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U.S. Department of Energy

Office of River Protection

JUN 1 7 2008

08-ESQ-109

CCN: 173337

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

RECEIVED
JUN 1 8 2008
EDMC

Dear Ms. Hedges:

REQUEST FOR RELEASE OF VESSEL ACCESS HOLDS AND FABRICATION

References: 1. WA7890008967, "Dangerous Waste Portion of the Hanford Facility Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste," Part III, Operating Unit 10, "Waste Treatment and Immobilization Plant."

2. Ecology letter from S. Dahl to R. J. Schepens, ORP, and W. S. Elkins, BNI, "Wear Allowance and Integrity Assessment for Vessels with Pulse Jet Mixers," dated June 28, 2006.

0070086

3. Meeting Minutes for the "Dangerous Waste Permit Integration Meeting," CCN: 170006, dated February 11, 2008.

This letter requests that the Washington State Department of Ecology (Ecology) provide approval required by Permit Condition III.10.E.2.d, Reference 1, of the tank system designs for wear allowance related to vessels HOP-VSL-903 and HOP-VSL-904, so that construction access no longer needs to be maintained. Additionally, this letter requests Ecology exempt the six vessels from the fabrication hold requirement contained in Permit Condition III.10.E.2.d.ii. Permit Conditions III.10.E.2.d and III.10.E.2.d.ii are provided below for your convenience.

"III.10.E.2.d. The Permittees will maintain construction access to the internal portions of installed tanks with pulse jet mixers until Ecology has provided written approval of the tank system designs for wear allowance pursuant to WAC 173-303-640(3)(a).

III.10.E.2.d.ii. Except where exempted in writing by Ecology on the basis that wear allowance provisions will not be affected, fabrication and assembly of the following tanks and their internal components will be suspended until Ecology has provided written approval of the tank system designs for wear allowance pursuant to WAC 173-303-640(3)(a).

- HLW Feed Receipt Vessel, HLP-VSL-00022.
- HLW Lag Storage Vessels, HLP-VSL-00027A and HLP-VSL-00027B.
- HLW Feed Blend Vessel, HLP-VSL-00028.
- Ultrafiltration Feed Vessels, UFP-VSL-00002A and UFP-VSL-00002B."

This request is based on the attached presentation which was discussed with Mr. Ed Fredenburg of your staff on May 9, 2008. The presentation reviewed the data and results from the first four erosion tests conducted by Bechtel National, Inc. (BNI) and U.S. Department of Energy, Office of River Protection using stainless steel coupons. As shown below in the table, erosion rates are well below the 40-year design erosion allowance included in the design of the vessels.

Vessel	40-Year Design Allowance (Inches)	40-Year Scare Depth Not Adjusted for Scale Up (Inches)	40 Year Scare Depth Adjusted for Scale Up (Inches)
PWD-44	0.59	0.015	0.007
HLP-22	1.49	0.144	0.072
UFP-1A/B	0.84	0.013	0.006
HLP-27A/B	1.25	0.391	0.196
HLP-28	1.21	0.479	0.240
UFP-2A/B	1.24	0.479	0.240
RLD-07	0.49	0.001	0.0004
RLD-08	0.44	0.009	0.004
HOP-903 & -904	0.51*	0.002	0.001

*HOP-VSL-903 and HOP-VSL-904 have wear plates with Stellite overlays that are more resistant to erosion than stainless steel. The added erosion resistance of Stellite is not factored into the 40-year design allowance (a conservative assumption) column above. Stellite is expected to be approximately 1.4 times more resistant to erosion than stainless steel (Attachment 2).

The direct access requirements imposed by Permit Condition III.10.E.2.d are interfering with High-Level Waste (HLW) construction activities. Structural steel beams are being installed above the Melter Offgas Treatment Process (HOP) vessels. The Waste Treatment and Immobilization Plant (WTP) Project is ready to start installing piping above the two HOP vessels in preparation for placing a concrete slab at the 0-foot elevation. Access to the cells will be maintained for several years through Pour Tunnels 1 and 2 respectively. Reference 2 stated that Ecology would require resubmittal of the following documents prior to eliminating access to the Black Cells:

- Description of Access for Conducting Integrity Assessments, 24590-WTP-PER-M-02-005.
- Annotated Outline for Integrity Assessments of Tank Systems, 24590-WTP-PER-M-03-001.

At the Dangerous Waste Permit Integration Meeting on February 11, 2008, Ecology stated that prior to releasing the construction access hold on the two HOP vessels, BNI would need to at least provide the schedule for resubmitting these two documents (Reference 3). BNI is preparing two facility specific documents (for HLW, Pretreatment and Low-Activity Waste, Balance of Facilities, and Analytical Laboratory respectively) to describe the WTP integrity assessment program which will supersede the two documents identified in the previous paragraph requested. This work started on April 1, 2008, and the reports are expected to be submitted to Ecology on or before December 1, 2008.

In order to avoid the WTP losing shop priority at the vendor's facility, which would result in a schedule delay, it is important that design and fabrication inputs be provided to the vendor in July 2008 to support a restart of fabrication in late 2008. The six vessels identified in Permit Condition III.10.E.2.d.ii.take approximately one year to fabricate. The final four erosion tests are expected to be complete by late July 2008 with a final test report being issued by September 30, 2008. In the unlikely event that the final report shows that additional erosion protection is required, the installation of wear plates or surface hardening can occur at any time prior to installation of the six vessels. Updated vessel erosion calculations and final Independent Qualified Registered Professional Engineer Reports will be submitted after the erosion testing is completed and to support a request for vessel installation. Additionally, load definitions for the vessel internals associated with multiple pulse jet mixer overblows are expected to be obtained from the vendor in June 2008.

If you have any questions, please contact either of us, or your staff may contact either Lori A. Huffman, Division Director, Environmental Compliance Division, (509) 376-0104, or Stan Hill, BNI, (509) 371-3432.

for

Shirley J. Olinger, Manager
Office of River Protection

W. S. Elkins, Project Director
Bechtel National, Inc.

ESQ:LAH

Attachments:
1. Presentation of Erosion Data and Results
2. Erosion Resistance of Stellite Compared to Stainless Steel

cc: See page 4

cc w/attachs:
W. S. Elkins, BNI
J. S. Hill, BNI
L. T. Lamm, BNI
I. G. Papp, BNI
P. E. Peistrup, BNI
L. J. Simmons, BNI
T. P. Troutman, BNI
B. Becker-Khaleel, Ecology
S. L. Dahl, Ecology
E. A. Fredenburg, Ecology
Administrative Record (WTP H-0-8)
BNI Correspondence

cc w/o attachs:
S. A. Thompson, FH
A. C. McKarns, RL
D. J. Sommer, SCS

Attachment 1
08-ESQ-109

Presentation of Erosion Data and Results

M2 Erosion Testing: Initial Results and Design Basis Assessment

River Protection Project

WASTE TREATMENT PLANT

Ivan Papp

Department of Energy

Office of River Protection

Bechtel National, Inc.

Initial Conclusions

Based on 4 of 8 wear rate experiments completed, the following is tentatively concluded.

1. WTP design wear estimates are bounded
2. Consistent wear trends are observed between erosion estimates and key variables
   - PJM Velocity
   - Solids Concentration
   - Weighted Mean Particle Size
3. Sufficient data exists to develop correlations from experimentally derived values (e.g. velocity and concentration exponents)

M2 Erosion Testing and Design Basis Assessment Initial Results

- Presentation Objectives :
  - Present methodology used to evaluate the M2 erosion testing data.
  - Provide results of the first four erosion tests.
  - Compare erosion wear test results with WTP Design Basis.

Test Program Description

Testing Objective

1. Conduct prototypic PJM erosion wear rate testing to develop estimated wear rates over the 40yr design life of the WTP.

Scope:

1. Testing is comprised of 8 NQA-1 tests which gather information from two submerged jets in the ¼ scale test apparatus (giving two effective measurements per test run)
2. Simulant developed to match WTP-153 for particle size distribution, density, chemistry, hardness, speciation
3. Testing assesses conditions which result in maximum erosion based on: velocity, mean particle size, solids concentration, impingement angle, hardness, flow conditions (pulsed vs. continuous), and materials of construction.

Correlation used to Compare WTP Baseline and Experimental Wear Rate Estimates

$$E_w = E_{wref}\left[\frac{V_a}{V_{ref}}\right]^n\left[\frac{P_a}{P_{ref}}\right]^p\left[(1-I)\left(\frac{G}{C_{ref}}\right)^q + I\left(\frac{H}{C_{ref}}\right)^q\right](F)(E)(D)(Ia)(Sc)$$

Equation presented in reference: CCN 137165

where

- E_w = Scar depth at end of design life (mpy)
- E_{wref} = Scar depth of reference case (mpy)
- V_a = Velocity of jet actual (m/s)
- V_{ref} = Velocity of jet from reference case (m/s)
- P_a = Particle mean diameter actual (m)
- P_{ref} = Particle mean diameter from reference case (m)
- I = Fraction of time for maximum solids loading (%)
- G = Normal Solids concentration (wt%)
- H = Maximum Solids concentration (wt%)
- C_{ref} = Reference case concentration (wt%)
- F = Vessel usage factor (%)
- E = PJM Duty Factor (%)
- D = Design Life (yrs)
- Ia = Factor for impingement angle
- Sc = Scale Factor (1/4 to full scale).

The exponents n,p,q are experimentally derived

V_{ref}, P_{ref}, C_{ref} are from experimental conditions and E_{wref} is the measured wear at those conditions

Experimental Measurements taken to Estimate Erosion

Primary data used in analysis

- Scar depth
- Mass loss
- Flowrate
- Simulant particle size
- Simulant concentration

Test Apparatus

- Offset of coupon to nozzle
- Nozzle diameter

Simulant

- Particle size distribution
- Particle size of individual components
- Concentration
- Abrasivity

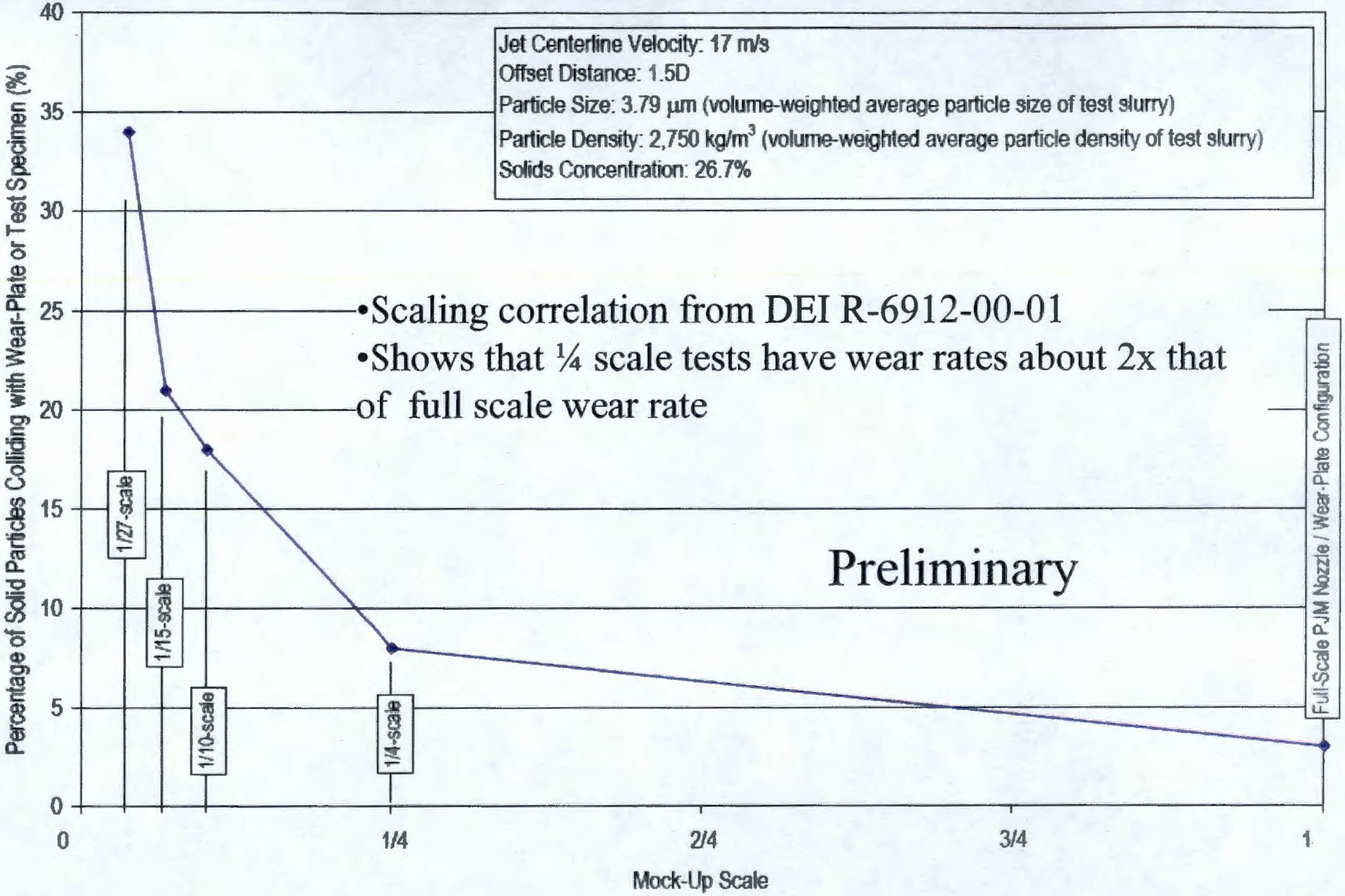
Test Coupon

- Dimensions
- Weight before and after test
- Geometry of wear (scar depth)

Operating Conditions

- Discharge velocity
- Test duration

Scaling Factor

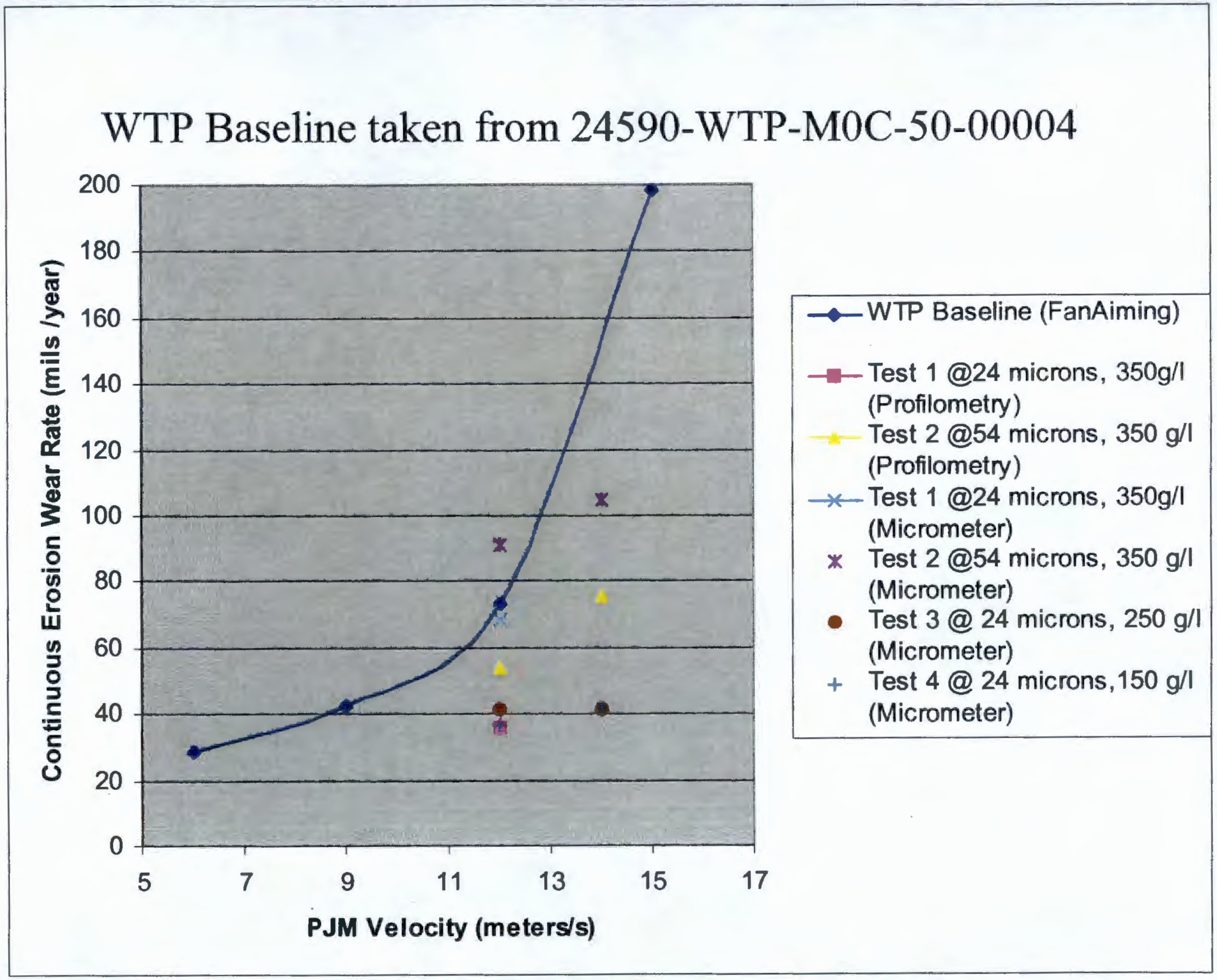


- Scaling correlation from DEI R-6912-00-01
- Shows that ¼ scale tests have wear rates about 2x that of full scale wear rate

Initial Test Results to date (all tests are 96 hr duration)

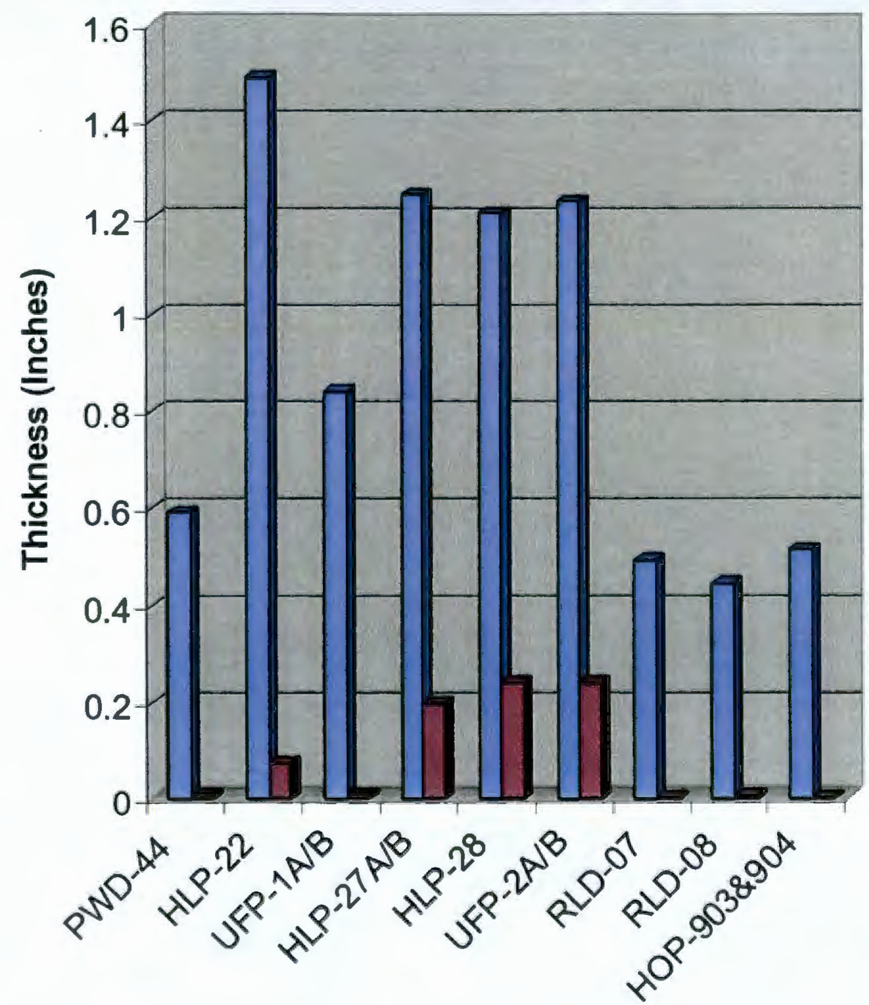
	Mass loss (grams)	PJM velocity (meters/s)	Slurry concentration (grams/liter)	Coupon	Scar (inches) micrometer	Scar (inches) Profilometry	Mean Particle size (microns)
Test run 1	3.4373	12	350	SS	0.0015	0.00078	24
Test run 2	5.0141	12	350	SS	0.002	0.00118	54
	7.6467	14	350	SS	0.0023	0.00165	54
Test run 3	1.2894	12	250	SS	0.0009		24
	2.2124	14	250	SS	0.0009		24
Test run 4	0.8756	12	150	SS	0.0008		24
	1.4029	14	150	SS	0.0009		24

Erosion comparison between Experimental Results and WTP baseline



- Majority of data indicates WTP wear rate data is bounded by WTP Baseline (FanAiming)
- 24 micron test represents mean particle size from WTP-153
- 54 micron test was performed as a sensitivity

40 yr Erosion Estimate based on worst scar depth (adjusted for scale)

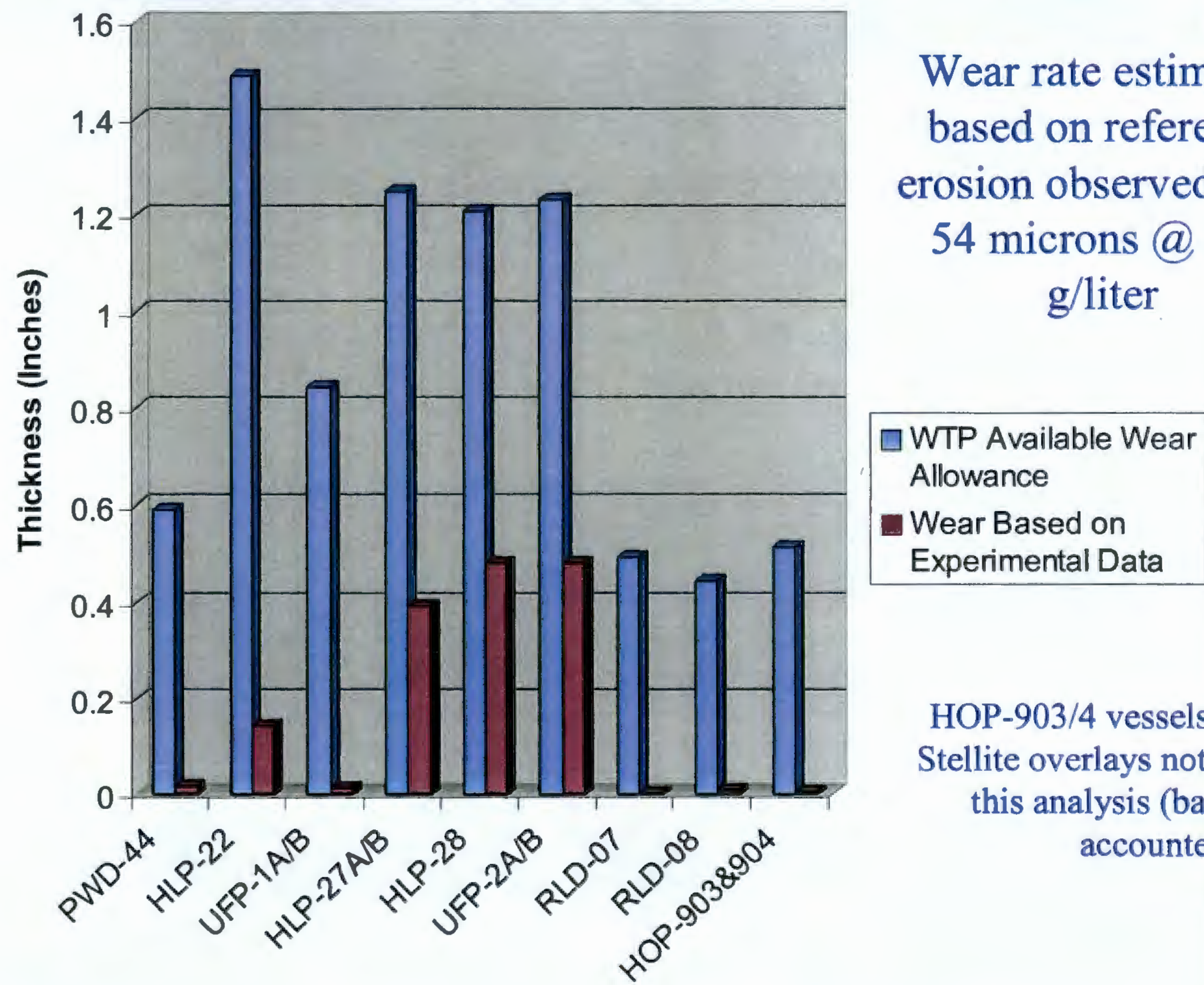


Wear rate estimates based on reference erosion observed with 54 microns @ 350 g/liter

HOP-903/4 vessels have additional Stellite overlays not yet factored into this analysis (base metal only accounted for) Equivalent thickness of total vessel allowance will be greater.

PJM velocity and duty factor selected for maximum wear

40 yr Erosion Estimate based on worst scar depth (not adjusted for scale)



Wear rate estimates based on reference erosion observed with 54 microns @ 350 g/liter

HOP-903/4 vessels have additional Stellite overlays not yet factored into this analysis (base metal only accounted for)

PJM velocity and duty factor selected for maximum wear

Conclusions and Path Forward

Conclusions

- Testing to date confirms adequacy of the existing vessel design

Path Forward

- Complete remaining 4 tests (all tests are going according to schedule). All testing results will be obtained by July,28, 2008

Run 5	Jet 1	39-µm	Per Hold 5	3.6 mohs	14 m/s	90°	refreshed	Continuous	Note 1 & 3
	Jet 2	39-µm	Per Hold 5	3.6 mohs	12 m/s	90°	refreshed	Continuous	
Run 6	Jet 1	24-µm	Per Hold 5	3.6 mohs	17 m/s[4]	90°	refreshed	Continuous	
	Jet 2	24-µm	Per Hold 5	3.6 mohs	8 m/s	90°	refreshed	Continuous	
Run 7	Jet 1	24-µm	Per Hold 5	4.4 mohs	12 m/s	90°	refreshed	Continuous	Note 1
	Jet 2	24-µm	Per Hold 5	4.4 mohs	12 m/s	90°	refreshed	Continuous	Use Ultimet® Coupon
Run 8	Jet 1	24-µm	Per Hold 5	3.6 mohs	12 m/s	65°	refreshed	Continuous	Note 1
	Jet 2	24-µm	Per Hold 5	3.6 mohs	12 m/s	90°	refreshed	Continuous	Use Ultimet® Coupon

  - Prepare final report to close out EFRT IRP for issue M2 by September 30, 2008

Attachment 2
08-ESQ-109

Erosion Resistance of Stellite Compared to Stainless Steel

R10923116

RPP WTP

Memorandum

To: Ivan Papp
From: Robert Davis
Ext: 371-3086
Fax:

Date: June 10, 2008
CCN: 179733

Subject: **SBS CONDENSATE VESSELS - HASTELLOY C22 EROSION (SUPERSEDES 160602)**

Reference: Kenneth J. Imrich, Brian K. Sides, and James T. Gee, Corrosion/Erosion Resistance of Ultimet® R31233 in a Simulated Feed for a Radioactive Vitrification Facility, WSRC-MS-98-00655

As discussed; Can the erosion-corrosion testing now underway at DEI (Dominion Engineering) on Type 304L coupons be comparable in any way to the materials of construction used in the SBS Condensate vessels 903 and 904? To clarify, the SBS Condensate vessels (HOP-VSL-00903 and HOP-VSL-00904) were fabricated using a high nickel super alloy manufactured by Haynes International called Hastelloy C-22 (UNS N06022). The question again; is the Hastelloy C-22 as good as or better than Type 304L stainless steel with respect to two-phase WTP slurry waste erosion corrosion?

The referenced paper discusses and presents results from a series of materials tests performed at the United States Department of Energy's Savannah River Site (SRS). The materials testing included corrosion, erosion and corrosion/erosion tests using simulated sludge/borosilicate glass frit slurry. The standard DWPF simulant uses borosilicate frit #202 with a median and mean particle size of 50μm and 70μm respectively. This frit was used for the erosion, erosion/corrosion, and SAR tests. The materials tested included four specialty alloys manufactured by Haynes International and are similar to those used at the WTP. The testing included erosion, corrosion, erosion/corrosion and Slurry Abrasion Response Number testing using Type 304L stainless steel, C-276, Stellite® ST6B, and Ultimet® coupons.

Approximate Composition of Borosilicate Frit #202

Oxide	~ Wt. %	Oxide	~ Wt. %	Oxide	~ Wt. %
Al_2O_3	2.99	CuO	0.40	MnO_2	1.69
B_2O_3	10.33	Fe_2O_3	13.25	Na_2O	12.62
BaO	0.20	K_2O	3.41	NiO	1.19
CaO	1.09	Li_2O	3.22	SiO_2	46.50
Cr_2O_3	0.15	MgO	1.41	TiO_2	0.58

Although the simulant in the corrosion testing used Formic and Nitric acid waste blends, a series of erosion tests were completed that used only a frit and water combination. The frit simulant selected was a combination of off gas mineral and glass phases, similar to what might be expected in the SBS Condensate vessels 903 and 904. The list below reports the results they obtained.

Average Degradation Rates for the Erosion Tests @ 100°C

Material	Erosion Frit/Water	
	mm/yr	mils/yr
Ultimet	0.002	0.073
C-276	0.003	0.123
ST6B	0.004	0.173
304L	0.006	0.250

The test matrix included the four materials; austenitic stainless steel (304L), high nickel alloy (C-276), and the two high cobalt alloys (Stellite and Ultimet). The WTP SBS condensate vessels (HOP-VSL-00903 and HOP-VSL-00904) are fabricated using Hastelloy C-22. Hastelloy C-22 is similar to C-276 in chemistry and performance. The table lists the composition of the four alloys tested and Hastelloy C-22 for comparison. One of the key differences between the two is the improved pitting and crevice corrosion resistance with Hastelloy C-22 as well as a slightly higher hardness of the produced plate.

Hardness and Nominal Composition (wt%) for the Materials Tested

Material	Hardness	Ni	Cr	Fe	W	Co	Mo	Mn	Si	C
Type 304L	88 HRB	9.0	19.0	Bal	--	--	--	2.0	1.0	0.03
*Type 316L	87 HRB	14.0	18.0	Bal	--	--	3.0	2.0	0.03	0.03
Hastelloy C276	90 HRB	Bal	15.0	5.5	4.0	2.5	16.0	1.00	0.08	0.01
**Hastelloy C22	95 HRB	Bal	22.0	3.0	3.0	2.5	13.0	0.50	0.08	0.010
Ultimet	28 HRC	9.0	26.0	3.0	2.0	54.0	5.0	0.8	0.30	0.06
Stellite 6B	38 HRC	3.0	30.0	3.0	4.5	Bal	1.5	2.00	2.00	1.10

* Type 316L was not used in the test program, but has similar chemistry to Type 304L
** Hastelloy C-22 was not used in the test program, but has similar chemistry as C-276

Based on the referenced paper and other knowledge, it is appropriate to consider the Hastelloy C-22 performance as good as or better than the austenitic stainless steel.

Robert Davis, PhD MSE
Materials Engineering Technology

Distribution

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Julyk, John	MS 5-G
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