CORROSION EVALUATION

R11061745

HLP-BRKPT-00004 & HLP-BRKPT-00006 (PTF)
Cs Concentrate Receipt Breakpots

ISSUED BY
RPP-WTP PDC

- Design Temperature (°F) (max/min): 383/59
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell; rooms P-0102 and P-0102A

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- While the breakpots are normally empty and at ambient temperatures, high-pressure steam is received in the breakpots; therefore, short-term operations at temperatures up to 212 °F are considered.

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 N06022

Recommended Corrosion Allowance:

Vessel -- 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Deflector Assembly -- 0.080 inch on each wetted surface (includes 0.024 inch corrosion allowance and 0.01 inch erosion allowance)

Process & Operations Limitations:

- Flush with water before acid washing.

Concurrence GJ
C & T

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
6	5/20/09	Incorporate additional references for suitability of recommended mat'l	DL Adler	RBDavis	NA	SWVail

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REVISION HISTORY

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	MET	APPROVER
5	10/7/08	Incorporate revised PCDS Revise mat'l recommendation Specify internals corrosion allowance Add AEA note to page2	DLAdler	JRDivine	RBDavis	SWVail
4	3/28/06	Update wear allowance based on 24590-WTP-RPT-M-04-0008	DLAdler	HMKrafft	NA	SWVail
3	5/17/04	Addition of information regarding inadvertent nitric acid addition Append updated PCDS	DLAdler	APRangus	NA	SWVail
2	5/11/04	Incorporate new PCDS Change in mat'l recommendation due to new process data	DLAdler	JRDivine	APR	APRangus
1	9/30/03	Correct from BRKPT-00005 to BRKPT-00006 Update vessel description Update design temp/pressure Re-format references Append updated MSDS	DLAdler	JRDivine	NA	SWVail
0	9/12/02	Initial Issue	DLAdler	JRDivine	SS	SMKirk

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.

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Corrosion Considerations:

Unneutralized Cs concentrate is transferred to HLP-VSL-00027A and HLP-VSL-00028 through HLP-BRKPT-00004 and HLP-BRKPT-00006.

a General Corrosion
Hamner (1981) lists a corrosion rate for type 304 (and type 304L) in 2 M HNO_3 of less than 2 mpy. Davis (1994) states the corrosion rate for 304L in 12% HNO_3 will be less than about 1 mpy up to about 212°F.

Hamner (1981) shows type 316 (and type 316L) has a rate of less than 2 mpy up to 122°F and 50% NaOH. Dillon (2000) and Sedriks (1996) both state that the 300 series alloys are acceptable in up to 50% NaOH at temperatures up to about 122°F or slightly above.

Even though significant quantities of Al^{+3} are present, the fluoride concentration is sufficient to cause high uniform corrosion rates in the 300 series stainless steels; therefore, a high nickel alloy such as C-22® (N06022) will be required. C-22 has a corrosion rate of about 1 mpy in 5 % HNO_3 at boiling (Haynes, 2002). In these solutions with <5 % HNO_3 and <1 % HCl, the corrosion rate will be smaller.

Conclusion:
In the presence of expected levels of halides, the recommended material is C-22® (N06022) with a corrosion allowance of 0.04 inch. Because of localized effects at the inlet, a higher corrosion allowance is recommended for the internal deflector assembly. The each wetted surface of the deflector assembly should have a corrosion allowance of 0.080 inch.

b Pitting Corrosion
With C-22® (N06022), pitting is not expected to be a problem.

Conclusion:
No significant pitting is expected.

c End Grain Corrosion
Not believed to be applicable to this system.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
C-22® (N06022) is not susceptible to stress corrosion cracking under these conditions.

Conclusion:
Not anticipated.

e Crevice Corrosion
See Pitting.

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)
The proposed operating conditions are not suitable for MIC.

Conclusion:
MIC is not considered a problem.

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h Fatigue/Corrosion Fatigue
Corrosion fatigue is a not expected to be a concern.

Conclusions
Not believed to be a concern.

i Vapor Phase Corrosion
Vapor phase corrosion is not expected to be a concern. Further, the presence of wash rings indicates deposits can be prevented.

Conclusion:
Not expected to be a concern

j Erosion
There are no solids and velocities within the breakpots are expected to be low. Erosion allowance of 0.004 inch for components with solids content less than 2 wt% at velocities less than 4 mps is based on 24590-WTP-RPT-M-04-0008.

Conclusion:
Not considered to be a problem.

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:
None anticipated

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
Breakpots normally operate at low pH.

Conclusion:
Not applicable.

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References:

1. 24590-WTP-RPT-M-04-0008, Rev. 2, *Evaluation Of Stainless Steel Wear Rates In WTP Waste Streams At Low Velocities*
2. CCN 130173, Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
3. CCN 167386, Memo from K Eager to D Adler, 1 February 2008, "Revised Process Corrosion Data Sheets For CNP VSL 00003 and CNP BRKPT 00001, CNP EVAP 00001 and CNP HX 00001, and HLP BRKPT 00004 and HLP BRKPT 00006"
4. Davis, JR (Ed), 1987, *ASM Handbook Volume 13: Corrosion*, ASM International, Metals Park, OH 44073
5. Davis, JR (Ed), 1994, *ASM Specialty Handbook: Stainless Steels*, ASM International, Metals Park, OH 44073
6. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX
7. Haynes International, Inc., Hastelloy® C-22 Alloy®, 2002.
8. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158

Bibliography:

1. 24590-PTF-MVD-HLP-00011, Rev. 6, *24590-PTF-MV-HLP-BRKPT-00006 - HLP System CS Concentrate Receipt Breakpot*
2. 24590-WTP-RPT-PR-04-0001, Rev. C, *WTP Process Corrosion Data*
3. CCN 130171, Ohl, 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.
4. CCN 130175, Boschen, Steve, http://www.al6xn.com/images/stainlessguide.pdf
5. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
6. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
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8. Rebak, RB, 2006, *Industrial Experience on the Caustic Cracking of Stainless Steels and Nickel Alloys – A Review, UCRL-PROC-216072*, Presented at Corrosion/2006 Conference and Exposition, San Diego, CA, March 12-16, 2006, NACE International, Houston TX 77218.
9. Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
10. Van Delinder, LS (Ed), 1984, Corrosion Basics, NACE International, Houston, TX 77084
11. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158
12. Wilding, MW and BE Paige, 1976, *Survey on Corrosion of Metals and Alloys in Solutions Containing Nitric Acid*, ICP-1107, Idaho Chemical Programs, Idaho National Engineering Laboratory, Idaho Falls, ID,

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Attachment to CCN 167386
Replaces Page A-21
24590-WTP-RPT-PR-04-0001, Rev. C
WTP Process Corrosion Data

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Cs concentrate receipt breakpot (HLP-BRKPT-00004, HLP-BRKPT-00006)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Max[2]		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/L	1.38E+01	1.29E+01			Assumption 1
Chloride	g/L	5.29E+00	5.89E+00			Assumption 1
Fluoride	g/L	6.28E+00	7.02E+00			Assumption 1
Iron	g/L	1.01E+00	1.05E+00			Assumption 1
Nitrate	g/L	5.78E+02	5.80E+02			Assumption 1
Nitrite	g/L	2.93E+01	3.25E+01			Assumption 1
Phosphate	g/L	2.11E+01	2.30E+01			Assumption 1
Sulfate	g/L	1.12E+01	1.25E+01			Assumption 1
Mercury	g/L	1.72E-02	7.88E-03			Assumption 1
Carbonate	g/L	3.95E+01	4.03E+01			Assumption 1
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/L					
Other	g/L					
pH	N/A					Assumption 2
Temperature	°F					Note 3

List of Organic Species:

References

System Description: 24590-PTF-3YD-HLP-00001
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: CNP12, CNP17 (Cs Conc from CNP-VSL-00003: same as CNP12)
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: N/A
PFD: 24590-PTF-M5-V17T-00008
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. Steam is used for transfer. The breakpot is normally empty and at ambient temperature most of the time.

Assumptions:

1. Compositions are assumed the same as that of unneutralized cesium concentrate in CNP-EVAP-00001.
   Cesium concentrate is normally transfered in an acidic (un-neutralized) state (page 1 of TN-24590-06-02962).
2. pH approx -0.7 consistant with 5-8 M HNO3.
   Minimum pH -0.9, consistant with 8 M nitric acid.
   Maximum pH approx 14, consistant with the non-routine neutralization of Cs concentrate.

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Attachment to CCN 167386
Replaces section 4.6.1 of
24590-WTP-RPT-PR-04-0001, Rev. C
WTP Process Corrosion Data

4.6.1 Cs Concentrate Receipt Breakpots (HLP-BRKPT-00004/6)

Routine Operations

Vessels HLP-VSL-000027A and HLP-VSL-00028 receive acidic Cs concentrate through breakpots HLP-BRKPT-00004 and HLP-BRKPT-00006.

Non-Routine Operations that Could Affect Corrosion or Erosion

Cs concentrate can also be received in a neutralized (alkaline) state.