PLANT ITEM MATERIAL SELECTION DATA SHEET

R10685021

CNP-VSL-00003 (PTF)

Eluate Contingency Storage Vessel

- Design Temperature (°F)(max/min): 255/40
- Design Pressure (psig) (max/min): 15/FV
- Location: incell
- PJM Discharge Velocity (fps): 40
- Drive Cycle: 17 % (at 40 fps)

ISSUED BY
RPP-WTP PDC

Off spring items

CNP-PJM-00013, CNP-PJM-00014, CNP-PJM-00015, CNP-PJM-00016, CNP-VSL-00166, CNP-RFD-00003

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 pH 0.3 at the normal operating temperature
- The vessel is pH 14 at the normal operating temperature
- Caustic available to wash rings and for neutralization prior to transfer

Materials Considered:

Material (UNS No.)	Relative Cost	Acceptable Material	Unacceptable Material
Carbon Steel	0.23		X
304L (S30403)	1.00	X (jacket only)	
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: Vessel: 316 (max 0.030% C; dual certified), or better
Jacket: 304 (max 0.030% C; dual certified), or better

Recommended Corrosion Allowance: 0.040 inch (includes 0.024 inch corrosion allowance and 0.016 inch general erosion allowance; additional localized protection required and discussed in section j)

Process & Operations Limitations:

- Develop procedure for thorough flushing/rinsing prior to addition of acid solutions.

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Corrosion Considerations:

Vessel is available to receive Cs concentrate and Cs eluate from the Cs evaporator breakpot. Also, if the HLP system cannot accept a required transfer, CNP-VSL-00003 is available to receive the transfer.

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. Uhlig (1948) shows the rate in water is < 1 mpy.

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 under all expected conditions.

b Pitting Corrosion
Chloride is notorious for causing pitting in acid and neutral solutions. Dillon (2000) is of the opinion that in alkaline solutions 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 concentrations in the solution are expected to be beneficial and either 304L or 316L can be used if the chloride conditions stated are met.

Some potential exists for pitting if the vessel contains waste, cooling fails and the solution begins to evaporate. Then chloride could concentrate at the interface making 316L marginal. However, conditions with hot solution are not anticipated.

Conclusion:
Under the stated conditions, 316L is the minimum alloy recommended. Evaporative conditions with salt concentrations at the interface are not anticipated to be a frequent occurrence.

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. The use of 316L is preferred over 304L because of greater cracking resistance.

According to Sedriks and Dillon (2000),, caustic cracking tends not to occur below 140°F, though Zapp suggests the temperature may be as high as 212°F. The high nitrate concentrations may inhibit pitting and cracking.

Some potential exists for cracking if the vessel contains waste, cooling fails and the solution begins to evaporate. Then chloride could concentrate at the interface making 316L marginal. However, conditions with hot solution are not anticipated.

Conclusion:
Because of the normal operating environment 316L stainless steel is expected to be acceptable. Evaporative conditions are not anticipated to be a frequent occurrence.

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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 applicable.

i Vapor Phase Corrosion
Due to agitation, some splashing is expected. Therefore there will be liquids on the dome of the vessel. This is not expected to be a concern because of the high nitrate content.

Conclusion:
Vapor phase corrosion is not expected.

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 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 solids concentrations of 2 wt% for a usage of 11 % operation as documented in 24590-WTP-M0E-50-00003. CNP-VSL-00003 requires at least 0.016-inch additional protection. The 2 wt% is considered to be conservative and is based on the WTP Prime Contract maximum. During normal operation, the solids content of CNP-VSL-00003 is expected to be well below the anticipated maximum.

The wear of the PJM nozzles can occur from flow for both the discharge and reflood cycles of operation. At least 0.010–inch of additional 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 solids concentrations of 2 wt% for usage of 11 % operation as documented in 24590-WTP-M0E-50-00003.

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 reflood velocities.

k Galling of Moving Surfaces
Not applicable.

Conclusion:
Not applicable.

l Fretting/Wear
No contacting surfaces expected.

Conclusion:
Not applicable.

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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.

PLANT ITEM MATERIAL SELECTION DATA SHEET

References:

1. 24590-WTP-M0E-50-00003, *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-PR-04-0001, Rev. B, *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. Dillon, CP (Nickel Development Institute), Personal Communication to J R Divine (ChemMet, Ltd., PC), 3 Feb 2000.
7. Hamner, NE, 1981, *Corrosion Data Survey*, Metals Section, 5th Ed, NACE International, Houston, TX
8. Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
9. Sedriks, AJ, 1996, *Corrosion of Stainless Steels*, John Wiley & Sons, Inc., New York, NY 10158
10. 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.
11. Uhlig, HH, 1948, *Corrosion Handbook*, John Wiley & Sons, New York, NY 10158

Bibliography:

1. Agarwal, DC, *Nickel and Nickel Alloys*, In: Revie, WW, 2000. *Uhlig's Corrosion Handbook*, 2nd Edition, Wiley-Interscience, New York, NY 10158
2. Blackburn, LD to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Evaluation of 240-AR Chloride Limit*, August 15, 1991.
3. Danielson, MJ & SG Pitman, 2000, *Corrosion Tests of 316L and Hastelloy C-22 in Simulated Tank Waste Solutions*, PNWD-3015 (BNFL-RPT-019, Rev 0), Pacific Northwest Laboratory, Richland WA.
4. Divine, JR, 1986, Letter to A.J. Diliberto, *Reports of Experimentation*, Battelle, Pacific Northwest Laboratories, Richland, WA 99352
5. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking*, ASM International, Metals Park, OH 44073
6. 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.
7. Van Delinder, LS (Ed), 1984, *Corrosion Basics*, NACE International, Houston, TX 77084

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.

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

4.1.4 Cs Evaporator Separator Vessel (CNP-EVAP-00001), Cs Evaporator Concentrate Reboiler (CNP-HX-00001), and Eluate Contingency Storage Vessel (CNP-VSL-00003)

Routine Operations

Eluate from CNP-BRKPT-00002 is gravity-fed through a lute pot, CNP-VSL-00001, into the separator vessel, CNP-EVAP-00001. The Cs evaporator eluate lute pot, CNP-VSL-00001, provides a vacuum seal between CNP-BRKPT-00002 and the Cs evaporator separator vessel, CNP-EVAP-00001. The cesium concentrate is transferred from the Cs evaporator separator vessel using transfer ejectors to send it to vessel HLP-VSL-00028 or HLP-VSL-00027B in the HLP system.

Non-Routine Operations that Could Affect Corrosion/Erosion

If the HLP system cannot accept additional volume at the time of a required transfer, the eluate contingency storage vessel, CNP-VSL-00003, will receive the transfer.