PLANT ITEM MATERIAL SELECTION DATA SHEET

R10682511

CNP-HX-00001 (PTF)

Cs Evaporator Concentrate Reboiler

ISSUED BY
RPP-WTP PDC

- Design Temperature (°F) (max/min): Shell side: 325/40; Tube side: 250/40
- Design pressure (psig) (max/min): Shell side: 50/FV; Tube side: 50/FV
- Location: hot cell

Design temperature and pressure information is considered bounding and to be confirmed by Vendor.

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 at the stated pH range at the normal operating 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 (shell-side)	
6% Mo (N08367/N08926)	7.64		X
Alloy 22 (N06022)	11.4	X	
Ti-2 (R50400)	10.1		X

Recommended Material:

Tube-side components: UNS N06022
Shell-side components (steam): 316 (max 0.030% C; dual certified)

Recommended Corrosion Allowance: Shell side and tube side; 0.040 inch (includes 0.024 inch corrosion allowance and 0.004 inch erosion allowance)

Process & Operations Limitations:

- Use DIW as process cooling water.

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5/24/06

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This bound document contains a total of 6 sheets.

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Corrosion Considerations:

a General Corrosion
In the proposed pH operating range, little specific information was found for the general/uniform corrosion of stainless steels or other material in the given waste. This lack of data is not critical because the alloys needed for the system typically fail by pitting, crevice corrosion, or cracking. On this basis, a corrosion allowance has little meaning though a nominal value is given.

Even during high chloride conditions, either 304L or 316L is expected to have a sufficiently low uniform corrosion rate.

Conclusion:
Both 304L and 316L are expected to be sufficiently resistant to the waste solution with a probable general corrosion rate of less than 1 mpy.

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 high nitrate concentrations in the solution are expected to be beneficial.

Because of the high chloride conditions, and the high design temperature, C-22 or better is required for the tube-side components of the reboiler that will be in contact with the waste. For the shell-side, which is in contact with steam only, 304L will be sufficiently resistant. However, taking into consideration the relatively elevated design temperature on the shell side and the increased possibility of crevice corrosion, 316L is recommended.

Conclusion:
The high chloride conditions are such that an alloy such as C-22 or better will be required for only the components in contact with waste. Otherwise, 316L is suitable.

c End Grain Corrosion
Not believed to be 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. 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. The use of high nickel alloys for the tube-side components (waste) reduces the susceptibility to cracking.

Conclusion:
With the suggested high chloride conditions, C-22 will be needed for the tube-side components.

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.

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g Microbiologically Induced Corrosion (MIC)
The proposed operating conditions are suitable for MIC. However, MIC is not normally observed in operating systems.

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
Not applicable to this system.

Conclusion:
Not expected to be a concern.

j Erosion
Velocities within the vessel 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 believed to be a concern.

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 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 Addition of Nitric Acid
Reboiler routinely operates 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. 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. CCN 130177, Zapp, PE, 2000, *Material Corrosion and Plate-Out Test of Types 304L and 316L Stainless Steel,* WSRC-TR-2000-00434, Savannah River Site, Aiken, SC
5. Davis, JR (Ed), 1987, *Corrosion, Vol 13,* In "Metals Handbook", ASM International, Metals Park, OH 44073
6. Revie, WW, 2000. *Uhlig's Corrosion Handbook,* 2nd Edition, Wiley-Interscience, New York, NY 10158
7. Sedriks, AJ, 1996, *Corrosion of Stainless Steels,* John Wiley & Sons, Inc., New York, NY 10158
8. Uhlig, HH, 1948, *Corrosion Handbook,* John Wiley & Sons, New York, NY 10158

Bibliography:

1. CCN 130170, Blackburn, LD to PG Johnson, Internal Memo, Westinghouse Hanford Co, *Evaluation of 240-AR Chloride Limit,* August 15, 1991.
2. 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.
3. Agarwal, DC, *Nickel and Nickel Alloys,* In: Revie, WW, 2000. *Uhlig's Corrosion Handbook,* 2nd Edition, Wiley-Interscience, New York, NY 10158
4. Davis, JR (Ed), 1994, *Stainless Steels,* In ASM Metals Handbook, ASM International, Metals Park, OH 44073
5. Hamner, NE, 1981, *Corrosion Data Survey,* Metals Section, 5th Ed, NACE International, Houston, TX
6. Jones, RH (Ed.), 1992, *Stress-Corrosion Cracking,* ASM International, Metals Park, OH 44073
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 #) Cs evaporator separator vessel (CNP-EVAP-00001)
Cs concentrate reboiler (CNP-HX-00001)

Facility PTF

In Black Cell? Yes (CNP-EVAP-00001 only)

Chemicals	Unit[1]	Contract Max		Non-Routine		Notes
		Leach	No leach	Leach	No Leach	
Aluminum	g/l	1.38E+01	1.29E+01			
Chloride	g/l	5.29E+00	5.89E+00			
Fluoride	g/l	6.28E+00	7.02E+00			
Iron	g/l	1.01E+00	1.05E+00			
Nitrate	g/l	5.78E+02	5.80E+02			
Nitrite	g/l	2.93E+01	3.25E+01			
Phosphate	g/l	2.11E+01	2.30E+01			
Sulfate	g/l	1.12E+01	1.25E+01			
Mercury	g/l	1.72E-02	7 88E-03			
Carbonate	g/l	3.95E+01	4.03E+01			
Undissolved solids	wt%					
Other (NaMnO4, Pb,...)	g/l					
Other	g/l					
pH	N/A					Note 2
Temperature	°F					Note 3

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 #: CNP02, CNP03,CNP12, CNP10,CNP20
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. pH approximately 0.3 to 14. Operates primarily at acidic end, NaOH added prior to transfer out. Minimum pH based on 0.5 M nitric acid.
3 Tnormal operation 122 °F to 140 °F (24590-PTF-M5C-CNP-00001, Rev 0)

Assumptions:
Breakpot CNP-BRKT-00001 and CNP-VSL-00003 are for non-routine use and are normally empty. These vessels can receive a range of evaporator concentrate.

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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.