reference 2.1.5) Note: leaks around the gasket/disk area are acceptable as long as the test pressure is maintained throughout the test duration.
13. Upon successful completion of the test (including retest after repairs, if applicable) document the test results, disassemble and drain the assembly.
14. Fabricate upper tube assembly (WTP-M-13505-31). NDE and document welds.
15. Weld upper tube assembly to lower tube assembly. See elevation view on WTP-M-13500, sheet 2. NDE and document weld.
16. Install nipple (WTP-M-13505-12) into recess in cover.
17. Install poppet (WTP-M-13505-14) into housing. Confirm a smooth sliding fit.
18. Attach rocker arm (WTP-M-13505-21) to housing (capturing poppet) using pivot pin (WTP-M-13505-22) and set screws (WTP-M-13500-19 and WTP-M-13500-15). Attach screen (WTP-M-13505-10) to housing using machine screws and flat washers (WTP-M-13500-23 & 24).
19. Orient housing with cover such that the free end of the rocker arm aligns with the scribe line between the bolt holes on the cover. Attach housing to cover with studs, lock washers, flat washers and nuts (WTP-M-13500-25, 26, 27 & 28).
20. Fabricate flange assembly (WTP-M-13505-1). NDE and document welds.
21. Attach flange assembly to upper tube assembly, sliding the ¼" and ½" pipes through their respective holes in the flange assembly. Seat flange on upper tube assembly. Note: the flange assembly will have to be shifted over about 1" to mate with the upper tube assembly. This will cause the ¼" and ½" pipes to bend slightly. This is ok. However, make sure not to twist the flange assembly relative to the pipes. See Section C-C on WTP-M-13500, sheet 3. TACK WELD ONLY flange assembly to upper tube assembly. (Full welding will be done after lift rod operation is verified).
22. Install bushing (WTP-M-13500-36) in flange assembly.
23. Assemble lift rod assembly (WTP-M-13505-36).
24. Install lift rod assembly through bushing in flange assembly. Slide lift rod guide assembly (WTP-M-13505-40) over lift rod assembly.
25. Attach lift rod assembly to rocker arm using lift rod pin (WTP-M-13505-23), flat washers (WTP-M-13500-20) and roll pin (WTP-M-13500-22).

**Functional Test**

26. Manually operate the lift rod assembly to check for smooth operation. There should be no binding. Binding will be eliminated with proper orientation of the flange assembly relative to the upper tube assembly.
27. Locate the lift rod guide assembly at the proper elevation and weld to upper tube assembly. NDE and document welds.
28. Weld flange assembly to upper tube assembly. Weld ¾" and ½" pipes to flange assembly. NDE and document welds.
29. Weld round pins to lift rod pin.
30. Attach the lift rod magnet target (WTP-M-13505-20) to the lift rod assembly.
31. Attach the actuator magnet targets (WTP-M-13505-15) to the flange assembly using the threaded studs (WTP-M-13500-11).
32. Attach the vent pipe boot (WTP-M-13505-19) and boot retainer (WTP-M-13505-17) to the flange assembly using the flat washers, lock washers and machine screws (WTP-M-13500-38, 29 & 33).
33. Fabricate the lift bail assembly (WTP-M-13505-5). NDE and document welds.
34. Attach lift bail assembly to flange assembly using shoulder screws, flat washers and nuts (WTP-M-13500-31, 34 & 39).
35. Fabricate the actuator assembly (WTP-M-13510-1).
36. Fabricate the vent valve assembly (WTP-M-13515-1).

**Leak Test**

37. Attach actuator assembly to magnets on flange assembly.
38. Provide for filling the lower chamber with potable water through the ½" pipe complete with a calibrated pressure gauge 0-60 psig and a valve to regulate pressure up to 40 psig.
39. Cap the ¾" pipe with a stainless steel cap.
40. Position the ADS pump assembly in the vertical position with room at the bottom for a five gallon bucket.

41. Pressurize the air cylinder on the actuator assembly with 35 psig air to push the lift rod into the "down" position (poppet valve in the down position) and pressurize the lower chamber with water to 40 psig.
42. Place the 5 gallon bucket under the pump assembly and begin timing for the leak test per section 6.4.5 of this specification.
43. Drain the test water and disconnect the test apparatus.
44. Attach couplings (WTP-M-13500-37 & 40) to ¼" and ½" pipes.
45. Install O-ring (WTP-M-13500-30) on flange assembly.
46. If leak test is acceptable, tack weld roll pin item (WTP-M-13500-22) to lift rod pin (WTP-M-13505-23).

**Hanford Facility RCRA Permit Modification Notification Forms**

**Part III, Operating Unit 15**

**331-C Storage Unit**

Index

Page 2 of 3: Hanford Facility RCRA Permit, III.15

Page 3 of 3: Addendum A, Part A Form, Section XIV, Line 50:

Submitted by Co-Operator:

Reviewed by RL Program Office:

*Alice K. Ikenberry*  
Alice K. Ikenberry

25 Aug 08  
Date

*Joe R. Franco*  
Joe R. Franco

9/27/08  
Date

<b>Hanford Facility RCRA Permit Modification Notification Form</b>														
Unit: <b>325 Hazardous Waste Treatment Units</b>	Permit Part <b>Part III, Operating Unit 5</b>													
<p><u>Description of Modification:</u>                      Hanford Facility RCRA Permit III.5:  <b>PART III, OPERATING UNIT 15 UNIT-SPECIFIC CONDITIONS</b>  <b>331-C Storage Unit</b></p> <p>The 331-C Storage Unit is a dangerous waste storage unit located in the 300 Area. The unit is used for the collection, consolidation, packaging, storage, and preparation for transport and disposal of dangerous waste. The waste stored at the 331-C Storage Unit consist of listed waste, waste from nonspecific sources, characteristic waste, and state-only waste derived from research activities and facility operations.</p> <p>This document sets forth the operating conditions for the 331-C Storage Unit.</p> <p><b>III.15.A COMPLIANCE WITH PERMIT CONDITIONS</b></p> <p>The Permittees shall comply with all requirements set forth in the Hanford Facility Dangerous Waste Permit including all approved modifications. All chapters, subsections, figures, tables, and appendices included in the following unit-specific Permit Conditions are enforceable in their entirety.</p> <p>In the event that the Part III-Unit-Specific Conditions for Operating Unit 15, 331-C Storage Unit conflict with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-specific conditions for Operating Unit 15, 331-C Storage Unit prevail.</p> <p><b><u>OPERATING UNIT 15:</u></b></p> <p><u>Addendum A Chapter 1.0</u> Part A Form, Revision 0A, dated <del>September 30, 2008</del> December 15, 2006</p> <p>Chapter 2.0 Unit Description, dated January 2007</p> <p>Chapter 3.0 Waste Analysis Plan, dated January 2007</p> <p>Chapter 4.0 Process Information, dated December 31, 2007</p> <p>Chapter 6.0 Procedures to Prevent Hazards dated December 31, 2007 (also refer to Permit Attachment 33, §6.1)</p> <p>Chapter 7.0 Contingency Plan, dated December 31, 2007</p> <p>Chapter 8.0 Training Plan, dated January 2007</p> <p>Chapter 11.0 Closure and Postclosure Requirements, dated January 2007</p> <p>Chapter 12.0 Reporting and Recordkeeping (refer to Permit Attachment 33, Table 12.1)</p> <p><b>III.15.B UNIT-SPECIFIC CONDITIONS 331-C STORAGE UNIT</b></p> <p>III.15.B.1 Portions of Permit Attachment 4, <i>Hanford Emergency Management Plan</i>, (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.</p>														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">WAC 173-303-830 Modification Class</td> <td style="width: 12.5%; padding: 2px;">Class 1</td> <td style="width: 12.5%; padding: 2px;">Class 1</td> <td style="width: 12.5%; padding: 2px;">Class 2</td> <td style="width: 12.5%; padding: 2px;">Class 3</td> </tr> <tr> <td style="padding: 2px;">Please mark the Modification Class:</td> <td style="text-align: center; padding: 2px;">X</td> <td></td> <td></td> <td></td> </tr> </table>					WAC 173-303-830 Modification Class	Class 1	Class 1	Class 2	Class 3	Please mark the Modification Class:	X			
WAC 173-303-830 Modification Class	Class 1	Class 1	Class 2	Class 3										
Please mark the Modification Class:	X													
<p>Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1.</p> <p>Enter wording of WAC 173-303-830, Appendix I Modification citation:                      A.1. General Permit Provisions, Administrative and informational changes</p>														
<p>Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)</p> <p><u>Reason for denial:</u></p>			<p>Reviewed by Ecology:</p> <p style="text-align: center;"><i>Greta P. Davis</i> 8-28-08</p>											
			<p style="text-align: center;">G. P Davis <span style="float: right;">Date</span></p>											

**Hanford Facility RCRA Permit Modification Notification Form**

Unit: <b>325 Hazardous Waste Treatment Units</b>	Permit Part <b>Part III, Operating Unit 5</b>
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Description of Modification:

Addendum A, Part A Form, Section XIV, Line 50:

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process	
				(1) Process Codes (enter)	(2) Process Description [if a code is not entered in D (1)]
50	F032	200	K	S01	Includes Debris

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.1. General Permit Provisions, Administrative and informational changes

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*Greta P. Davis* 8-28-08  
G. P Davis Date

---

**Hanford Facility RCRA Permit Modification**

**Part III, Operating Unit 15  
331-C Storage Unit**

---

**Remove and Replace the Following Section:**

- Permit Conditions dated December 31, 2007 with Permit Conditions dated September 30, 2008
- Chapter 1.0, dated January 2007 with Addendum A, dated September 30, 2008

1                                   **PART III, OPERATING UNIT 15 UNIT-SPECIFIC CONDITIONS**

2   **331-C Storage Unit**

---

3   The 331-C Storage Unit is a dangerous waste storage unit located in the 300 Area. The unit is used for  
4   the collection, consolidation, packaging, storage, and preparation for transport and disposal of dangerous  
5   waste. The waste stored at the 331-C Storage Unit consist of listed waste, waste from nonspecific  
6   sources, characteristic waste, and state-only waste derived from research activities and facility operations.

7   This document sets forth the operating conditions for the 331-C Storage Unit.

8   **III.15.A           COMPLIANCE WITH PERMIT CONDITIONS**

9   The Permittees shall comply with all requirements set forth in the Hanford Facility Dangerous Waste  
10  Permit including all approved modifications. All chapters, subsections, figures, tables, and appendices  
11  included in the following unit-specific Permit Conditions are enforceable in their entirety.

12  In the event that the Part III-Unit-Specific Conditions for Operating Unit 15, 331-C Storage Unit conflict  
13  with the Part I-Standard Conditions and/or Part II-General Facility Conditions of the Permit, the unit-  
14  specific conditions for Operating Unit 15, 331-C Storage Unit prevail.

15  **OPERATING UNIT 15:**

- 16  Addendum A   Part A Form, Revision 0A, dated September 30, 2008
- 17  Chapter 2.0    Unit Description, dated January 2007
- 18  Chapter 3.0    Waste Analysis Plan, dated January 2007
- 19  Chapter 4.0    Process Information, dated December 31, 2007
- 20  Chapter 6.0    Procedures to Prevent Hazards dated December 31, 2007 (also refer to Permit  
21                   Attachment 33, §6.1)
- 22  Chapter 7.0    Contingency Plan, dated December 31, 2007
- 23  Chapter 8.0    Training Plan, dated January 2007
- 24  Chapter 11.0   Closure and Postclosure Requirements, dated January 2007
- 25  Chapter 12.0   Reporting and Recordkeeping (refer to Permit Attachment 33, Table 12.1)

26  **III.15.B           UNIT-SPECIFIC CONDITIONS 331-C STORAGE UNIT**

27  III.15.B.1    Portions of Permit Attachment 4, *Hanford Emergency Management Plan*,  
28                   (DOE/RL-94-02) that are not made enforceable by inclusion in the applicability matrix  
29                   for that document are not made enforceable by reference in this document.

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1 **Addendum A** **Part A Form**

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2 1.0 PART A FORM .....1.1

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WASHINGTON STATE  
DEPARTMENT OF  
E C O L O G Y

**Dangerous Waste Permit Application  
Part A Form**

Date Received			Reviewed by:				Date:				
Month	Day	Year	Approved by:				Date:				

**I. This form is submitted to: (place an "X" in the appropriate box)**

Request modification to a final status permit (commonly called a "Part B" permit)

Request a change under Interim status

Apply for a final status permit. This includes the application for the initial final status permit for a site or for a permit renewal (i.e., a new permit to replace an expiring permit).

Establish interim status because of the wastes newly regulated on: \_\_\_\_\_ (Date) \_\_\_\_\_

List waste codes: \_\_\_\_\_

**II. EPA/State ID Number**

W	A	7	8	9	0	0	0	8	9	6	7
---	---	---	---	---	---	---	---	---	---	---	---

**III. Name of Facility**

US Department of Energy - Hanford Facility

**IV. Facility Location (Physical address not P.O. Box or Route Number)**

**A. Street**

825 Jadwin

<b>City or Town</b>	<b>State</b>	<b>ZIP Code</b>
Richland	WA	99352

<b>County Code (if known)</b>	<b>County Name</b>
0 0 5	Benton

<b>B. Land Type</b>	<b>C. Geographic Location</b>	<b>Longitude (degrees, mins, secs)</b>	<b>D. Facility Existence Date</b>
F	Latitude (degrees, mins, secs) Refer to TOPO Map (Section XV.)		Month Day Year 0 3 0 2 1 9 4 3

**V. Facility Mailing Address**

**Street or P.O. Box**

P.O. Box 550

<b>City or Town</b>	<b>State</b>	<b>ZIP Code</b>
Richland	WA	99352

<b>VI. Facility contact (Person to be contacted regarding waste activities at facility)</b>											
<b>Name (last)</b>						<b>(first)</b>					
Klein						Keith					
<b>Job Title</b>						<b>Phone Number (area code and number)</b>					
Manager						(509) 376-7395*					
<b>Contact Address</b>											
<b>Street or P.O. Box</b>											
P.O. Box 550											
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>			
Richland						WA		99352			
<b>VII. Facility Operator Information</b>											
<b>A. Name</b>						<b>Phone Number</b>					
Department of Energy* Owner/Operator						(509) 376-7395					
Pacific Northwest National Laboratory Co-Operator for 331-C Storage Unit*						(509) 376-1187*					
<b>Street or P.O. Box</b>											
P.O. Box 550											
P.O. Box 999*											
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>			
Richland						WA		99352			
<b>B. Operator Type</b>		F									
<b>C. Does the name in VII.A reflect a proposed change in operator?</b>						<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No			
If yes, provide the scheduled date for the change:						<b>Month</b>		<b>Day</b>		<b>Year</b>	
<b>D. Is the name listed in VII.A. also the owner? If yes, skip to Section VIII.C.</b>						<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No			
<b>VIII. Facility Owner Information</b>											
<b>A. Name</b>						<b>Phone Number (area code and number)</b>					
Keith A. Klein, Operator/Facility-Property Owner						(509) 376-7395					
<b>Street or P.O. Box</b>											
P.O. Box 550											
<b>City or Town</b>						<b>State</b>		<b>ZIP Code</b>			
Richland						WA		99352			
<b>B. Owner Type</b>		F									
<b>C. Does the name in VIII.A reflect a proposed change in owner?</b>						<input type="checkbox"/> Yes		<input checked="" type="checkbox"/> No			
If yes, provide the scheduled date for the change:						<b>Month</b>		<b>Day</b>		<b>Year</b>	
<b>IX. NAICS Codes (5/6 digit codes)</b>											
<b>A. First</b>						<b>B. Second</b>					
5	4	1	7	1		Research & Development in the Physical, Engineering, & Life Sciences					
<b>C. Third</b>						<b>D. Fourth</b>					

X. Other Environmental Permits (see instructions)													
A. Permit Type		B. Permit Number										C. Description	
E		A	I	R	0	2	-	1	2	0	2	WAC 246-247, Non radioactive Air, 40 CFR 61, Subpart H, NESHAPS	
E		D	E	9	8	N	W	P	-	0	0	3	WAC 173-400, General Regulations for Air Pollution Sources WAC 173-460, Controls for New Sources of Toxic Air Pollutants

**XI. Nature of Business (provide a brief description that includes both dangerous waste and non-dangerous waste areas and activities)**

Pacific Northwest National Laboratory (PNNL) is one of nine Department of Energy (DOE) multiprogram national laboratories and is managed by DOE's Office of Science (SC). PNNL program areas include fundamental science, environmental technology, computational and information sciences, national security, and energy science and technology along with the programs of the Environmental Molecular Sciences Laboratory.

The 331-C Storage Unit is a dangerous waste storage unit owned and operated by DOE's Richland Operations Office (RL) and co-operated by PNNL. The unit is used for the collection, consolidation, packaging, storage, and preparation for transport and disposal of dangerous waste. It is an integral part of PNNL's waste management system.

Dangerous waste is managed in segregated cells, cabinets, and other areas as described in the Part B permit application. The waste stored at the 331-C Storage Unit consists of listed waste, waste from nonspecific sources, characteristic waste, and state-only waste derived from research activities and facility operations.

**EXAMPLE FOR COMPLETING ITEMS XII and XIII (shown in lines numbered X-1, X-2, and X-3 below):** A facility has two storage tanks that hold 1200 gallons and 400 gallons respectively. There is also treatment in tanks at 20 gallons/hr. Finally, a one-quarter acre area that is two meters deep will undergo *in situ* vitrification.

Section XII. Process Codes and Design Capacities							Section XIII. Other Process Codes							
Line Number	A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	Line Number	A. Process Codes (enter code)			B. Process Design Capacity		C. Process Total Number of Units	D. Process Description
	1	2	3	1. Amount	2. Unit of Measure (enter code)			1	2	3	1. Amount	2. Unit of Measure (enter code)		
X 1	S	0	2	1,600	G	002	X 1	T	0	4	700	C	001	In situ vitrification
X 2	T	0	3	20	E	001								
X 3	T	0	4	700	C	001								
1	S	0	1	20,000	G	001	1							
2							2							
3							3							
4							4							
5							5							
6							6							
7							7							
8							8							
9							9							
1 0							1 0							
1 1							1 1							
1 2							1 2							
1 3							1 3							
1 4							1 4							
1 5							1 5							
1 6							1 6							
1 7							1 7							
1 8							1 8							
1 9							1 9							
2 0							2 0							
2 1							2 1							
2 2							2 2							
2 3							2 3							
2 4							2 4							
2 5							2 5							

**XIV. Description of Dangerous Wastes**

**Example for completing this section:** A facility will receive three non-listed wastes, then store and treat them on-site. Two wastes are corrosive only, with the facility receiving and storing the wastes in containers. There will be about 200 pounds per year of each of these two wastes, which will be neutralized in a tank. The other waste is corrosive and ignitable and will be neutralized then blended into hazardous waste fuel. There will be about 100 pounds per year of that waste, which will be received in bulk and put into tanks.

Line Number	A. Dangerous Waste No. (enter code)					B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Processes														
	(1) Process Codes (enter)										(2) Process Description [if a code is not entered in D (1)]											
X 1	D	0	0	2	400	P	S	0	1	T	0	1										
X 2	D	0	0	1	100	P	S	0	2	T	0	1										
X 3	D	0	0	2																		Included with above
	1	D	0	0	1	10,000	K	S	0	1												Includes Debris
	2	D	0	0	2	10,000	K	S	0	1												Includes Debris
	3	D	0	0	3	1000	K	S	0	1												Includes Debris
	4	D	0	0	4	1000	K	S	0	1												Includes Debris
	5	D	0	0	5	1000	K	S	0	1												Includes Debris
	6	D	0	0	6	1000	K	S	0	1												Includes Debris
	7	D	0	0	7	5,000	K	S	0	1												Includes Debris
	8	D	0	0	8	5,000	K	S	0	1												Includes Debris
	9	D	0	0	9	1000	K	S	0	1												Includes Debris
	1 0	D	0	1	0	1000	K	S	0	1												Includes Debris
	1 1	D	0	1	1	1000	K	S	0	1												Includes Debris
	1 2	D	0	1	2	220	K	S	0	1												Includes Debris
	1 3	D	0	1	3	220	K	S	0	1												Includes Debris
	1 4	D	0	1	4	220	K	S	0	1												Includes Debris
	1 5	D	0	1	5	220	K	S	0	1												Includes Debris
	1 6	D	0	1	6	220	K	S	0	1												Includes Debris
	1 7	D	0	1	7	220	K	S	0	1												Includes Debris
	1 8	D	0	1	8	2,000	K	S	0	1												Includes Debris
	1 9	D	0	1	9	2,000	K	S	0	1												Includes Debris
	2 0	D	0	2	0	220	K	S	0	1												Includes Debris
	2 1	D	0	2	1	220	K	S	0	1												Includes Debris
	2 2	D	0	2	2	2,000	K	S	0	1												Includes Debris
	2 3	D	0	2	3	2,000	K	S	0	1												Includes Debris
	2 4	D	0	2	4	2,000	K	S	0	1												Includes Debris
	2 5	D	0	2	5	2,000	K	S	0	1												Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
2 6	D 0 2 6	2,000	K	S	0	1						Includes Debris
2 7	D 0 2 7	220	K	S	0	1						Includes Debris
2 8	D 0 2 8	220	K	S	0	1						Includes Debris
2 9	D 0 2 9	220	K	S	0	1						Includes Debris
3 0	D 0 3 0	220	K	S	0	1						Includes Debris
3 1	D 0 3 1	220	K	S	0	1						Includes Debris
3 2	D 0 3 2	220	K	S	0	1						Includes Debris
3 3	D 0 3 3	220	K	S	0	1						Includes Debris
3 4	D 0 3 4	220	K	S	0	1						Includes Debris
3 5	D 0 3 5	2,000	K	S	0	1						Includes Debris
3 6	D 0 3 6	220	K	S	0	1						Includes Debris
3 7	D 0 3 7	2,000	K	S	0	1						Includes Debris
3 8	D 0 3 8	2,000	K	S	0	1						Includes Debris
3 9	D 0 3 9	2,000	K	S	0	1						Includes Debris
4 0	D 0 4 0	2,000	K	S	0	1						Includes Debris
4 1	D 0 4 1	220	K	S	0	1						Includes Debris
4 2	D 0 4 2	220	K	S	0	1						Includes Debris
4 3	D 0 4 3	2,000	K	S	0	1						Includes Debris
4 4	F 0 0 1	2,000	K	S	0	1						Includes Debris
4 5	F 0 0 2	2,000	K	S	0	1						Includes Debris
4 6	F 0 0 3	5,000	K	S	0	1						Includes Debris
4 7	F 0 0 4	1,000	K	S	0	1						Includes Debris
4 8	F 0 0 5	2,000	K	S	0	1						Includes Debris
4 9	F 0 2 7	200	K	S	0	1						Includes Debris
5 0	F 0 3 9	200	K	S	0	1						Includes Debris
5 1	P 0 0 1	200	K	S	0	1						Includes Debris
5 2	P 0 0 2	200	K	S	0	1						Includes Debris
5 3	P 0 0 3	200	K	S	0	1						Includes Debris
5 4	P 0 0 4	200	K	S	0	1						Includes Debris
5 5	P 0 0 5	200	K	S	0	1						Includes Debris
5 6	P 0 0 6	200	K	S	0	1						Includes Debris
5 7	P 0 0 7	200	K	S	0	1						Includes Debris
5 8	P 0 0 8	200	K	S	0	1						Includes Debris
5 9	P 0 0 9	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
6 0	P 0 1 0	200	K	S	0	1						Includes Debris
6 1	P 0 1 1	200	K	S	0	1						Includes Debris
6 2	P 0 1 2	200	K	S	0	1						Includes Debris
6 3	P 0 1 3	200	K	S	0	1						Includes Debris
6 4	P 0 1 4	200	K	S	0	1						Includes Debris
6 5	P 0 1 5	200	K	S	0	1						Includes Debris
6 6	P 0 1 6	200	K	S	0	1						Includes Debris
6 7	P 0 1 7	200	K	S	0	1						Includes Debris
6 8	P 0 1 8	200	K	S	0	1						Includes Debris
6 9	P 0 2 0	200	K	S	0	1						Includes Debris
7 0	P 0 2 1	200	K	S	0	1						Includes Debris
7 1	P 0 2 2	200	K	S	0	1						Includes Debris
7 2	P 0 2 3	200	K	S	0	1						Includes Debris
7 3	P 0 2 4	200	K	S	0	1						Includes Debris
7 4	P 0 2 6	200	K	S	0	1						Includes Debris
7 5	P 0 2 7	200	K	S	0	1						Includes Debris
7 6	P 0 2 8	200	K	S	0	1						Includes Debris
7 7	P 0 2 9	200	K	S	0	1						Includes Debris
7 8	P 0 3 0	200	K	S	0	1						Includes Debris
7 9	P 0 3 1	200	K	S	0	1						Includes Debris
8 0	P 0 3 3	200	K	S	0	1						Includes Debris
8 1	P 0 3 4	200	K	S	0	1						Includes Debris
8 2	P 0 3 6	200	K	S	0	1						Includes Debris
8 3	P 0 3 7	200	K	S	0	1						Includes Debris
8 4	P 0 3 8	200	K	S	0	1						Includes Debris
8 5	P 0 3 9	200	K	S	0	1						Includes Debris
8 6	P 0 4 0	200	K	S	0	1						Includes Debris
8 7	P 0 4 1	200	K	S	0	1						Includes Debris
8 8	P 0 4 2	200	K	S	0	1						Includes Debris
8 9	P 0 4 3	200	K	S	0	1						Includes Debris
9 0	P 0 4 4	200	K	S	0	1						Includes Debris
9 1	P 0 4 5	200	K	S	0	1						Includes Debris
9 2	P 0 4 6	200	K	S	0	1						Includes Debris
9 3	P 0 4 7	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
9 4	P 0 4 8	200	K	S	0	1						Includes Debris
9 5	P 0 4 9	200	K	S	0	1						Includes Debris
9 6	P 0 5 0	200	K	S	0	1						Includes Debris
9 7	P 0 5 1	200	K	S	0	1						Includes Debris
9 8	P 0 5 4	200	K	S	0	1						Includes Debris
9 9	P 0 5 6	200	K	S	0	1						Includes Debris
1 0 0	P 0 5 7	200	K	S	0	1						Includes Debris
1 0 1	P 0 5 8	200	K	S	0	1						Includes Debris
1 0 2	P 0 5 9	200	K	S	0	1						Includes Debris
1 0 3	P 0 6 0	200	K	S	0	1						Includes Debris
1 0 4	P 0 6 2	200	K	S	0	1						Includes Debris
1 0 5	P 0 6 3	200	K	S	0	1						Includes Debris
1 0 6	P 0 6 4	200	K	S	0	1						Includes Debris
1 0 7	P 0 6 5	200	K	S	0	1						Includes Debris
1 0 8	P 0 6 6	200	K	S	0	1						Includes Debris
1 0 9	P 0 6 7	200	K	S	0	1						Includes Debris
1 1 0	P 0 6 8	200	K	S	0	1						Includes Debris
1 1 1	P 0 6 9	200	K	S	0	1						Includes Debris
1 1 2	P 0 7 0	200	K	S	0	1						Includes Debris
1 1 3	P 0 7 1	200	K	S	0	1						Includes Debris
1 1 4	P 0 7 2	200	K	S	0	1						Includes Debris
1 1 5	P 0 7 3	200	K	S	0	1						Includes Debris
1 1 6	P 0 7 4	200	K	S	0	1						Includes Debris
1 1 7	P 0 7 5	200	K	S	0	1						Includes Debris
1 1 8	P 0 7 6	200	K	S	0	1						Includes Debris
1 1 9	P 0 7 7	200	K	S	0	1						Includes Debris
1 2 0	P 0 7 8	200	K	S	0	1						Includes Debris
1 2 1	P 0 8 1	200	K	S	0	1						Includes Debris
1 2 2	P 0 8 2	200	K	S	0	1						Includes Debris
1 2 3	P 0 8 4	200	K	S	0	1						Includes Debris
1 2 4	P 0 8 5	200	K	S	0	1						Includes Debris
1 2 5	P 0 8 7	200	K	S	0	1						Includes Debris
1 2 6	P 0 8 8	200	K	S	0	1						Includes Debris
1 2 7	P 0 8 9	200	K	S	0	1						Includes Debris



EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [if a code is not entered in D (1)]			
1 6 2	P 1 9 0	200	K	S	0	1						Includes Debris
1 6 3	P 1 9 1	200	K	S	0	1						Includes Debris
1 6 4	P 1 9 2	200	K	S	0	1						Includes Debris
1 6 5	P 1 9 4	200	K	S	0	1						Includes Debris
1 6 6	P 1 9 6	200	K	S	0	1						Includes Debris
1 6 7	P 1 9 7	200	K	S	0	1						Includes Debris
1 6 8	P 1 9 8	200	K	S	0	1						Includes Debris
1 6 9	P 1 9 9	200	K	S	0	1						Includes Debris
1 7 0	P 2 0 1	200	K	S	0	1						Includes Debris
1 7 1	P 2 0 2	200	K	S	0	1						Includes Debris
1 7 2	P 2 0 3	200	K	S	0	1						Includes Debris
1 7 3	P 2 0 4	200	K	S	0	1						Includes Debris
1 7 4	P 2 0 5	200	K	S	0	1						Includes Debris
1 7 5	U 0 0 1	200	K	S	0	1						Includes Debris
1 7 6	U 0 0 2	200	K	S	0	1						Includes Debris
1 7 7	U 0 0 3	200	K	S	0	1						Includes Debris
1 7 8	U 0 0 4	200	K	S	0	1						Includes Debris
1 7 9	U 0 0 5	200	K	S	0	1						Includes Debris
1 8 0	U 0 0 6	200	K	S	0	1						Includes Debris
1 8 1	U 0 0 7	200	K	S	0	1						Includes Debris
1 8 2	U 0 0 8	200	K	S	0	1						Includes Debris
1 8 3	U 0 0 9	200	K	S	0	1						Includes Debris
1 8 4	U 0 1 0	200	K	S	0	1						Includes Debris
1 8 5	U 0 1 1	200	K	S	0	1						Includes Debris
1 8 6	U 0 1 2	200	K	S	0	1						Includes Debris
1 8 7	U 0 1 4	200	K	S	0	1						Includes Debris
1 8 8	U 0 1 5	200	K	S	0	1						Includes Debris
1 8 9	U 0 1 6	200	K	S	0	1						Includes Debris
1 9 0	U 0 1 7	200	K	S	0	1						Includes Debris
1 9 1	U 0 1 8	200	K	S	0	1						Includes Debris
1 9 2	U 0 1 9	200	K	S	0	1						Includes Debris
1 9 3	U 0 2 0	200	K	S	0	1						Includes Debris
1 9 4	U 0 2 1	200	K	S	0	1						Includes Debris
1 9 5	U 0 2 2	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process									
				(1) Process Codes (enter)						(2) Process Description [If a code is not entered in D (1)]			
1 9 6	U 0 2 3	200	K	S	0	1							Includes Debris
1 9 7	U 0 2 4	200	K	S	0	1							Includes Debris
1 9 8	U 0 2 5	200	K	S	0	1							Includes Debris
1 9 9	U 0 2 6	200	K	S	0	1							Includes Debris
2 0 0	U 0 2 7	200	K	S	0	1							Includes Debris
2 0 1	U 0 2 8	200	K	S	0	1							Includes Debris
2 0 2	U 0 2 9	200	K	S	0	1							Includes Debris
2 0 3	U 0 3 0	200	K	S	0	1							Includes Debris
2 0 4	U 0 3 1	200	K	S	0	1							Includes Debris
2 0 5	U 0 3 2	200	K	S	0	1							Includes Debris
2 0 6	U 0 3 3	200	K	S	0	1							Includes Debris
2 0 7	U 0 3 4	200	K	S	0	1							Includes Debris
2 0 8	U 0 3 5	200	K	S	0	1							Includes Debris
2 0 9	U 0 3 6	200	K	S	0	1							Includes Debris
2 1 0	U 0 3 7	200	K	S	0	1							Includes Debris
2 1 1	U 0 3 8	200	K	S	0	1							Includes Debris
2 1 2	U 0 3 9	200	K	S	0	1							Includes Debris
2 1 3	U 0 4 1	200	K	S	0	1							Includes Debris
2 1 4	U 0 4 2	200	K	S	0	1							Includes Debris
2 1 5	U 0 4 3	200	K	S	0	1							Includes Debris
2 1 6	U 0 4 4	200	K	S	0	1							Includes Debris
2 1 7	U 0 4 5	200	K	S	0	1							Includes Debris
2 1 8	U 0 4 6	200	K	S	0	1							Includes Debris
2 1 9	U 0 4 7	200	K	S	0	1							Includes Debris
2 2 0	U 0 4 8	200	K	S	0	1							Includes Debris
2 2 1	U 0 4 9	200	K	S	0	1							Includes Debris
2 2 2	U 0 5 0	200	K	S	0	1							Includes Debris
2 2 3	U 0 5 1	200	K	S	0	1							Includes Debris
2 2 4	U 0 5 2	200	K	S	0	1							Includes Debris
2 2 5	U 0 5 3	200	K	S	0	1							Includes Debris
2 2 6	U 0 5 5	200	K	S	0	1							Includes Debris
2 2 7	U 0 5 6	200	K	S	0	1							Includes Debris
2 2 8	U 0 5 7	200	K	S	0	1							Includes Debris
2 2 9	U 0 5 8	200	K	S	0	1							Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
2 3 0	U 0 5 9	200	K	S	0	1						Includes Debris
2 3 1	U 0 6 0	200	K	S	0	1						Includes Debris
2 3 2	U 0 6 1	200	K	S	0	1						Includes Debris
2 3 3	U 0 6 2	200	K	S	0	1						Includes Debris
2 3 4	U 0 6 3	200	K	S	0	1						Includes Debris
2 3 5	U 0 6 4	200	K	S	0	1						Includes Debris
2 3 6	U 0 6 6	200	K	S	0	1						Includes Debris
2 3 7	U 0 6 7	200	K	S	0	1						Includes Debris
2 3 8	U 0 6 8	200	K	S	0	1						Includes Debris
2 3 9	U 0 6 9	200	K	S	0	1						Includes Debris
2 4 0	U 0 7 0	200	K	S	0	1						Includes Debris
2 4 1	U 0 7 1	200	K	S	0	1						Includes Debris
2 4 2	U 0 7 2	200	K	S	0	1						Includes Debris
2 4 3	U 0 7 3	200	K	S	0	1						Includes Debris
2 4 4	U 0 7 4	200	K	S	0	1						Includes Debris
2 4 5	U 0 7 6	200	K	S	0	1						Includes Debris
2 4 6	U 0 7 7	200	K	S	0	1						Includes Debris
2 4 7	U 0 7 8	200	K	S	0	1						Includes Debris
2 4 8	U 0 7 9	200	K	S	0	1						Includes Debris
2 4 9	U 0 8 0	200	K	S	0	1						Includes Debris
2 5 0	U 0 8 1	200	K	S	0	1						Includes Debris
2 5 1	U 0 8 2	200	K	S	0	1						Includes Debris
2 5 2	U 0 8 3	200	K	S	0	1						Includes Debris
2 5 3	U 0 8 4	200	K	S	0	1						Includes Debris
2 5 4	U 0 8 5	200	K	S	0	1						Includes Debris
2 5 5	U 0 8 6	200	K	S	0	1						Includes Debris
2 5 6	U 0 8 7	200	K	S	0	1						Includes Debris
2 5 7	U 0 8 8	200	K	S	0	1						Includes Debris
2 5 8	U 0 8 9	200	K	S	0	1						Includes Debris
2 5 9	U 0 9 0	200	K	S	0	1						Includes Debris
2 6 0	U 0 9 1	200	K	S	0	1						Includes Debris
2 6 1	U 0 9 2	200	K	S	0	1						Includes Debris
2 6 2	U 0 9 3	200	K	S	0	1						Includes Debris
2 6 3	U 0 9 4	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
2 6 4	U 0 9 5	200	K	S	0	1						Includes Debris
2 6 5	U 0 9 6	200	K	S	0	1						Storage-Container
2 6 6	U 0 9 7	200	K	S	0	1						Includes Debris
2 6 7	U 0 9 8	200	K	S	0	1						Includes Debris
2 6 8	U 0 9 9	200	K	S	0	1						Includes Debris
2 6 9	U 1 0 1	200	K	S	0	1						Includes Debris
2 7 0	U 1 0 2	200	K	S	0	1						Includes Debris
2 7 1	U 1 0 3	200	K	S	0	1						Includes Debris
2 7 2	U 1 0 5	200	K	S	0	1						Includes Debris
2 7 3	U 1 0 6	200	K	S	0	1						Includes Debris
2 7 4	U 1 0 7	200	K	S	0	1						Includes Debris
2 7 5	U 1 0 8	200	K	S	0	1						Includes Debris
2 7 6	U 1 0 9	200	K	S	0	1						Includes Debris
2 7 7	U 1 1 0	200	K	S	0	1						Includes Debris
2 7 8	U 1 1 1	200	K	S	0	1						Includes Debris
2 7 9	U 1 1 2	200	K	S	0	1						Includes Debris
2 8 0	U 1 1 3	200	K	S	0	1						Includes Debris
2 8 1	U 1 1 4	200	K	S	0	1						Includes Debris
2 8 2	U 1 1 5	200	K	S	0	1						Includes Debris
2 8 3	U 1 1 6	200	K	S	0	1						Includes Debris
2 8 4	U 1 1 7	200	K	S	0	1						Includes Debris
2 8 5	U 1 1 8	200	K	S	0	1						Includes Debris
2 8 6	U 1 1 9	200	K	S	0	1						Includes Debris
2 8 7	U 1 2 0	200	K	S	0	1						Includes Debris
2 8 8	U 1 2 1	200	K	S	0	1						Includes Debris
2 8 9	U 1 2 2	200	K	S	0	1						Includes Debris
2 9 0	U 1 2 3	200	K	S	0	1						Includes Debris
2 9 1	U 1 2 4	200	K	S	0	1						Includes Debris
2 9 2	U 1 2 5	200	K	S	0	1						Includes Debris
2 9 3	U 1 2 6	200	K	S	0	1						Includes Debris
2 9 4	U 1 2 7	200	K	S	0	1						Includes Debris
2 9 5	U 1 2 8	200	K	S	0	1						Includes Debris
2 9 6	U 1 2 9	200	K	S	0	1						Includes Debris
2 9 7	U 1 3 0	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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**Continuation of Section XIV. Description of Dangerous Waste**

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
2 9 8	U 1 3 1	200	K	S	0	1						Includes Debris
2 9 9	U 1 3 2	200	K	S	0	1						Includes Debris
3 0 0	U 1 3 3	200	K	S	0	1						Includes Debris
3 0 1	U 1 3 4	200	K	S	0	1						Includes Debris
3 0 2	U 1 3 5	200	K	S	0	1						Includes Debris
3 0 3	U 1 3 6	200	K	S	0	1						Includes Debris
3 0 4	U 1 3 7	200	K	S	0	1						Includes Debris
3 0 5	U 1 3 8	200	K	S	0	1						Includes Debris
3 0 6	U 1 4 0	200	K	S	0	1						Includes Debris
3 0 7	U 1 4 1	200	K	S	0	1						Includes Debris
3 0 8	U 1 4 2	200	K	S	0	1						Includes Debris
3 0 9	U 1 4 3	200	K	S	0	1						Includes Debris
3 1 0	U 1 4 4	200	K	S	0	1						Includes Debris
3 1 1	U 1 4 5	200	K	S	0	1						Includes Debris
3 1 2	U 1 4 6	200	K	S	0	1						Includes Debris
3 1 3	U 1 4 7	200	K	S	0	1						Includes Debris
3 1 4	U 1 4 8	200	K	S	0	1						Includes Debris
3 1 5	U 1 4 9	200	K	S	0	1						Includes Debris
3 1 6	U 1 5 0	200	K	S	0	1						Includes Debris
3 1 7	U 1 5 1	200	K	S	0	1						Includes Debris
3 1 8	U 1 5 2	200	K	S	0	1						Includes Debris
3 1 9	U 1 5 3	200	K	S	0	1						Includes Debris
3 2 0	U 1 5 4	200	K	S	0	1						Includes Debris
3 2 1	U 1 5 5	200	K	S	0	1						Includes Debris
3 2 2	U 1 5 6	200	K	S	0	1						Includes Debris
3 2 3	U 1 5 7	200	K	S	0	1						Includes Debris
3 2 4	U 1 5 8	200	K	S	0	1						Includes Debris
3 2 5	U 1 5 9	200	K	S	0	1						Includes Debris
3 2 6	U 1 6 0	200	K	S	0	1						Includes Debris
3 2 7	U 1 6 1	200	K	S	0	1						Includes Debris
3 2 8	U 1 6 2	200	K	S	0	1						Includes Debris
3 2 9	U 1 6 3	200	K	S	0	1						Includes Debris
3 3 0	U 1 6 4	200	K	S	0	1						Includes Debris
3 3 1	U 1 6 5	200	K	S	0	1						Includes Debris



EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
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Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)	B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
				(1) Process Codes (enter)					(2) Process Description [If a code is not entered in D (1)]			
3 6 6	U 2 0 4	200	K	S	0	1						Includes Debris
3 6 7	U 2 0 5	200	K	S	0	1						Includes Debris
3 6 8	U 2 0 6	200	K	S	0	1						Includes Debris
3 6 9	U 2 0 7	200	K	S	0	1						Includes Debris
3 7 0	U 2 0 8	200	K	S	0	1						Includes Debris
3 7 1	U 2 0 9	200	K	S	0	1						Includes Debris
3 7 2	U 2 1 0	200	K	S	0	1						Includes Debris
3 7 3	U 2 1 1	200	K	S	0	1						Includes Debris
3 7 4	U 2 1 3	200	K	S	0	1						Includes Debris
3 7 5	U 2 1 4	200	K	S	0	1						Includes Debris
3 7 6	U 2 1 5	200	K	S	0	1						Includes Debris
3 7 7	U 2 1 6	200	K	S	0	1						Includes Debris
3 7 8	U 2 1 7	200	K	S	0	1						Includes Debris
3 7 9	U 2 1 8	200	K	S	0	1						Includes Debris
3 8 0	U 2 1 9	200	K	S	0	1						Includes Debris
3 8 1	U 2 2 0	200	K	S	0	1						Includes Debris
3 8 2	U 2 2 1	200	K	S	0	1						Includes Debris
3 8 3	U 2 2 2	200	K	S	0	1						Includes Debris
3 8 4	U 2 2 3	200	K	S	0	1						Includes Debris
3 8 5	U 2 2 5	200	K	S	0	1						Includes Debris
3 8 6	U 2 2 6	200	K	S	0	1						Includes Debris
3 8 7	U 2 2 7	200	K	S	0	1						Includes Debris
3 8 8	U 2 2 8	200	K	S	0	1						Includes Debris
3 8 9	U 2 3 4	200	K	S	0	1						Includes Debris
3 9 0	U 2 3 5	200	K	S	0	1						Includes Debris
3 9 1	U 2 3 6	200	K	S	0	1						Includes Debris
3 9 2	U 2 3 7	200	K	S	0	1						Includes Debris
3 9 3	U 2 3 8	200	K	S	0	1						Includes Debris
3 9 4	U 2 3 9	200	K	S	0	1						Includes Debris
3 9 5	U 2 4 0	200	K	S	0	1						Includes Debris
3 9 6	U 2 4 3	200	K	S	0	1						Includes Debris
3 9 7	U 2 4 4	200	K	S	0	1						Includes Debris
3 9 8	U 2 4 6	200	K	S	0	1						Includes Debris
3 9 9	U 2 4 7	200	K	S	0	1						Includes Debris

EPA/State ID Number	W	A	7	8	9	0	0	0	8	9	6	7
---------------------	---	---	---	---	---	---	---	---	---	---	---	---

Continuation of Section XIV. Description of Dangerous Waste

Line Number	A. Dangerous Waste No. (enter code)			B. Estimated Annual Quantity of Waste	C. Unit of Measure (enter code)	D. Process								
						(1) Process Codes (enter)				(2) Process Description [If a code is not entered in D (1)]				
4 0 0	U	2	4 8	200	K	S	0	1						Includes Debris
4 0 1	U	2	4 9	200	K	S	0	1						Includes Debris
4 0 2	U	2	7 1	200	K	S	0	1						Includes Debris
4 0 3	U	2	7 8	200	K	S	0	1						Includes Debris
4 0 4	U	2	7 9	200	K	S	0	1						Includes Debris
4 0 5	U	2	8 0	200	K	S	0	1						Includes Debris
4 0 6	U	3	2 8	200	K	S	0	1						Includes Debris
4 0 7	U	3	5 3	200	K	S	0	1						Includes Debris
4 0 8	U	3	5 9	200	K	S	0	1						Includes Debris
4 0 9	U	3	6 4	200	K	S	0	1						Includes Debris
4 1 0	U	3	6 7	200	K	S	0	1						Includes Debris
4 1 1	U	3	7 2	200	K	S	0	1						Includes Debris
4 1 2	U	3	7 3	200	K	S	0	1						Includes Debris
4 1 3	U	3	8 7	200	K	S	0	1						Includes Debris
4 1 4	U	3	8 9	200	K	S	0	1						Includes Debris
4 1 5	U	3	9 4	200	K	S	0	1						Includes Debris
4 1 6	U	3	9 5	200	K	S	0	1						Includes Debris
4 1 7	U	4	0 4	200	K	S	0	1						Includes Debris
4 1 8	U	4	0 9	200	K	S	0	1						Includes Debris
4 1 9	U	4	1 0	200	K	S	0	1						Includes Debris
4 2 0	U	4	1 1	200	K	S	0	1						Includes Debris
4 2 1	W	P	C B	5,000	K	S	0	1						Includes Debris
4 2 2	W	P	0 1	2,000	K	S	0	1						Includes Debris
4 2 3	W	P	0 2	2,000	K	S	0	1						Includes Debris
4 2 4	W	P	0 3	500	K	S	0	1						Includes Debris
4 2 5	W	T	0 1	20,000	K	S	0	1						Includes Debris
4 2 6	W	T	0 2	20,000	K	S	0	1						Includes Debris
4 2 7	W	S	C 2	5,000	K	S	0	1						Includes Debris
4 2 8	K	0	1 3	200	K	S	0	1						Includes Debris
4 2 9	K	0	4 4	200	K	S	0	1						Includes Debris

**XV. Map**

Attach to this application a topographic map of the area extending to at least one (1) mile beyond property boundaries. The map must show the outline of the facility; the location of each of its existing and proposed intake and discharge structures; each of its dangerous waste treatment, storage, recycling, or disposal units; and each well where fluids are injected underground. Include all springs, rivers, and other surface water bodies in this map area, plus drinking water wells listed in public records or otherwise known to the applicant within ¼ mile of the facility property boundary. The instructions provide additional information on meeting these requirements.

Topographic map is located in the Ecology Library

**XVI. Facility Drawing**

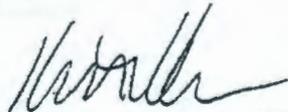
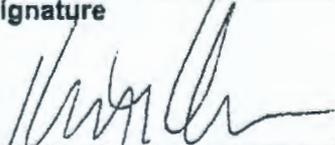
All existing facilities must include a scale drawing of the facility (refer to instructions for more detail).

**XVII. Photographs**

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment, recycling, and disposal areas; and sites of future storage, treatment, recycling, or disposal areas (refer to instructions for more detail).

**XVIII. Certifications**

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

<p><b>Operator</b> Name and Official Title (type or print) Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office</p>	<p><b>Signature</b> </p>	<p><b>Date Signed</b> 12/15/05</p>
<p><b>Co-Operator*</b> Name and Official Title (type or print) Roby D. Enge, Director Environment, Safety, Health and Quality Pacific Northwest National Laboratory</p>	<p><b>Signature</b> </p>	<p><b>Date Signed</b> 11/30/05</p>
<p><b>Co-Operator* – Address and Telephone Number</b> 3350 George Washington Way P.O. Box 999 Richland, WA 99352 (509) 376-1187</p>		
<p><b>Facility-Property Owner</b> Name and Official Title (type or print) Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office</p>	<p><b>Signature</b> </p>	<p><b>Date Signed</b> 12/15/05</p>

**Comments**

**331-C Storage Unit**

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**331-C Front**

**Photo Taken 2005**



**331-C East Side**

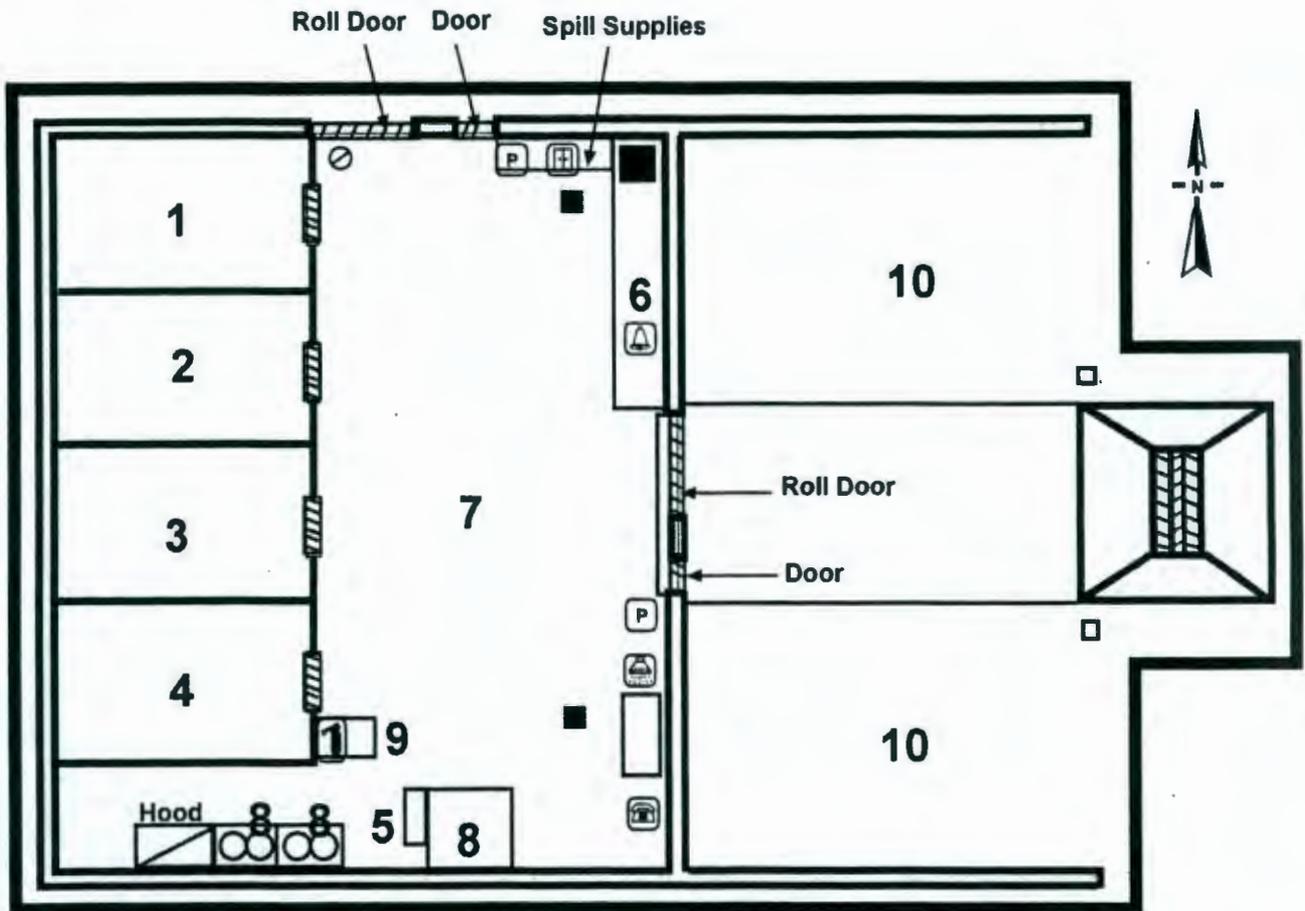
**Photo Taken 2005**



**331-C Inside**

**Photo Taken 2005**

331-C Storage Unit



Legend					
	Emergency Equipment Cabinet		Phone		Fire Alarm Pull Box
	Safety Shower/Eyewash		Fire Alarm Bell		10 Lb. ABC Fire Extinguisher
	Emergency Lights		Collection Sump		15 Lb. Or Larger Class D Fire Extinguisher
	HVAC Shutoff		TSD Boundary		

Legend

1. Acids, Oxidizers
2. Poisons, Class 9
3. Alkaline, WSDW, Organic Peroxides
4. Organics Flammable and Compressed Aerosols
5. Compressed gases
6. Universal/Recycling Storage Area
7. Class 9, WSDW, Non-flammable and Compatible Waste
8. Flammable Storage
9. Explosive Magazine
10. Outdoor Non-regulated Drum Storage



## 331-C Storage Unit

Prepared for:  
US DEPARTMENT OF ENERGY  
RICHLAND OPERATIONS OFFICE  
Created and Published by:  
Central Mapping Services  
Fluor Hanford, Richland, WA  
(509) 373-9076  
Intended Use: REFERENCE ONLY  
Topographic Data:  
1996, Bechtel Hanford, Inc.

### Hanford Site



Unit Location

- |                                 |               |
|---------------------------------|---------------|
| TSD Unit Boundary               | Buildings     |
| DOE Operating Areas             | Structures    |
| Hanford Facility                | Concrete      |
| Injection and Withdrawal Wells  | Major Roads   |
| Contours at 1 Meter Intervals   | Service Roads |
| Depression Contours             | Railroads     |
| SVMUs and Known Releases        | Fences        |
| Linear SVMUs and Known Releases |               |
| Spot SVMUs and Known Releases   |               |



**Hanford Facility RCRA Permit Modification Notification Forms**

**Part III, Operating Unit 16  
400 Area Waste Management Unit**

Index

Page 2 of 3: Hanford Facility RCRA Permit, III.16

Page 3 of 3: Addendum E, §E.4.3

Submitted by Co-Operator:

Steven Doebler

Steven V. Doebler

9/4/08

Date

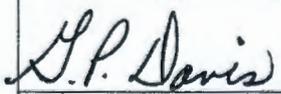
*MSM*

Reviewed by RL Program Office:

Matthew S. McCormick 9/11/08

Matthew S. McCormick

Date

<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>400 Area Waste Management Unit</b>	Permit Part <b>Part III, Operating Unit 16</b>			
<p><u>Description of Modification:</u>                      Hanford Facility RCRA Permit III.16:  <b>OPERATING UNIT GROUP 16 PERMIT CONDITIONS</b>  <b>400 Area Waste Management Unit</b></p>				
<u>UNIT DESCRIPTION</u>				
<p>The 400 Area Waste Management Unit (WMU) is located within the Fast Flux Test Facility (FFTF) Property Protected Area (PPA) in the 400 Area of the Hanford Facility. The 400 Area WMU consists of two container storage units as follows:</p> <ul style="list-style-type: none"> <li>• Fuel Storage Facility (FSF, Building 403). The FSF is a reinforced concrete substructure covered by a steel frame metal-sided high bay building. Building dimensions are 34 x 27 x 12 meters (112 x 90 x 40 feet). The container storage unit is the ground-level floor of the building. Two large steel boxes containing sodium-contaminated Core Component Pots (CCPs) are in storage in the FSF as of the effective date of this permit. While the FSF is physically capable of accommodating additional containers of mixed waste, any additional wastes that may be accepted for storage within the 400 Area WMU are anticipated to be placed in the Interim Storage Area.</li> <li>• Interim Storage Area, 4718 (ISA) (including Building 432A). The ISA consists of 156 x 247 meters (513 x 247 feet) totally fenced area with perimeter lighting that has been designated for above ground dry cask storage of spent fuel. A concrete pad located within the ISA, which measures 27 x 37 meters (90 x 120 feet), was used for dry cask storage, but will not necessarily be used for mixed waste management. The remainder of the ISA surface is gravel. The ISA is generally flat, but graded to drain in accordance with the general drainage plan for the FFTF PPA. One structure, is open on the east side, and is located on the west fence line of the ISA, but will not be used for mixed waste management.</li> </ul> <p>The location of each storage unit is shown on the scale map contained in Addendum A. The mixed waste stored in these two container storage units is limited exclusively to debris (e.g., piping, equipment, and components) contaminated with elemental sodium and sodium hydroxide (D002). This waste stream is designated as (D001, D003, and WSC2). Neither bulk metallic sodium nor bulk sodium hydroxide will be stored or otherwise managed in the FSF or the ISA.</p>				
<u>LIST OF ADDENDUMS</u>				
Addendum A Part A Form, dated May 2007 Addendum B Waste Analysis Plan, dated August 27, 2007 Addendum C Reserved Addendum D Reserved Addendum E Contingency Plan, dated <del>September 30, 2008</del> June 30, 2008 Addendum F Personnel Training, dated August 27, 2007 Addendum G Closure Plan, dated August 27, 2007 Addendum H Inspection Plan, dated August 27, 2007 ...				
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.1. General Permit Provisions, Administrative and informational changes				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) <u>Reason for denial:</u>			Reviewed by Ecology: 	
			 Date	G. P Davis Date

**Hanford Facility RCRA Permit Modification Notification Form**

Unit: <b>400 Area Waste Management Unit</b>	Permit Part <b>Part III, Operating Unit 16</b>
--	---

Description of Modification:

Addendum E, §E.4.3:

**E.4.3 Communications Equipment/Warning Systems**

COMMUNICATIONS EQUIPMENT		
TYPE	LOCATION	CAPABILITY
Alert tone HI-LOW TONE	Throughout the PPA	Informing facility personnel of forthcoming emergency announcements
Oxygen Monitor Alarm INTERMITTENT HIGH PITCHED HORN	Throughout FFTF and MASF in areas where oxygen deficiency is possible	Alarms when low level of oxygen is detected
PA System	Throughout PPA and parts of the 400 Area outside the PPA	Provides for information dissemination to facility personnel
Fire Alarm CONTINUOUSLY RINGING BELL OR ELECTRONIC GONG AND STROBE	Throughout 400 Area at or near building exits	Alerts personnel of a potential fire in their area
2-Way Radio/Cell Phone	At least one with personnel while in the TSD unit location	Notify personnel to summon emergency assistance
Radio and Fire Alarm Reporter Box	Inside building 484.	Notifies fire department of over or under pressure in the inert cover gas for building 403
<u>Argon pressure monitoring system</u>	<u>FTTF argon dewar pad</u>	<u>Notify personnel of over or under pressure in the inert cover gas for piping and components containing sodium residuals</u>

Note: Sitewide communications and warning systems are identified in Permit Attachment 4, *Hanford Emergency Management Plan* (DOE/RL-94-02), Table 5.1.

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.1. General Permit Provisions, Administrative and informational changes

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*G.P. Davis* 9-16-08

G. P Davis

Date

---

**Hanford Facility RCRA Permit Modification**

**Part III, Operating Unit 16  
400 Area Waste Management Unit**

---

**Remove and Replace the Following Sections:**

- Part III, Operating Unit 16, Unit-Specific Conditions dated June 30, 2008, replace with Unit-Specific Conditions dated September 30, 2008

**PART III OPERATING UNIT GROUP 16 PERMIT CONDITIONS**

**400 Area Waste Management Unit**

---

UNIT DESCRIPTION

The 400 Area Waste Management Unit (WMU) is located within the Fast Flux Test Facility (FFTF) Property Protected Area (PPA) in the 400 Area of the Hanford Facility. The 400 Area WMU consists of two container storage units as follows:

- Fuel Storage Facility (FSF, Building 403). The FSF is a reinforced concrete substructure covered by a steel frame metal-sided high bay building. Building dimensions are 34 x 27 x 12 meters (112 x 90 x 40 feet). The container storage unit is the ground-level floor of the building. Two large steel boxes containing sodium-contaminated Core Component Pots (CCPs) are in storage in the FSF as of the effective date of this permit. While the FSF is physically capable of accommodating additional containers of mixed waste, any additional wastes that may be accepted for storage within the 400 Area WMU are anticipated to be placed in the Interim Storage Area.
- Interim Storage Area, 4718 (ISA) (including Building 432A). The ISA consists of 156 x 247 meters (513 x 247 feet) totally fenced area with perimeter lighting that has been designated for above ground dry cask storage of spent fuel. A concrete pad located within the ISA, which measures 27 x 37 meters (90 x 120 feet), was used for dry cask storage, but will not necessarily be used for mixed waste management. The remainder of the ISA surface is gravel. The ISA is generally flat, but graded to drain in accordance with the general drainage plan for the FFTF PPA. One structure, is open on the east side, and is located on the west fence line of the ISA, but will not be used for mixed waste management.

The location of each storage unit is shown on the scale map contained in Addendum A. The mixed waste stored in these two container storage units is limited exclusively to debris (e.g., piping, equipment, and components) contaminated with elemental sodium and sodium hydroxide (D002). This waste stream is designated as (D001, D003, and WSC2). Neither bulk metallic sodium nor bulk sodium hydroxide will be stored or otherwise managed in the FSF or the ISA.

LIST OF ADDENDUMS

- Addendum A Part A Form, dated May 2007
- Addendum B Waste Analysis Plan, dated August 27, 2007
- Addendum C Reserved
- Addendum D Reserved
- Addendum E Contingency Plan, dated September 30, 2008
- Addendum F Personnel Training, dated August 27, 2007
- Addendum G Closure Plan, dated August 27, 2007
- Addendum H Inspection Plan, dated August 27, 2007

DEFINITIONS

Reserved

ACRONYMS

The following acronyms are specific to Part III Chapter 16 of this permit:

- CCPs Core Component Pots
- FFTF Fast Flux Test Facility
- FSF Fuel Storage Facility
- ISA Interim Storage Area
- PPA Property Protected Area
- WMU Waste Management Unit

- 1 III.16.A COMPLIANCE WITH PERMIT CONDITIONS
- 2 The Permittees are authorized to accept and store mixed waste in the 400 Area WMU  
3 container storage units, the FSF and the ISA. These dangerous waste management units  
4 and corresponding waste management activities will be subject to conditions in this  
5 Chapter, its addendums, and the applicable requirements in Parts I and II.
- 6 III.16.B GENERAL WASTE MANAGEMENT STANDARDS
- 7 III.16.B.1 General Waste Management
- 8 The Permittees may accept for storage in the 400 Area WMU ISA only those mixed  
9 wastes that are identified in Addendum A.
- 10 III.16.B.2 Waste Analysis Plan
- 11 III.16.B.2.a The Permittees will maintain an accurate and complete knowledge for the waste stream  
12 identified in permit condition III.16.B.1. An electronic or hard copy of this information  
13 must be available to personnel at the 400 Area Waste Management Unit at all times  
14 wastes are being received or managed.
- 15 III.16.B.2.b The Permittees will maintain appropriate administrative controls and work practices to  
16 ensure that only wastes specified in Permit Condition III.16.B.1 are received by the ISA  
17 for storage, and that no commingling or cross-contamination of the waste stream  
18 specified in Permit Condition III.16.B.1 with any other waste stream may occur.
- 19 III.16.B.2.c Upon receipt of a waste shipment at the ISA in accordance with Addendum B, the  
20 Permittees will verify that the corresponding wastes match the specification of wastes  
21 acceptable for storage at the ISA in Permit Condition III.16.B.1 through process  
22 knowledge and records review. The Permittee will place documentation of the results of  
23 this verification and the identity of all wastes accepted for management in the 400 Area  
24 WMU portion of the Hanford Facility operating record required by Permit Condition II.I.
- 25 III.16.B.3 Recordkeeping and Reporting
- 26 III.16.B.3.a The Permittees will comply with the recordkeeping requirements in  
27 WAC 173-303-380(1)(o), incorporated by reference.
- 28 III.16.B.4 Preparedness and Prevention
- 29 III.16.B.4.a The Permittees will post warning signs stating "DANGER—UNAUTHORIZED  
30 PERSONNEL KEEP OUT" or an equivalent legend will be posted at entrances to the  
31 FSF and the ISA. These signs are, or will be, written in English, legible from a distance  
32 of 7.6 meters, and visible from any approach.
- 33 III.16.B.4.b The Permittees will comply with the requirements of WAC 173-303-395(1), (2), and (6),  
34 incorporated by reference.
- 35 III.16.B.5 Inspections
- 36 III.16.B.5.a The Permittees will perform inspections of the 400 Area WMU, FSF and the ISA  
37 according to the inspection plan in Addendum H. The Permittee will remedy any  
38 deterioration or malfunction discovered by an inspection as required by  
39 WAC 173-202-320(3), incorporated by reference.

- 1 III.16.B.5.b The Permittees will place inspection records in the 400 Area WMU portion of the  
2 Hanford Facility operating record required by Permit Condition II.I. These records will  
3 contain the following information:
- 4 1. Date and time of inspection
  - 5 2. Printed name and the handwritten signature of the inspector
  - 6 3. Notation of the observations made
  - 7 4. Date and nature of any repairs or remedial actions taken, or the scheduled date for  
8 such repairs or remedial actions
- 9 III.16.B.6 Contingency Plan
- 10 The Permittees will comply with the 400 Area WMU Contingency Plan in Addendum E  
11 to this Chapter in addition to the requirements of Permit Condition II.A.
- 12 III.16.B.7 Training Plan
- 13 III.16.B.7.a The Permittees will comply with the training requirements in Addendum F to this  
14 Chapter in addition to the requirements of Permit Condition II.C.
- 15 III.16.B.8 Closure
- 16 III.16.B.8.a The Permittees will close the 400 Area WMU Container Storage Units in accordance  
17 with the Closure Plan in Addendum G.
- 18 III.16.B.8.b The Permittees will amend the Closure Plan in accordance with Permit Condition II.J.3  
19 and the Closure Plan in Addendum G.
- 20 III.16.B.8.c The Permittees will provide Ecology with a Notice of Closure according to  
21 WAC 173-303-610(3)(c).
- 22 III.16.B.9 Land Disposal Restriction Requirements
- 23 The Permittees will ensure a schedule of compliance and any applicable associated work  
24 requirements are included in the land disposal restrictions report required by the  
25 HFFACO Milestone M-26, incorporated by reference by permit condition II.S for  
26 treatment and/or acquisition of treatment capacity for wastes which are or are expected to  
27 be stored in the 400 Area WMU container storage units.
- 28 III.16.C CONTAINERS
- 29 III.16.C.1 Container Dangerous Waste Management Unit Configuration and Waste Management  
30 Capacity
- 31 III.16.C.1.a The Permittees will maintain the physical configuration of the FSF and the ISA according  
32 to the Unit Description above.
- 33 III.16.C.1.b The Permittees are authorized to store CCPs generated prior to the effective date of this  
34 permit in two large metal boxes in the 400 Area WMU FSF.
- 35 III.16.C.1.c The Permittees are authorized store mixed waste in the ISA up to a maximum capacity of  
36 19,000 gallons.
- 37 III.16.C.2 Identification of Containers and Container Management Practice
- 38 III.16.C.2.a The Permittees will ensure that all containers remain in good condition. If a container  
39 holding mixed waste is not in good condition (e.g., severe rusting or corrosion, or  
40 apparent structural defects), or if it begins to leak, the Permittee must transfer the waste  
41 from the container to a container that is in good condition or place the leaking container  
42 in an appropriate over-pack container. [WAC 173-303-630(2)]

- 1 III.16.C.2.b The Permittees will label containers in accordance with the requirements of  
2 WAC 173-303-630(3), incorporated by reference.
- 3 III.16.C.2.c The Permittees shall ensure that all containers are constructed of carbon steel or stainless  
4 steel, or other materials compatible with metallic sodium and sodium hydroxide.  
5 [WAC 173-303-630(4)]
- 6 III.16.C.2.d The Permittees will manage waste in containers according to the requirements of  
7 WAC 173-303-630(5), incorporated by reference.
- 8 III.16.C.2.e All containers must be stored in accordance with WAC 173-303-630(8)(b), incorporated  
9 by reference.
- 10 III.16.C.2.f The Permittees must remove spilled or leaked waste within secondary containment  
11 pursuant to WAC 173-303-630(7)(a)(ii), incorporated by reference.
- 12 III.16.C.2.g The Permittees will store waste in the 400 Area WMU container storage units according  
13 to the requirements of WAC 173-303-640(8)(b), incorporated by reference.  
14 [WAC 173-303-640(8)]
- 15 III.16.C.3 Requirements for the Fuel Storage Facility
- 16 III.16.C.3.a The Permittee will maintain an inert gas (argon or nitrogen) cover within each large metal  
17 box to prevent contact of the metallic sodium with the water vapor in the air and the  
18 formation of free liquids.
- 19 III.16.C.3.b The Permittees will place large boxes stored in the FSF in drip pans to ensure a base free  
20 of cracks or gaps, and ensure that the large boxes are elevated or otherwise protected  
21 from contact with accumulated liquids.
- 22 III.16.C.4 Requirements for the Interim Storage Area
- 23 III.16.C.4.a The Permittee may store wastes in the ISA in standard metal containers (e.g., 208-liter  
24 drums), large metal boxes fabricated to accommodate the size and shape of a particular  
25 component or debris, or unique components removed from FFTF that when closed in  
26 accordance with WAC 173-303-630(5)(a) serve as a primary container.
- 27 III.16.C.4.b Unique containers stored in the ISA must be placed on drip pans; or if containing free  
28 liquids, within secondary containment having sufficient capacity to contain ten percent of  
29 the volume of all containers within the same secondary containment area or the largest  
30 container, whichever is greater. [WAC 173-303-630(7)]
- 31 III.16.C.4.c The Permittees will store standard metal containers in the ISA within container storage  
32 modules specifically configured for storage of reactive, ignitable, and corrosive waste,  
33 and that protect containers from precipitation and run-on. Container storage modules  
34 may be placed on gravel within the ISA, and must be properly anchored to prevent  
35 displacement or overturning.
- 36 III.16.C.4.d The Permittees will manage unique components stored in the ISA on the gravel surface  
37 with sufficient open space between components and between components and the fence  
38 line to accommodate inspections and movement of equipment.
- 39 III.16.C.4.e The Permittees will not place wastes in the open-sided structure within the ISA identified  
40 in the Unit Description.

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**Hanford Facility RCRA Permit Modification Notification Forms**

**Part V, Closure Unit 10**

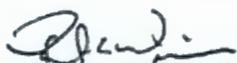
**224-T Transuranic Waste Storage and Assay Facility**

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- Page 6 of 10: Closure Plan, §2.0, §2.1, §2.2, and §2.3
- Page 7 of 10: Closure Plan, §3.0
- Page 8 of 10: Closure Plan, §3.2, §3.2.1, §3.2.2, §3.2.3, and §3.2.4
- Page 9 of 10: Closure Plan, §3.3
- Page 10 of 10: Closure Plan, §3.5

Submitted by Co-Operator:

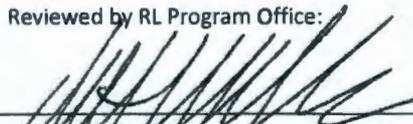


Robert E. Wilkinson

8/12/08

Date

Reviewed by RL Program Office:



Matthew S. McCormick

8/25/08

Date

Hanford Facility RCRA Permit Modification Notification Form				
Unit: <b>224-T TRUSAF</b>	Permit Part <b>Part V, Closure Unit 10</b>			
<p><u>Description of Modification:</u> Hanford Facility RCRA Permit V.10</p> <p style="text-align: center;"><b>PART V, CLOSURE UNIT 10 PERMIT CONDITIONS</b> <b>224-T Transuranic Waste Storage and Assay Facility</b></p> <p>The 224-T Transuranic Waste Storage and Assay Facility (224-T TRUSAF) treatment, storage, and/or disposal unit is part of the 224-T Plutonium Concentration Facility. The 224-T Plutonium Concentration Facility is adjacent to T Plant in the 200 West Area. The 224-T TRUSAF stored transuranic waste, transuranic mixed waste, mixed waste, and other properly characterized and packaged low-level waste. Dangerous wastes were removed from 224-T TRUSAF and the unit is no longer being operated as a TSD unit.</p> <p><b>V.10.A. COMPLIANCE WITH APPROVED CLOSURE PLAN</b></p> <p>The Permittees will comply with all requirements set forth in Hanford Facility Dangerous Waste Permit, as specified in Permit Attachment 3, Permit Applicability Matrix and the unit-specific conditions identified below for the 224-T Transuranic Waste Storage and Assay Facility</p> <p><b><u>CLOSURE UNIT 10</u></b></p> <p>Part A Form, Revision 7, dated July 2007</p> <p>Closure Plan, dated <del>August 2007</del> <u>September 30, 2008</u></p>				
WAC 173-303-830 Modification Class	Class 1	Class '1	Class 2	Class 3
Please mark the Modification Class:	X			
<p>Enter relevant WAC 173-303-830, Appendix I Modification citation number: A.1.</p> <p>Enter wording of WAC 173-303-830, Appendix I Modification citation:</p> <p>A.1. General Permit Provisions, Administrative and informational changes</p>				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) Reason for denial:	Reviewed by Ecology: <i>Greta P. Davis</i> Date: <u>8-6-08</u>			
	G. P Davis		Date	

<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>224-T TRUSAF</b>	Permit Part <b>Part V, Closure Unit 10</b>			
<p><u>Description of Modification:</u> Closure Plan, §1.0:</p> <p><b>1.0 FACILITY DESCRIPTION</b></p> <p>The 224-T Transuranic Waste Storage and Assay Facility (224-T TRUSAF) treatment, storage, and/or disposal unit is part of the 224-T Plutonium Concentration Facility. The 224-T Plutonium Concentration Facility is adjacent to T Plant in the 200 West Area. The 224-T TRUSAF stored transuranic waste, transuranic mixed waste, mixed waste, and other properly characterized and packaged low-level waste. Dangerous wastes were removed from 224-T TRUSAF and the unit is no longer being operated as a TSD unit. Because dangerous waste does not include the source, special nuclear, and by-product material components of mixed waste, radionuclides are not within the scope of this documentation. The information on radionuclides is provided only for general knowledge.</p> <p><u>This closure plan achieves clean closure of the 224-T TRUSAF TSD unit. The future 224-T Plutonium Concentration Facility remediation, which will include the clean closed 224-T TRUSAF TSD unit, will be conducted as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) removal action. The response action will be conducted as described in the joint Department of Energy/U.S. Environmental Protection Agency (EPA) policy, <i>Policy on Decommissioning Department of Energy Facilities under CERCLA</i>, for decommissioning surplus DOE facilities consistent with the requirements of the CERCLA.</u></p>				
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: WAC 173-303-830-(4)(d) Other modifications				
Enter wording of WAC 173-303-830, Appendix I Modification citation:				
Request reviewed and approved as a Class <sup>1</sup> 1 modification				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)	Reviewed by Ecology:  Date: 8-6-08			
Reason for denial:	G. P Davis <span style="float: right;">Date</span>			

<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>224-T TRUSAF</b>	Permit Part <b>Part V, Closure Unit 10</b>			
<p><u>Description of Modification:</u>  <b>Closure Plan, §1.1:</b></p> <p><b>1.1 FACILITY OPERATIONS</b></p> <p>On receipt of the transuranic mixed waste or mixed waste, the 224-T TRUSAF operations personnel performed an inspection (exterior only) of the waste container(s) and associated documentation, a neutron assay of the waste container to determine fissile isotope content, and/or an examination with a real-time radiography system to confirm the absence of prohibited items (e.g., free liquids). If the waste container(s) and accompanying documentation were acceptable, the 224-T TRUSAF operations personnel stored the waste.</p> <p>The 224-T Plutonium Concentration Facility, constructed in the early 1940's entirely of reinforced concrete, was used as a chemical processing unit for purifying liquid plutonium nitrate by the lanthanum fluoride process. The 224-T Plutonium Concentration Facility remained idle for several years after new processes made the lanthanum fluoride process obsolete. In 1975, the mission of the 224-T Plutonium Concentration Facility changed to that of storing plutonium solutions and solid plutonium scrap. To meet the requirements for this new mission and the criteria for storing plutonium, the 224-T Plutonium Concentration Facility underwent major structural upgrades and modifications. The modifications included reinforcing the facility for tornado and seismic loads and sealing off the areas previously used for chemical separations from personnel entry. The three floors of the building contain six radiologically contaminated process cells, which were sealed from the rest of the building in 1975. The six process cells (cells A through F) are not included in this closure plan documentation. In 1985, the storage of transuranic waste, transuranic mixed waste, mixed waste, and low-level waste commenced, and the portion of the 224-T Plutonium Concentration Facility being operated was redesignated as the 224-T TRUSAF. This closure plan documentation covers only the RCRA regulated portion of the 224-T Plutonium Concentration Facility referred to as 224-T TRUSAF. The entire building will be remediated as a decontamination and decommissioning activity as part of a CERCLA removal action.</p> <p>The configuration of 224-T TRUSAF, which is approximately 60 meters long by 18.3 meters wide, allowed for approximately 1,068 square meters of storage space.</p> <p>The three floors of the 224-T TRUSAF are connected by stairway A at the north end of the building, by stairway B at the south end of the building, and by an elevator adjacent to stairway A. There also is a concrete elevator loading deck off the elevator on the outside of the building. The roof contains the ventilation exhaust equipment and a penthouse. The penthouse contains the elevator mechanical equipment.</p> <p>The first floor contained storage modules, and includes a restroom, an administration office, a heating and ventilation mechanical room, an elevator, a transuranic waste assayer room, and a real-time radiography. The storage modules on the first floor were in open areas and were marked with tape or paint on the floor. <del>The second and third floors also contained open storage modules marked on the floor with tape or paint.</del> The floors of the 224-T TRUSAF were sealed with an epoxy sealant to meet secondary containment requirements. The fire protection system consisted of a dry-pipe fire system. Each floor had emergency exits and fire alarm pull boxes.</p> <p>The 224-T TRUSAF consisted of the following areas:</p> <ul style="list-style-type: none"> <li>• Administration office</li> <li>• Real-time radiography room</li> <li>• Transuranic waste assayer room</li> <li>• Assay control room and storage unit operations office</li> <li>• Elevator and stairways</li> <li>• Heating and ventilation mechanical room</li> <li>• Waste storage and holding areas</li> <li>• Incoming waste receiving area</li> <li>• Storage modules                         <ul style="list-style-type: none"> <li>○ Acids</li> <li>○ Caustics</li> <li>○ Mixed waste</li> <li>○ Nonhazardous</li> </ul> </li> </ul>				
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: WAC 173-303-830-(4)(d) Other modifications				
Enter wording of WAC 173-303-830, Appendix I Modification citation:				
Request reviewed and approved as a Class 1 modification				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)	Reviewed by Ecology:			
<u>Reason for denial:</u>				
	G. P Davis		Date	

**Hanford Facility RCRA Permit Modification Notification Form**

Unit:  
**224-T TRUSAF**

Permit Part  
**Part V, Closure Unit 10**

Description of Modification:

Closure Plan, §1.2:

**1.2 SECURITY INFORMATION**

Security information for the Hanford Facility is discussed in Permit Attachment 33, §6.1 Security.

The 224-T TRUSAF is posted with signs stating *DANGER-UNAUTHORIZED PERSONNEL KEEP OUT* or an equivalent legend, in black and red letters on a white background. These signs are in English, legible from a distance of 7.6 meters, and visible from all angles of approach. ~~In addition to these signs, the fences around the 200 West Area are posted with signs, printed in English, warning against unauthorized entry. The signs also are visible from all angles of approach. The 224 T TRUSAF also has its own perimeter fencing that remains locked during nonroutine working hours. The perimeter fence has postings to keep unauthorized personnel out, in addition to an access control point trailer (MO 289) within the fenced area.~~

WAC 173-303-830 Modification Class

Please mark the Modification Class:

Class 1	Class <sup>1</sup> 1	Class 2	Class 3
	X		

Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830-(4)(d) Other modifications

Enter wording of WAC 173-303-830, Appendix I Modification citation:

Request reviewed and approved as a Class <sup>1</sup>1 modification

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*Greta P. Davis 8-6-08*

G. P Davis

Date

**Hanford Facility RCRA Permit Modification Notification Form**

Unit:  
**224-T TRUSAF**

Permit Part  
**Part V, Closure Unit 10**

Description of Modification:

Closure Plan, §2.0, §2.1, §2.2, and §2.3:

**2.0 CLOSURE STRATEGY AND PERFORMANCE STANDARDS**

The 224-T TRUSAF was a clean and well-maintained TSD unit and will be clean closed. Therefore, post closure activities are not anticipated. Closure of the 224-T TRUSAF will be accomplished by documenting in this closure plan that the current condition of the 224-T TRUSAF floors and structures meet the clean debris surface standard in 40 CFR 268.45, Table 1 incorporated by reference at WAC 173-303-140.

Clean debris surface means the surface, when viewed without magnification, shall be free of all visible contaminated soil and hazardous waste except that 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 percent of each square inch of surface area.

integrating the closure activities with the proposed CERCLA removal action for the entire 224 T Plutonium Concentration Facility. Because the entire building will be disposed of in the Environmental Restoration Disposal Facility (ERDF), s Based on a site visit consisting of representatives from Ecology, DOE, and Fluor Hanford on June 25, 2008, the visit concluded that the floor meets the clean debris surface standard, and further actions ampling activities will not be necessary to achieve clean closure.

**2.1 MINIMIZE THE NEED FOR FURTHER MAINTENANCE**

Closure of the 224-T TRUSAF by the eventual disposal of the building decontamination and decommissioning materials in ERDF will minimize the need for further maintenance specific to the 244-T TRUSAF.

**2.2 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT**

The 224-T TRUSAF will be clean closed by the approval of this closure plan eventual disposal of the building into ERDF, which will provides for protection for human health and the environment.

**2.3 RETURN LAND TO THE APPEARANCE AND USE OF SURROUNDINGS**

Future land use determinations will be made following clean closure of the 224 T TRUSAF and disposition of the entire 224-T Plutonium Concentration Facility and the decision will be deferred to after the CERCLA removal action. The current proposal for the 224 T Plutonium Concentration Facility is a 'slab on grade', which consists of the following primary elements:

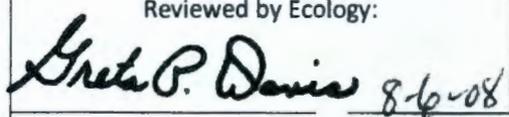
- ~~Remove the nonradiological and radiological hazardous substances from the facility~~
- ~~Remove equipment and associated piping~~
- ~~Decontaminate/stabilize contamination~~
- ~~Demolish structure to grade~~
- ~~Dispose of waste generated during these operations~~
- ~~Stabilize the area~~

WAC 173-303-830 Modification Class	Class 1	Class <sup>1</sup> 1	Class 2	Class 3
Please mark the Modification Class:		X		

Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830-(4)(d) Other modifications  
 Enter wording of WAC 173-303-830, Appendix I Modification citation:  
 Request reviewed and approved as a Class <sup>1</sup>1 modification

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:  
  
 G. P Davis Date

<b>Hanford Facility RCRA Permit Modification Notification Form</b>														
Unit: <b>224-T TRUSAF</b>	Permit Part <b>Part V, Closure Unit 10</b>													
<p><u>Description of Modification:</u>                      Closure Plan, §3.0:</p> <p><b>3.0 CLOSURE APPROACH ACTIVITIES</b></p> <p>The strategy for closure of the 224-T TRUSAF is clean closure. The waste inventory has been relocated to the Central Waste Complex or to another permitted TSD unit. Based on the clean nature of the 224-T TRUSAF and the proposed CERCLA removal action for the entire 224-T Plutonium Concentration Facility of decontamination and decommissioning with the material being disposed of in ERDF, sampling will not be performed. Certification of clean closure by an independent registered professional engineer will document demonstrate that 224-T TRUSAF was clean closed <del>ure</del> according to the specifications in this closure plan. This closure plan documents that the 224-T TRUSAF meets the clean debris surface closure performance standards <del>have been met</del>.</p>														
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">WAC 173-303-830 Modification Class</td> <td style="width: 10%; padding: 2px;">Class 1</td> <td style="width: 10%; padding: 2px;">Class <sup>1</sup>1</td> <td style="width: 10%; padding: 2px;">Class 2</td> <td style="width: 10%; padding: 2px;">Class 3</td> </tr> <tr> <td style="padding: 2px;">Please mark the Modification Class:</td> <td></td> <td style="text-align: center;">X</td> <td></td> <td></td> </tr> </table>					WAC 173-303-830 Modification Class	Class 1	Class <sup>1</sup> 1	Class 2	Class 3	Please mark the Modification Class:		X		
WAC 173-303-830 Modification Class	Class 1	Class <sup>1</sup> 1	Class 2	Class 3										
Please mark the Modification Class:		X												
<p>Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830-(4)(d) Other modifications</p> <p>Enter wording of WAC 173-303-830, Appendix I Modification citation:</p> <p>Request reviewed and approved as a Class <sup>1</sup>1 modification</p>														
<p>Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)</p> <p>Reason for denial:</p>			<p>Reviewed by Ecology:</p> <p style="font-family: cursive; font-size: 1.2em;"><i>Greta P. Davis</i> 8-6-08</p>											
			G. P Davis	Date										

**Hanford Facility RCRA Permit Modification Notification Form**

Unit:  
**224-T TRUSAF**

Permit Part  
**Part V, Closure Unit 10**

Description of Modification:

Closure Plan, §3.2, §3.2.1, §3.2.2, §3.2.3, and §3.2.4:

**3.2 CLOSURE ACTIVITIES**

Closure activities have been completed. The only remaining action is to obtain the independent registered professional engineer certification. ~~will be integrated with the implementation of the Engineering Evaluation/Cost Analysis (EE/CA) for 224 T Plutonium Concentration Facility. The EE/CA proposes that the 224 T facility be decontamination and decommissioned with the material being disposed of in ERDF.~~

**3.2.1 Constituents of Concern for Closure**

There are no remaining constituents of concern and sampling for dangerous waste constituents is not required to achieve clean closure not anticipated at this time.

**3.2.2 Field Logbook**

No field activities are required for clean closure. All field activities will be recorded in a field logbook. All entries will be made in ink, signed, and dated.

**3.2.3 Reporting**

No reporting activities are required since no field activities are necessary. After completion of closure activities, certification will be produced to verify clean closure.

**3.2.4 Personnel Training**

No personnel training requirements apply, as no field activities are necessary. All personnel involved with the closure activities at the 224 T TRUSAF will receive training concerning the handling of mixed waste.

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: WAC 173-303-830-(4)(d) Other modifications  
 Enter wording of WAC 173-303-830, Appendix I Modification citation:  
 Request reviewed and approved as a Class <sup>1</sup> modification

Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial) Reason for denial:	Reviewed by Ecology: <i>Greta P. Davis</i> 8/6-08 G. P Davis Date
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<b>Hanford Facility RCRA Permit Modification Notification Form</b>				
Unit: <b>224-T TRUSAF</b>	Permit Part <b>Part V, Closure Unit 10</b>			
<p><u>Description of Modification:</u>                      Closure Plan, §3.3:</p> <p><b>3.3 SCHEDULE OF CLOSURE</b></p> <p><del>There is no schedule of closure except for only remaining activity is certification as described in Section 3.5. will be integrated with the 224 T Plutonium Concentration Facility CERCLA removal action.</del></p>				
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: WAC 173-303-830-(4)(d) Other modifications Enter wording of WAC 173-303-830, Appendix I Modification citation: Request reviewed and approved as a Class <sup>1</sup> 1 modification				
Modification Approved: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No (state reason for denial)		Reviewed by Ecology:		
Reason for denial:		<i>Greta P. Davis</i> 8-16-08		
		G. P Davis		Date

**Hanford Facility RCRA Permit Modification Notification Form**

Unit:  
**224-T TRUSAF**

Permit Part  
**Part V, Closure Unit 10**

Description of Modification:

Closure Plan, §3.5:

**3.5 CERTIFICATION OF CLOSURE**

Certification of closure will be prepared as discussed in WAC 173-303-610(6), within 90-days following approval of this plan.

WAC 173-303-830 Modification Class

Please mark the Modification Class:

Class 1

Class 1

Class 2

Class 3

X

Enter relevant WAC 173-303-830, Appendix I Modification citation number: WAC 173-303-830-(4)(d) Other modifications

Enter wording of WAC 173-303-830, Appendix I Modification citation:

Request reviewed and approved as a Class 1 modification

Modification Approved:  Yes  No (state reason for denial)

Reason for denial:

Reviewed by Ecology:

*Greta P. Davis* 8/16/08

G. P Davis

Date

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**Hanford Facility RCRA Permit Modification**  
**Part V, Closure Unit 10**  
**224-T Transuranic Waste Storage and Assay Facility**

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**Remove and Replace the Following Sections:**

- Part V, Closure Unit 10, Unit Specific Conditions dated August 2008, replace with Unit Specific Conditions dated September 30, 2008
- Closure Plan, dated August 2008, with Closure Plan, dated September 30, 2008

1                                   **PART V    CLOSURE UNIT 10 PERMIT CONDITIONS**

2                                   **224-T Transuranic Waste Storage and Assay Facility**

---

3    The 224-T Transuranic Waste Storage and Assay Facility (224-T TRUSAF) treatment, storage, and/or  
4    disposal unit is part of the 224-T Plutonium Concentration Facility. The 224-T Plutonium Concentration  
5    Facility is adjacent to T Plant in the 200 West Area. The 224-T TRUSAF stored transuranic waste,  
6    transuranic mixed waste, mixed waste, and other properly characterized and packaged low-level waste.  
7    Dangerous wastes were removed from 224-T TRUSAF and the unit is no longer being operated as a TSD  
8    unit.

9    **V.10.A.            COMPLIANCE WITH APPROVED CLOSURE PLAN**

10   The Permittees will comply with all requirements set forth in Hanford Facility Dangerous Waste Permit,  
11   as specified in Permit Attachment 3, Permit Applicability Matrix and the unit-specific conditions  
12   identified below for the 224-T Transuranic Waste Storage and Assay Facility

13   **CLOSURE UNIT 10**

14   Part A Form, Revision 7, dated July 2007

15   224-T Transuranic Waste Storage and Assay Facility Closure Plan, dated September 30, 2008

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1 **Closure Plan** **224-T Transuranic Waste Storage and Assay Facility**

2 **1.0 FACILITY DESCRIPTION**

3 The 224-T Transuranic Waste Storage and Assay Facility (224-T TRUSAF) treatment, storage, and/or  
4 disposal unit is part of the 224-T Plutonium Concentration Facility. The 224-T Plutonium Concentration  
5 Facility is adjacent to T Plant in the 200 West Area. The 224-T TRUSAF stored transuranic waste,  
6 transuranic mixed waste, mixed waste, and other properly characterized and packaged low-level waste.  
7 Dangerous wastes were removed from 224-T TRUSAF and the unit is no longer being operated as a TSD  
8 unit. Because dangerous waste does not include the source, special nuclear, and by-product material  
9 components of mixed waste, radionuclides are not within the scope of this documentation. The  
10 information on radionuclides is provided only for general knowledge.

11 This closure plan achieves clean closure of the 224-T TRUSAF TSD unit. The future 224-T Plutonium  
12 Concentration Facility remediation, which will include the clean closed 224-T TRUSAF TSD unit, will  
13 be conducted as a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)  
14 removal action.

15 **1.1 FACILITY OPERATIONS**

16 On receipt of the transuranic mixed waste or mixed waste, the 224-T TRUSAF operations personnel  
17 performed an inspection (exterior only) of the waste container(s) and associated documentation, a neutron  
18 assay of the waste container to determine fissile isotope content, and/or an examination with a real-time  
19 radiography system to confirm the absence of prohibited items (e.g., free liquids). If the waste  
20 container(s) and accompanying documentation were acceptable, the 224-T TRUSAF operations personnel  
21 stored the waste.

22 The 224-T Plutonium Concentration Facility, constructed in the early 1940's entirely of reinforced  
23 concrete, was used as a chemical processing unit for purifying liquid plutonium nitrate by the lanthanum  
24 fluoride process. The 224-T Plutonium Concentration Facility remained idle for several years after new  
25 processes made the lanthanum fluoride process obsolete. In 1975, the mission of the 224-T Plutonium  
26 Concentration Facility changed to that of storing plutonium solutions and solid plutonium scrap. To meet  
27 the requirements for this new mission and the criteria for storing plutonium, the 224-T Plutonium  
28 Concentration Facility underwent major structural upgrades and modifications. The modifications  
29 included reinforcing the facility for tornado and seismic loads and sealing off the areas previously used  
30 for chemical separations from personnel entry. The three floors of the building contain six radiologically  
31 contaminated process cells, which were sealed from the rest of the building in 1975. The six process cells  
32 (cells A through F) are not included in this closure plan documentation. In 1985, the storage of  
33 transuranic waste, transuranic mixed waste, mixed waste, and low-level waste commenced and the  
34 portion of the 224-T Plutonium Concentration Facility being operated was redesignated as the  
35 224-T TRUSAF. This closure plan documentation covers only the RCRA regulated portion of the  
36 224-T Plutonium Concentration Facility referred to as 224-T TRUSAF. The entire building will be  
37 remediated as a decontamination and decommissioning activity as part of a CERCLA removal action.

38 The configuration of 224-T TRUSAF, which is approximately 60 meters long by 18.3 meters wide,  
39 allowed for approximately 1,068 square meters of storage space.

40 The three floors of the 224-T TRUSAF are connected by stairway A at the north end of the building, by  
41 stairway B at the south end of the building, and by an elevator adjacent to stairway A. There also is a  
42 concrete elevator loading deck off the elevator on the outside of the building. The roof contains the  
43 ventilation exhaust equipment and a penthouse. The penthouse contains the elevator mechanical  
44 equipment.

1 The first floor contained storage modules, and includes a restroom, an administration office, a heating and  
2 ventilation mechanical room, an elevator, a transuranic waste assayer room, and a real-time radiography.  
3 The storage modules on each floor were in open areas and were marked with tape or paint on the floor.  
4 The floors of the 224-T TRUSAF were sealed with an epoxy sealant to meet secondary containment  
5 requirements. The fire protection system consisted of a dry pipe fire system. Each floor had emergency  
6 exits and fire alarm pull boxes.

7 The 224-T TRUSAF consisted of the following areas:

- 8 • Administration office
- 9 • Real-time radiography room
- 10 • Transuranic waste assayer room
- 11 • Assay control room and storage unit operations office
- 12 • Elevator and stairways
- 13 • Heating and ventilation mechanical room
- 14 • Waste storage and holding areas
- 15 • Incoming waste receiving area
- 16 • Storage modules
  - 17 ○ Acids
  - 18 ○ Caustics
  - 19 ○ Mixed waste
  - 20 ○ Nonhazardous

#### 21 **1.1.1 Real-time Radiography Room**

22 Real-time radiography was operated from a desk and control terminal. Only one container at a time was  
23 staged in this area for x-raying. In the real-time radiography room, a roll-up door was used for building  
24 services. The entrance had a 5.08-centimeter high curb with a 0.3-meter long ramp leading down to floor  
25 level. The room contains no floor drains. Three personnel entrances to the real-time radiography room  
26 were available, all with a 5.08-centimeter curb and a 0.3-meter-long ramp.

#### 27 **1.1.2 Transuranic Waste Assayer Room**

28 Only one container at a time was staged in the transuranic waste assayer room. The transuranic waste  
29 assayer room contains the first floor emergency exit. All floor drains in the transuranic waste assayer  
30 room are sealed.

#### 31 **1.1.3 Assay Control Room and Storage Unit Operations Office**

32 The assay control room and storage unit operations office served as the operations center. The  
33 transuranic waste assayer was operated from this office. There are no floor drains in the assay control  
34 room and storage unit operations office.

#### 35 **1.1.4 Elevator and Stairways**

36 The elevator and stairways are located on the west side of the storage building service all three floors of  
37 the 224-T TRUSAF. The elevator was used for transporting waste to the upper floors for storage, for  
38 moving large or heavy equipment, and for out loading waste. Main floor entrances to the elevator are  
39 equipped with a 5.08-centimeter curb and a 0.3-meter-long ramp down to floor level. The elevator is not  
40 equipped with curbs.

#### 41 **1.1.5 Heating and Ventilation Mechanical Room**

42 The heating and ventilation equipment in the mechanical room, on the west central side of the first floor,  
43 provided a constant negative pressure with respect to the atmosphere. The heating and ventilation system

1 is currently deactivated. The two entrances from the hallway into the heating and ventilation mechanical  
2 room have 5.08-centimeter curbs with 15.24-centimeter-long ramps down to floor level.

### 3 **1.1.6 Waste Storage Modules**

4 Waste storage modules on all three floors were open array storage modules, delineated by markings taped  
5 or painted on the floor to prevent inadvertent commingling of incompatible waste forms. Incompatible  
6 dangerous waste was separated by placement on different floors or in different rooms on the second floor.  
7 Transuranic mixed waste was stored based on both transuranic element content and dangerous waste  
8 constituents. All floor drains in these areas were sealed with nonshrinking concrete and covered with  
9 epoxy sealant.

#### 10 **1.1.6.1 Receiving Area**

11 The receiving area was located in the southeast corner of the first floor. A double metal door was  
12 provided for entrance to the receiving area to allow the movement of a forklift. A concrete pad outside of  
13 the door was used for unloading waste. The ceiling is two floors high in the extreme southeast portion of  
14 the receiving area. A portion of the ceiling is only one floor high and contains a 1-ton crane used for  
15 container over packing operations.

#### 16 **1.1.6.2 Temporary Staging Area**

17 The temporary staging area, located at the southeast end, was used until offloading operations were  
18 complete.

#### 19 **1.1.6.3 First Floor Storage Modules**

20 The first floor storage modules were used for short-term storage before examination and transfer of waste  
21 to other locations (i.e., upper floor storage, return to generators and/or generating units, Low-Level Burial  
22 Grounds), etc. All transuranic mixed waste was separated into compatible modules, two containers high,  
23 two containers wide, and as long as necessary to accommodate the amount of the waste.

#### 24 **1.1.6.4 Second Floor Storage Modules**

25 The majority of the second floor was reserved for transuranic waste. Transuranic mixed waste also was  
26 stored on the second floor. Transuranic mixed waste containers were stored in open array modules, two  
27 containers wide, and two containers high. Incompatible mixed waste was separated by being placed in  
28 different rooms on the second floor.

#### 29 **1.1.6.5 Third Floor Storage Modules**

30 The third floor storage area contained two types of waste storage modules. Modules 3-1 were for  
31 transuranic mixed waste. Modules 3-2 were for transuranic waste. No incompatible transuranic mixed  
32 waste was stored on the third floor.

### 33 **1.2 SECURITY INFORMATION**

34 Security information for the Hanford Facility is discussed in Permit Attachment 33, §6.1 Security.

35 The 224-T TRUSAF is posted with signs stating *DANGER-UNAUTHORIZED PERSONNEL KEEP OUT*  
36 or an equivalent legend, in black and red letters on a white background. These signs are in English,  
37 legible from a distance of 7.6 meters, and visible from all angles of approach.

1 **2.0 CLOSURE STRATEGY AND PERFORMANCE STANDARDS**

2 The 224-T TRUSAF was a clean and well-maintained TSD unit and will be clean closed. Therefore, post  
3 closure activities are not anticipated. Closure of the 224-T TRUSAF will be accomplished by  
4 documenting in this closure plan that the current condition of the 224-T TRUSAF floors and structures  
5 meet the *clean debris surface* standard in 40 CFR 268.45, Table 1 incorporated by reference at  
6 WAC 173-303-140.

7 *Clean debris surface* means the surface, when viewed without magnification, shall be free of all visible  
8 contaminated soil and hazardous waste except that residual staining from soil and waste consisting of  
9 light shadows, slight streaks, or minor discolorations, and soil and waste in cracks, crevices, and pits may  
10 be present provided that such staining and waste and soil in cracks, crevices, and pits shall be limited to  
11 no more than 5 percent of each square inch of surface area.

12 Based on a site visit consisting of representatives from Ecology, DOE, and Fluor Hanford on  
13 June 25, 2008, the visit concluded that the floor meets the clean debris surface standard, and further  
14 actions will not be necessary to achieve clean closure.

15 **2.1 MINIMIZE THE NEED FOR FURTHER MAINTENANCE**

16 Closure of the 224-T TRUSAF will minimize the need for further maintenance specific to the  
17 244-T TRUSAF.

18 **2.2 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT**

19 The 224-T TRUSAF will be clean closed by the approval of this closure plan, which provides for  
20 protection for human health and the environment.

21 **2.3 RETURN LAND TO THE APPEARANCE AND USE OF SURROUNDINGS**

22 Future land use determinations will be made following disposition of the entire 224-T Plutonium  
23 Concentration Facility and the decision will be deferred to after the CERCLA removal action.

24 **3.0 CLOSURE APPROACH**

25 The strategy for closure of the 224-T TRUSAF is clean closure. The waste inventory has been relocated  
26 to the Central Waste Complex or to another permitted TSD unit. Based on the clean nature of the  
27 224-T TRUSAF, sampling will not be performed. Certification by an independent registered professional  
28 engineer will document that 224-T TRUSAF was clean closed according to the specifications in this  
29 closure plan. This closure plan documents that the 224-T TRUSAF meets the clean debris surface closure  
30 performance standards.

31 **3.1 REMOVAL OF DANGEROUS WASTE INVENTORY**

32 The waste inventory has been removed and relocated to the CWC or to another permitted TSD unit.

33 **3.2 CLOSURE ACTIVITIES**

34 Closure activities have been completed. The only remaining action is to obtain the independent registered  
35 professional engineer certification.

1 **3.2.1 Constituents of Concern for Closure**

2 There are no remaining constituents of concern and sampling for dangerous waste constituents is not  
3 required to achieve clean closure.

4 **3.2.2 Field Logbook**

5 No field activities are required for clean closure.

6 **3.2.3 Reporting**

7 No reporting activities are required since no field activities are necessary.

8 **3.2.4 Personnel Training**

9 No personnel training requirements apply, as no field activities are necessary.

10 **3.3 SCHEDULE OF CLOSURE**

11 The only remaining activity is certification as described in Section 3.5.

12 **3.4 AMENDMENT OF PLAN**

13 Amendments to the closure plan, if required, will be prepared as described in WAC 173-303-610(3)(b).

14 **3.5 CERTIFICATION OF CLOSURE**

15 Certification of closure will be prepared as discussed in WAC 173-303-610(6), within 90-days following  
16 approval of this plan.

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