1219493

OFFICE OF RIVER PROTECTION
P.O. Box 450, MSIN H6-60
Richland, Washington 99352

FEB 25 2013

13-ECD-0010

Ms. Jane A. Hedges, Program Manager
Nuclear Waste Program
Washington State
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

SUBMITTAL OF HANFORD FACILITY RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) PERMIT MODIFICATION NOTIFICATION FORM 24590-HLW-PCN-ENV-11-007, UPDATED CORROSION EVALUATION FOR THE HIGH-LEVEL WASTE (HLW) CANISTER DECON VESSEL (HDH-VSL-00002/4) IN APPENDIX 10.9 OF REFERENCE 1

Reference: WA7890008967, "Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Operating Unit 10, 'Waste Treatment and Immobilization Plant.'"

This letter transmits Hanford Facility RCRA Permit Modification Notification Form 24590-HLW-PCN-ENV-11-007, attached, for the Washington State Department of Ecology (Ecology) review and approval. The form describes a requested Class 1 modification requiring concurrence or approval to the Reference.

Modification Notification Form 24590-HLW-PCN-ENV-11-007 submits updated corrosion evaluation for the HLW Canister Decon Vessel (HDH-VSL-00002/4) in Appendix 10.9 of the Dangerous Waste Permit.

Ecology comments resulting from review of this modification notification form and the associated information have been resolved.

H-0.8

If you have any questions, please contact me, or your staff may contact Gae M. Neath, Environmental Compliance Division, (509) 376-7828.

P. G. Harrington

Paul G. Harrington, Assistant Manager
Technical and Regulatory Support

ECD:GMN

Attachment

cc w/attach:
B. L. Curn, BNI
B. Dubiel, BNI
B. G. Erlandson, BNI
P. A. Fisher, BNI
S. K. Murdock, BNI
F. M. Russo, BNI
Administrative Record (WTP H-0-8)
BNI Correspondence
Environmental Portal, LMSI

cc electronic:
D. L. Becker, Ecology
J. Cantu, Ecology (2 hard copies)
A. S. Carlson, Ecology (5 hard copies, Public Review)
M. E. Jones, Ecology
A. C. Tortoso, Ecology
J. K. Perry, MSA
A. C. McKarns, RL
D. J. Sommer, SCS

cc w/o attach:
D. M. Busche, BNI
J. Cox, CTUIR
S. G. Harris, CTUIR
S. L. Dahl, Ecology
D. McDonald, Ecology
G. P. Bohnee, NPT
K. Niles, Oregon Energy
S. R. Weil, RL
R. Jim, YN

Attachment
13-ECD-0010
(8 Pages – Mostly Double Sided)

Hanford Facility RCRA Permit Modification Notification
Form 24590-HLW-PCN-ENV-11-007

Quarter Ending March 31, 2013 24590-HLW-PCN-ENV-11-007

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 Corrosion Evaluation Data Sheet for the HLW Canister Decontamination Handling System (HDH) Canister Decon Vessels in Appendix 10.9 of the Dangerous Waste Permit (DWP).

Submitted by Co-Operator:

Donna Busche 2/4/13

D. M. Busche Date

Reviewed by ORP Program Office:

2/21/13

D. L. Noyes Date

Hanford Facility RCRA Permit Modification Notification Form

Unit:	Permit Part:
Waste Treatment and Immobilization Plant	**Part III, Operating Unit 10**

Description of Modification:

The purpose of this Class 1 prime modification is to update the HLW facility *Corrosion Evaluation HLW HDH-VSL-00002 & HDH-VSL-00004 (HLW) Canister Decon Vessels* in Appendix 10.9 of the DWP. This PCN will replace one permit Material Selection Data Sheet incorporated into the DWP with one source Corrosion Evaluation Data Sheet as indicated in the Table below. Note the title of the data sheet has been changed from the permit version "Plant Item Material Selection Data Sheet" to the source "Corrosion Evaluation."

The following source document is submitted to replace the permit document currently in Appendix 10.9:

Appendix 10.9			
Replace:	24590-HLW-HDH-P0003 Rev. 1	With:	24590-HLW-N1D-HDH-00003 Rev. 8

This modification requests Ecology approval and incorporation into the permit, the specific changes to the document that have been issued since the last revision of the permitted version; the changes are described in Revision History. The revised corrosion evaluation provides more detailed information which resulted in substantial changes to the document. The following identifies those changes:

- Added the facility room location
- Added discussion of heating and cooling coils and temperature ranges
- Added corrosion allowance for cooling coils
- Expanded discussion on Titanium corrosion resistance under paragraph a, General Corrosion
- Added general description of parameters including in selecting materials including, heat transfer, material thickness effects, corrosion and fouling
- Updated expected pH range
- Updated Operating Modes Considered
- Deleted temperature of high pressure steam that is used to raise temperature of decontamination solution
- Updated Design Pressure
- Updated Operating Modes
- Updated References and Bibliography, including CCN 240368

This modification requests Ecology approval and incorporation into the permit, the specific changes to this data sheet, as indicated by revision bars, that have been issued since the last revision of the permitted version. Revisions are the result of ongoing design changes. The following identifies the significant types of changes on the attached data sheets:

None.

In accordance with Permit Condition III.10.C.2.e, this permit modification may include page changes to the Permit, attachments, and permit application supporting documentation. The necessary permit changes were submitted for Ecology's approval. Ecology is requested to approve the attached permit changes and incorporate the changes in the next revision of the WTP DWP.

Quarter Ending March 31, 2013 24590-HLW-PCN-ENV-11-007

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

Enter relevant WAC 173-303-830, Appendix I Modification citation number: 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]1 modification. WAC 173-303-830(4)(d)(ii)(A) states, "Class 1 modifications apply to minor changes that keep the permit current with routine changes to the facility or its operation. These changes do not substantially alter the permit conditions or reduce the capacity of the facility to protect human health or the environment. In the case of Class 1 modifications, the director may require prior approval."

Modification Approved/Concur: ☐ Yes ☐ Denied (state reason below) Reason for denial:	Reviewed by Ecology: S. Dahl Date

Table III.10.E.C – HLW Vitrification Plant Tank Systems Description

Mixed Waste Tank Systems Name	Unit Designation	Engineering Description (Drawing Nos, Specification Nos, etc.)	Narrative Description, Tables & Figures	Maximum Capacity (gallons)
HDH-VSL-00003 (Waste Neutralization Vessel) HDH-VSL-00004 (Canister Decon Vessel 2)		-M0-HDH-P0012001, Rev 1 -M0-HDH-P0012002, Rev 1 -MV-HDH-P0003, Rev 1 -MVD-HDH-P0003, Rev 2 -MVD-HDH-00006, Rev 5 -MVD-HDH-P0009, Rev 0 -N1D-HDH-~~P0003~~-00003, Rev ~~1~~8 -N1D-HDH-P0005, Rev 1 -N1D-HDH-P0007, Rev 1 -P1-P01T-00001, Rev 9 -P1-P01T-00002, Rev 7 -3YD-HDH-00002[a] **24590-WTP** -3PS-G000-T0002, Rev 8 -3PS-MV00-T0001, Rev4 -3PS-MV00-T0002, Rev 3 -3PS-MV00-T0003, Rev 3		
HLW Melter Cave Support Handling System HSH-TK-00001 (Decontamination Tank Melter Cave 1) HSH-TK-00002 (Decontamination Tank Melter Cave 2)	HSH	**24590-HLW** -M6-HSH-00004001, Rev 1 -M6-HSH-00004001, Rev 1 -M6-HSH-20004001, Rev 1 -M6-HSH-20004002, Rev 1 -M0-HSH-P0072, Rev 1 -N1D-HSH-P0001, Rev 1 -P1-P01T-00002, Rev 7	Section 4.1.4.7; Tables 4-4 and 4-6; Figures C1-1 and C1-4 of Operating Unit Group 10, Addendum C of this Permit.	HSH-TK-00001 = 4,000 HSH-TK-00002 = 4,000
HLW Vitrification Plant Radioactive Liquid Waste Disposal System	RLD	**24590-HLW** -3YD-RLD-00001[a] -M5-V17T-P0007001, Rev 1	Section 4.1.5.5; Tables 4-4 and 4-6; Figures C1-1 and C1-4 of Operating Unit Group 10, Addendum C of this Permit.	RLD-VSL-00002 = 334 RLD-VSL-00007 = 18,145

CORROSION EVALUATION

ISSUED BY
RPP-WTP PDC

R11555248

HDH-VSL-00002 & HDH-VSL-00004 (HLW)
Canister Decon Vessels

- Design Temperature (°F) (max/min): 225/40
- Design Pressure (psig) (internal/external): 15/FV
- Location: Room H-B035; out cell

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- The tank is filled with the acidic decontamination solution at normal operating temperature.
- Internal coils are present to maintain temperature at 149 °F for decontamination.
- Internal coils are present to cool contents to 104 °F following decontamination.
- Rinsing, draining, and drying preparatory to lay-up.

Materials Considered:

Material (UNS No.)	Acceptable Material	Unacceptable Material
Carbon Steel		X
Type 304L (S30403)		X
Type 316L (S31603)		X
6% Mo (N08367/N08926)		X
Hastelloy® C-22® (N06022)		X
Ti-2 (R50400)	X	

Recommended Material: UNS R50400 Grade 2

Recommended Corrosion Allowance: Vessel -- 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)
Cooling coils – No corrosion allowance is required because cooling coils can be replaced. Additionally, a corrosion allowance is impractical as heat transfer efficiency is lost with increasing thickness.

Process & Operations Limitations:

- None identified

Concurrence NA
Operations

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
8	10/29/12	Extensive re-write; no rev bars Update design pressure Include additional general discussion on titanium corrosion-resistance throughout Include additional references Remove personal communications references Include updated PCDS	DLAdler	RBDavis	NA	[signature]

REVISION HISTORY CORROSION EVALUATION

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
7	11/18/10	Include CA for internal coils Text modification due to design change Incorporate revised PCDS Add AEA notice Editorial and format changes	DLAdler	RBDavis	NA	SWVail
6	5/27/05	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	JRDivine	NA	APRangus
5	9/18/04	Incorporate new PCDS Add section p – Inadvertent Addition of Nitric Acid	DLAdler	JRDivine	NA	APRangus
4	3/15/04	Revised to incorporate comments from review of DWP document	DLAdler	JRDivine	NA	APRangus
3	12/16/03	Update design pressure Additional Vessel Add DWPA note Re-format references Append updated MSDS	DLAdler	JRDivine	NA	APRangus
2	10/29/02	Editorial changes Append amended MSDS	DLAdler	JRDivine	NA	SMKirk
1	9/12/02	Add DWP note Revise to remove open issues	DLAdler	JRDivine	NA	SKirk
0	6/2/02	Initial Issue	DLAdler	JRDivine	SS	SK

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 8 sheets.

CORROSION EVALUATION

Corrosion Considerations:

Canister decontamination vessels hold the filled canister and the ceric nitrate solution during decontamination. Internal coils are used to maintain the decontamination solution at 149 °F. After the decontamination solution is drained from the vessel, spray rings rinse the canister with nitric acid and demineralized water. The decontamination vessels are located such that replacement is possible should it be necessary.

When cooling and heating coils are included in the design of a vessel, heat exchanger, or cooler they are generally specified without extra thickness that defeats or slows the heat transfer. The design objective is to efficiently transfer heat. Typically, heating elements and coils are designed in such a fashion that they can be replaced. The decontamination vessels are located in the HLW hot cells; should retubing be required, the vessels can be removed and either discarded and replaced.

a General Corrosion

Corrosion rates of Type 304 stainless steel in Ce-IV/nitric acid solutions depend on temperature, nitric acid concentration, and cerium concentration, but are typically about 350 mpy. Thus, the neat solution is good for decontamination of stainless steel but cannot be stored in stainless steel containers.

Craig (1989) states that Ti is very resistant to nitric acid; except that in the 20-70 % concentration range the corrosion rate is relatively high, with a maximum at about 45 %. The use of about 12% acid minimizes this. Corrosion is inhibited by Ti^{+4}, Cr^{+6}, and Fe^{+3} ions as well as by other oxidizing ions. Ce^{+4} is not mentioned; however, it is expected to behave similarly.

Titanium is a very reactive metal that shows remarkable corrosion resistance to oxidizing acids over a wide range of concentrations and temperatures because of a passive oxide film that is formed instantaneously. Like stainless steels, titanium depends on this oxide film for its corrosion resistance. If damaged, the film reforms readily as long as there is some source of oxygen in the environment. Therefore, it performs best in oxidizing media such as warm nitric acid. The oxide film formed on titanium is more adherent and therefore more protective than that on stainless steel. Titanium alloys perform well in media that would cause pitting and crevice corrosion in stainless steels (e.g., seawater, wet chlorine, organic chlorides). More information on the corrosion resistance of titanium can be found in CCN 240368, *Supplemental Information for Corrosion Evaluation 24590-HLW-N1D-HDH-00003*, 23 May, 2012.

The conditions under which Ti Grade 2 is susceptible to corrosion are strongly reducing acids, alkaline peroxide solutions, and molten chloride salts. Crevice corrosion can occur in hot halide or sulfate solutions; however, neither condition exists in the present application.

Titanium is highly resistant to oxidizing acids over a wide range of concentrations and temperatures up to 160 °F. Common acids in this category include nitric, chromic, perchloric, and hypochlorous acids. These oxidizing compounds ensure oxide film stability. Low, but finite, corrosion rates from continued surface oxidation may be observed at higher temperatures and highly oxidizing conditions. Titanium offers excellent resistance over the full concentration range at sub-boiling temperatures. At higher temperatures, however, titanium's corrosion resistance is highly dependent on nitric acid purity. In hot, very pure solutions or vapor condensates of nitric acid, significant general corrosion (and trickling acid condensate attack) may occur in the 20 to 70 wt % range. Corrosion is inhibited when the nitric acid solution is contaminated with various metallic species such as Si, Cr, Fe, Ti, or various precious metal ions (e.g., Pt, Ru). Titanium often exhibits superior performance to stainless steel alloys in high temperature metal-contaminated nitric acid media, such as those associated with the Purex Process for U_3O_8 recovery. Titanium's own corrosion product Ti^{+4}, is a very potent inhibitor.

Partridge, Lerch and Bosuego (1979) performed a series of corrosion experiments on the decontamination of TRU contaminated metal surfaces. Titanium was found to be very resistant to corrosion in a cerium (IV)-nitric acid solution. Corrosion tests at 194 °F (90 °C) measured a corrosion rate of ~0.014 mpy.

Uniform corrosion loss on the HDH-VSL-00002 and HDH-VSL-00004 pressure boundary materials will be negligible over the expected life.

West Valley Nuclear Services has not examined their Ti-2 vessel for corrosion. However, they do not believe it has been a problem. Another reason that Ti was selected was that it was recommended by Battelle-Northwest (PNNL). PNNL recommended it because electrodes used in several earlier studies were Ti and had not visibly degraded.

The corrosion rates on the heating and cooling coils should be similar to the Grade 2 used for vessel fabrication. The design of the heating and cooling coils is optimized for heat transfer. Heat transfer is the ability of a surface to transfer heat from one side to the opposite side. The inverse of the heat transfer is the resistance to heat flow; the resistance can be minimized by the design, flow, surface area, and tube wall thickness. Five component resistances make up the total resistance to heat transfer: tube-side boundary fluid layer, tube-side fouling, tube metal thickness, shell-side fouling, and shell-side boundary fluid layer. For the HDH cooling coils the fluid boundary layers and fouling on each side are expected to be small and the resistance to heat transfer is dependent on the thickness of the surface and the transfer coefficient of the material. From the design perspective, once titanium has been selected, the thickness becomes the only tool the engineer has to optimize heat transfer. Thin heat transfer surfaces use corrosion resistant materials, thereby increasing the life and reducing the extra thickness material needed to anticipate corrosion loss. (CCN 240368).

Specifying a corrosion resistant alloy for heat exchange surfaces is customary at the WTP. A zero corrosion allowance can be specified for stainless steels, duplex stainless steels, copper alloys, nickel alloys, and titanium providing process conditions can be controlled. The high resistance of these alloys to corrosion prevents buildup of corrosion products. Titanium is corrosion resistant and has excellent heat transfer properties as well. Zero corrosion allowance is recommended for titanium heat transfer surface in the Canister Decontamination Vessels.

CORROSION EVALUATION

Conclusion:
Commercially-pure titanium, Grade 2, is an acceptable alloy based on the referenced literature specific to decontamination (i.e., West Valley). Based on an examination of the chemical and electrochemical behaviors of Ti alloys and Ce^{+4} solutions, no corrosion problem appears to exist. Based on the low corrosion rates, no corrosion allowance is required for the heat transfer surfaces.

b Pitting Corrosion
The vessel material and solution chemistry combination are one-of-a-kind applications, no direct pitting corrosion data is available for the chemistry listed in the Process Corrosion Data Sheet. However, Ti is resistant to pitting in chloride solutions although the effects of a highly oxidizing medium, such as Ce^{+4}, with chloride are have not been studied, other than the experience at West Valley and that reported by Partridge, Lerch, and Bosuego (1979). However, in this system, there should be no chloride except for that brought over with any external ^{137}Cs contamination. This should amount only to 0.13 Ci of ^{137}Cs, equivalent to about 1.5 mg of Cs and therefore 0.4 mg of chloride. With approximately 800 L of solution, the chloride is expected to be about 0.5 ppb.

Conclusion:
Pitting of the Decontamination Vessel is not expected to be a problem.

c End Grain Corrosion
End grain attack is the preferential corrosion attack of a metal. When metals are worked and formed into shapes, rods, and bars by rolling, the grains becomes elongated along the rolling direction. The rolling is a continuous process and the shapes, rods, and bars are sliced to lengths perpendicular to the rolling direction. The exposed end grains are more susceptible to corrosion because of a combination of high stress, inclusions, high surface density of the grain boundaries, and micro fissures. These represent easy pathways for the solution chemistry and mass transfer reactions. End grain attack is specific to the cold worked materials. End grain attack is generally not a concern for plate, forgings, castings, pipes, and tubes. Materials that are rolled and solution annealed are also not a problem. Commercially pure Titanium Grade 2 is supplied in the annealed condition for corrosion resistance.

Conclusion:
End grain corrosion is not expected on Titanium Grade 2, and, therefore, is not expected in this system.

d Stress Corrosion Cracking
Ti Grade 2 is fully resistant to stress corrosion cracking in aqueous solutions and is largely immune to SCC in general. The exceptions are the general group of organic solvents, anhydrous methanol, methanol halide-solutions, red fuming nitric acid, nitrous oxide, liquid or solid cadmium, and liquid mercury (CCN 240368). Past work at West Valley has shown that cracking of the decontamination vessel is not a concern.

Conclusion:
Ti-2 is acceptable.

e Crevice Corrosion
See Pitting.

Conclusion:
See Pitting.

f Corrosion at Welds
Corrosion at welds is not considered a problem in the proposed environment: compatible weld consumables, materials, and methods are required. The welding procedure specification (WPS) has been qualified (PQR) according the WTP specifications and good practices. Quality control of the welding process is expected to prevent welding problems, and non destructive testing is expected to identify and provide evidence of proper welding. West Valley reports no problems with similar titanium vessels. Proper welding techniques will be required (H_2, O_2, or N_2 shall not be present in the welding cover gas).

Conclusion:
Weld corrosion is not considered a problem because of welding and fabrication controls.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are not conducive to microbial growth.

Conclusion:
MIC is not considered a problem.

h Fatigue/Corrosion Fatigue
Corrosion fatigue is a potential problem if the component is free to vibrate. In WTP vessels, because of possible earthquake concerns, all components are well anchored and virtually immovable. Corrosion fatigue is not expected to be a problem because all attachments are fully supported and movement is minimal. The temperature cycle is minimal, 70 °F max delta, and is not expected to generate a thermal fatigue load. The longest cantilever is the heating/cooling coil and the entry point into the vessel; however, the bulk of the weight is on the frame lugs welded to the vessel. The design and material will accommodate these loads.

Conclusions
Proper design and material choice mitigates this concern.

CORROSION EVALUATION

i Vapor Phase Corrosion
West Valley has encountered no problems.

Conclusion:
Not expected to be a concern.

j Erosion
Velocities 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-04-0008.

Conclusion:
Not expected to be a concern.

k Galling of Moving Surfaces
Not applicable because of no moving parts.

Conclusion:
Not applicable.

l Fretting/Wear
As designed, there is no contact between surfaces of the vessel or the coils and the canister.

Conclusion:
Fretting is not expected.

m Galvanic Corrosion
The canister is expected to be anodic relative to the vessel. The canister is purposely being corroded to clean the surface and so this state is acceptable. Gaseous corrosion reaction products such as hydrogen will likely bubble to the top and mix with the room air, not permeate into the titanium. Because of the strong oxidizing nature of the solution, hydrogen, if present, is not expected to survive long enough to diffuse into the Ti.

Conclusion:
The hydrogen generation from the hydrolysis of water at the Ti-2 surface is not expected to be a concern.

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 Addition of Nitric Acid
Vessels normally contain nitric acid and operate at a low pH.

Conclusion:
Not applicable.

CORROSION EVALUATION

References:

1. 24590-WTP-RPT-M-04-0008, Rev. 3, *Evaluation Of Stainless Steel and Nickel Alloy Wear Rates In WTP Waste Streams At Low Velocities*
2. 24590-WTP-RPT-PR-04-0001, Rev. 0CD, *WTP Process Corrosion Data*
3. Craig, BD, Editor, 1989, *Handbook of Corrosion Data*, ASM International, Metals Park, OH 44073
4. Deleted
5. Deleted
6. Partridge J, Lerch R, and Bosuego G. 1979. *Decontamination of TRU Contaminated Metals*, HEDL-TC-1503, Hanford Engineering Development Laboratory, Richland, WA.
7. CCN 240368, memorandum, R Davis to D Adler and others, *Supplemental Information For Corrosion Evaluation 24590-HLW-NID-HDH-00003*, 23 May, 2012

Bibliography:

1. 24590-HLW-MVD-HDH-00006, *Mechanical Data Sheet for Canister Decon Vessel 1, 24590-HLW-MV-HDH-VSL-00002. Canister Decon Vessel 2, 24590-HLW-MV-HDH-VSL-00004.*
2. Bray, LA, 1988, *Development of a Chemical Process Using Nitric Acid-Cerium (IV) for Decontamination of High-Level Waste Canisters*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
3. Bray, LA, MR Elmore, KJ Carson, RJ Elovich, GM Richardson, and LD Anderson, 1992, *Decontamination Testing of Radioactive-Contaminated Stainless Steel Coupons Using a Ce(IV) Solution*, Battelle, Pacific Northwest Laboratory, Richland, WA 99352
4. Deleted
5. Clark W and Gens TA. 1961. *Study of Dissolution of Reactor Fuels Containing Zirconium in a Titanium Vessel*, ORNL-3118. Oak ridge National Laboratory, Oak Ridge, TN.

CORROSION EVALUATION

24590-WTP-RPT-PR-04-0001, Rev. 0CD
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Canister decon vessel (HDH-VSL-00002, HDH-VSL-00004)

Facility HLW

In Black Cell? No

Chemicals	Unit[1]	Contract Maximum[2]		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/L	1.15E-03	1.92E-03			
Chloride	g/L					
Fluoride	g/L					
Iron	g/L	7.39E-01	7.37E-01			
Nitrate	g/L	2.42E+02	2.42E+02			
Nitrite	g/L					
Phosphate	g/L					
Sulfate	g/L					
Mercury	g/L					
Carbonate	g/L					
Undissolved solids	wt %	5.45E-02	5.45E-02			
Other (Pb)	g/L	2.23E-04	1.69E-04			
Other(Cerium)	g/L	6.81E+01	6.81E+01			
pH	N/A					Note 3
Temperature	°F					Note 4

List of Organic Species:

References

System Description: 24590-HLW-3YD-HDH-00002
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: HDH01, HDH05, HDH03, NAR21
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: N/A
PFD: 24590-HLW-M5-V17T-00006
Technical Reports: N/A

Notes:

1. Concentrations less than 1x 10^{-4} g/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. Approximate pH 0 to 10 (sheets 92-97, 24590-HLW-M4C-HDH-00001, Rev 0).
* 4. Maximum temperature of acidic solutions is 175 °F (sheet 95, 24590-HLW-M4C-HDH-00001, Rev 0)
Normal operating temperatures range from about 80 °F to about 155 °F (sheets 92-97, 24590-HLW-M4C-HDH-00001, Rev 0).
The vessel contains coils that carry high pressure steam for heating of solutions.

Assumptions

* Referenced calculation 24590-HLW-M4C-HDH-00001 has been revised. Maximum temperature of acidic solutions based on HDH05 in revision 2 of referenced calculation is 149 °F. Normal operating temperature range is 80 to 149 °F. According to the system description, 24590-HLW-3YD-HDH-00002, decontamination fluid will be at 149 ± 5 °F, and the contents will be cooled to 104 °F or below before transfer.

CORROSION EVALUATION

24590-WTP-RPT-PR-04-0001, Rev. 0CD
WTP Process Corrosion Data

Routine Operations

The canister decon vessel is used to hold the filled canister and ceric nitrate solution during the decontamination process. Nitric acid and demineralized water spray washes also take place in this vessel. * High-pressure steam is supplied to coils to raise the solution temperature from 73 °F to 149 °F and is held at 149 °F for 6 hours during the decontamination process. Heating and cooling coils maintain the temperature of the liquid at the desired temperatures over the cycle. The nitric acid solution is drained from the vessel. Spray rings will rinse the canister with nitric acid and demineralized water. The canister is then removed from the vessel.

Non-Routine Operations that Could Affect Corrosion or Erosion

None identified.

* Due to a change in design, steam is no longer directly supplied to the vessel. Hot water is provided to the vessel to heat the solution to 149 °F.