PLANT ITEM MATERIAL SELECTION DATA SHEET

R10667001

CNP-BRKPT-00001, (PTF)
Cs Concentrate Breakpot

- Design Temperature (°F) (max/min): 372/40
- Design Pressure (psig) (internal/external): 15/FV
- Location: incell

ISSUED BY
RPP-WTP PDC

Contents of this document are Dangerous Waste Permit affecting

Operating conditions are as stated on attached Process Corrosion Data Sheet

Operating Modes Considered:

- The vessel is normally empty and at ambient temperature

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: 316 (max 0.030% C; dual certified), or better

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

Process & Operations Limitations:

- Develop procedure for thorough removal of caustic solution by rinsing/flushing before adding acidic solutions.

STEVEN WAKEMAN VAIL
STATE OF WASHINGTON
39250
REGISTERED PROFESSIONAL ENGINEER
3/8/06
EXPIRES: 12/07/07

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 6 sheets.

REV	DATE	REASON FOR REVISION	PREPARER	CHECKER	APPROVER
1	3/8/06	Issued for Permitting Use	[signature]	[signature]	[signature]
0	6/23/04	Issued for Permitting Use	DLA	JRD	APR

PLANT ITEM MATERIAL SELECTION DATA SHEET

Corrosion Considerations:

This vessel is normally empty but is available to receive recovered acid flows from the Cs evaporator nitric acid rectifier or from the Cs ion exchange columns or Cs concentrate from the Cs evaporator separator vessel.

a General Corrosion
Hamner (1981) lists a corrosion rate for 304 (and 304L) in NaOH of less than 20 mpy (500 μm/y) at 77°F and over 20 mpy at 122°F. He shows 316 (and 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. Davis (1994) states the corrosion rate for 304L in pure NaOH will be less than about 0.1 mpy up to about 212°F though Sedriks states the data beyond about 122°F are incorrect.

Hamner (1981) lists a corrosion rate for 304 (and 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.

Conclusion:
316L is expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy at the stated conditions providing breakpots are flushed before acidic solutions are introduced.

b Pitting Corrosion
Chloride is notorious for causing pitting in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions, pH>12, chlorides are likely to promote pitting only in tight crevices. At pH < 12, chloride can be a concern. However, Revie (2000) and Uhlig (1948) both note nitrate inhibits chloride corrosion. Therefore the nitrate concentration in the solution is expected to be beneficial and 316L can be used if the chloride concentration is not more than stated.

Conclusions
Under the stated conditions, 316L is the minimum alloy recommended.

c End Grain Corrosion
Not applicable to this system.

Conclusion:
Not applicable to this system.

d Stress Corrosion Cracking
The exact amount of chloride required to stress corrosion crack stainless steel 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), stress corrosion cracking does not usually occur below about 140°F. Further, the use of "L" grade stainless reduces the opportunity for sensitization to cracking.

Conclusions:
At the normal operating environment 316L stainless steel is expected to be 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.

Conclusion:
Weld corrosion is not considered a problem for this system.

g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are suitable for MIC. However, MIC is not normally observed in operating systems except for those exposed to untreated process water.

Conclusion:
MIC is not considered a problem.

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

Conclusions
Not believed to be a concern.

PLANT ITEM MATERIAL SELECTION DATA SHEET

i Vapor Phase Corrosion
No vapor phase corrosion is expected.

Conclusion:
Not applicable.

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:
None expected.

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 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 Nitric Acid Addition
Higher chloride contents and higher temperatures usually require higher alloy materials. Nitrate ions inhibit the pitting and crevice corrosion of stainless alloys. Furthermore, nitric acid passivates these alloys; therefore, lower pH values brought about by increases in the nitric acid content of process fluid will not cause higher corrosion rates for these alloys. The upset condition that was most likely to occur is lowering of the pH of the vessel content by inadvertent addition of 0.5 M nitric acid. Lowering of pH may make a chloride-containing solution more likely to cause pitting of stainless alloys. Increasing the nitric acid content of the process fluid adds more of the pitting-inhibiting nitrate ion to the process fluid. In addition, adding the nitric acid solution to the stream will dilute the chloride content of the process fluid.

Conclusion:
The recommended materials will be able to withstand a plausible inadvertent addition of 0.5 M nitric acid.

PLANT ITEM MATERIAL SELECTION DATA SHEET

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. B, *WTP Process Corrosion Data*
3. CCN 130173, Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
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
7. Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
8. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
9. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158

Bibliography:

1. 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
2. CCN 130175, Boschen, Steve, http://www.al6xn.com/images/stainlessguide.pdf
3. CCN 130176, Cole, HS, 1974, *Corrosion of Austenitic Stainless Steel Alloys Due to HNO_3 – HF Mixtures*, ICP-1036, Idaho Chemical Programs – Operations Office, Idaho Falls, ID
4. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. Phull, BS, WL Mathay, & RW Ross, 2000, *Corrosion Resistance of Duplex and 4-6% Mo-Containing Stainless Steels in FGD Scrubber Absorber Slurry Environments*, Presented at Corrosion 2000, Orlando, FL, March 26-31, 2000, NACE International, Houston TX 77218.
7. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084
8. 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

PLANT ITEM MATERIAL SELECTION DATA SHEET

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

PROCESS CORROSION DATA SHEET

Component(s) (Name/ID #) Eluate contingency vessel (CNP-VSL-00003)
Eluate contingency breakpot (CNP-BRKPT-00001)

Facility PTF

In Black Cell? Yes

Chemicals	Unit[1]	Contract Max		Non-Routine 4		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.17E+01	1.10E+01			
Chloride	g/l	4.51E+00	5.02E+00			
Fluoride	g/l	5.36E+00	5.98E+00			
Iron	g/l	8.60E-01	8.97E-01			
Nitrate	g/l	4.93E+02	4.94E+02			
Nitrite	g/l	2.49E+01	2.77E+01			
Phosphate	g/l	1.80E+01	1.96E+01			
Sulfate	g/l	9.58E+00	1.06E+01			
Mercury	g/l	1.47E-02	6.71E-03			
Carbonate	g/l	3.36E+01	3.43E+01			
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 3
Temperature	°F					Note 2
						Note 4

List of Organic Species:

References

System Description: 24590-PTF-3YD-CNP-00001, Rev 0
Mass Balance Document: 24590-WTP-M4C-V11T-00005, Rev A
Normal Input Stream #: CNP12, CNP14, CXP11, CXP12
Off Normal Input Stream # (e.g., overflow from other vessels): N/A
P&ID: N/A
PFD: 24590-PTF-M5-V17T-P0014, Rev 1
Technical Reports: N/A

Notes:

1. Concentrations less than 1x 10^{-4} g/l do not need to be reported; list values to two significant digits max.
2. Steam is used for transfer. The breakpot is normally empty and at ambient temperature most of the time.
   CNP-VSL-00003: T normal operation 77 °F (eluate stream) to 140 °F (24590-PTF-M5C-CNP-00001, Rev 0)
3. Composition can vary and is received on a contingency basis.
   The vessel reveives Cs Eluate at low pH of approx. 0.3 or more, with low levels of Cl, F, etc, also can receive Cs Evap Concentrate that has been neutralized to pH approx. 14 with high levels of Cl, F, etc. Minumum pH based on 0.5M nitric acid
4. Note CXP11 has the same composition as CXP21 but CXP21 does not appear in the mass balance because it is a contingent stream to the vessel.

Assumptions:

This vessel is a contingency vessel and under normal operations contains a heel only. It is available to receive Cs Concentrate and Cs Eluate.

PLANT ITEM MATERIAL SELECTION DATA SHEET

4.1.1 Cs Evaporator Breakpot (CNP-BRKPT-00001)

Routine Operations

This vessel is normally empty and is not used on a routine basis but is available to receive Cs concentrate and Cs eluate, which drains to the eluate contingency storage vessel (CNP-VSL-00003).

Non-Routine Operations that Could Affect Corrosion/Erosion

Recovered acid flows by gravity from the bottom of the Cs evaporator nitric acid rectifier (CNP-DISTC-00001) to the Cs evaporator recovered nitric acid vessel (CNP-VSL-00004). CNP-VSL-00004 has enough eluant to complete one elution of a normal bed of SuperLig 644 resin. If the acid needs reprocessing, as evidenced by an activity above allowable levels, it is recycled through the nitric acid recovery process by way of a steam ejector to the Cs concentrate breakpot, CNP-BRKPT-00001, draining to the eluate contingency storage vessel (CNP-VSL-00003). Then it is sent back to the cesium evaporator breakpot (CNP-BRKPT-00002) at the beginning of the system. If the acid is acceptable (low gamma and correct HNO_3 concentration), it is transferred directly into the eluant stream feeding the IX columns.