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TABLE OF CONTENTS

1.0 PURPOSE 4
2.0 SCOPE 5
3.0 REFERENCES 7
4.0 METHODOLOGY 9
5.0 SYSTEM CONDITIONS 10
6.0 CORROSION PROCESSES 14
7.0 MATERIALS OF CONSTRUCTION EVALUATIONS 15
8.0 PROCESS ENCLOSURE MATERIALS 21
9.0 CONCLUSIONS 23

LIST OF APPENDICES

Appendix A - Tank Side Cesium Removal (TSCR) IXC-150 Corrosion White Paper 24
Appendix B – Materials of Construction Tabulation – Waste-Contacting Components 25
Appendix C – Materials of Construction Tabulation – Waste-Contacting Instruments 29
Appendix D – Materials of Construction Tabulation – Non-Waste-Contacting Components 31
Appendix E – Materials of Construction Tabulation – Non-Waste-Contacting Instruments 34
Appendix F – Materials of Construction Tabulation – Chemical Compatibility Components 36
Appendix G – Materials of Construction Tabulation – Chemical Compatibility – Instruments 39

LIST OF FIGURES

Figure 1. TSCR Block Flow Diagram 4

LIST OF TABLES

Table 1. General Material Requirements from RPP-SPEC-61910 6
Table 2. Select Physical Characteristics of Waste Feed 12
Table 3. Select Chemical Components of Waste Feed 12
Table 4. Typical Analysis of Hanford Water 12
Table 5. Metallic Materials in Contact with Tank Waste 16
Table 6. General Compositions of 304 and 316 Stainless Steel 16
Table 7. Non-Metallic Materials Chemical Compatibility Ratings* 18
Table 8. Non-Metallic Materials for Tank Waste-contacting Components 19
Table 9. Non-Metallic Materials in Potential Radiation Field 19
Table 10. Radiation Resistance for Non-Metallic Materials 20
Table 11. Non-metallic Materials for Chemical Compatibility 21

LIST OF TERMS

Abbreviations, Initialisms, and Acronyms

DST	double-shell tank
EPDM	ethylene-propylene-diene monomer
ERUL	Estimated Remaining Useful Life
FKM	Fluoro Rubber
IXC	ion exchange column
HDPE	high-density polyethylene
LAW	low activity waste
NaOH	sodium hydroxide
PTFE	polytetrafluoroethylene
TSCR	Tank Side Cesium Removal
UHMWPE	ultra-high molecular weight polyethylene
WTP	Waste Treatment and Immobilization Plant

Units

°C	degrees Celsius
cP	centipoise
°F	degrees Fahrenheit
gal	gallon
M	molar
pH	logarithm of the activity of dissolved hydrogen ions
ppm	parts per million
psi	pounds per square inch
psi(d)	pounds per square inch, differential

1.0 PURPOSE

The Tank Side Cesium Removal (TSCR) System consists of two primary waste processing operations, filtration and ion exchange, and uses limited reagents/chemicals and water. This evaluation identifies the materials of construction for each waste processing operation, the reagent/chemical system, and the water supply system for a 5-year system design life as specified by RPP-SPEC-61910, *Specification for the Tank-Side Cesium Removal Demonstration Project (Project TD101)*, and the applicable requirements of the State of Washington Administrative Code 173-303-640(3), "Tank Systems – Design and Installation of New Tank Systems or Components".

This report evaluates both corrosion and erosion, although corrosion was the main concern as the solids content of most systems is relatively low. Cathodic and/or induced corrosion is not considered.

The TSCR primary function is to remove entrained and suspended solids and radioactive cesium (primarily ^{137}Cs) from the double-shell tank (DST) System supernatant waste. The treated waste is stored in a designated DST (AP-106) for future transfer to the Waste Treatment and Immobilization Plant (WTP). The solids removed from the supernatant will be returned to a designated DST (AP-108). A block flow diagram of the TSCR is provided in Figure 1.

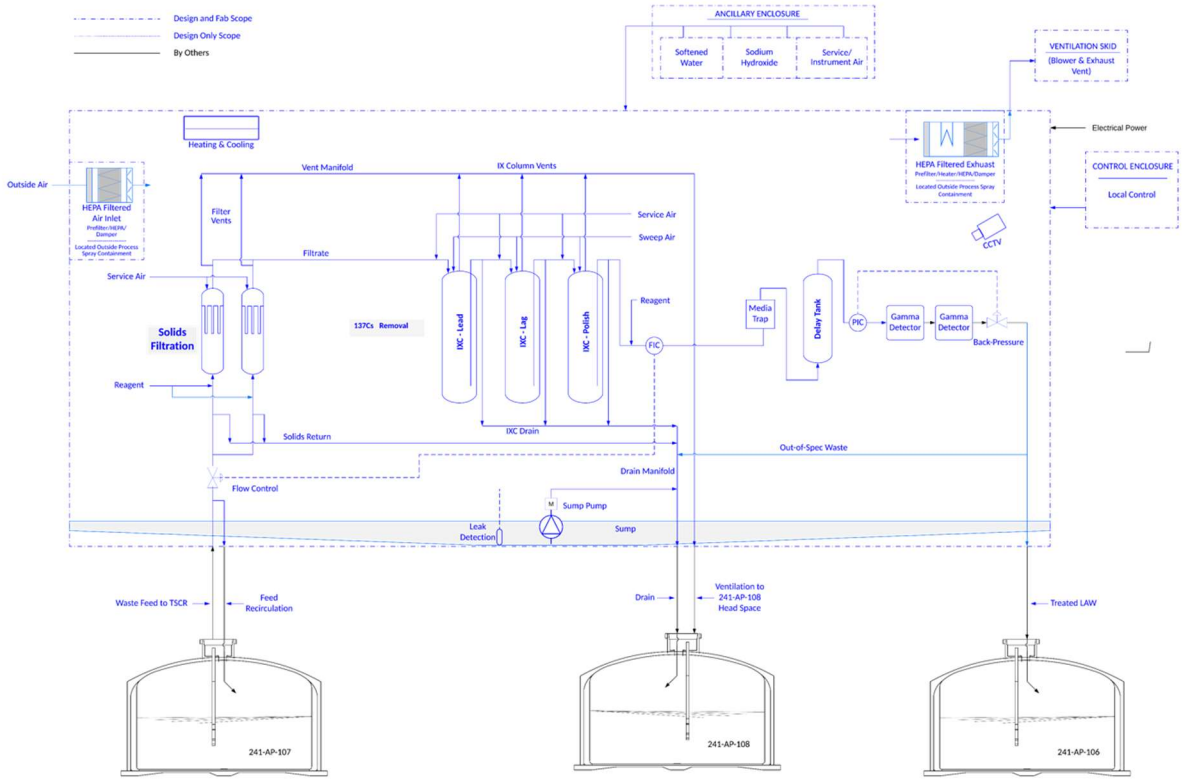

Figure 1. TSCR Block Flow Diagram

In order to evaluate materials for TSCR components, chemical constituents in the supernatant waste transfer and components of the support systems (e.g., reagent and water) were reviewed. The chemicals that could influence corrosion parameters in the waste feed include chlorides, fluorides, nitrates, nitrites, hydroxide, and sulfate. Similarly, the chemicals (and impurities) associated with the support systems that could influence corrosion parameters include chlorides, fluorides, nitrates, hydroxide, and sulfate. Other considerations for corrosion that were evaluated include:

- Temperature
- Flow rate
- pH
- 5-year system life

Proper selection of materials of construction and corrosion/erosion allowances are important for safety functions as required per RPP-SPEC-61910.

- For the Primary Process Piping and Pressurized Equipment, the safety function is to provide confinement of waste.
- For the Reagent System Confinement Boundary, the safety function is to provide confinement of corrosive chemicals.

2.0 SCOPE

The evaluation confirms that materials of construction used for the primary processes of filtration and cesium removal from tank waste supernatant are appropriate for their application in accordance with the requirements of the TSCR specification and supporting material compatibility documents, including:

- RPP-SPEC-61910, Section 3.3 – Design and Construction Requirements;
- TFC-ENG-STD-22, Section 3.5.2.1 – Corrosion Allowance; and
- TFC-ENG-STD-34, Section 3.2 – Materials Selection.

The evaluation focuses on the general material requirements from RPP-SPEC-61910, which are listed in Table 1, and considers chemical corrosion and erosion only. Other material requirements associated with cathodic/induced corrosion, welding, cleanliness, packaging, storage, transport and load handling are outside of the scope of this document. Specific material characteristics (e.g., yield, tensile, etc.) are addressed in applicable calculations and are also not addressed in this evaluation.

Table 1. General Material Requirements from RPP-SPEC-61910

Section	Requirement
3.3.5 a)	Equipment, components, and assemblies that may come into contact with waste or waste treatment materials shall be compatible with their physical, chemical, and radioactive properties including those in Table 3-7 above.
3.3.5 b)	Materials used shall be noncombustible and corrosion resistant in the environment in which they will be used, including chemical, galvanic, or other reactions that can occur between materials.
3.3.5 c)	Equipment providing a confinement function shall be fabricated of materials compatible with the material to be stored to minimize corrosion and generation of hydrogen.
3.3.5 e)	TFC-ENG-STD-34 shall be used for selection of non-metallic materials.
3.3.5 f)	Metallic surfaces, which will routinely contact tank waste, shall be fabricated from stainless steel.
3.3.5 g)	Corrosion-erosion allowance used for design shall comply with TFC-ENG-STD-22, Section 3.5.2.1.
3.3.5 h)	Components, including elastomeric seals, shall be selected to withstand a lifetime total integrated radiation dose consistent with dose and shielding calculations.
3.3.5.9.8 j)	Jumpers and piping systems used for liquid waste shall be of welded construction to the fullest extent practical. Materials of construction shall be selected to minimize all forms of corrosion.
3.3.5.11 b)	Bronze, copper, lead, zinc, tin, antimony, cadmium, or other low-melting point metals, their alloys, or materials containing such metals as their basic constituents or molybdenum and halogens, shall not be used in direct contact with stainless steel, with the exception of oil impregnated bronze bearings. This prohibition applies to use of tools, fixtures, and paints. This requirement does not apply to encapsulated lead shielding.
3.3.8 d) 6)	Materials contacting austenitic stainless steel and nickel-alloy surfaces shall not be compounded from, or treated with chemical compounds containing elements in such quantities that harmful concentrations are leachable, or that they could be released by breakdown under expected environmental conditions and could contribute to inter-granular cracking or stress corrosion cracking, such as those containing fluorides, chlorides, sulfur, lead, zinc, copper, and mercury.

3.0 REFERENCES

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8. RPP-SPEC-61910, Rev 1, "*Specification for the Tank-Side Cesium Removal Demonstration Project (Project TD101)*", Washington River Protection Solutions, LLC.

9. Sherwin Williams, MACROPOXY® 646N Product Data Sheet, 2018.

10. TFC-ENG-STD-22, Rev G-2, "*Piping, Jumpers, and Valves*", Washington River Protection Solutions, LLC.

11. TFC-ENG-STD-34, Rev A-1, "*Standard for the Selection of Non-Metallic Materials in Contact with Tank Waste*", Washington River Protection Solutions, LLC.

12. TOC-PRES-15-3560-FP, Rev 0, "*Determination of Erosion/Corrosion Rates in Hanford Tank Farms Radioactive Waste Transfer System Pipelines*", Washington River Protection Solutions, LLC.

13. State of Washington Administrative Code 173-303-640, "*Tank Systems*".

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16. RPP-CALC-62497, *TSCR IXC-150 Sizing*, AVANTech, Inc.

17. ASTM D870, *Standard Practice for Testing Water Resistance of Coatings Using Water Immersion*, ASTM International.

18. ASTM D1308, *Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes*, ASTM International.

19. ASTM D3911, *Standard Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions*, ASTM International.

20. ASTM D3912, *Standard Test Method for Chemical Resistance of Coatings and Linings for Use in Nuclear Power Plants*, ASTM International.

21. ASTM D4082, *Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants*, ASTM International.

22. ASTM D4256, *Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants*, ASTM International.

23. ASTM D6943, *Standard Practice for Immersion Testing of Industrial Protective Coatings and Linings*, ASTM International.

24. H-14-111280, Rev. 0, "*Process Enclosure Frame Weldment*", AVANTech, Inc.

25. RPP-RPT-60033, Rev. 0, "*Low Activity Waste Pretreatment System Non-Metallic Component Material Evaluation*", Washington Review Protection Solutions, LLC.

26. RPP-CALC-62570, *Radiation Shielding Calculation for Continuously and Intermittently Occupied Areas*, ARES Corporation.

4.0 METHODOLOGY

The evaluation focused on the compatibility of TSCR metallic materials and non-metallic materials in contact with tank waste under normal waste processing conditions. Radiation resistance, chemical resistance, temperature constraints, and application constraints are considered in this evaluation. Other components that would be in possible leak paths (i.e., sumps and mis-route prevention cabinets) are also considered. Finally, materials not exposed to tank waste were evaluated for chemical compatibility and/or radiation resistance as applicable.

4.1 NORMAL WASTE PROCESSING CONSIDERATIONS

This evaluation takes advantage of previous reports addressing materials of construction, corrosion and erosion at the Hanford Tank Farm and at WTP. Considerable research and evaluations have been performed on materials of construction selection for storing, transporting and treating essentially the same waste as will be treated in the TSCR System. These reports were augmented with other literature sources.

General (uniform) corrosion, localized corrosion including pitting corrosion, crevice corrosion and stress corrosion cracking, and erosion were considered. The most important consideration for selection of materials for the waste processing streams was to ensure that the materials will not be susceptible to excessive localized corrosion, as this could lead to premature failure of equipment or piping.

Considering the 5-year design life of the TSCR System, the hazardous nature of the materials handled, and the limited accessibility of the main process, the primary approach for this evaluation is one of conservatism. This conservative approach applies both to the selection of materials and to the corrosion/erosion allowances.

4.2 SPENT COLUMN PAD STORAGE

Ion exchange columns removed from service after processing waste supernatant are to be stored on a designated storage pad. AVANTech previously assessed the likelihood of corrosion in the ion exchange columns (IXCs) under storage conditions (i.e., residual water in a bulk dewatered column for a period of 50 years) [Reference 15]. The assessment is included as Appendix A.

5.0 SYSTEM CONDITIONS

5.1 TSCR SYSTEM

RPP-RPT-61030, "Process Operations Description", [Reference 7] provides an overall description of the TSCR System, including the sequence of activities for each condition assessed in this evaluation. In summary, the TSCR System filters entrained solids and separates cesium, both non-radioactive and radioactive isotopes, from 241-AP-107 supernatant waste using a simple once-through design with key elements of:

- Filtration to protect the ion exchange media from solids accumulation;
- Ion exchange to remove cesium from the liquid waste;
- Media trap to capture ion exchange media in the unlikely event of an IXC screen failure;
- Delay tank to allow decay of short-lived isotopes;
- Gamma detectors to verify effluent meets treated waste effluent requirements; and
- Backpressure to increase hydrogen solubility.

5.2 PROCESSING CONDITIONS

TSCR treats waste from 241-AP-107 at a nominal flow rate of 5 gpm. A normal cesium loading cycle begins with one filter and two IXCs in a lead-lag configuration. After exiting the last IXC, cesium-depleted supernatant passes through the Media Trap and Delay Tank before continuing through the back-pressure control valve to the Treated Waste Effluent Tank, 241-AP-106.

The system continues to run until the differential pressure across the filter increases 1.8 psi(d) or 24 hours of runtime have passed, whichever occurs first. At this time, valves open for service to the second filter. Both filters are in service simultaneously for a moment until the position indicators for the second filter confirm the open positions. At this point, the valves around the first filter close to remove it from service and ready it for backwash.

The system continues to run until the second filter differential pressure increases 1.8 psi(d) or another 24 hours have passed, whichever comes first. The same steps are repeated to bring the first filter, which has been backwashed, online. This cycling continues throughout the cesium loading cycle.

When the treated effluent threshold limit on the gamma detectors is activated, the inlet and outlet valves on the third IXC open. Now the ion exchange columns are running Lead-Lag-Polish. TSCR will continue to run, switching between the filters as described above, until the gamma detectors reach the treated waste setpoint criteria. At this point the lead and lag IXCs are deemed exhausted / loaded and the system will shut down so IXC changeout can occur.

Under normal processing conditions, the TSCR System experiences the following conditions:

1. Filled with waste supernatant (pH ≥ 13),
2. Filled with dilute sodium hydroxide (pH of 13),
3. Rinsed with softened water (pH of ~9 when accounting for residual sodium hydroxide), and
4. Bulk dewatered (i.e., service air is used to push fluid from piping and vessels).

All processing occurs at temperatures less than 35°C.

In addition to the above, the IXCs are dried with air after bulk dewatering to prepare for IXC changeout. Material selection for the IXCs during a 50-year outdoor storage period is addressed in Appendix A.

5.3 FLUIDS AND SERVICE AIR

The TSCR System handles four primary fluids and compressed air (i.e., service and instrument air) during operation. The primary fluids are: 1) waste, 2) reagent water, 3) sodium hydroxide, both concentrated and diluted solutions, and 4) softened water. As presented below, the tank waste supernatant contains concentrations of halogen ions (chloride and fluoride) that far exceed the concentrations in the reagent/chemical system. As such, waste feed is the predominant fluid considered during materials selection.

5.3.1 Waste Feed

The TSCR System receives waste feed from the DST System. Physical characteristics of the waste feed germane to the materials of construction evaluation are presented in Table 2. The normal operating temperature for all piping and equipment in waste service during normal operations is between 20 and 35°C.

Table 2. Select Physical Characteristics of Waste Feed

Parameter	Unit	Nominal Value	Range
Density	g/mL	1.27	1.0 – 1.35
Viscosity	cP	3.7	1 – 8
Solids Concentration	ppm	200	0 – 15,000
Waste Temperature	°C	25	20 – 35

Source: Reference 8, Table 3-4.

Likewise, Table 3 lists average concentrations of key chemical components present in the waste feed. The pH of the waste is ~14 based on the hydroxide [OH^-] concentration.

Table 3. Select Chemical Components of Waste Feed

Component	Unit	Liquid Phase	Solid Phase
Cl^-	gmole/L	7.94E-02	2.56E-05
F^-	gmole/L	5.29E-02	2.95E-04
NO_2^-	gmole/L	1.12E+00	3.41E-04
NO_3^-	gmole/L	1.64E+00	4.67E-04
OH^-	gmole/L	1.35E+00	4.23E-04
SO_4^{-2}	gmole/L	4.63E-02	5.62E-05

Source: Reference 8, Table 3-3.

5.3.2 Reagent Water

The Hanford Site supplies water for use in the TSCR reagent water system. Table 4 lists the composition of key anions of the as-received water from a 2016 analysis. The supplied water is stored in an insulated tank and maintained between 70 and 85°F by a dedicated heater and chiller.

Table 4. Typical Analysis of Hanford Water

Component	Unit	Reported Value
Cl^-	mg/L $CaCO_3$	6.66
F^-	mg/L $CaCO_3$	<0.020
NO_3^-	mg/L $CaCO_3$	0.249
SO_4^{-2}	mg/L $CaCO_3$	30.2
Free Chlorine (Cl_2)	mg/L	0.47

Source: Reference 14.

5.3.3 Softened Water

The reagent/chemical system employs a softened water system to condition the water prior to use. For softened water, the total chloride is comprised of both chloride and chlorine. The dissolved chloride content is 6.66 mg/L CaCO3 [Section 5.3.2], which is converted to 4.7 mg/L.

The concentration of free chlorine is 0.47 mg/L [Section 5.3.2]. Combining the dissolved chloride content with the free chlorine content provides a total value of 5.17 mg/L Cl^- in the softened water effluent. Therefore, the effluent chloride concentration of the softened water will be 5.17 mg/L.

5.3.4 Sodium Hydroxide

Sodium hydroxide (NaOH) is used as a reagent in TSCR. NaOH contains small amounts of impurities – including chloride. Membrane grade NaOH has a maximum chloride concentration of 50 ppm. The TSCR System uses 55-gal drums of 25wt% NaOH in ~ 5,000 gallons of softened water to produce a 0.1 M NaOH caustic solution that is used for displacing liquid waste and flushing TSCR components. Accordingly, a 50 ppm Cl^- concentration in the 25wt% sodium hydroxide reagent stock contributes 0.7 mg/L of Cl^- to the water used in TSCR. When combined with the softened water contribution, the total chloride concentration in the 0.1 M NaOH caustic solution is 5.87 mg/L.

5.3.5 Service Air

Air is supplied to the TSCR System by a dedicated compressor housed in the Ancillary Enclosure. The compressed air is conditioned by an on-demand desiccant dryer to remove residual humidity. Once conditioned, the compressed air is used for instrument air and service air. Instrument air provides the motive force for air-operated valves and select control valves. Service air is heated to 80°F by an in-line heater and is used for sweep air and blowdown / drying air. Neither air supply contains appreciable concentrations of nitrites, nitrates, sulfates, or halogen ions.

5.4 LIFETIME DOSE

The TSCR System includes integral shielding around the filters, ion exchange columns, delay tank and associated piping. The integral shielding limits the radiation field both within and external to the Process Enclosure. As personnel access will not be permitted during normal operations, the composite dose within the Process Enclosure was not formally estimated, but composite dose maps for the exterior of the Process Enclosure were estimated in RPP-CALC-62570, *Radiation Shielding Calculation for Continuously and Intermittently Occupied Areas*. RPP-CALC-62570 generated the dose maps using the maximum radionuclide conditions provided in RPP-SPEC-61910 and the IXC design basis

loading limit (141,600 Ci Cs-137), creating a conservative, bounding dose map at the exterior of the Process Enclosure. Using RPP-CALC-62570 as a guide, a bounding dose rate of 200 mrem/hr was selected for the interior of the Process Enclosure and used to estimate a lifetime dose to equipment and materials. As the dominant radiation type is gamma radiation, 1 rem of equivalent dose is equal to an absorbed dose of 1 Rad (10 CFR 20.1004) or 200 mrem/hr equates to 0.2 Rad/hr.

RPP-CALC-62497 estimates a cycle at the nominal waste feed concentration will last from 24 to 27 days, depending on whether the cycle is started with a fresh or partially expended lead IXC. Assuming a seven [7] day duration between completion of a campaign and start of a new campaign, the maximum lifetime dose over the 5-year design life is:

$$27\ \frac{d}{campaign} \times 24\frac{hr}{d} \times \left(\frac{365\ d}{27\ d + 7\ d}\right)\frac{campaign}{yr} \times 0.2\frac{Rad}{hr} \times 5\ yr = 7.0 \times 10^3\ Rad$$

At the end of each cycle, supernatant is displaced from the system in order to ready the exhausted IXCs for replacement. Accordingly, the TSCR system experiences intermittent radiation exposure during operations and, coupled with integral shielding and self-shielding of components, the actual lifetime dose is likely to be less than the lifetime dose presented above while still meeting the 70% annual integrated system availability requirement of RPP-SPEC-61910.

6.0 CORROSION PROCESSES

Corrosion is an electrochemical process by which materials return to their original energy state by sharing electrons and undergoing a change that can be measured in terms of mass loss or rate of penetration. In simple terms, corrosion is a process by which refined metals revert to the chemical composition of the original base ore. Its rate and severity are governed by environmental factors and the geometry of the affected structure. [Reference 2]

There are multiple forms of corrosion, but the primary forms applicable to Hanford tank waste processing are general (uniform) corrosion, pitting and crevice corrosion, intergranular corrosion, and stress corrosion cracking. Each of these forms are briefly described below [Reference 5]:

- **General (uniform) corrosion:** Corrosion that is distributed uniformly over the surface of a material without appreciable localization. This leads to relatively uniform thinning on sheet and plate materials and general thinning for pipe and tubing. General corrosion can be mitigated by proper material selection, such as stainless steel alloys with higher nickel and molybdenum content.

- **Pitting and crevice corrosion:** Pitting is localized corrosion of a metal surface that is confined to a point or small area and takes the form of cavities. Crevice corrosion is a form of localized corrosion of a metal or alloy surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment. Pitting and crevice corrosion can be mitigated by alloys with higher nickel and molybdenum contents. Standard weld procedures employed during fabrication can prevent creation of weld areas susceptible to pitting and crevice corrosion.

- **Intergranular corrosion:** Intergranular corrosion can occur in austenitic stainless steels that have been heated between 500 and 800°C, which typically occurs in the heat-affected zone induced by welding. Intergranular corrosion can be prevented by material selection and adherence to well-established weld protocols to prevent creation of susceptible weld areas during fabrication.

- **Stress corrosion cracking:** Stress corrosion cracking is the cracking of a material produced by the combined action of corrosion and sustained tensile stress. Stress corrosion cracking in austenitic stainless steels can occur when suitable conditions of tensile stress, solution chemistry, temperature and time are present. Halogens ions, particularly chloride ions, are associated with stress-corrosion cracking in aqueous solutions, especially in low pH solutions. In general, stress corrosion cracking is mitigated by proper material selection and maintaining elevated pH conditions (i.e., pH >9) where practical.

7.0 MATERIALS OF CONSTRUCTION EVALUATIONS

The components and piping were grouped by type and fluid exposure for materials of construction evaluations. The grouping is solely for the purpose of selecting materials of construction based on similarity of corrosive and erosive properties. Appendices B through F tabulate a list of each component and instrument by system, equipment identity number (EIN), service fluid (e.g., tank waste, reagent, compressed air, etc.), presence within a radiation field and materials of construction.

7.1 METALLIC MATERIALS IN CONTACT WITH TANK WASTE

Metallic materials were selected for their performance in contact with waste under normal processing conditions. In accordance with TFC-ENG-STD-22 [Reference 10], all metallic piping (and tubing) in contact with tank waste is 304 or 316 stainless steel. Similarly, all pressure vessels and waste processing components (e.g., valves) designed to provide primary confinement of waste supernatant are constructed of 316 stainless steel (Table 5).

Table 5. Metallic Materials in Contact with Tank Waste

Component Type	Metallic Material†
Air Operated Valves (AOVs)	316 SS
Delay Tank	316/316L SS
Filters	316/316L SS
Ion Exchange Columns (IXCs)	316/316L SS
Media Trap	316/316L SS; HASTELLOY® C-276
Piping	304/304L; 316/316L SS
Pressure Safety Valves (PSVs)	316 SS
Non-AOV Valves	316 SS

† Wetted materials only.

7.1.1 Type 304/304L and 316/316L Stainless Steel

Based on tank waste processing experience at Hanford, 300-series stainless steel is adequate for service (refer to Section 7.1.3). Although not required for the TSCR System processing conditions, AVANTech selected the improved corrosion-resistant properties of 316 or 316L stainless, when available, as the metallic material of construction for piping, vessels, and waste-contacting components. Both 304 and 316 stainless steel alloys are part of a family of nickel- and chromium-bearing austenitic stainless steels (Table 6). A chromium oxide layer (or protective film), which forms on the surface of the metal, naturally passivates the stainless steel and resists deterioration. In general, stainless steel resists staining, pitting and corrosion in most environments that do not contain a significant amount of halogen ions, particularly chlorides.

Table 6. General Compositions of 304 and 316 Stainless Steel

Element	304 Steel	316 Steel
Chromium	18.0 – 20.0%	16.0 – 18.0%
Nickel	8.0 – 10.0%	10.0 – 14.0%
Molybdenum	---	2.0 – 3.0%
Iron, Carbon, other trace metals	Balance	Balance

Research [Reference 1] places the relative susceptibility of 304 and 316 alloys to corrosion at 304 > 304L > 316L. That is, when corrosive conditions are present, 316 alloys are generally less susceptible than 304 alloys to corrosive attack. Within alloys (i.e., 304/304L and 316/316L), lower carbon content grades designated by the “L” suffix are less susceptible to corrosive attack. Of the 304 and 316 stainless steel alloys, 316 or 316L was selected as the preferred metallic material. Although both 304 and 316 alloys provide good corrosion resistance, the higher nickel and molybdenum content of 316 stainless steel generally provides better overall corrosion resistant properties.

7.1.2 HASTELLOY C-276

The internal wedge wire screen of the Media Trap, which does not provide primary confinement, is constructed of HASTELLOY® C-276.When compared to 316L stainless steel, HASTELLOY® C-276 exhibits superior corrosion resistance due to its high nickel-chromium-molybdenum (57-16-16 wt%) composition and very low carbon content (0.01 wt% maximum). The compositional advantages of this alloy reduce susceptibility to stress corrosion cracking, pitting and crevice corrosion in the presence of chlorides and other halides [Reference 3]. As such, the internal wedge wire of the Media Trap is expected to perform better than 316L stainless steel.

7.1.3 Corrosion-Erosion Allowance

TFC-ENG-STD-22 [Reference 10], Section 3.5.2.1 specifically addresses corrosion-erosion allowance for austenitic stainless steel piping and carbon steel piping, stating:

"For both austenitic stainless steel piping and carbon steel piping, the corrosion-erosion allowance used for pressure design of piping components and determining longitudinal stresses in piping systems shall be 0.2 mils per year for the expected service life of the system."

The 0.2 mils per year allowance was developed following fitness-for-service examinations completed for a representative cross-section of metallic[1] pipelines that make up the existing Hanford Tank Farms' Waste Transfer System [Reference 12]. The allowance applies to wall thinning rates for primary piping and provides the basis for predicting the Estimated Remaining Useful Life (ERUL) of the existing Waste Transfer System. Based on the examinations, the study concluded that the ERUL ranges from ~100 years to ~400 years, well in excess of the 5-year design life of the TSCR System.

Per Reference 10, the 0.2 mils per year allowance has been implemented for the TSCR System. Over a 5-year design life, 0.2 mils per year converts to a corrosion-erosion allowance of 0.001 inch by:

$$0.2\ \frac{mils}{yr} \times \frac{0.001\ inch}{1\ mils} \times 5\ yrs = 0.001\ inch$$

Based on the reported performance of carbon steel and 304L stainless steel in the existing Waste Transfer System, the selection of 304/304L and 316/316L stainless steel alloys is expected to conservatively meet the 0.001-inch corrosion-erosion allowance.

[1] The selected cross-section consisted of Schedule 40 carbon steel and 304L stainless steel of various diameters and included both straight sections and elbows.

7.2 NON-METALLIC MATERIALS IN CONTACT WITH TANK WASTE

Non-metallic materials were also selected for their performance in contact with waste supernatant and radiation resistance considering the 5-year design life of the TSCR System. Table 1 of TFC-ENG-STD-34 [Reference 11] was used to select non-metallic materials in captive geometries (i.e., o-rings, gaskets, compressed gaskets' fillers and binders, valve seats, valve body seals, valve and instrument body seal gaskets, valve stem seals or packing, and valve cavity fillers). Both chemical and radiation resistance were considered in the selection and non-metallic materials were only selected from the materials identified in Table 1 of TFC-ENG-STD-34.

7.2.1 Chemical Resistance

RPP-RPT-58308, *241-AX Farm Waste Retrieval System Component Material Evaluation*, [Reference 6] performed a literature review and summary compilation of chemical compatibility for non-metallic components. The corresponding chemical compatibility ratings for the specific non-metallic materials in the TSCR System are reproduced in Table 7.

Table 7. Non-Metallic Materials Chemical Compatibility Ratings*

Component Material	Reference Name	NaCl	NaOH	$NaNO_3$	$NaNO_2$
Carbon, Graphite	Graphite	B to 340°F	B to 260°F	B to 380°F	B to 110°F
Ethylene Propylene Diene Monomer (EPDM)	EPDM	A to 176°F, B to 300°F	A to 300°F	A to 200°F, B to 280°F	A to 176°F, B to 210°F
Fluor Rubber (FKM), Viton® A	FKM	A to 212°F, C to 400°F	B to 120°F, C to 176°F (70 wt%)	A to 212°F	A to 212°F
Polytetrafluoroethylene (PTFE), Teflon	PTFE	A to 500°F	A to 480°F	A to 500°F	A to 500°F
Ultra-high Molecular Weight Polyethylene (UHMWPE)	UHMWPE	A to 170°F	A to 175°F (50 wt%)	B to 140°F, C to 169°F	A to 170°F

* *Rating is indicative of exposure to a saturated solution of the chemical specified, unless otherwise noted. A: Excellent, B: Good, C: Acceptable, D: Unacceptable.*

The tank waste-contacting, non-metallic materials used in the TSCR System are summarized in Table 8. As shown in Tables 7 and 8, the non-metallic materials in contact with tank waste that were selected for use in the TSCR System exhibit good or better chemical resistance at temperatures above the expected processing conditions of TSCR.

Chemical resistance over the 5-year design life will meet the requirements of RPP-SPEC-61910. Appendices B and C tabulates each component and instrument by system that comes in contact with tank waste during normal operations. The list is cross-referenced by EIN, fluids, materials of construction, and drawing / sheet number.

Table 8. Non-Metallic Materials for Tank Waste-contacting Components

Non-Metallic Material†	Component or Instrument
BLUE-GARD[2] 3700	Flange Gaskets
EPDM	Flange Gaskets, o-rings
EPDM (with fully encapsulated reinforcement)	Hose
LineBacker[3]	Flange Gaskets
Ultra-high Molecular Weight Polyethylene (UHMWPE)	AOVs, Valves (Seats & Seals)

† Wetted materials only.

7.2.2 Radiation Resistance

The approved list in TFC-ENG-STD-34 was also used to select non-metallic materials for other components and instruments, like those shown in Table 9, that do not contact tank waste but are physically located within a potential radiation field (i.e., the Process Enclosure space). These items are confined to Sheets 4 through 11 of the *TSCR Piping & Instrumentation Diagram* [Reference 43]. Appendices D and E list the components and instruments potentially exposed to the lifetime dose estimated in Section 5.4.

Table 9. Non-Metallic Materials in Potential Radiation Field

Non-Metallic Material†	Component or Instrument
EPDM	Check Valves; Valves
GLASS / SAPPHIRE	Flow Control Valves; Rotameters
PTFE	Differential Pressure; Pressure Control Valve
UHMWPE	AOVs; Valves (Seats & Seals)
VITON® / FKM[4]	Flow Control Valves; Check Valves

† Wetted materials only.

The estimated lifetime dose is 7.0×10^3 Rad, which is below the value of 1.5×10^4 Rad for PTFE – the non-metallic material with the least resistance of any of the TSCR-selected materials. Radiation resistance of non-metallic materials is good based on the radiation

[2] BLUE-GARD is a registered trademark of EnPro Industries, Charlotte, North Carolina. BLUE-GARD 3700 gaskets are approved in TFC-ENG-STD-34, Rev. A-1.
[3] LineBacker is a registered trademark of GPT Industries, Houston, Texas. These gaskets consist of EPDM seals in a supporting Epoxy Glass ring. The LineBacker gaskets were technically evaluated for waste compatibility in RPP-RPT-60033 [Reference 25].
[4] FKM is ASTM's abbreviated shorthand for the fluoroelastomer category of materials. VITON is a brand of FKM and is a registered trademark of The Chemours Company FC, LLC, Wilmington, Delaware.

resistance values presented in TFC-ENG-STD-34. A summary of radiation resistance is provided in Table 10.

Radiation exposure can also lead to premature degradation of the electronic components of instruments and imaging components of closed-circuit TV. A total dose analysis on the instrumentation inside the Process Area of the TSCR Process Enclosure was not performed because of the modest lifetime dose. For TSCR, the sources of radiation (IXCs, filters, waste-conveying piping) are all shielded, limiting the dose to the electronic components of the instruments. Based on Hanford experience with industrial instruments in a variety of radiation fields, the instruments are expected to maintain performance over the 5-year design life of TSCR. Furthermore, instruments within the Process Area are maintainable and replaceable. If an instrument or closed-circuit TV should fail within the TSCR design life, a replacement can be installed.

Table 10. Radiation Resistance for Non-Metallic Materials

Component Material	Summary of Radiation Resistance
EPDM	Radiation resistant for all applications. *
VITON / FKM	Radiation resistant to ~5 x 10^6 Rad, minimum. Avoid continuous exposure. *
PTFE	Low values for radiation resistance are ~1.5 x 10^4 Rad, other sources indicate higher values, avoid continuous exposure, qualified by prior field use. *
UHMWPE	Radiation resistant for all applications. *

* *TFC-ENG-STD-34, Rev. A-1 [Reference 11]*

7.3 NON-METALLIC MATERIALS – OTHER AREAS

Finally, non-metallic materials that are neither exposed to tank waste nor radiation fields were selected for chemical compatibility (Table 11). To the extent possible, materials selection sought to minimize the variety of non-metallic materials used throughout the TSCR System. Grafoil and HDPE are the only two non-metallic materials not covered under Section 7.2.1. Both exhibit good or better chemical resistance and will meet the chemical resistance requirements of RPP-SPEC-61910. A complete list of components and instruments that fall within this category is provided in Appendices F and G.

Table 11. Non-metallic Materials for Chemical Compatibility

Non-Metallic Material†	Component or Instrument
EPDM	Check Valve; Valves
GRAFOIL®[5]	Block & Bleed Valves
HDPE‡	Caustic Level Transmitters
PTFE	Conductivity Transmitter
VITON® / FKM	Reagent Water Level Transmitter; Check Valve
UHMWPE	Valves (Seats & Seals)

† Wetted materials only.
‡ Caustic level transmitters do not contact the fluid.

8.0 PROCESS ENCLOSURE MATERIALS

All TSCR System process piping and components in contact with tank waste supernatant are contained in the Process Enclosure. The Process Enclosure itself provides secondary (spray and leak) containment for the waste processing components in accordance with Washington Administrative Code 173-303-640 [Reference 13]. The materials of construction were selected accordingly.

8.1 PROCESS ENCLOSURE SUMP

Carbon steel is used for the structure (including pipe supports), doors, access panels/ports, and spray/leak containment. Carbon steel that may be exposed to tank waste supernatant, such as the Process Enclosure Sump, is coated with a waste compatible, high-solids, high build, fast drying, polyamide epoxy (MACROPOXY® 646N[6]) designed to protect steel and concrete in industrial and marine exposures [Reference 9]. MACROPOXY 646N is formulated and manufactured for nuclear applications, meeting the ASTM standards below:

- **ASTM D3911:** Standard Test Method for Evaluating Coatings Used in Light-Water Nuclear Power Plants at Simulated Design Basis Accident (DBA) Conditions

- **ASTM D3912:** Standard Test Method for Chemical Resistance of Coatings and Linings for Use in Nuclear Power Plants

[5] Grafoil is a registered trademark of Graftech International Holdings Inc., Parma, Ohio.
[6] MACROPOXY is a registered trademark of Sherwin-Williams, Cleveland, Ohio.

- **ASTM D4082:** Standard Test Method for Effects of Gamma Radiation on Coatings for Use in Nuclear Power Plants

- **ASTM D4256:** Test Method for Determination of the Decontaminability of Coatings Used in Light-Water Nuclear Power Plants[7]

In addition to ASTM D3912, MACROPOXY 646N is chemically resistant to the sodium-form of OH^-, NO_3^-, NO_2^-, $SO4^{-2}$, Cl^-, and F^- at the design basis maximum temperature of the TSCR waste feed (115°F). Chemical resistance is tested for both spot resistance (ASTM D1308) and immersion (ASTM D870 and ASTM D6943).

The Process Enclosure Sump Pump is not intended for normal operations and will only be exposed to process fluids (i.e., tank waste supernatant, 0.1M NaOH and softened water) under off-normal conditions. Consequently, either stainless steel alloy (304 or 316) provides adequate corrosion resistance. A sump pump with the lower carbon content of 304L was selected based on compatibility and availability. Similarly, the Process Enclosure Sump leak detector uses a 304 stainless steel electrode material.

8.2 MIS-ROUTE PREVENTION CABINET

Components to prevent migration of tank waste supernatant into reagent or air lines are enclosed in a 304 stainless steel NEMA 4X cabinet. The cabinet is fitted with leak detection. The leak detector is constructed of 316L stainless steel.

8.3 MISCELLANEOUS MATERIALS

Other metallic materials within the Process Enclosure include 304 stainless steel grating for the walkway and epoxy-coated carbon steel for the airlock floor. Non-metallic materials include Rockwool non-combustible insulation and EPDM seals for the doors and access ports.

8.4 DISSIMILAR AND LOW MELTING POINT METALS

Low melting point metals, such as those listed in RPP-SPEC-61910 Section 3.3.5.11 b), were avoided for components that come in contact with waste feed. A small number of support components (i.e., either reagent or service air equipment that does not come into contact with waste feed) include brass, bronze or copper items that are intrinsic to the

[7] The standard was withdrawn by ASTM in 1995 but is included here for completeness.

package system (e.g., cooling coils associated with reagent water chiller). These items are listed in Appendices D through G, as appropriate.

Design of the TSCR System also avoided dissimilar metals whenever possible. In the limited instances where bolts could contact dissimilar metals, the bolts should be segregated and isolated from contact either by: 1) a neoprene separation strip and a bonded sealing washer, or 2) a non-metallic gasket.

Contact between dissimilar metals is limited to welded interfaces between stainless steel and carbon steel. Each weld is clearly flagged in the design media and identifies the specific stainless-to-carbon weld procedures for use during fabrication. Welded interfaces are limited to the Process Enclosure Frame Weldment (H-14-111280), specifically:

- **H-14-111280, Sheet 10:** Filter seismic restraints.
- **H-14-111280, Sheet 11:** HIHTL containment box to stainless pipe.
- **H-14-111280, Sheet 12:** Carbon steel pipe supports welded to stainless steel secondary containment.
- **H-14-111280, Sheet 13:** Stainless steel secondary containment to carbon steel structural base.
- **H-14-111280, Sheet 14:** IXC-150 seismic restraints.
- **H-14-111280, Sheet 15:** Filter seismic restraint gusset.
- **H-14-111280, Sheet 17:** Delay Tank shielding to stainless steel base.

9.0 CONCLUSIONS

The evaluation covers metallic and non-metallic materials used in either the Process Enclosure or the Ancillary Enclosure for the normal processing conditions of the TSCR System over a 5-year design life. The materials of construction used for primary confinement of tank waste supernatant, both metallic and non-metallic, in the TSCR System were selected to meet the requirements of RPP-SPEC-61910 [Reference 8] and supporting documents. Non-waste contacting, non-metallic materials were selected based on chemical compatibility and radiation resistance, as applicable, using the approved materials from TFC-ENG-STD-34 [Reference 11].

A separate, stand-alone evaluation for spent ion exchange columns concluded that the IXC-150 will maintain its integrity over a 50-year outdoor storage period.

Appendix A - Tank Side Cesium Removal (TSCR) IXC-150 Corrosion White Paper

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Table of Contents

1. Introduction 3
1.1. Scope 3
2. References 3
3. Acronyms 3
4. Inputs 4
4.1. IXC-150 4
4.2. CHLORIDE PRESENCE 4
4.2.1. 0.1M SODIUM HYDROXIDE 4
4.2.2. SOFTENED WATER 4
4.2.3. CST 5
4.2.4. Residual Liquid Volume 5
5. Discussion 5
5.1. Corrosion Processes 5
5.2. Chloride Exposure 6
5.3. Literature Results 6
6. CONCLUSIONS AND RECOMMENDATIONS 7

1. Introduction

1.1. Scope

The scope of this white paper is to assess the likelihood of corrosion in the IXC-150 from residual water in a bulk dewatered column for a period of 50 years. The bulk dewatered condition occurs after:

1. liquid waste has been flushed from the ion exchange column (IXC) with 0.1M NaOH,
2. the 0.1M NaOH has been displaced from the IXC by service air,
3. the IXC is rinsed with ~1 column volume of softened, potable water, and
4. water is displaced from the IXC by service air, but the ion exchange media is not dried.

2. References

2.1. Baker, E. A. and Lee, T. S., "Long-Term Atmospheric Corrosion Behavior of Various Grades of Stainless Steel," *Degradation of Metals in the Atmosphere*, ASTM STP 965, S. W. Dean and T. S. Lee, Eds., American Society of Testing and Materials, Philadelphia, 1988, pp. 52-67.

2.2. DS-1813-00, Rev. B2, *IXC-150 Data Sheet*, AVANTech, Inc., Columbia, SC.

2.3. Johnson, M. J. and Pavlik, P. J., "Atmospheric Corrosion of Stainless Steel," *Atmospheric Corrosion*, W. H. Ailor, Ed., John Wiley and Sons, New York, 1980.

2.4. Potable Water Certificate of Analysis, Analysis No. 119691 – Flush Point #7 LAW Facility WTP, dated 11/08/2016, Evoqua Water Technologies, Rockford, IL.

2.5. RPP-CALC-62783, Rev. A, *TSCR Hydrogen Generation Rate*, AVANTech, Inc., Columbia, SC.

2.6. RPP-SPEC-61910, Rev. 0, *Specification for the Tank-Side Cesium Removal Demonstration Project (Project TD101)*, Washington River Protection Solutions LLC, Richland, WA.

2.7. Smart, N.R., Review of Effect of Chloride on Corrosion of Stainless Steels in Cementitious Environments, Report No. SA/SIS/14921/R001 Issue 3, Nuclear Decommissioning Authority, SERCO, July 2010.

3. Acronyms

CST	crystalline silicotitanate
IXC	ion exchange column
HAZ	heat-affected zone
LAW	low activity waste
TSCR	Tank Side Cesium Removal

4. Inputs

4.1. IXC-150

All internal, wetted parts of IXC-150 are comprised of dual certified 316/316L stainless steel [Ref 2.2]. Alloy 316/316L is molybdenum-bearing austenitic stainless steel. The higher nickel and molybdenum content in this grade allows it to demonstrate better overall corrosion resistant properties than 304 stainless steel, especially with regard to pitting and crevice corrosion in chloride environments.

Alloy 316/316L is referred to as Type 316 throughout this document as shorthand for the group of austenitic chromium-nickel stainless steels containing between two and three percent molybdenum (Table 1).

Table 1 - Type 316 Steel General Compositions

Element	Concentration
Chromium	16.0 – 18.0%
Nickel	10.0 – 14.0%
Molybdenum	2.0 – 3.0%
Iron, Carbon, other trace metals	Balance

A chromium oxide layer (or protective film), which forms on the surface of the metal, naturally passivates Type 316 stainless steels and prevents deterioration. Stainless steel resists staining, pitting and corrosion in almost any atmosphere that does not contain a significant amount of halogen ions, particularly chlorides.

4.2. CHLORIDE PRESENCE

4.2.1. 0.1M SODIUM HYDROXIDE

NaOH is used as a reagent in TSCR. NaOH contains small amounts of impurities – including chloride (Cl^-). Membrane grade NaOH has a maximum chloride concentration of 50 ppm. AVANTech plans to use a 55-gal drum of 25wt% NaOH in ~ 5,000 gallons of potable water to produce an 0.1 M NaOH caustic solution that is used for displacing liquid waste and flushing TSCR components. If 50 ppm of Cl^- is in the 25wt% sodium hydroxide that we use, then it will contribute 0.7 mg/L of Cl^- to the water used in TSCR.

4.2.2. SOFTENED WATER

For softened water, the chloride component comes from two sources: 1) the dissolved chloride in the Hanford potable water source used for the softened water system, and 2) the added chloride content from chlorine decomposition associated with potable water treatment. The dissolved chloride content is 6.66 mg/L $CaCO_3$ [Ref 2.4], which is converted to mg/L by:

$$6.66\frac{mg}{L}\ as\ CaCO_3 \times \frac{35.453\ meq\ Cl}{50.000\ meq\ CaCO3} = 4.7\frac{mg}{L}Cl^-$$

When chlorine is added to water it hydrolyzes to hydrochloric acid and hypochlorous acid:

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

Dechlorination involves a chemical reaction of the activated carbon's surface being oxidized by chlorine. This reaction decomposes hypochlorous acid (HOCl) and hypochlorite (OCl-) to oxidized carbon (C*O) and chlorine (Cl-) by the reactions:

$$Carbon + HOCl \rightarrow CO + H^+ + Cl^-$$
$$Carbon + OCl^- \rightarrow CO + Cl^-$$

The concentration of free chlorine from these reactions is 0.47 mg/L [Ref 2.4].

Combining the dissolved chloride content with the free chlorine content provides a total value of 5.17 mg/L in the softened water effluent. Therefore, the effluent chloride concentration entering the TSCR System will be 5.17 mg/L.

4.2.3. CST

The IXC-150 contains 156 gals of crystalline silicotitanate (CST) ion exchange media [Ref 2.2]. CST consists of three primary components (Na_2O-Ti_2O-SiO_2), a dopant, and a binder. Neither the dopant nor the binder contains halogen ions and, therefore, the CST does not contribute any halides for corrosion effects.

4.2.4. Residual Liquid Volume

The residual liquid volume in a bulk dewatered IXC-150 is 153.4 L and consists of the water associated with the nominal moisture content of the CST, the volume of water adhering to CST beads in the IXC media bed, and the remaining fluid in the bottom of the IXC [Ref 2.5]. The remaining fluid in the bottom of the IXC-150 has a depth of approximately 5/8" with a corresponding volume of 4.1 L and consists of the primary volume of liquid in contact with the metal surface.

5. Discussion

5.1. Corrosion Processes

The corrosion resistance of stainless steels is well established in the literature (e.g., Ref 2.3) and general corrosion is typically not experienced except in environments where catastrophic oxidation, catastrophic sulfidation, or nitric-hydrofluoric acid conditions exist. None of these extreme corrosion conditions are present in the TSCR System.

Stainless steels can experience localized corrosion effects with intergranular attack, stress-corrosion cracking, and pitting being the important corrosion mechanisms:

- Intergranular corrosion can occur in austenitic stainless steels that have been heated between 500 and 800°C, which typically occurs in the heat-affected zone (HAZ) induced by welding.

- Stress-corrosion cracking in austenitic stainless steels can occur when suitable conditions of tensile stress, solution chemistry, temperature and time are present. Halogens ions, particularly chloride ions, are associated with stress-corrosion cracking in aqueous solutions, especially in low pH solutions.
- Like stress-corrosion cracking, pitting and crevice corrosion of stainless steels is associated with the presence of halogen ions, particularly chloride ions, in aqueous solutions. Pitting is more likely in low pH solutions as alkaline chloride solutions cause little to no pitting.

5.2. IXC-150 Interior Environment and Chloride Exposure

As previously stated, at the end of a cesium loading cycle the waste-filled IXC-150 will be flushed with 0.1 M NaOH, rinsed with potable water and then blown down with compressed air (bulk dewatering case). In this case, the interior cavity of a bulk dewatered IXC-150 will contain 156-gal of damp CST and approximately 4 L of residual potable water accumulated in the bottom of the ion exchange column. The potable water will have a chloride (Cl^-) concentration of approximately 6 mg/L, so the residual water should also be low in Cl^- as well. Prior to the potable water rinse, the IXC would have contained waste with a hydroxide concentration of ≈ 1 M OH^- (pH≈14), and a dilute 0.1 M caustic (pH≈13). Some of the OH^- remnants are likely to be present in the residual water; therefore, the pH is expected to be > 9.0 based on AVANTech's previous experience with washing caustic form CST.

5.3. Literature Results

The atmospheric corrosion of Type 316 stainless steels has been studied for decades with published data extending back to the 1930s. The bulk dewatered condition of the IXC-150 is analogous to exposure of stainless steels to marine atmospheres, where the steel is constantly exposed to aqueous solutions containing chlorides while experiencing atmospheric pressure and temperature variation over the course of years. The concentration of halogen ions in surface marine waters is approximately 18,000 – 20,000 mg Cl^-/L, considerably greater than the maximum chloride exposure in a bulk dewatered IXC and even greater than the design basis concentration of the tank waste supernatant (~2,800 mg Cl^-/L [Ref 2.6]). Further, the marine environment is at near neutral pH whereas the contents of the IXC-150 should be at an elevated pH, which further reduces corrosion rates [Ref 2.7].

Baker and Lee [Ref 2.1] exposed multiple grades of Type 316 stainless steel to moderate-to-severe marine atmospheres for 26 years. Summarizing the results:

- For non-welded and unstressed areas, all grades of Type 316 showed no evidence of stress corrosion failure and exhibited pitting of <0.01 mm over the duration of the study.
- For spot-welded surfaces, pits ranging between <0.01 mm and 0.14 mm were observed. Some crevice corrosion was observed and intergranular corrosion in the weld and weld HAZ was found.
- For arc-welded surfaces, there was no evidence of weld failure.
- For stressed areas, there was no evidence of stress corrosion failure.

The corresponding average corrosion rate for Type 316 steel under the conditions above was reported as <0.00003 mm per year [Ref 2.3]

6. CONCLUSIONS AND RECOMMENDATIONS

Based on the information included in this white paper and other information within the available corrosion literature, we have concluded that Type 316 stainless steel has excellent corrosion resistance for the bulk dewatered condition that an IXC-150 may experience. Standard weld procedures to prevent creation of weld areas susceptible to intergranular, pitting, and crevice corrosion will be necessary. Non-welded surfaces exposed to residual liquid within the IXC-150 can reasonably be expected to experience pitting depths of <0.5 mm over a 50-year period and stress-corrosion resistance is expected to be even better. Furthermore, we conclude that the Type 316 stainless steel vessel will maintain its integrity over a 50-year outdoor storage period.

Appendix B – Materials of Construction Tabulation – Waste-Contacting Components

Components that are installed within the Process Enclosure and contact waste. The components are exposed to a radiation field.

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
WP	Drain	AOV	WP-AOV-610	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	5	2	DS-1813-22
WP	Reagent	AOV	WP-AOV-308	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-19
WP	Drain	AOV	WP-AOV-605	AIR OPERATED VALVE	YES	1	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-22
WP	Drain	Pump	WP-P-604	SUMP PUMP	YES	1, 2, 3	304L SS	H-14-024857	6	2	DS-1813-96
WP	Drain	Sump	N/A	ENCLOSURE SUMP	YES	1	CS w/MARINE GRADE EPOXY COATING	H-14-024857	6	2	H-14-111280
WP	Feed	Valve	WP-V-303	ISOLATION VALVE	YES	1	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-107
WP	Feed	Valve	WP-V-305	ISOLATION VALVE	YES	1	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-107
WP	Feed	Valve	WP-FCV-306	FLOW CONTROL VALVE	YES	1	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-26
WP	Filtration	AOV	WP-AOV-311	AIR OPERATED VALVE	YES	1, 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-20
WP	Filtration	AOV	WP-AOV-324A	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-324B	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-330A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-330B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-331A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-23
WP	Filtration	AOV	WP-AOV-331B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-23
WP	Filtration	AOV	WP-AOV-335A	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-335B	AIR OPERATED VALVE	YES	1, 2, 3	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-332A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-332B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-327A	AIR OPERATED VALVE	YES	1, 2	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	AOV	WP-AOV-327B	AIR OPERATED VALVE	YES	1, 2	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-19
WP	Filtration	Filter	WP-FLT-325A	FILTER	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	7	2	DS-1813-01
WP	Filtration	Filter	WP-FLT-325B	FILTER	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	7	2	DS-1813-01
WP	Filtration	Hose	WP-HOSE-323A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	7	2	DS-1813-40
WP	Filtration	Hose	WP-HOSE-323B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	7	2	DS-1813-40
WP	Filtration	Hose	WP-HOSE-329A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	7	2	DS-1813-41
WP	Filtration	Hose	WP-HOSE-329B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	7	2	DS-1813-41
WP	Filtration	PSV	WP-PSV-325A	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-97
WP	Filtration	PSV	WP-PSV-325B	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-97
WP	Filtration	Valve	WP-V-328A	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-16
WP	Filtration	Valve	WP-V-328B	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-16
WP	Filtration	Valve	WP-V-333A	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-70
WP	Filtration	Valve	WP-V-333B	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-70
WP	Ion Exchange	AOV	WP-AOV-405A	AIR OPERATED VALVE	YES	1, 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-75
WP	Ion Exchange	AOV	WP-AOV-405B	AIR OPERATED VALVE	YES	1, 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-75
WP	Ion Exchange	AOV	WP-AOV-413A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-413B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-412	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-414A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-414B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
WP	Ion Exchange	AOV	WP-AOV-415A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-415B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-416A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-416B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-417	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-424A	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-424B	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-19
WP	Ion Exchange	Hose	WP-HOSE-425A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-425B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-401A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-401B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-402A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-402B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-403A	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-403B	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	8	2	DS-1813-40
WP	Ion Exchange	IXC	WP-IX-400A	ION EXCHANGE COLUMN	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	8	2	DS-1813-00
WP	Ion Exchange	IXC	WP-IX-400B	ION EXCHANGE COLUMN	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	8	2	DS-1813-00
WP	Ion Exchange	PSV	WP-PSV-400A	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-97
WP	Ion Exchange	PSV	WP-PSV-400B	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-97
WP	Ion Exchange	Valve	WP-V-407A	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-86
WP	Ion Exchange	Valve	WP-V-407B	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-86
WP	Ion Exchange	Valve	WP-V-408A	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-86
WP	Ion Exchange	Valve	WP-V-408B	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-86
WP	Ion Exchange	Valve	WP-V-409A	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-16
WP	Ion Exchange	Valve	WP-V-409B	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-16
WP	Ion Exchange	AOV	WP-AOV-405C	AIR OPERATED VALVE	YES	1, 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-75
WP	Ion Exchange	AOV	WP-AOV-413C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-408C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-71
WP	Ion Exchange	AOV	WP-AOV-414C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-415C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-416C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-424C	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	AOV	WP-AOV-422	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Treated Effluent	AOV	WP-AOV-554	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-19
WP	Ion Exchange	Hose	WP-HOSE-425C	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	9	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-401C	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	9	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-402C	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	9	2	DS-1813-40
WP	Ion Exchange	Hose	WP-HOSE-403C	INTERCONNECTING HOSE	YES	1, 2, 3, AND 4	EPDM	H-14-024857	9	2	DS-1813-40
WP	Ion Exchange	IXC	WP-IX-400C	ION EXCHANGE COLUMN	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	9	2	DS-1813-00
WP	Ion Exchange	PSV	WP-PSV-400C	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	9	2	DS-1813-97

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
WP	Ion Exchange	Valve	WP-V-407C	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-86
WP	Ion Exchange	Valve	WP-V-409C	ISOLATION VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-16
WP	Treated Effluent	AOV	WP-AOV-501	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-19
WP	Treated Effluent	AOV	WP-AOV-503	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-19
WP	Treated Effluent	AOV	WP-AOV-553	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-19
WP	Treated Effluent	AOV	WP-AOV-561	AIR OPERATED VALVE	YES	1, 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-75
WP	Treated Effluent	AOV	WP-AOV-556	AIR OPERATED VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-73
WP	Treated Effluent	AOV	WP-AOV-560	AIR OPERATED VALVE	YES	1	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-71
WP	Treated Effluent	Pipe	WP-RT-500	MEDIA TRAP	YES	1, 2, 3, and 4	316/316L SS; HASTELLOY C-276	H-14-024857	10	2	DS-1813-03
WP	Treated Effluent	PSV	WP-PSV-550	PRESSURE SAFETY VALVE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	10	2	DS-1813-97
WP	Treated Effluent	Tank	WP-TK-550	DELAY TANK	YES	1, 2, 3, and 4	316/316L SS	H-14-024857	10	2	DS-1813-02
WP	Treated Effluent	Valve	WP-V-504	DRAIN VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-86
WP	Treated Effluent	Valve	WP-PCV-557	PRESSURE CONTROL VALVE	YES	1, 2, 3, AND 4	316 SS; UHMWPE	H-14-024857	10	2	DS-1813-26
WP	Treated Effluent	Orifice	WP-FO-563	FLOW ORIFICE	YES	1, 2, 3, AND 4	316 SS	H-14-024857	10	2	DS-1813-134

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

Appendix C – Materials of Construction Tabulation – Waste-Contacting Instruments

Instruments that are installed within the Process Enclosure and contact waste. The instruments are exposed to a radiation field.

System	Subsystem	Instrument	EIN	Indication Type	Location	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
WP	Feed	Temperature	WP-TT-300	TRANSMITTER	AP-107 RECIRCULATION LOOP	YES	1	316 SS	H-14-024857	6	2	DS-1813-83
WP	Vent	Pressure	WP-PIT-611	TRANSMITTER	AP-108 VENT LINE	YES	1, 2, 3, AND 4	316L SS	H-14-024857	6	2	DS-1813-30
WP	Drain	Level Switch	WP-LT-603	SWITCH	WP-P-604	YES	1, 2, 3	316 SS	H-14-024857	6	2	DS-1813-81
WP	Feed	Leak Detection	WP-LDE-618	DETECTOR	WP-TK-603	YES	1, 2, 3	304 SS; POLYETHYLENE	H-14-024857	6	2	DS-1813-80
WP	Filtration	Pressure	WP-PIT-310	TRANSMITTER	WP-FLT-325A/B INLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-30
WP	Filtration	Pressure	WP-PI-334A	GAUGE	WP-FLT-325A	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-82
WP	Filtration	Pressure	WP-PI-334B	GAUGE	WP-FLT-325B	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-82
WP	Filtration	Pressure	WP-PIT-313	TRANSMITTER	WP-FLT-325A/B OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	7	2	DS-1813-30
WP	Drain	Temperature	WP-TT-616	TRANSMITTER	DRAIN MANIFOLD	YES	1, 2, 3, AND 4	316 SS	H-14-024857	8	2	DS-1813-84
WP	Ion Exchange	Pressure	WP-PI-426A	GAUGE	WP-IX-400A EFFLUENT OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-82
WP	Ion Exchange	Level Switch	WP-LS-423A	SWITCH	WP-IX-400A VENT	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-35
WP	Ion Exchange	Pressure	WP-PIT-419A	TRANSMITTER	WP-IX-400A EFFLUENT OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-30
WP	Ion Exchange	Pressure	WP-PI-426B	GAUGE	WP-IX-400B EFFLUENT OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-82
WP	Ion Exchange	Level Switch	WP-LS-423B	SWITCH	WP-IX-400B VENT	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-35
WP	Ion Exchange	Pressure	WP-PIT-419B	TRANSMITTER	WP-IX-400B EFFLUENT OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	8	2	DS-1813-30
WP	Ion Exchange	Pressure	WP-PI-426C	GAUGE	WP-IX-400C INLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	9	2	DS-1813-82
WP	Ion Exchange	Pressure	WP-PIT-419C	TRANSMITTER	WP-IX-400C EFFLUENT OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	9	2	DS-1813-30
WP	Ion Exchange	Level Switch	WP-LS-423C	SWITCH	WP-IX-400C VENT	YES	1, 2, 3, AND 4	316L SS	H-14-024857	9	2	DS-1813-35
WP	Treated Effluent	Temperature	WP-TT-500	TRANSMITTER	WT-RT-500 INLET	YES	1, 2, 3, AND 4	316 SS	H-14-024857	9	2	DS-1813-83
WP	Treated Effluent	Flow	WP-FIT-309	TRANSMITTER	WT-RT-500 INLET	YES	1, 2, 3, AND 4	316 SS	H-14-024857	9	2	DS-1813-38
WP	Treated Effluent	Pressure	WP-PIT-505	TRANSMITTER	WT-RT-500 OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	10	2	DS-1813-30
WP	Treated Effluent	Pressure	WP-PIT-558	TRANSMITTER	WP-TK-550 OUTLET	YES	1, 2, 3, AND 4	316L SS	H-14-024857	10	2	DS-1813-30

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

Appendix D – Materials of Construction Tabulation – Non-Waste-Contacting Components

Components that are installed within the Process Enclosure but do not contact waste. The components are exposed to a radiation field.

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
SA	Service Air	AOV	SA-AOV-222	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-12
SA	Service Air	AOV	SA-AOV-232	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-20
WP	Monitoring	CCTV	WP-TV-233	CLOSED CIRCUIT TELEVISION	YES	N/A	N/A	H-14-024857	4	2	DS-1813-43
WP	Drying Air	CCTV	WP-TV-405	CLOSED CIRCUIT TELEVISION	YES	N/A	N/A	H-14-024857	4	2	DS-1813-43
SA	Service Air	Heater	SA-HTR-212	HEATER	YES	4	ALUMINUM	H-14-024857	4	2	DS-1813-93
SA	Service Air	Valve	SA-CV-220	CHECK VALVE	YES	4	316 SS; EPDM	H-14-024857	4	2	DS-1813-25
SA	Service Air	Valve	SA-PCV-221	PRESSURE CONTROL VALVE	YES	4	ALUMINUM	H-14-024857	4	2	DS-1813-99
SA	Sweep Air	Valve	SA-PCV-222	PRESSURE CONTROL VALVE	YES	4	ALUMINUM	H-14-024857	4	2	DS-1813-64
SA	Sweep Air	Valve	SA-FCV-225A	FLOW CONTROL VALVE	YES	4	316 SS; GLASS; VITON	H-14-024857	4	2	DS-1813-62
SA	Sweep Air	Valve	SA-FCV-225B	FLOW CONTROL VALVE	YES	4	316 SS; GLASS; VITON	H-14-024857	4	2	DS-1813-62
SA	Sweep Air	Valve	SA-FCV-225C	FLOW CONTROL VALVE	YES	4	316 SS; GLASS; VITON	H-14-024857	4	2	DS-1813-62
WP	Sweep Air	Valve	WP-CV-421A	CHECK VALVE	YES	4	316 SS; FKM	H-14-024857	4	2	DS-1813-78
WP	Sweep Air	Valve	WP-CV-421B	CHECK VALVE	YES	4	316 SS; FKM	H-14-024857	4	2	DS-1813-78
WP	Sweep Air	Valve	WP-CV-421C	CHECK VALVE	YES	4	316 SS; FKM	H-14-024857	4	2	DS-1813-78
WP	Sweep Air	AOV	WP-AOV-420A	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-72
WP	Sweep Air	AOV	WP-AOV-420B	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-72
WP	Sweep Air	AOV	WP-AOV-420C	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-72
SA	Drying Air	Valve	SA-PCV-223	PRESSURE CONTROL VALVE	YES	4	ALUMINUM	H-14-024857	4	2	DS-1813-88
SA	Drying Air	Valve	SA-V-209A	V-BALL VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-105
SA	Drying Air	Valve	SA-V-209B	V-BALL VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-105
SA	Drying Air	Valve	SA-V-209C	V-BALL VALVE	YES	4	316 SS; UHMWPE	H-14-024857	4	2	DS-1813-105
RA	Reagent	AOV	RA-AOV-152	AIR OPERATED VALVE	YES	2, 3	316 SS; UHMWPE	H-14-024857	5	2	DS-1813-46
RA	Reagent	AOV	RA-AOV-153	AIR OPERATED VALVE	YES	2, 3	316 SS; UHMWPE	H-14-024857	5	2	DS-1813-87
RA	Reagent	Valve	RA-CV-150	CHECK VALVE	YES	2, 3	316/316L SS; EPDM	H-14-024857	5	2	DS-1813-48
RA	Reagent	Valve	RA-PCV-151	PRESSURE CONTROL VALVE	YES	2, 3	316 SS; PTFE/BUNA-N	H-14-024857	5	2	DS-1813-54
WP	Vent	AOV	WP-AOV-619	AIR OPERATED VALVE	YES	4, 8	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-108
WP	Vent	AOV	WP-AOV-614	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-74
WP	Vent	AOV	WP-AOV-615	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-75
SA	Service Air	AOV	SA-AOV-230	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-12
WP	Monitoring	CCTV	WP-TV-620	CLOSED CIRCUIT TELEVISION	YES	N/A	N/A	H-14-024857	6	2	DS-1813-43
WP	Vent	Eductor	WP-EJR-613	EDUCTOR	YES	8	316 SS	H-14-024857	6	2	DS-1813-90
SA	Service Air	Tank	SA-TK-225	AIR RECEIVER (20 GAL)	YES	4	316/316L SS	H-14-024857	6	2	DS-1813-09
WP	Reagent	Valve	WP-CV-307	CHECK VALVE	YES	2, 3	316/316L SS; EPDM	H-14-024857	6	2	DS-1813-76
SA	Service Air	Valve	SA-V-229	V-BALL VALVE	YES	4	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-106
SA	Service Air	Valve	SA-V-231	ISOLATION VALVE	YES	4	316 SS; UHMWPE	H-14-024857	6	2	DS-1813-68
SA	Service Air	Valve	SA-PCV-224	PRESSURE CONTROL VALVE	YES	4	ALUMINUM	H-14-024857	6	2	DS-1813-28
WP	Filtration	Valve	WP-CV-322	CHECK VALVE	YES	4	316 SS; EPDM	H-14-024857	6	2	DS-1813-25
SA	Service Air	Valve	SA-V-226	DRAIN VALVE	YES	4	316 SS	H-14-024857	6	2	DS-1813-14
WP	Filtration	AOV	WP-AOV-321A	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-69
WP	Filtration	AOV	WP-AOV-321B	AIR OPERATED VALVE	YES	4	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-69

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
WP	Filtration	AOV	WP-AOV-320A	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-21
WP	Filtration	AOV	WP-AOV-320B	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	7	2	DS-1813-21
WP	Filtration	Valve	WP-CV-312	CHECK VALVE	YES	4	316 SS; EPDM	H-14-024857	7	2	DS-1813-25
WP	Reagent	Valve	WP-CV-333A	CHECK VALVE	YES	2, 3	316/316L SS; EPDM	H-14-024857	7	2	DS-1813-76
WP	Reagent	Valve	WP-CV-333B	CHECK VALVE	YES	2, 3	316/316L SS; EPDM	H-14-024857	7	2	DS-1813-76
WP	Ion Exchange	AOV	WP-AOV-410A	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-21
WP	Ion Exchange	AOV	WP-AOV-410B	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	8	2	DS-1813-21
WP	Ion Exchange	Valve	WP-CV-406A	CHECK VALVE	YES	4	316/316L SS; EPDM	H-14-024857	8	2	DS-1813-77
WP	Ion Exchange	Valve	WP-CV-406B	CHECK VALVE	YES	4	316/316L SS; EPDM	H-14-024857	8	2	DS-1813-77
WP	Ion Exchange	AOV	WP-AOV-410C	AIR OPERATED VALVE	YES	8	316 SS; UHMWPE	H-14-024857	9	2	DS-1813-21
WP	Ion Exchange	Valve	WP-CV-406C	CHECK VALVE	YES	4	316/316L SS; EPDM	H-14-024857	9	2	DS-1813-77
WP	Treated Effluent	Valve	WP-CV-555	CHECK VALVE	YES	2, 3	316/316L SS; EPDM	H-14-024857	9	2	DS-1813-76
WP	Sweep Air	CCTV	WP-TV-225	CLOSED CIRCUIT TELEVISION	YES	N/A	N/A	H-14-024857	9	2	DS-1813-43
WP	Treated Effluent	Valve	WP-CV-562	CHECK VALVE	YES	4	316/316L SS; EPDM	H-14-024857	10	2	DS-1813-77
IA	Instrument Air	Valve	IA-CV-260	CHECK VALVE	YES	6	316 SS; FKM	H-14-024857	11	2	DS-1813-24
IA	Instrument Air	Valve	IA-V-263	ISOLATION VALVE	YES	4	316 SS	H-14-024857	11	2	DS-1813-13
VT	Ventilation	Damper	VT-DMPR-900	DAMPER	YES	8	ALUMINUM	H-14-021357	1	0	DS-1813-119
VT	Ventilation	Filter	VT-FLT-903	INLET FILTER	YES	8	SYNTHETIC FIBERS	H-14-021357	1	0	DS-1813-116
VT	Ventilation	Heater	VT-HTR-909	INLET HEATER	YES	8	Galvanized Steel; Ni-Cr Wire	H-14-021357	1	0	DS-1813-123
VT	Ventilation	Damper	VT-DMPR-905	DAMPER	YES	8	304/304L SS	H-14-021357	1	0	DS-1813-133
VT	Ventilation	Heater	VT-HTR-925	AIRLOCK HEATER	YES	8	Ni-Cr Element	H-14-021357	1	0	DS-1813-125
VT	Ventilation	Heat Pump	VT-HP-901	AIRLOCK HEAT PUMP	YES	8	VARIES	H-14-021357	1	0	DS-1813-120
VT	Ventilation	Valve	VT-V-922	SAMPLE VALVE (AIR)	YES	8	316 SS; UHMWPE	H-14-021357	1	0	DS-1813-91
VT	Ventilation	Damper	VT-DMPR-906	DAMPER	YES	8	ALUMINUM	H-14-021357	1	0	DS-1813-118
VT	Ventilation	Heater	VT-HTR-926	PROCESS AREA HEATER	YES	8	Ni-Cr Element	H-14-021357	1	0	DS-1813-127
VT	Ventilation	Heat Pump	VT-HP-902	PROCESS AREA HEAT PUMP	YES	8	VARIES	H-14-021357	1	0	DS-1813-130
VT	Ventilation	Damper	VT-DMPR-913	DAMPER	YES	8	304/304L SS	H-14-021357	1	0	DS-1813-133
VT	Ventilation	Filter	VT-FLT-911	EXHAUST TRAIN INLET FILTER	YES	8	SYNTHETIC FIBERS	H-14-021357	1	0	DS-1813-132
VT	Ventilation	Heater	VT-HTR-914	EXHAUST TRAIN HEATER	YES	8	Galvanized Steel; Ni-Cr Wire	H-14-021357	1	0	DS-1813-129
VT	Ventilation	Filter	VT-FLT-916	EXHAUST TRAIN HEPA FILTER	YES	8	304 SS; ALUMINUM; GLASS	H-14-021357	1	0	DS-1813-117
VT	Ventilation	Damper	VT-DMPR-919	DAMPER	YES	8	ALUMINUM	H-14-021357	1	0	DS-1813-133

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

Appendix E – Materials of Construction Tabulation – Non-Waste-Contacting Instruments

Instruments that are installed within the Process Enclosure but do not contact waste. The instruments are exposed to a radiation field.

System	Subsystem	Instrument	EIN	Indication Type	Location	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
SA	Service Air	Temperature	SA-TIT-212	TRANSMITTER	SA-HTR-212 DISCHARGE	YES	4	316 SS	H-14-024857	4	2	DS-1813-67
SA	Service Air	Pressure	SA-PI-221	GAUGE	SA-PCV-221	YES	4	316L SS	H-14-024857	4	2	DS-1813-110
SA	Service Air	Diff. Pressure	SA-PDIT-220	TRANSMITTER	POR655-WP-ENCL-004	YES	4	316L SS; PTFE	H-14-024857	4	2	DS-1813-61
SA	Sweep Air	Pressure	SA-PI-222	GAUGE	SA-PCV-222	YES	4	316L SS	H-14-024857	4	2	DS-1813-110
SA	Sweep Air	Flow	SA-FI-225A	ROTAMETER	SA-FCV-225A	YES	4	316 SS; VITON; SAPPHIRE	H-14-024857	4	2	DS-1813-62
SA	Sweep Air	Flow	SA-FI-225B	ROTAMETER	SA-FCV-225B	YES	4	316 SS; VITON; SAPPHIRE	H-14-024857	4	2	DS-1813-62
SA	Sweep Air	Flow	SA-FI-225C	ROTAMETER	SA-FCV-225C	YES	4	316 SS; VITON; SAPPHIRE	H-14-024857	4	2	DS-1813-62
SA	Drying Air	Pressure	SA-PI-223	GAUGE	SA-PCV-223	YES	4	316L SS	H-14-024857	4	2	DS-1813-110
SA	Drying Air	Pressure	SA-PIT-227	TRANSMITTER	DRYING AIR MANIFOLD	YES	4	316L SS	H-14-024857	4	2	DS-1813-66
SA	Drying Air	Flow	SA-FIT-405A	TRANSMITTER	WP-IX-400A DRYING AIR INLET	YES	4	316/316L SS	H-14-024857	4	2	DS-1813-63
SA	Drying Air	Flow	SA-FIT-405B	TRANSMITTER	WP-IX-400B DRYING AIR INLET	YES	4	316/316L SS	H-14-024857	4	2	DS-1813-63
SA	Drying Air	Flow	SA-FIT-405C	TRANSMITTER	WP-IX-400C DRYING AIR INLET	YES	4	316/316L SS	H-14-024857	4	2	DS-1813-63
RA	Reagent	Pressure	RA-PI-151	GAUGE	RA-PCV-151	YES	2, 3	316L SS	H-14-024857	5	2	DS-1813-111
RA	Reagent	Diff. Pressure	RA-PDIT-150	TRANSMITTER	POR655-WP-ENCL-004	YES	2, 3	316L SS; PTFE	H-14-024857	5	2	DS-1813-50
WP	Feed	Leak Detection	WP-LD-610	DETECTOR	POR655-WP-ENCL-004	YES	2, 3	316L SS	H-14-024857	5	2	DS-1813-79
SA	Service Air	Pressure	SA-PI-224	GAUGE	SA-PCV-224	YES	4	316L SS	H-14-024857	6	2	DS-1813-110
SA	Service Air	Pressure	SA-PIT-228	TRANSMITTER	SA-TK-225 LINE PRESSURE	YES	4	316L SS	H-14-024857	6	2	DS-1813-66
WP	Monitoring	Radiation	WP-RIT-612	DETECTOR	PROCESS ENCLOSURE	YES	8	ABS / PMMA (Glass Fiber Reinforced)	H-14-024857	10	2	DS-1813-98
WP	Treated Effluent	Radiation	WP-RD-559A	DETECTOR	WP-TK-550 OUTLET	YES	N/C	N/A	H-14-024857	10	2	DS-1813-37
WP	Treated Effluent	Radiation	WP-RD-559B	DETECTOR	WP-TK-550 OUTLET	YES	N/C	N/A	H-14-024857	10	2	DS-1813-37
VT	Ventilation	Diff. Pressure	VT-PDIT-903	TRANSMITTER	VT-FLT-903	YES	8	HASTELLOY C-276; 316L SS; PTFE	H-14-021357	1	0	DS-1813-112
VT	Ventilation	Temperature	VT-TIT-930	TRANSMITTER	AIRLOCK	YES	8	PLATINUM	H-14-021357	1	0	DS-1813-85
VT	Ventilation	Diff. Pressure	VT-PDIT-907	TRANSMITTER	AIRLOCK / PROCESS AREA	YES	8	HASTELLOY C-276; 316L SS; PTFE	H-14-021357	1	0	DS-1813-121
VT	Ventilation	Temperature	VT-TIT-931	TRANSMITTER	PROCESS AREA	YES	8	PLATINUM	H-14-021357	1	0	DS-1813-85
VT	Ventilation	Temperature	VT-TT-910	TRANSMITTER	EXHAUST TRAIN INLET	YES	8	316 SS	H-14-021357	1	0	DS-1813-113
VT	Ventilation	Diff. Pressure	VT-PDIT-911	TRANSMITTER	EXHAUST TRAIN INLET FILTER	YES	8	HASTELLOY C-276; 316L SS; PTFE	H-14-021357	1	0	DS-1813-112
VT	Ventilation	Temperature	VT-TT-915	TRANSMITTER	EXHAUST TRAIN OUTLET	YES	8	316 SS	H-14-021357	1	0	DS-1813-113
VT	Ventilation	Diff. Pressure	VT-PDIT-916	TRANSMITTER	EXHAUST TRAIN HEPA	YES	8	HASTELLOY C-276; 316L SS; PTFE	H-14-021357	1	0	DS-1813-143
VT	Ventilation	Relative Humidity	VT-AIT-917	TRANSMITTER	EXHAUST TRAIN OUTLET	YES	8	POLYMER	H-14-021357	1	0	DS-1813-131

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

Appendix F – Materials of Construction Tabulation – Chemical Compatibility Components

Components that are assessed for chemical compatibility. The components are not exposed to waste nor are they exposed to a radiation field.

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
RA	Reagent Water	AOV	RA-AOV-157	AIR OPERATED VALVE	NO	7	316 SS; RPTFE	H-14-024857	2	2	DS-1813-47
RA	Reagent Water	Chiller	RA-CHL-166	CHILLER	NO	7	SS; NON-FERROUS HOSE; EPDM	H-14-024857	2	2	DS-1813-39
RA	Softened Water	Filter	RA-FLT-102	INLET FILTER	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Filter	RA-FLT-109	OUTLET FILTER	NO	8	Provided by Others	H-14-024857	2	2	N/A
RA	Reagent Water	Heater	RA-HTR-156	HEATER	NO	7	304 SS; ALLOY 800	H-14-024857	2	2	DS-1813-92
RA	Softened Water	Hose	RA-HOSE-103	INTERCONNECTING HOSE	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Hose	RA-HOSE-104	INTERCONNECTING HOSE	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Hose	RA-HOSE-105	INTERCONNECTING HOSE	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Hose	RA-HOSE-107	INTERCONNECTING HOSE	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Reagent	Mixer	RA-MX-120	STATIC MIXER	NO	2, 3	316L SS	H-14-024857	2	2	DS-1813-07
RA	Reagent	Needle	RA-IN-118	INJECTION NEEDLE	NO	3, 5	PVC; CERAMIC; HASTELLOY C-276	H-14-024857	2	2	DS-1813-07
RA	Reagent Water	PSV	RA-PSV-158	PRESSURE SAFETY VALVE	NO	7	316 SS; CS	H-14-024857	2	2	DS-1813-57
RA	Caustic	PSV	RA-PSV-157	PRESSURE SAFETY VALVE	NO	5	316 SS; EPDM/PTFE	H-14-024857	2	2	DS-1813-33
RA	Reagent Water	Pump	RA-P-139	REAGENT WATER PUMP	NO	7	300-Series SS	H-14-024857	2	2	DS-1813-94
RA	Caustic	Pump	RA-P-130	CAUSTIC METERING PUMP	NO	5	PVDF; PTFE	H-14-024857	2	2	DS-1813-05
RA	Reagent Water	Tank	RA-TK-138	REAGENT WATER TANK	NO	7	304 SS	H-14-024857	2	2	DS-1813-101
RA	Reagent Water	Tank	RA-TK-135	BLADDER TANK	NO	7	304 SS	H-14-024857	2	2	DS-1813-100
RA	Caustic	Tank	RA-TK-127A	CAUSTIC DRUM	NO	5	CS w/PHENOLIC EPOXY LINING; BUNA-N	H-14-024857	2	2	N/A
RA	Caustic	Tank	RA-TK-127B	CAUSTIC DRUM	NO	5	CS w/PHENOLIC EPOXY LINING; BUNA-N	H-14-024857	2	2	N/A
RA	Reagent Water	Valve	RA-V-138	BLOCK & BLEED	NO	7	316 SS; GRAFOIL	H-14-024857	2	2	DS-1813-31
RA	Reagent Water	Valve	RA-V-145	FILL VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-18
RA	Reagent Water	Valve	RA-V-162	DRAIN VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-V-164	CHILLER INLET LOOP	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-V-165	CHILLER RETURN LOOP	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-V-142	BACKPRESSURE VALVE	NO	7	316 SS; RPTFE	H-14-024857	2	2	DS-1813-103
RA	Reagent Water	Valve	RA-V-167	DRAIN VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-CV-143	CHECK VALVE	NO	7	316/316L SS; EPDM	H-14-024857	2	2	DS-1813-89
RA	Reagent Water	Valve	RA-V-144	ISOLATION VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-V-141	ISOLATION VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent Water	Valve	RA-V-140	BLOCK & BLEED	NO	7	316 SS; GRAFOIL	H-14-024857	2	2	DS-1813-31
RA	Reagent Water	Valve	RA-V-168	DRAIN VALVE	NO	7	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Softened Water	Valve	RA-V-111	VESSEL VENT	NO	3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-17
RA	Softened Water	Valve	RA-V-112	VESSEL VENT	NO	3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-17
RA	Softened Water	Valve	RA-V-115	ISOLATION VALVE	NO	3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Softened Water	Valve	RA-V-116	DRAIN VALVE	NO	3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-59
RA	Reagent	Valve	RA-CV-137	CHECK VALVE	NO	3	316/316L SS; EPDM	H-14-024857	2	2	DS-1813-48
RA	Reagent	Valve	RA-V-121	ISOLATION VALVE	NO	2, 3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-15
RA	Reagent	Valve	RA-V-122	BLOCK & BLEED	NO	2, 3	316 SS; GRAFOIL	H-14-024857	2	2	DS-1813-31
RA	Reagent	Valve	RA-V-124	ISOLATION VALVE	NO	2, 3	316 SS; UHMWPE	H-14-024857	2	2	DS-1813-15
RA	Reagent	Valve	RA-CV-125	CHECK VALVE	NO	2, 3	316/316L SS; EPDM	H-14-024857	2	2	DS-1813-48

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

System	Subsystem	Component	EIN	Service	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
RA	Caustic	Valve	RA-V-146A	CAUSTIC DRUM CHEMWAND	NO	5	POLYPROPYLENE; POLYETHYLENE; VITON	H-14-024857	2	2	DS-1813-104
RA	Caustic	Valve	RA-V-146B	CAUSTIC DRUM CHEMWAND	NO	5	POLYPROPYLENE; POLYETHYLENE; VITON	H-14-024857	2	2	DS-1813-104
RA	Caustic	Valve	RA-V-128A	SUPPLY VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Caustic	Valve	RA-V-128B	SUPPLY VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Caustic	Valve	RA-V-161	DRAIN VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Caustic	Valve	RA-CV-149	CHECK VALVE	NO	5	316 SS; FKM	H-14-024857	2	2	DS-1813-49
RA	Caustic	Valve	RA-V-129	DRAIN VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Caustic	Valve	RA-V-131	BLOCK & BLEED	NO	5	316 SS; GRAFOIL	H-14-024857	2	2	DS-1813-31
RA	Caustic	Valve	RA-V-132	DRAIN VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Caustic	Valve	RA-V-133	ISOLATION VALVE	NO	5	300-Series SS; PTFE	H-14-024857	2	2	DS-1813-60
RA	Softened Water	Vessel	RA-PV-111	ACTIVATED CARBON BED	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Vessel	RA-PV-112	CATION BED #1	NO	7	Provided by Others	H-14-024857	2	2	N/A
RA	Softened Water	Vessel	RA-PV-113	CATION BED #2	NO	7	Provided by Others	H-14-024857	2	2	N/A
SA	Compressed Air	Compressor	SA-CMP-200	AIR COMPRESSOR	NO	4	COPPER	H-14-024857	3	2	DS-1813-10
SA	Compressed Air	Dryer	SA-DRY-207	COMPRESSED AIR DRYER	NO	4	METAL BEARINGS; COPPER; PTFE	H-14-024857	3	2	DS-1813-11
SA	Compressed Air	Filter	SA-FLT-257	DRYER FILTER - INLET	NO	4	ACTIVATED ALUMINA	H-14-024857	3	2	DS-1813-11
SA	Compressed Air	Filter	SA-FLT-258	DRYER FILTER - OUTLET	NO	4	ACTIVATED ALUMINA	H-14-024857	3	2	DS-1813-11
SA	Compressed Air	ADV	SA-ADV-206	CONDENSATE DRAIN VALVE	NO	9	BRASS	H-14-024857	3	2	DS-1813-32
IA	Instrument Air	ADV	IA-ADV-254	CONDENSATE DRAIN VALVE	NO	9	BRASS	H-14-024857	3	2	DS-1813-32
SA	Compressed Air	SRV	SA-SRV-203	SAFETY RELIEF VALVE	NO	4	316 SS	H-14-024857	3	2	DS-1813-36
IA	Instrument Air	SRV	IA-SRV-252	SAFETY RELIEF VALVE	NO	6	316 SS / CS	H-14-024857	3	2	DS-1813-128
SA	Compressed Air	Tank	SA-TK-204	AIR ACCUMULATOR (80 GAL)	NO	4	CS	H-14-024857	3	2	DS-1813-08
IA	Instrument Air	Tank	IA-TK-253	INSTRUMENT AIR RECEIVER	NO	4	CS	H-14-024857	3	2	DS-1813-45
SA	Compressed Air	Valve	SA-V-200	ISOLATION VALVE	NO	4	316 SS; UHMWPE	H-14-024857	3	2	DS-1813-68
SA	Compressed Air	Valve	SA-PCV-201	PRESSURE CONTROL VALVE	NO	4	ALUMINUM	H-14-024857	3	2	DS-1813-99
SA	Compressed Air	Valve	SA-V-202	BLOCK & BLEED	NO	4	316 SS; GRAFOIL	H-14-024857	3	2	DS-1813-31
SA	Compressed Air	Valve	SA-V-205	ISOLATION VALVE	NO	4	316 SS; UHMWPE	H-14-024857	3	2	DS-1813-68
SA	Service Air	Valve	SA-V-234	NEEDLE VALVE	NO	4	316 SS; UHMWPE	H-14-024857	3	2	DS-1813-102
SA	Service Air	Valve	SA-V-208	ISOLATION VALVE	NO	4	316 SS; UHMWPE	H-14-024857	3	2	DS-1813-68
IA	Instrument Air	Valve	IA-V-250	ISOLATION VALVE	NO	4	316 SS	H-14-024857	3	2	DS-1813-13
IA	Instrument Air	Valve	IA-CV-251	CHECK VALVE	NO	4	316 SS; FKM	H-14-024857	3	2	DS-1813-24
IA	Instrument Air	Valve	IA-PCV-255	PRESSURE CONTROL VALVE	NO	6	ALUMINUM	H-14-024857	3	2	DS-1813-27
IA	Instrument Air	Valve	IA-V-259	BLOCK & BLEED	NO	6	316 SS; GRAFOIL	H-14-024857	3	2	DS-1813-31
VT	Ventilation	Valve	VT-V-921	SAMPLE VALVE (AIR)	NO	8	316 SS; UHMWPE	H-14-021357	1	0	DS-1813-91
VT	Ventilation	Blower	VT-BLO-920	EXHAUST TRAIN BLOWER	NO	8	ALUMINUM	H-14-021357	1	0	DS-1813-115
VT	Ventilation	Valve	VT-V-923	DRAIN VALVE	NO	8, 9	316 SS; UHMWPE	H-14-021357	1	0	DS-1813-124
VT	Ventilation	Valve	VT-V-924	SAMPLE VALVE (AIR)	NO	8	316 SS; UHMWPE	H-14-021357	1	0	DS-1813-91
VT	Ventilation	Valve	VT-V-927	SAMPLE VALVE (AIR)	NO	8	316 SS; UHMWPE	H-14-021357	1	0	DS-1813-91
VT	Ventilation	Condenser	VT-CONDS-900	HEAT PUMP CONDENSER	NO	9	VARIES	H-14-021357	1	0	DS-1813-122

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate

Appendix G – Materials of Construction Tabulation – Chemical Compatibility – Instruments

Instruments that are assessed for chemical compatibility. The instruments are not exposed to waste nor are they exposed to a radiation field.

System	Subsystem	Instrument	EIN	Indication Type	Location	In Rad Field	Service Fluid(s)	Material of Construction	Drawing No.	Sheet	Rev	Datasheet
RA	Reagent Water	Level	RA-LIT-138	TRANSMITTER	RA-TK-138	NO	7	CERAMIC; VITON	H-14-024857	2	2	DS-1813-53
RA	Reagent Water	Temperature	RA-TIT/TE-155	TRANSMITTER	RA-TK-138	NO	7	316 SS	H-14-024857	2	2	DS-1813-58
RA	Reagent Water	Level Switch	RA-LS-163	SWITCH	RA-TK-138	NO	7	316 SS	H-14-024857	2	2	DS-1813-126
RA	Reagent Water	Pressure	RA-PIT-140	TRANSMITTER	INLET TO SOFTENED WATER	NO	7	316L SS	H-14-024857	2	2	DS-1813-56
RA	Softened Water	Flow	RA-FIT/FE-117	TRANSMITTER	SOFTENED WATER SUPPLY	NO	3	316L SS	H-14-024857	2	2	DS-1813-51
RA	Caustic	Level	RA-LT-127A	TRANSMITTER	RA-TK-127A	NO	N/C	316 SS; BUNA-N	H-14-024857	2	2	DS-1813-52
RA	Caustic	Level	RA-LT-127B	TRANSMITTER	RA-TK-127B	NO	N/C	316 SS; BUNA-N	H-14-024857	2	2	DS-1813-52
RA	Caustic	Pressure	RA-PI-131	GAUGE	RA-P-130 DISCHARGE	NO	5	316L SS	H-14-024857	2	2	DS-1813-29
RA	Reagent	Pressure	RA-PI-122	GAUGE	RA-MX-120 DISCHARGE	NO	2, 3	316 SS	H-14-024857	2	2	DS-1813-55
RA	Reagent	Conductivity	RA-CIT/CE-123	TRANSMITTER	RA-MX-120 DISCHARGE	NO	2, 3	Ti; PTFE; SS	H-14-024857	2	2	DS-1813-34
SA	Compressed Air	Pressure	SA-PI-201	GAUGE	SA-CMP-200 DISCHARGE	NO	4	316L SS	H-14-024857	3	2	DS-1813-110
SA	Compressed Air	Pressure	SA-PI-202	GAUGE	SA-TK-204	NO	4	316L SS	H-14-024857	3	2	DS-1813-65
IA	Instrument Air	Pressure	IA-PI-255	GAUGE	IA-PCV-255	NO	6	316L SS	H-14-024857	3	2	DS-1813-110
IA	Instrument Air	Pressure	IA-PIT-259	TRANSMITTER	IA-TK-253 DISCHARGE	NO	6	316L SS	H-14-024857	3	2	DS-1813-44
VT	Ventilation	Flow	VT-FT-918	TRANSMITTER	EXHAUST TRAIN FLOW	NO	8	316 SS	H-14-021357	1	0	DS-1813-114

* Wetted materials only. N/C: non-contacting

[1]Fluids:	1. Waste	2. 0.1 M NaOH	3. Softened Water	4. Service Air	5. 25 wt% NaOH	6. Instrument Air	7. Reagent Water	8. Air / Gas	9. Condensate