X-SD-J-00002
Revision: 3
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SALT WASTE PROCESSING FACILITY

CAUSTIC-SIDE SOLVENT EXTRACTION

SYSTEM DESCRIPTION

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For Caustic-side Solvent Extraction operations with Next Generation Solvent, refer to X-SD-J-00009.

This Document Affected By	
Design Change Document	Initial/Date

SUMMARY OF CHANGES

Revision No.	Date	Description of Change
0	05/19/08	Issued for Enhanced Final Design
1	08/27/2015	Incorporate DCN-0641. Revise Per DCN-1473. Issued for Approval. This is a complete rewrite. No deletions or Revision bars shown.
2	10/17/2017	Revise Per DCN-1954 and DCN-1802 Rev.1.
3	10/01/2019	Revise per DCN-2039, DCN-7015, DCN-2101, DCN-2205, DCN-2212, and DCN-2230.

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ACRONYMS AND ABBREVIATIONS

%	Percent
°C	degrees Celsius
°F	degrees Fahrenheit
AFF	Alpha Finishing Facility
Al	Aluminum
APA	Air Pulse Agitator
ASP	Alpha Strike Process
AST-A	Alpha Sorption Tank-A (TK-101)
AST-B	Alpha Sorption Tank-B (TK-221)
Ba	Barium
BDT	Ba-137 Decay Tank (TK-206)
Btu/hr	British thermal units per Hour
BOBCalixC6	Calix[4]arene-bis(tert-octylbenzo-crown-6)
CCA	Cold Chemicals Area
CDCSS	Cesium-depleted Clarified Salt Solution
Ci/gal	Curies per gallon
CIP	Clean-In-Place
CF	Concentration Factor
CPA	Central Processing Area
Cs	Cesium
Cs-7SB	1-(2,2,3,3-tetrafluoropropoxy)-3-(4-sec-butylphenoxy)-2-propanol
CSSX	Caustic-side Solvent Extraction
CSS	Clarified Salt Solution
DCS	Distributed Control System
DI	Deionized Water
dP	Differential Pressure
DSS	Decontaminated Salt Solution
DSSHT	Decontaminated Salt Solution Hold Tank (TK-207)
DWPF	Defense Waste Processing Facility
Fe	Iron
FFT-A	Filter Feed Tank-A (TK-102)
ft	Feet/Foot
gpm	Gallons per minute
H_2	Hydrogen
Hg	Mercury
HNO_3	Nitric Acid
hp	Horsepower
IST	Intermediate Storage Tank (TK-220)
K	Potassium
kW	Kilowatt
LFL	Lower Flammability Limit
M	Molar

ACRONYMS AND ABBREVIATIONS (cont.)

MST	Monosodium Titanate
N/A	Not Applicable
Na	Sodium
Na^+	Sodium ion
NaOH	Sodium Hydroxide
NTU	Nephelometric Turbidity Units
O/A	Organic to Aqueous
P&ID	Piping and Instrumentation Diagram
P&VG	Pump and Valve Gallery
PFD	Process Flow Diagram
pH	Hydrogen Ion Concentration
psig	Pounds per square inch gauge
rpm	Revolutions per Minute
s.g.	Specific gravity
SDT	Solvent Drain Tank (TK-208)
SEHT	Strip Effluent Hold Tank (TK-205)
SHT	Solvent Hold Tank (TK-202)
SQL	Structured Query Language
SSFT	Salt Solution Feed Tank (TK-109)
SWPF	Salt Waste Processing Facility
T/T	Tangent-Tangent (height)
Top/T	Top – Tangent (height)
TCV	Temperature Control Valve
TOA	Tri-n-octylamine
VFD	Variable Frequency Drive
WTE	Waste Transfer Enclosure

DEFINITIONS/GLOSSARY

There are no definitions or glossary items for this System Description.

1.0 SCOPE

The scope of this System Description is the equipment related to the Caustic-side Solvent Extraction (CSSX) process. The CSSX System provides the cesium (Cs) removal function for the salt solution in the Salt Waste Processing Facility (SWPF). The following subsystems are involved.

- The Salt Solution Feed Tank (SSFT) (TK-109) and Pumps (P-109A/B) receive clarified salt solution (CSS) from the Alpha Sorption Filters (FLT-102A/B/C) and feed the Extraction Contactors (EXT-201A/P) for Cs removal.
- The extraction contactors are used to remove Cs from the CSS.
- The Decontaminated Salt Solution (DSS) Solvent Recovery and Barium (Ba)-137 Decay System recovers solvent from the DSS prior to its transfer to the Alpha Finishing Facility (AFF). The DSS Stilling Tank (TK-211) receives DSS from the extraction contactors and provides a mechanism for gross solvent recovery. The DSS remains in the Ba-137 Decay Tank (BDT) (TK-206) to allow the Cs daughter product, ^{137m}Ba, to decay sufficiently before being subsequently transferred to the AFF via the DSS Coalescer (TK-201).
- The Solvent Hold Tank (SHT) (TK-202) collects solvent from various sources and serves as the solvent reservoir.
- The Scrub Contactors remove sodium ions (Na^+) and potassium (K) ions from the Cs-rich solvent, using 0.05 Molar (M) Nitric Acid (HNO_3).
- The Strip Contactors strip the Cs into a weak nitric solution so the solvent can be recycled in the process.
- The Caustic Wash Contactors, Caustic Wash Tank (TK-204), and Pumps remove impurities from the solvent with 0.01 – 0.3M Sodium Hydroxide (NaOH).
- The Strip Effluent Solvent Recovery and Ba In-growth System include three vessels. The Strip Effluent Stilling Tank (TK-212) and Strip Effluent Coalescer (TK-203) provide a mechanism to recover solvent from the strip effluent stream. The Strip Effluent Pump Tank (TK-215) provides additional residence time for ^{137m}Ba in-growth so the ^{137}Cs content can be more accurately monitored.
- The Strip Effluent Hold Tank (SEHT) (TK-205) and Pumps (P-205A/B) store the strip effluent and transfer it to the Defense Waste Processing Facility (DWPF).

The CSSX System interfaces with components in the following System Descriptions:

- E-SD-J-00002, *SWPF Electrical System Description*[1];
- J-SD-J-00002, *SWPF Instrumentation and Controls System Description*[2];
- M-SD-J-00005, *SWPF Utilities System Description*[3];
- X-SD-J-00001, *SWPF Alpha Strike Process System Description*[4];
- X-SD-J-00003, *SWPF Cold Chemicals Area System Description*[5];

- X-SD-J-00004, *SWPF Alpha Finishing Process System Description*[6];
- X-SD-J-00005, *SWPF Drains System Description*[7]
- X-SD-J-00006, *SWPF Sampling System Description*[8]; and
- X-SD-J-00007, *SWPF Air Pulse Agitators System Description*[9].

The safety analysis requirements related to system functions for this system are documented in Chapter 4 of S-SAR-J-00002[10], *SWPF Documented Safety Analysis*[10].

The safety analysis requirements related to operability for this system are documented in Chapter 5 of S-SAR-J-00002[10].

The discrete project design requirements for this system are documented in P-DB-J-00002, *SWPF Design Criteria Database*[11].

As Part of the maintenance of the SWPF Master Equipment list (see PP-EN-5042, *Master Equipment List*)[12], all permanent plant equipment is assigned a unique tag number. Each component (equipment, instrumentation, specialty item, etc.) is assigned to one (and only one) CSE system code. Structured Query Language (SQL) reports are generated (real time) off the controlled Master Equipment List. These are filterable by the CSE system. A complete listing of all components associated with this system can be found using the following reports, and filtering by Drain:

- MEL Cables
- MEL Equipment
- MEL Instruments
- MEL Lines
- MEL Manual Valves
- MEL Specialty Items

Similarly, all essential and support drawings are coded to the appropriate CSE system code (with only one code allowed per drawing). Using the following link: Drawing Category Status, a report may be generated for DRAIN and selecting the drawing type (Essential, Support). Reference drawings are not assigned System Codes and not required to be maintained current with facility modifications per PP-EN-5001[12], *Design Control* and P-CDM-J-00001, *Configuration Management Plan*[13].

2.0 GENERAL OVERVIEW

The Simplified CSSX Process Flow Diagram (PFD) (Figure 2-1) is a schematic showing the main process equipment and flow paths of the CSSX System. The CSSX Process Drain Schematic () is a schematic showing the CSSX drainage routes to the SDT (TK-208). The SDT (TK-208) and associated equipment is covered in X-SD-J-00005[7].

Figure 2-1. Simplified CSSX PFD

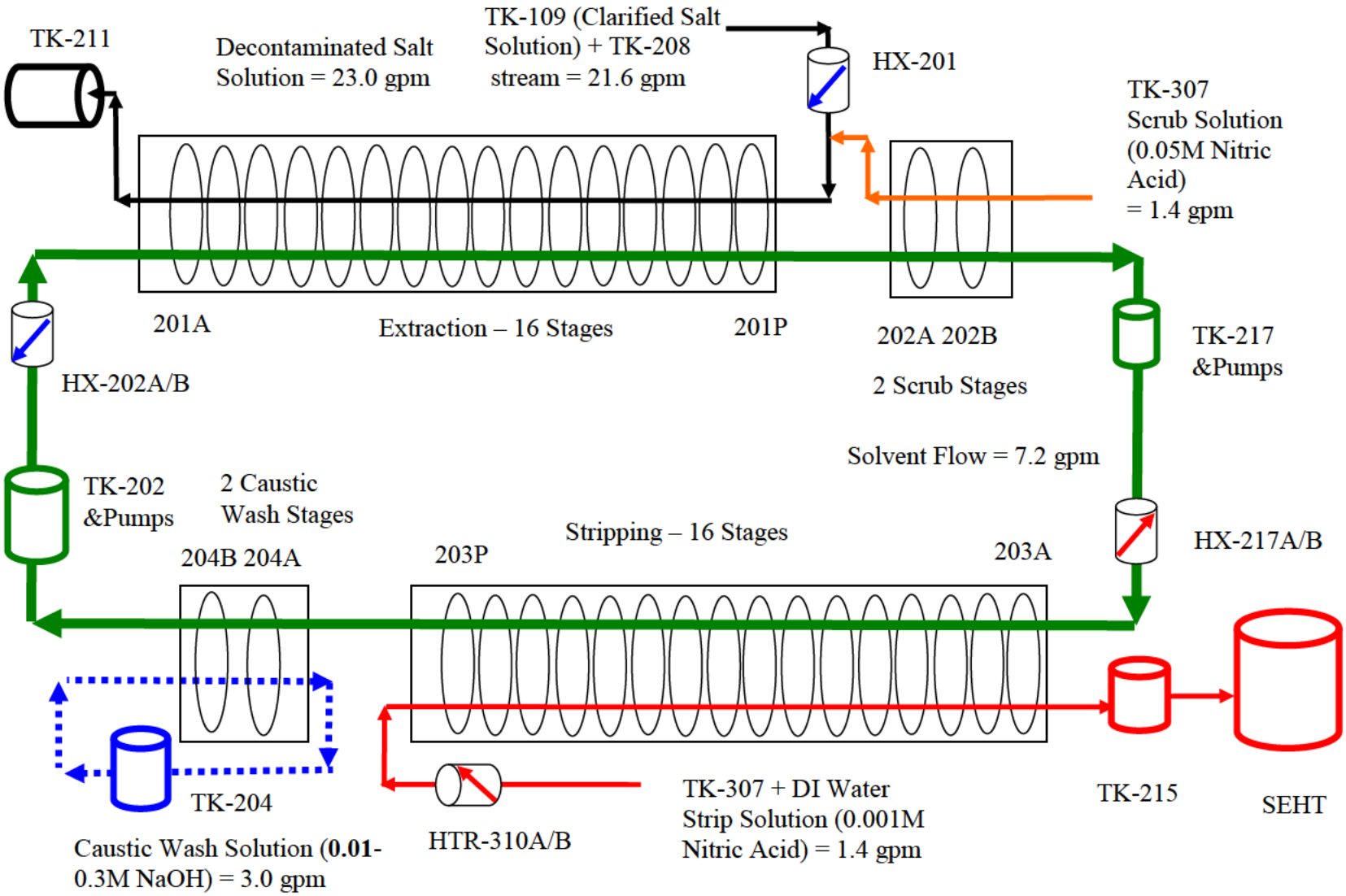
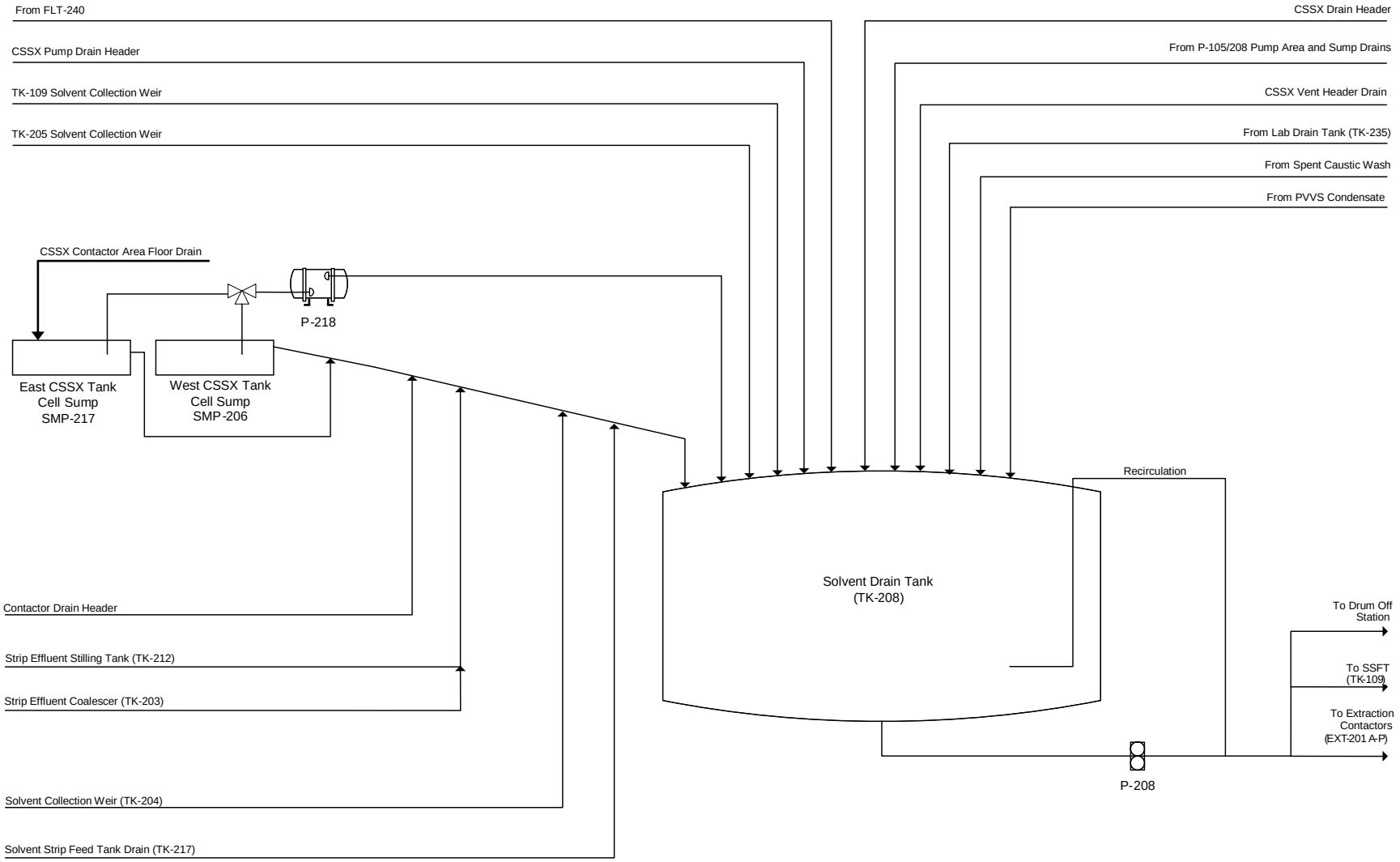


Figure 2-2. Caustic-side Solvent Extraction Process Drain Schematic



3.0 SSFT (TK-109) AND PUMPS

3.1 System Functions

- The SSFT (TK-109) receives CSS from the Alpha Sorption Filter (FLT-102A/B/C) (see P-DB-J-00003, *SWPF Process Basis of Design*[14]).
- The SSFT (TK-109) provides storage of CSS that allows for transition between the batch Alpha Strike Process (ASP) and the continuous CSSX process (see P-DB-J-00003[14]).
- Pumps (P-109A/B) feed the Extraction Contactors (EXT-201A/P) for Cs removal (see P-DB-J-00003[14]).

3.2 Operational Overview

The SSFT (TK-109) collects CSS from the ASP filters. The normal operating level for SSFT (TK-109) is 20,700 gallons. This normal operating level allows the CSSX System to operate at full capacity for up to 16 hours with no CSS production (ASP section shutdown). This normal operating level also allows the ASP System to operate at full capacity for up to 16 hours with no CSSX operations (CSSX System Shutdown).

During system startup, DSS is fed to the CSSX extraction contactors for a period of time, with the aqueous effluent from EXT-201A being routed to the SSFT (TK-109). External cooling coils maintain the SSFT (TK-109) contents within a range of 73 ± 5 degrees Fahrenheit (°F). Means are provided to support sampling the SSFT (TK-109) contents (see X-SD-J-00006[8]). If the contents are not within acceptable process limits (high strontium/actinide level, high solids content), the CSS may be recycled to Alpha Sorption Tank-A (AST-A) (TK-101) or Filter Feed Tank-A (FFT-A) (TK-102) for reprocessing. Pumps P-109A/B are normally used to transfer CSS to the extraction contactors at a controlled rate.

3.3 Configuration Information

3.3.1 Description of System

Refer to Piping and Instrumentation Diagrams (P&IDs) and PFDs listed in Table 3-1.

Table 3-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0006	*SWPF Salt Solution Feed Tank and Solvent Drain Tank PFD (U)*[16]
M-M6-J-0030	*SWPF Process Building Salt Solution Feed Tank TK-109 P&ID (U)*[17]
M-M6-J-0031	*SWPF Process Building Salt Solution Feed Pumps P-109A/B P&ID (U)*[18]
M-M6-J-0045	*SWPF Process Building Salt Solution Feed Cooler HX-201 P&ID (U)*[19]

3.3.2 Major Components

See Table 3-2 for a list of major components.

Table 3-2. Major Components

Component	Description
SSFT (TK-109)	Stainless steel pressure vessel that receives CSS from FLT-101A/B/C and provides sufficient capacity for SWPF processing requirements [20]) Capacity to Overflow: 45,000 gallons (see M-CLC-J-00032[20]) Dimensions: 21 foot (ft) diameter x 16 ft-3 inch Tangent to Tangent height (T/T) Design features: • The SSFT (TK-109) is maintained under vacuum, with respect to the cell, for containment/confinement. • The SSFT (TK-109) includes an overflow line that enters the SSFT Cell Sump (SMP-109) below the liquid level. • The SSFT (TK-109) includes a solvent recovery weir and line to allow solvent removal and gravity drain to the SDT (TK-208). • The SSFT (TK-109) is equipped with external cooling coils to cool and maintain the tank contents at 73 ± 5 °F. • The SSFT (TK-109) is equipped with an air purge to prevent the accumulation of flammable vapors.
SSFT Air Pulse Agitator (APA) (AGT-109)	APA is used to maintain the contents of SSFT (TK-109) in suspension Air Usage: 262 Standard cubic feet per minute (see M-CLC-J-00094, *SWPF SSFT Pulse Mixer Sizing Calculation*[21]) Design features: • AGT-109 includes 7 pulse pots.
SSFT Pumps (P-109A/B)	Positive displacement pumps with variable frequency drives (VFDs) that provide a controlled feed to the extraction contactors Capacity: 30 gallons per minute (gpm) (see M-CLC-J-00099, *SWPF Salt Solution Feed Pumps Sizing Calculation, P-109A/B*[22]) Horsepower (hp): 5.0 Design features: • The SSFT Pumps (P-109A/B) have drain and flush capability.

Table 3-2. Major Components (cont.)

Component	Description
Salt Solution Feed Cooler (HX-201)	Heat exchanger used to cool the salt solution feed stream to the extraction contactors. Rating: 64,000 British thermal units per Hour (Btu/hr) (see M-DS-J-00014, *SWPF Salt Solution Feed Cooler HX-201*[23]) Design features: • The Salt Solution Feed Cooler (HX-201) is a shell and tube heat exchanger. • The Salt Solution Feed Cooler (HX-201) is sized to remove the entire required heat load for the CSS stream (i.e., redundant with the SSFT [TK-109] cooling jacket: see M-CLC-J-00140, *SWPF SSFT Cooling Jacket Sizing Calculation*[24]).

3.3.3 Stream Data

See Table 3-3 for a listing of streams.

Table 3-3. Streams

Stream	Description
CSS	CSS is received in the SSFT (TK-109) from the ASP filters (FLT-101A/B/C). CSS is sent to the extraction contactors from the SSFT Pumps (P-109A/B). Properties: 1.25 specific gravity (s.g.) (M-CLC-J-00143, *SWPF Mass Balance Model Calculations as a Result of Nitric Acid Replacing Oxalic Acid*[25]) 5.60M Na+ concentration (M-CLC-J-00143[25])

3.3.4 Physical Location and Layout

The SSFT (TK-109) is located in the SSFT Cell in the Central Processing Area (CPA). The SSFT Pumps (P-109A/B) are located in the CSSX Pump and Valve Gallery (P&VG) area. An automatic isolation valve is located at the labyrinth wall to separate the tank and transfer pumps.

3.3.5 System Control Features and Interlocks

3.3.5.1 System Monitoring

The SSFT system has instrumentation to monitor the status of the system, provide control functions and initiate corrective actions, if necessary. Local and Control Room indications are provided to the Distributed Control System (DCS).

The SSFT (TK-109) has two redundant bubbler level instruments to monitor the level in the tank. The bubbler level instruments also provide density indication. The SSFT (TK-109) has a thermowell and temperature element with a high/low alarm installed in the tank to monitor the temperature of tank contents. The SSFT (TK-109) includes two external cooling water coils (1/2 pipe) with temperature control valves (TCVs). The SSFT (TK-109) includes a pressure differential instrument to monitor the relative pressure in the tank vapor space.

The SSFT Transfer Pumps (P-109A/B) have instrumentation to monitor and control the pump speed. A magnetic flow meter is installed on the discharge side of the pumps to regulate the flow rate from the SSFT (TK-109). Total flow rate is set by the SSFT Transfer Pump (P-109A/B) speed.

Redundant turbidity monitors measure the solids content of the CSS.

The discharge temperature at the exit of the Salt Solution Feed Cooler (HX-201) is monitored. TCV is controlled to adjust the flow of cooling water to the cooler.

See Table 3-4 for a listing of instruments.

Table 3-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-109A	M-M6-J-0031[18]	N/A	Pump Status	Run/Off
P-109B	M-M6-J-0031[18]	N/A	Pump Status	Run/Off
LIT-1390	M-M6-J-0030[17]	J-JZ-J-0018, *SWPF LI-1390 SSFT Level*[26]	SSFT (TK-109) level	Gallons
DIT-1390	M-M6-J-0030[17]	J-JZ-J-00198, *SWPF DI-1390 SSFT Density*[27]	SSFT (TK-109) Liquid Density	s.g.
TE-1394	M-M6-J-0030[17]	J-JZ-J-00201, *SWPF TIC-1394 SSFT Temp*[28]	SSFT (TK-109) Liquid Temperature	°F
TV-1394A	M-M6-J-0030[17]	J-JZ-J-00201[28]	Valve Position	0-100 percent (%) Open
TV-1394B	M-M6-J-0030[17]	J-JZ-J-00201[28]	Valve Position	0-100% Open
LIT-1395	M-M6-J-0030[17]	J-JZ-J-0019, *SWPF LI-1395 SSFT Level*[29]	SSFT (TK-109) Level	Gallons
DIT-1395	M-M6-J-0030[17]	J-JZ-J-00199, *SWPF DI-1395 SSFT Density*[30]	SSFT (TK-109) Liquid Density	s.g.
HV-1450	M-M6-J-0031[18]	N/A	AST-A Isolation Valve Position	Open/Closed
FV-1451	M-M6-J-0031[18]	N/A	DSS Feed Flow Valve Position	0-100% Open
HV-1452	M-M6-J-0031[18]	N/A	FFT-A Isolation Valve Position	Open/Closed
HV-1453	M-M6-J-0031[18]	N/A	P-109A/B Isolation Valve Position	A-C/B-C position

Table 3-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
HV-1454	M-M6-J-0031[18]	N/A	Valve Position	A-C/B-C position
HV-1456	M-M6-J-0031[18]	N/A	Drain Valve position	Open/Closed
HV-1457	M-M6-J-0031[18]	N/A	Drain Valve Position	Open/Closed
HV-1458	M-M6-J-0031[18]	N/A	Valve Position	Open/Closed
AE-1459	M-M6-J-0031[18]	J-JZ-J-00202, *SWPF AI-1459 CSSX Feed Turbidity*[31]	CSSX Feed Turbidity	Nephelometric Turbidity Units (NTU)
AE-1460	M-M6-J-0031[18]	J-JZ-J-00203, *SWPF AI-1460, CSSX Feed Turbidity*[32]	CSSX Feed Turbidity	NTU
HV-1461	M-M6-J-0031[18]	N/A	Drain Valve Position	Open/Closed
HV-1462	M-M6-J-0031[18]	N/A	Drain Valve Position	Open/Closed
HV-1465	M-M6-J-0031[18]	N/A	Valve Position	Open/Closed
HV-2245	M-M6-J-0045[19]	N/A	Valve Position	A-C/B-C/A-B
FE-1467	M-M6-J-0031[18]	J-JZ-J-00204, *SWPF FIC-1467 Salt Solution Feed Flow*[33]	Flow rate, P-109A/B	gpm
SC-1467A	M-M6-J-0031[18]	J-JZ-J-01065, *SWPF SIC-1467A Salt Solution Feed Pump A Speed*[34]	P-109A Speed	0 – 100%
SC-1467B	M-M6-J-0031[18]	J-JZ-J-01066, *SWPF SIC-1467B Salt Solution Feed Pump B Speed*[35]	P-109B Speed	0 – 100%
TE-2128	M-M6-J-0045[19]	J-JZ-J-00444, *TIC-2128 Salt Solution Feed Temp*[36]	Salt Solution Temperature (HX-201)	°F
TV-2128	M-M6-J-0045[19]	J-JZ-J-00444[36]	Valve Position	0-100% Open
PDIT-4520	M-M6-J-0030[17]	J-JZ-J-00200, *SWPF PDI-4520 SSFT Vacuum*[37]	SSFT (TK-109) Vapor space to Cell differential pressure (dP)	Inches water vacuum
VE-9249A/B/C/D	M-M6-J-0031[18]	N/A	P-109A Vibration	Cycles/second Inches/sec
VE-9250A/B/C/D	M-M6-J-0031[18]	N/A	P-109B Vibration	Cycles/second Inches/sec

3.3.5.2 Control Functions

See Table 3-5 for a listing of control loops.

Table 3-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
TIC-1394	M-M6-J-0030[17]	J-JZ-J-00201[28]	SSFT (TK-109) temperature	73°F
FIC-1467A	M-M6-J-0031[18]	J-JZ-J-00204[33]	P-109A Discharge flow rate	Operator-entered
FIC-1467B	M-M6-J-0031[18]	N/A	P-109B Discharge flow rate	Operator-entered
SIC-1467A	M-M6-J-0031[18]	J-JZ-J-01065[34]	P-109A Pump Speed/Pump flow rate	Operator-entered, manual operation
SIC-1467B	M-M6-J-0031[18]	J-JZ-J-01066[35]	P-109B Pump Speed/Pump flow rate	Operator-entered, manual operation
TIC-2128	M-M6-J-0045[19]	J-JZ-J-00444[36]	Salt Solution Temperature– HX-201 Exit	73°F

3.4 Operations

3.4.1 Initial Configuration

The salt solution in the SSFT (TK-109) is the filtrate (CSS) from FLT-102A/B/C. The ASP is operated until a sufficient inventory of CSS is collected in the SSFT (TK-109) (see X-SD-J-00001[4]). The SSFT Feed Pumps are off.

3.4.2 System Startup

Once the SSFT (TK-109) has sufficient inventory, the CSSX process will be started. During system startup, DSS is fed to the CSSX extraction contactors via P-109A/B for a period of time. The DSS Hold Tank (DSSHT) Transfer Pumps (P-207A/B) are operated to mix the DSSHT (TK-207) using DSS Hold Tank Eductors (EDT-207). A side stream is taken off the DSSHT eductor line to send DSS to the inlet of P-109A/B. The aqueous effluent from EXT-201A is routed to the AFF. DSS is used during CSSX startup to establish process flows prior to introducing feed that requires decontamination. Once process flows have been established, the extraction feed stream is changed from DSS to CSS.

See Section 4.4.2 for a detailed description of CSSX System startup.

3.4.3 Normal Operations

Normal operation includes the SSFT (TK-109) receiving CSS and Pumps P-109A/B transferring CSS from the SSFT (TK-109) to the extraction contactors at the same nominal rate (21.6 gpm). These flow rates will be adjusted to maintain the level in the SSFT (TK-109) within a band centered on 20,700 gallons. This normal operating level allows the CSSX System to operate at full capacity (21.6 gpm) for up to 16 hours with no CSS production (ASP section shutdown).

This normal operating level also allows the ASP System to operate at full capacity (21.6 gpm, nominal) for up to 16 hours with no CSSX operations (CSSX System shutdown). A 16-hour surge capacity corresponds to the estimated time required to replace a contactor (see P-ESR-J-00003, *SWPF Operations Assessment and Tank Utilization Models*[38]). External cooling coils (2 zones) maintain the SSFT (TK-109) contents within a range of 73 ± 5 ºF to support the CSSX extraction process. Salt Solution Feed Cooler (HX-201) ensures that the contactor feed stream is maintained within this temperature range. Means are provided to support sampling the SSFT (TK-109) contents (see X-SD-J-00006[8]). The tank is periodically sampled, and AGT-109 (see X-SD-J-00007[9]) is used to keep the SSFT (TK-109) contents mixed.

The process sequences for the SSFT system are included in Section 3.0 of X-PCD-J-00001, *SWPF Automation Functional Control Sequence for: Caustic-Side Solvent Extraction*[39].

3.4.4 Off-Normal and Recovery Operation

Solvent recovery in the SSFT (TK-109) is a non-routine activity requiring Operator action. The SSFT (TK-109) includes a solvent recovery weir and line to allow the solvent to gravity-drain to the SDT (TK-208). The level in SSFT (TK-109) is raised slowly, using CSS feed to just below the solvent overflow weir. Operation of the ASP is suspended to stop additional transfers into the SSFT (TK-109). The level in SSFT (TK-109) is then slowly raised. The fluid in SSFT (TK-109) will flow over the solvent recovery overflow weir and exit the tank. The SSFT (TK-109) level is then returned to within the normal operating range by operating the CSSX process. The ASP operation (production of filtrate) can be restored after the SSFT (TK-109) level is dropped below the high level alarm set points.

If required, the CSS can be recycled to AST-A (TK-101) or FFT-A (TK-102) for reprocessing. Transfer of the SSFT (TK-109) contents to AST-A (TK-101) or FFT-A (TK-102) is a non-routine activity requiring Operator action.

Personnel entry into the P&VG labyrinth will require the SSFT (TK-109) related equipment located in the labyrinth to be flushed and drained.

Table 3-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 3-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
SSFT (TK-109) TCV failure (TV-1394A / TV-1394B)	High or Low temperature alarm	None	Tank cooling can be operated manually, using the TCV bypass valve until repairs are completed.
Salt Solution Feed Pump failure (P-109A/B)	Low flow alarm (FIC-1467) / Pump status on DCS.	Switch to the alternate pump (automatic switchover feature is enabled).	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping will be flushed and drained prior to P&VG labyrinth entry.
Salt Solution Feed Cooler TCV failure (TV-2128)	High or Low temperature alarm	None	Cooling can be operated manually, using the TCV bypass valve until repairs are completed.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.
CSSX Hard Shutdown Initiated by Operator	Operator action	Perform Hold Logic for Running Sequence.	Operator to investigate reason for hard Shutdown.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	dP Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.

3.4.5 System Shutdown

In order to shut down the CSSX process, feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. DSS is fed to the CSSX extraction contactors for a period of time via P-109A/B, with the aqueous effluent from EXT-201A being routed to the AFF. DSSHT Transfer Pumps (P-207A/B) are used to transfer DSS to the inlet of P-109A/B while the DSSHT (TK-207) is being mixed. DSS is used during the CSSX shutdown to reduce the Cs content in the contactors.

4.0 EXTRACTION CONTACTORS

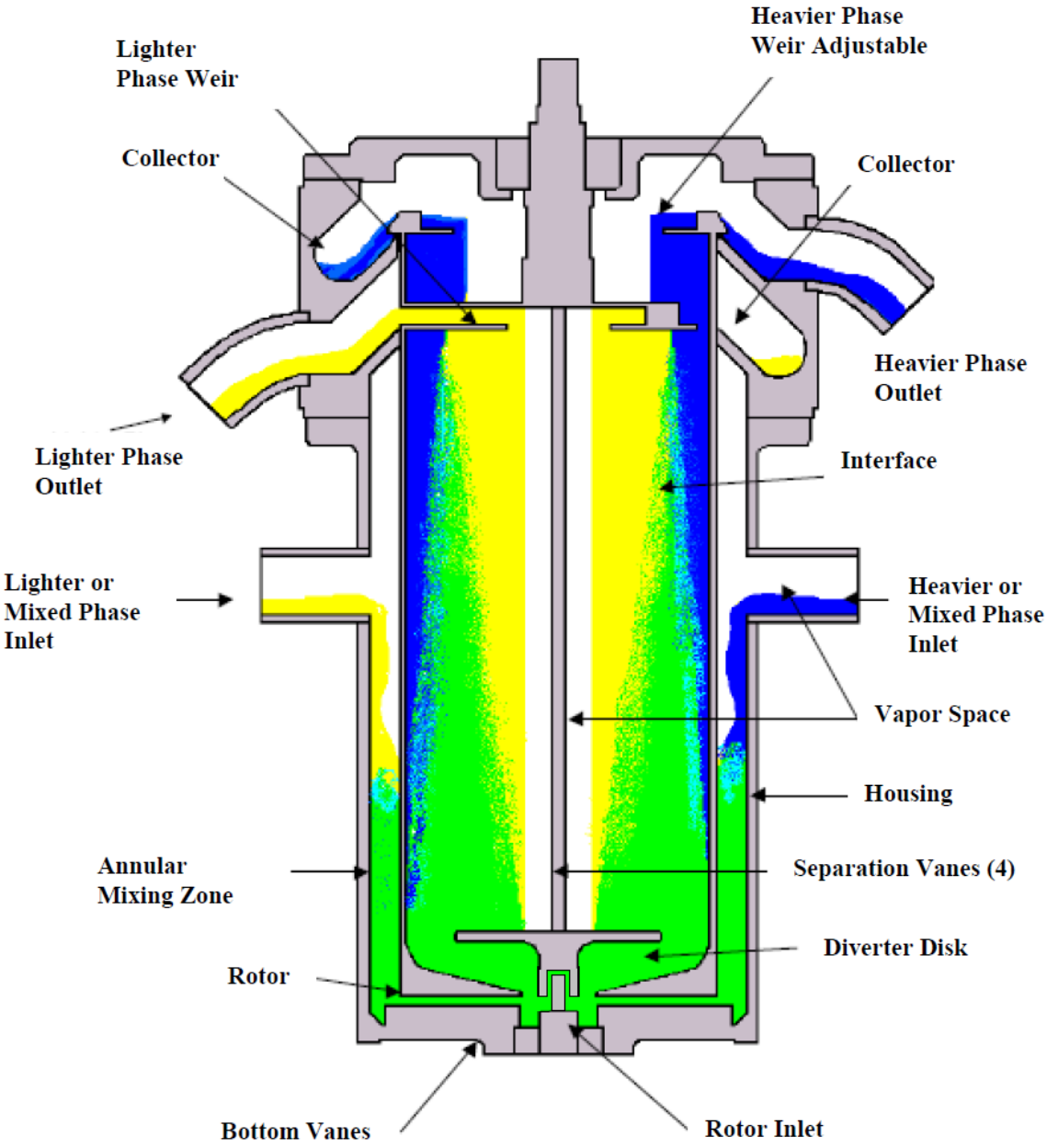
4.1 System Functions

The general purpose of the extraction contactors is to remove Cs from the salt solution and concentrate it in the solvent (see P-DB-J-00003[14]).

4.2 Operational Overview

The extraction section consists of 16 centrifugal contactors. The contactors are centrifugal mixers and separators, in which two immiscible liquids of different densities are mixed in the annular mixing zone and then separated by centrifugal force in the spinning rotor. The Cs is removed by contacting the CSS counter-current with an engineered organic solvent that selectively removes Cs from the solution. The figure below provides a cutaway view of a centrifugal contactor.

Figure 4-1. Cutaway View of a CINC Contactor with a Hanging Rotor



Aqueous feed to the system is pumped through the Salt Solution Feed Cooler (HX-201) to control the feed inlet temperature at 73 ± 5°F. Solvent is fed to the extraction stage organic inlet. The solvent flow control set point is based on total hydraulic capacity of the contactors (organic plus aqueous) and the reduction in Cs content required for the given feed. The aqueous (CSS) and organic (solvent) flow rates are specified based on the Cs removal required. The DCS is used to monitor the relative organic to aqueous (O/A) ratio. The O/A ratio in extraction is expected to be approximately 1/3.

The stripped aqueous stream (DSS) is fed to the DSS Stilling Tank (TK-211) to recover any entrained solvent. The Cs-laden solvent is directed to the scrub contactors (EXT-202A/B).

4.3 Configuration Information

4.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 4-1.

Table 4-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0007	*SWPF Solvent Extraction and Acid Scrub PFD (U)*[40]
M-M6-J-0034 SH1	*SWPF Process Building Solvent Extraction Contactors EXT-201A/B P&ID (U)*[41]
M-M6-J-0034 SH2	*SWPF Process Building Solvent Extraction Contactors EXT-201C/D P&ID (U)*[42]
M-M6-J-0035 SH1	*SWPF Process Building Solvent Extraction Contactors EXT-201E/F P&ID (U)*[43]
M-M6-J-0035 SH2	*SWPF Process Building Solvent Extraction Contactors EXT-201G/H P&ID (U)*[44]
M-M6-J-0036 SH1	*SWPF Process Building Solvent Extraction Contactors EXT-201 I/J P&ID (U)*[45]
M-M6-J-0036 SH2	*SWPF Process Building Solvent Extraction Contactors EXT-201K/L P&ID (U)*[46]
M-M6-J-0037 SH1	*SWPF Process Building Solvent Extraction Contactors EXT-201M/N P&ID (U)*[47]
M-M6-J-0037 SH2	*SWPF Process Building Solvent Extraction Contactors EXT-201O/P P&ID (U)*[48]
M-M6-J-0076 SH2	*SWPF Process Building Process Water Pressure Tank TK-305 P&ID (U)*[49]
M-M6-J-0157	*SWPF Process Building Flush Main Header P&ID (U)*[50]
M-M6-J-0162 SH1	*SWPF Process Building CSSX South Contactor/Tank Cell Flush Header P&ID (U)*[51]

4.3.2 Major Components

See Table 4-2 for a list of major components.

Table 4-2. Major Components

Component	Description
Extraction Contactors (EXT-201A/P)	Centrifugal contactors that continuously contact aqueous phase (CSS) and organic phase (process solvent) in a counter-current fashion. Centrifugal contactors are equipped with VFD motors for rotor speed control. Capacity: 30 gpm (hydraulic) hp: 10.0 Design features: Each V-10 contactor is equipped with a VFD that allows the contactor to be started/stopped and speed of the rotor to be controlled by the DCS. Each contactor can handle a hydraulic throughput of up to 30 gpm. The contactors can be safely operated dry. Each contactor is equipped with a system for Clean-In-Place (CIP) flushing of the rotor and inside of the housing. Each contactor is equipped with a cooling water jacket. Cooling water is distributed from the process cooling water supply and returned to the process cooling water return for recycle to the process chiller units. The feed and miscellaneous process solutions are pumped through a heat exchanger to control the temperature, prior to being fed to the extraction contactors. Each inter-stage line is vented to the process vessel vent header. This ensures that the solution gravity-drains from one stage to the next without creating pressure differentials between contactor stages. Proper venting of the gravity-drain system from one contactor to the next is essential for hydraulic operation of the contactors. Flush capability is provided for the vent piping. Each contactor is equipped with a labyrinth seal to prevent process fluid contacting the rotor bearings. The labyrinth seal requires an air purge that is supplied from the Plant Air system. Each contactor is equipped with a heavy phase weir for phase separation. The weir size for each contactor location is provided below. Process Location — Weir Size EXT-201A — 5.4-inch EXT-201B — 5.4-inch EXT-201C — 5.4-inch EXT-201D — 5.4-inch EXT-201E — 5.4-inch EXT-201F — 5.4-inch EXT-201G — 5.4-inch EXT-201H — 5.4-inch EXT-201I — 5.4-inch EXT-201J — 5.4-inch EXT-201K — 5.4-inch EXT-201L — 5.4-inch EXT-201M — 5.4-inch EXT-201N — 5.4-inch EXT-201O — 5.4-inch EXT-201P — 5.6-inch
MIX-301B	In-line mixer for process water and caustic or for process water and HNO_3 supply. This mixer provides chemical flushing solutions for the CSSX flush header.

4.3.3 Stream Data

See Table 4-3 for a listing of streams.

Table 4-3. Streams

Stream	Description
CSS	CSS is sent to the Extraction Contactors (EXT-201P) from the SSFT pumps (P-109A/B) Properties 1.25 s.g. (M-CLC-J-00143[25]) 5.60M Na+ concentration (M-CLC-J-00143[25])
Solvent	Solvent is transferred to EXT-201A from the Solvent Feed Pumps (P-202A/B). Cs-laden solvent is gravity-fed from EXT-201P to the Scrub Contactors (EXT-202A/B). Properties 0.85 s.g. at 25 degrees Celsius °C- (see ORNL/TM-2002/204, *Density Changes in the Optimized CSSX Solvent System*[52])
DSS	DSS is gravity-fed to the DSS Stilling Tank (TK-211) from EXT-201A. Properties 1.24 s.g. (M-CLC-J-00143[25]) 5.25M Na+ concentration (M-CLC-J-00143[25])

4.3.4 Physical Location and Layout

The Extraction Contactors (EXT-201A/P) are located on the Contactor Operating Deck in the CPA.

4.3.5 System Control Features and Interlocks

4.3.5.1 System Monitoring

The Extraction Contactors (EXT-201A/P) have instrumentation to monitor the status of the system, provide control functions, and initiate corrective actions, if necessary. Remote indications are provided to the DCS. The contactor rotation speed is set by using the DCS speed controller. Each contactor is individually controlled. The temperature of the aqueous stream exiting every fourth contactor is monitored and used to control the cooling water flow to the set of four contactors.

See Table 4-4 for a listing of instruments.

Table 4-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SC-9201	M-M6-J-0034 SH1[41]	Not Applicable (N/A)	Contactor Speed (EXT-201A)	Revolutions per minute (rpm)
SC-9202	M-M6-J-0034 SH1[41]	N/A	Contactor Speed (EXT-201B)	rpm
SC-9203	M-M6-J-0034 SH2[42]	N/A	Contactor Speed (EXT-201C)	rpm
SC-9204	M-M6-J-0034 SH2[42]	N/A	Contactor Speed (EXT-201D)	rpm
SC-9205	M-M6-J-0035 SH1[43]	N/A	Contactor Speed (EXT-201E)	rpm
SC-9206	M-M6-J-0035 SH1[43]	N/A	Contactor Speed (EXT-201F)	rpm
SC-9207	M-M6-J-0035 SH2[44]	N/A	Contactor Speed (EXT-201G)	rpm
SC-9208	M-M6-J-0035 SH2[44]	N/A	Contactor Speed (EXT-201H)	rpm
SC-9209	M-M6-J-0036 SH1[45]	N/A	Contactor Speed (EXT-201I)	rpm
SC-9210	M-M6-J-0036 SH1[45]	N/A	Contactor Speed (EXT-20J1)	rpm
SC-9211	M-M6-J-0036 SH2[46]	N/A	Contactor Speed (EXT-201K)	rpm
SC-9212	M-M6-J-0036 SH2[46]	N/A	Contactor Speed (EXT-201L)	rpm
SC-9213	M-M6-J-0037 SH1[47]	N/A	Contactor Speed (EXT-201M)	rpm
SC-9214	M-M6-J-0037 SH1[47]	N/A	Contactor Speed (EXT-201N)	rpm
SC-9215	M-M6-J-0037 SH2[48]	N/A	Contactor Speed (EXT-201O)	rpm
SC-9216	M-M6-J-0037 SH2[48]	N/A	Contactor Speed (EXT-201P)	rpm
SE-9201	M-M6-J-0034 SH1[41]	N/A	Contactor Speed (EXT-201A)	rpm
SE-9202	M-M6-J-0034 SH1[41]	N/A	Contactor Speed (EXT-201B)	rpm

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SE-9203	M-M6-J-0034 SH2[42]	N/A	Contactor Speed (EXT-201C)	rpm
SE-9204	M-M6-J-0034 SH2[42]	N/A	Contactor Speed (EXT-201D)	rpm
SE-9205	M-M6-J-0035 SH1[43]	N/A	Contactor Speed (EXT-201E)	rpm
SE-9206	M-M6-J-0035 SH1[43]	N/A	Contactor Speed (EXT-201F)	rpm
SE-9207	M-M6-J-0035 SH2[44]	N/A	Contactor Speed (EXT-201G)	rpm
SE-9208	M-M6-J-0035 SH2[44]	N/A	Contactor Speed (EXT-201H)	rpm
SE-9209	M-M6-J-0036 SH1[45]	N/A	Contactor Speed (EXT-201I)	rpm
SE-9210	M-M6-J-0036 SH1[45]	N/A	Contactor Speed (EXT-20J1)	rpm
SE-9211	M-M6-J-0036 SH2[46]	N/A	Contactor Speed (EXT-201K)	rpm
SE-9212	M-M6-J-0036 SH2[46]	N/A	Contactor Speed (EXT-201L)	rpm
SE-9213	M-M6-J-0037 SH1[47]	N/A	Contactor Speed (EXT-201M)	rpm
SE-9214	M-M6-J-0037 SH1[47]	N/A	Contactor Speed (EXT-201N)	rpm
SE-9215	M-M6-J-0037 SH2[48]	N/A	Contactor Speed (EXT-201O)	rpm
SE- 9216	M-M6-J-0037 SH2[48]	N/A	Contactor Speed (EXT-201P)	rpm
VE-9201	M-M6-J-0034 SH1[41]	J-JZ-J-00295, *SWPF VA-9201 EXT-201A Vibration*[53]	Vibration (EXT-201A)	Cycles/second Inches/second
VE-9202	M-M6-J-0034 SH1[41]	J-JZ-J-00296, *SWPF VA-9202 EXT-201B Vibration*[54]	Vibration (EXT-201B)	Cycles/second Inches/second
VE-9203	M-M6-J-0034 SH2[42]	J-JZ-J-00297, *SWPF VA-9203 EXT-201C Vibration*[55]	Vibration (EXT-201C)	Cycles/second Inches/second
VE-9204	M-M6-J-0034 SH2[42]	J-JZ-J-00298, *SWPF VA-9204 EXT-201D Vibration*[56]	Vibration (EXT-201D)	Cycles/second Inches/second

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
VE-9205	M-M6-J-0035 SH1[43]	J-JZ-J-00299, *SWPF VA-9205 EXT-201E Vibration*[57]	Vibration (EXT-201E)	Cycles/second Inches/second
VE-9206	M-M6-J-0035 SH1[43]	J-JZ-J-00300, *SWPF VA-9206 EXT-201F Vibration*[58]	Vibration (EXT-201F)	Cycles/second Inches/second
VE-9207	M-M6-J-0035 SH2[44]	J-JZ-J-00301, *SWPF VA-9207 EXT-201G Vibration*[59]	Vibration (EXT-201G)	Cycles/second Inches/second
VE-9208	M-M6-J-0035 SH2[44]	J-JZ-J-00302, *SWPF VA-9208 EXT-201H Vibration*[60]	Vibration (EXT-201H)	Cycles/second Inches/second
VE-9209	M-M6-J-0036 SH1[45]	J-JZ-J-00303, *SWPF VA-9209 EXT-201I Vibration*[61]	Vibration (EXT-201I)	Cycles/second Inches/second
VE-9210	M-M6-J-0036 SH1[45]	J-JZ-J-00304, *SWPF VA-9210 EXT-201J Vibration*[62]	Vibration (EXT-201J)	Cycles/second Inches/second
VE-9211	M-M6-J-0036 SH2[46]	J-JZ-J-00305, *SWPF VA-9211 EXT-201K Vibration*[63]	Vibration (EXT-201K)	Cycles/second Inches/second
VE-9212	M-M6-J-0036 SH2[46]	J-JZ-J-00306, *SWPF VA-9212 EXT-201L Vibration*[64]	Vibration (EXT-201L)	Cycles/second Inches/second
VE-9213	M-M6-J-0037 SH1[47]	J-JZ-J-00307, *SWPF VA-9213 EXT-201M Vibration*[65]	Vibration (EXT-201M)	Cycles/second Inches/second
VE-9214	M-M6-J-0037 SH1[47]	J-JZ-J-00308, *SWPF VA-9214 EXT-201N Vibration*[66]	Vibration (EXT-201N)	Cycles/second Inches/second
VE-9215	M-M6-J-0037 SH2[48]	J-JZ-J-00309, *SWPF VA-9215 EXT-201O Vibration*[67]	Vibration (EXT-201O)	Cycles/second Inches/second
VE-9216	M-M6-J-0037 SH2[48]	J-JZ-J-00310, *SWPF VA-9216 EXT-201P Vibration*[68]	Vibration (EXT-201P)	Cycles/second Inches/second
TE-9201A	M-M6-J-0034 SH1[41]	J-JZ-J-00231, *SWPF TI-9201A EXT-201A Motor Top Bearing Temp*[69]	Motor Top bearing temperature	°F
TE-9202A	M-M6-J-0034 SH1[41]	J-JZ-J-00232, *SWPF TI-9202A EXT-201B Motor Top Bearing Temp*[70]	Motor Top bearing temperature	°F
TE-9203A	M-M6-J-0034 SH2[42]	J-JZ-J-00233, *SWPF TI-9203A EXT-201C Motor Top Bearing Temp*[71]	Motor Top bearing temperature	°F
TE-9204A	M-M6-J-0034 SH2[42]	J-JZ-J-00234, *SWPF TI-9204A EXT-201D Motor Top Bearing Temp*[72]	Motor Top bearing temperature	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9205A	M-M6-J-0035 SH1[43]	J-JZ-J-00235, *SWPF TI-9205A EXT-201E Motor Top Bearing Temp*[73]	Motor Top bearing temperature	°F
TE-9206A	M-M6-J-0035 SH1[43]	J-JZ-J-00236, *SWPF TI-9206A EXT-201F Motor Top Bearing Temp*[74]	Motor Top bearing temperature	°F
TE-9207A	M-M6-J-0035 SH2[44]	J-JZ-J-00237, *SWPF TI-9207A EXT-201G Motor Top Bearing Temp*[75]	Motor Top bearing temperature	°F
TE-9208A	M-M6-J-0035 SH2[44]	J-JZ-J-00238, *SWPF TI-9208A EXT-201H Motor Top Bearing Temp*[76]	Motor Top bearing temperature	°F
TE-9209A	M-M6-J-0036 SH1[45]	J-JZ-J-00239, *SWPF TI-9209A EXT-201I Motor Top Bearing Temp*[77]	Motor Top bearing temperature	°F
TE-9210A	M-M6-J-0036 SH1[45]	J-JZ-J-00240, *SWPF TI-9210A EXT-201J Motor Top Bearing Temp*[78]	Motor Top bearing temperature	°F
TE-9211A	M-M6-J-0036 SH2[46]	J-JZ-J-00241, *SWPF TI-9211A EXT-201K Motor Top Bearing Temp*[79]	Motor Top bearing temperature	°F
TE-9212A	M-M6-J-0036 SH2[46]	J-JZ-J-00242, *SWPF TI-9212A EXT-201L Motor Top Bearing Temp*[80]	Motor Top bearing temperature	°F
TE-9213A	M-M6-J-0037 SH1[47]	J-JZ-J-00243, *SWPF TI-9213A EXT-201M Motor Top Bearing Temp*[81]	Motor Top bearing temperature	°F
TE-9214A	M-M6-J-0037 SH1[47]	J-JZ-J-00244, *SWPF TI-9214A EXT-201N Motor Top Bearing Temp*[82]	Motor Top bearing temperature	°F
TE-9215A	M-M6-J-0037 SH2[48]	J-JZ-J-00245, *SWPF TI-9215A EXT-201O Motor Top Bearing Temp*[83]	Motor Top bearing temperature	°F
TE-9216A	M-M6-J-0037 SH2[48]	J-JZ-J-00246, *SWPF TI-9216A EXT-201P Motor Top Bearing Temp*[84]	Motor Top bearing temperature	°F
TE-9201B	M-M6-J-0034 SH1[41]	J-JZ-J-00247, *SWPF TI-9201B EXT-201A Motor Bottom Bearing Temp*[85]	Motor Bottom bearing temperature	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9202B	M-M6-J-0034 SH1[41]	J-JZ-J-00248, *SWPF TI-9202B EXT-201B Motor Bottom Bearing Temp*[86]	Motor Bottom bearing temperature	°F
TE-9203B	M-M6-J-0034 SH2[42]	J-JZ-J-00249, *SWPF TI-9203B EXT-201C Motor Bottom Bearing Temp*[87]	Motor Bottom bearing temperature	°F
TE-9204B	M-M6-J-0034 SH2[42]	J-JZ-J-00250, *SWPF TI-9204B EXT-201D Motor Bottom Bearing Temp*[88]	Motor Bottom bearing temperature	°F
TE-9205B	M-M6-J-0035 SH1[43]	J-JZ-J-00251, *SWPF TI-9205B EXT-201E Motor Bottom Bearing Temp*[89]	Motor Bottom bearing temperature	°F
TE-9206B	M-M6-J-0035 SH1[43]	J-JZ-J-00252, *SWPF TI-9206B EXT-201F Motor Bottom Bearing Temp*[90]	Motor Bottom bearing temperature	°F
TE-9207B	M-M6-J-0035 SH2[44]	J-JZ-J-00253, *SWPF TI-9207B EXT-201G Motor Bottom Bearing Temp*[91]	Motor Bottom bearing temperature	°F
TE-9208B	M-M6-J-0035 SH2[44]	J-JZ-J-00254, *SWPF TI-9208B EXT-201H Motor Bottom Bearing Temp*[92]	Motor Bottom bearing temperature	°F
TE-9209B	M-M6-J-0036 SH1[45]	J-JZ-J-00255, *SWPF TI-9209B EXT-201I Motor Bottom Bearing Temp*[93]	Motor Bottom bearing temperature	°F
TE-9210B	M-M6-J-0036 SH1[45]	J-JZ-J-00256, *SWPF TI-9210B EXT-201J Motor Bottom Bearing Temp*[94]	Motor Bottom bearing temperature	°F
TE-9211B	M-M6-J-0036 SH2[46]	J-JZ-J-00257, *SWPF TI-9211B EXT-201K Motor Bottom Bearing Temp*[95]	Motor Bottom bearing temperature	°F
TE-9212B	M-M6-J-0036 SH2[46]	J-JZ-J-00258, *SWPF TI-9212B EXT-201L Motor Bottom Bearing Temp*[96]	Motor Bottom bearing temperature	°F
TE-9213B	M-M6-J-0037 SH1[47]	J-JZ-J-00259, *SWPF TI-9213B EXT-201M Motor Bottom Bearing Temp*[97]	Motor Bottom bearing temperature	°F
TE-9214B	M-M6-J-0037 SH1[47]	J-JZ-J-00260, *SWPF TI-9214B EXT-201N Motor Bottom Bearing Temp*[98]	Motor Bottom bearing temperature	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9215B	M-M6-J-0037 SH2[48]	J-JZ-J-00261, *SWPF TI-9215B EXT-201O Motor Bottom Bearing Temp*[99]	Motor Bottom bearing temperature	°F
TE-9216B	M-M6-J-0037 SH2[48]	J-JZ-J-00262, *SWPF TI-9216B EXT-201P Motor Bottom Bearing Temp*[100]	Motor Bottom bearing temperature	°F
TE-9201C	M-M6-J-0034 SH1[41]	J-JZ-J-00263, *SWPF TI-9201C EXT-201A Rotor Top Bearing Temp*[101]	Rotor Top bearing temperature	°F
TE-9202C	M-M6-J-0034 SH1[41]	J-JZ-J-00264, *SWPF TI-9202C EXT-201B Rotor Top Bearing Temp*[102]	Rotor Top bearing temperature	°F
TE-9203C	M-M6-J-0034 SH2[42]	J-JZ-J-00265, *SWPF TI-9203C EXT-201C Rotor Top Bearing Temp*[103]	Rotor Top bearing temperature	°F
TE-9204C	M-M6-J-0034 SH2[42]	J-JZ-J-00266, *SWPF TI-9204C EXT-201D Rotor Top Bearing Temp*[104]	Rotor Top bearing temperature	°F
TE-9205C	M-M6-J-0035 SH1[43]	J-JZ-J-00267, *SWPF TI-9205C EXT-201E Rotor Top Bearing Temp*[105]	Rotor Top bearing temperature	°F
TE-9206C	M-M6-J-0035 SH1[43]	J-JZ-J-00268, *SWPF TI-9206C EXT-201F Rotor Top Bearing Temp*[106]	Rotor Top bearing temperature	°F
TE-9207C	M-M6-J-0035 SH2[44]	J-JZ-J-00269, *SWPF TI-9207C EXT-201G Rotor Top Bearing Temp*[107]	Rotor Top bearing temperature	°F
TE-9208C	M-M6-J-0035 SH2[44]	J-JZ-J-00270, *SWPF TI-9208C EXT-201H Rotor Top Bearing Temp*[108]	Rotor Top bearing temperature	°F
TE-9209C	M-M6-J-0036 SH1[45]	J-JZ-J-00271, *SWPF TI-9209C EXT-201I Rotor Top Bearing Temp*[109]	Rotor Top bearing temperature	°F
TE-9210C	M-M6-J-0036 SH1[45]	J-JZ-J-00272, *SWPF TI-9210C EXT-201J Rotor Top Bearing Temp*[110]	Rotor Top bearing temperature	°F
TE-9211C	M-M6-J-0036 SH2[46]	J-JZ-J-00273, *SWPF TI-9211C EXT-201K Rotor Top Bearing Temp*[111]	Rotor Top bearing temperature	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9212C	M-M6-J-0036 SH2[46]	J-JZ-J-00274, *SWPF TI-9212C EXT-201L Rotor Top Bearing Temp*[112]	Rotor Top bearing temperature	°F
TE-9213C	M-M6-J-0037 SH1[47]	J-JZ-J-00275, *SWPF TI-9213C EXT-201M Rotor Top Bearing Temp*[113]	Rotor Top bearing temperature	°F
TE-9214C	M-M6-J-0037 SH1[47]	J-JZ-J-00276, *SWPF TI-9214C EXT-201N Rotor Top Bearing Temp*[114]	Rotor Top bearing temperature	°F
TE-9215C	M-M6-J-0037 SH2[48]	J-JZ-J-00277, *SWPF TI-9215C EXT-201O Rotor Top Bearing Temp*[115]	Rotor Top bearing temperature	°F
TE-9216C	M-M6-J-0037 SH2[48]	J-JZ-J-00278, *SWPF TI-9216C EXT-201P Rotor Top Bearing Temp*[116]	Rotor Top bearing temperature	°F
TE-9201D	M-M6-J-0034 SH1[41]	J-JZ-J-00279, *SWPF TI-9201D EXT-201A Rotor Bottom Bearing Temp*[117]	Rotor Bottom bearing temperature	°F
TE-9202D	M-M6-J-0034 SH1[41]	J-JZ-J-00280, *SWPF TI-9202D EXT-201B Rotor Bottom Bearing Temp*[118]	Rotor Bottom bearing temperature	°F
TE-9203D	M-M6-J-0034 SH2[42]	J-JZ-J-00281, *SWPF TI-9203D EXT-201C Rotor Bottom Bearing Temp*[119]	Rotor Bottom bearing temperature	°F
TE-9204D	M-M6-J-0034 SH2[42]	J-JZ-J-00282, *SWPF TI-9204D EXT-201D Rotor Bottom Bearing Temp*[120]	Rotor Bottom bearing temperature	°F
TE-9205D	M-M6-J-0035 SH1[43]	J-JZ-J-00283, *SWPF TI-9205D EXT-201E Rotor Bottom Bearing Temp*[121]	Rotor Bottom bearing temperature	°F
TE-9206D	M-M6-J-0035 SH1[43]	J-JZ-J-00284, *SWPF TI-9206D EXT-201F Rotor Bottom Bearing Temp*[122]	Rotor Bottom bearing temperature	°F
TE-9207D	M-M6-J-0035 SH2[44]	J-JZ-J-00285, *SWPF TI-9207D EXT-201G Rotor Bottom Bearing Temp*[123]	Rotor Bottom bearing temperature	°F
TE-9208D	M-M6-J-0035 SH2[44]	J-JZ-J-00286, *SWPF TI-9208D EXT-201H Rotor Bottom Bearing Temp*[124]	Rotor Bottom bearing temperature	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9209D	M-M6-J-0036 SH1[45]	J-JZ-J-00287, *SWPF TI-9209D EXT-201I Rotor Bottom Bearing Temp*[125]	Rotor Bottom bearing temperature	°F
TE-9210D	M-M6-J-0036 SH1[45]	J-JZ-J-00288, *SWPF TI-9210D EXT-201J Rotor Bottom Bearing Temp*[126]	Rotor Bottom bearing temperature	°F
TE-9211D	M-M6-J-0036 SH2[46]	J-JZ-J-00289, *SWPF TI-9211D EXT-201K Rotor Bottom Bearing Temp*[127]	Rotor Bottom bearing temperature	°F
TE-9212D	M-M6-J-0036 SH2[46]	J-JZ-J-00290, *SWPF TI-9212D EXT-201L Rotor Bottom Bearing Temp*[128]	Rotor Bottom bearing temperature	°F
TE-9213D	M-M6-J-0037 SH1[47]	J-JZ-J-00291, *SWPF TI-9213D EXT-201M Rotor Bottom Bearing Temp*[129]	Rotor Bottom bearing temperature	°F
TE-9214D	M-M6-J-0037 SH1[47]	J-JZ-J-00292, *SWPF TI-9214D EXT-201N Rotor Bottom Bearing Temp*[130]	Rotor Bottom bearing temperature	°F
TE-9215D	M-M6-J-0037 SH2[48]	J-JZ-J-00293, *SWPF TI-9215D EXT-201O Rotor Bottom Bearing Temp*[131]	Rotor Bottom bearing temperature	°F
TE-9216D	M-M6-J-0037 SH2[48]	J-JZ-J-00294, *SWPF TI-9216D EXT-201P Rotor Bottom Bearing Temp*[132]	Rotor Bottom bearing temperature	°F
FE-2644	M-M6-J-0162 SH1[51]	N/A	Flow to CSSX Flush header	gpm
FE-2619	M-M6-J-0076 SH2[49]	N/A	Flow to CSSX Flush header	gpm
PIT-2621	M-M6-J-0076 SH2[49]	N/A	CSSX Flush header pressure	Pounds per square inch gauge (psig)
HV-2652	M-M6-J-0157[50]	N/A	Valve Position	Open/Closed
TE-2925	M-M6-J-0034 SH1[41]	J-JZ-J-00227, *SWPF TIC-2925 EXT-201 A-D Aqueous Outlet Temp*[133]	Aqueous stream temperature at exit of EXT-201A	°F
TV-2925	M-M6-J-0034 SH2[42]	J-JZ-J-00227[133]	Valve Position	0-100% Open
TE-2926	M-M6-J-0035 SH1[43]	J-JZ-J-00228, *SWPF TIC-2926 EXT-201 E-H Aqueous Outlet Temp*[134]	Aqueous stream temperature at exit of EXT-201E	°F

Table 4-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TV-2926	M-M6-J-0035 SH2[44]	J-JZ-J-00228[134]	Valve Position	0-100% Open
TE-2929	M-M6-J-0037 SH1[47]	J-JZ-J-00229, *SWPF TIC-2929 EXT-201 M-P Aqueous Outlet Temp*[135]	Aqueous stream temperature at exit of EXT-201M	°F
TV-2929	M-M6-J-0037 SH2[48]	J-JZ-J-00229[135]	Valve Position	0-100% Open
TE-2931	M-M6-J-0036 SH2[46]	J-JZ-J-00230, *SWPF TIC-2931 EXT-201 I-L Aqueous Outlet Temp*[136]	Aqueous stream temperature at exit of EXT-201I	°F
TV-2931	M-M6-J-0036 SH1[45]	J-JZ-J-00230[136]	Valve Position	0-100% Open

4.3.5.2 Control Functions

See Table 4-5 for a listing of control loops.

Table 4-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
TIC-2925	M-M6-J-0034 SH1[41]	J-JZ-J-00227[133]	Aqueous stream temperature, EXT-201A	73°F
TIC-2926	M-M6-J-0035 SH1[43]	J-JZ-J-00228[134]	Aqueous stream temperature, EXT-201E	73°F
TIC-2929	M-M6-J-0037 SH1[47]	J-JZ-J-00229[135]	Aqueous stream temperature, EXT-201M	73°F
TIC-2931	M-M6-J-0036 SH1[45]	J-JZ-J-00230[136]	Aqueous stream temperature, EXT-201I	73°F

4.4 Operations

4.4.1 Initial Configuration

The extraction contactors are flushed, drained, and not operating.

4.4.2 System Startup

Startup will be carried out initially with stored DSS used as feed to the extraction stage aqueous inlet. The startup process is described below.

1. Ensure that the heating and cooling systems for the CSSX equipment are in operation.
2. Enable level control for applicable effluent tanks and start all contactor motors.
3. Start strip solution to strip contactors at normal rate of approximately 1.0 gpm.

4. Start scrub solution supply to the scrub contactors at normal rate of approximately 1.0 gpm.
5. Start wash solution supply to the wash contactors at normal rate of approximately 3.0 gpm.
6. Start DSS supply to the extraction contactors at a flow rate of approximately 16.2 gpm.
7. After a pre-determined hold period, the organic (solvent) flow is started at a flow rate of approximately 5.4 gpm.
8. Once sufficient time has passed for the solvent to flow throughout the system, increase both the organic and DSS flow rates to the required values. After a time interval to achieve stability in the extraction circuit, the extraction stage feed is switched from DSS to CSS from the SSFT (TK-109) (ramp down the DSS flow rate and then initiate and ramp up the CSS flow rate).

After initial system startup, the CSSX circuit normally operates without direct Operator intervention, except for chemical make-up and for sampling and batch transfers of strip effluent. The Operator will monitor the strip effluent and extraction aqueous streams and monitor the O/A ratio in these sections, as needed.

4.4.3 Normal Operations

During normal operation, the CSSX System is operated in a continuous mode (i.e., feed and effluents are continually added and withdrawn from the process at steady-state conditions). The CSSX process is divided into four main sections: 1) extraction, 2) scrubbing, 3) stripping, and 4) washing. Each section has a number of stages (i.e., individual centrifugal contactors) associated with it and each section serves a different function.

CSS is drawn from the SSFT (TK-109) and fed to the first Extraction Contactor (EXT-201P). The extraction contactors consist of 16 centrifugal contactors (Costner Industries Nevada Corporation V-10 units) arranged in a counter-current cascade (i.e., the organic and aqueous streams move through the units in different directions). Each contactor provides mixing and subsequent separation of the aqueous and organic phases. The extraction process outlined in the preconceptual design stage envisioned 15 extraction stages to achieve the required design Decontamination Factor of 40,000 for ^{137}Cs (see WSRC-RP-99-00006, *Bases, Assumptions, and Results of the Flowsheet Calculations for the Decision Phase Salt Disposition Alternatives*[137]). For the SWPF, 16 extraction stages have been chosen to provide a measure of conservatism to ensure that the target of 40,000 will be achieved.

The solvent used in the CSSX process is primarily Isopar®L with a specialty extractant (Calix[4]arene-bis[tert-octylbenzo-crown-6 [BOBCalixC6]) at 0.007M concentration, a modifier (1-[2,2,3,3-tetrafluoropropoxy]-3-[4-sec-butylphenoxy]-2-propanol [Cs-7SB]) at 0.75M concentration, and a suppressant (tri-n-octylamine [TOA]) at 0.003M concentration (see ANL-02/22, *Simulant Flowsheet Test with Modified Solvent for Cesium Removal Using Caustic-Side Solvent Extraction*[138]). Cs is extracted into the solvent phase as a nitrate salt when the aqueous and organic phases are mixed and separated in the extraction stages. The Cs nitrate extraction operation is primarily driven by the high nitrate concentration in the aqueous phase. The Cs is extracted by the calixarene molecule (BOBCalixC6), while the modifier (Cs-7SB) stabilizes the nitrate ion. Due to the size of the opening in the calixarene molecule, Cs is removed in dramatic

preference to other cations (e.g., sodium [Na] and K). The high selectivity of the solvent for Cs (two orders of magnitude greater than for K and four orders of magnitude greater than for Na) is required to achieve the desired Cs removal due to the high ratio of Na to Cs in the waste feed. However, a measurable quantity of both Na and K are extracted and thus take up a portion of the sites. A limit on the K content of the waste feed is expected (controlled by blending of the waste feed tanks) so the solvent's Cs extraction performance is not adversely affected.

The CSSX extraction process needs to be maintained at approximately 73°F. Effectiveness of the solvent at removing Cs is related to the temperature of the solution; Cs removal is improved with lower temperatures. However; the feed temperature is controlled at approximately 73°F to minimize the potential for precipitation of components in the aqueous stream (i.e., aluminum [Al]) and to preclude third-phase formation from solvent components. In order to maintain the extraction section at 73°F, the feed passes through a heat exchanger (HX-201) and the solvent passes through another heat exchanger (HX-202A/B). The Extraction Contactors (EXT-201A/P) have cooling jackets supplied with process chilled water to maintain the process fluids at 73°F. Process chilled water is used to remove the mechanical heat input of the spinning contactor rotor and the conductive heat input from the contactor motor.

After passing through a heat exchanger (HX-201), the CSS (nominally 21.6 gpm) mixes with scrub solution from EXT-202A (nominally 1.4 gpm) and enters contactor EXT-201P. The Cs is extracted by contacting the CSS/scrub solution with the solvent (nominally 7.2 gpm) (see M-CLC-J-00143[25]). The O/A ratio (solvent volumetric flow to CSS flow) is maintained nominally at 1:3. The scrub flow is not included in the calculation of this O/A ratio. The aqueous outlet of the extraction stages (EXT-201A) is referred to as DSS when operating in a single-strike mode or as Cs-depleted CSS (CDCSS) during double-strike mode. The DSS or CDCSS is routed to the Alpha Finishing Process via the BDT (TK-206). The Cs-laden solvent is directed to the scrub contactors (EXT-202A/B).

Miscellaneous process solutions from the SDT (TK-208) are also introduced into the system at the feed stage EXT-201P. When the SDT (TK-208) contents are being transferred to the extraction contactors, this flow is included in the O/A ratio calculation. These solutions can be of various compositions and be either aqueous or organic. Therefore, they are bled into the feed at a slow rate, relative to the CSS feed rate, to minimize impacts to the overall operation of the extraction contactors.

The CSSX System is expected to be operated in the following manner (to be verified during Commissioning).

1. The Scrub flow will be operator adjusted (at a nominal O/A ratio of 5/1) and will be monitored by the DCS.
2. The Caustic Wash flow will be operator adjusted (at a nominal O/A ratio of 2.5/1) and will be monitored by the DCS.
3. The CSS flow rate (and SDT [TK-208] flow, when necessary) will be Operator-adjusted, based on the solvent flow rate and the gamma radiation measurement of the DSS. The solvent flow rate will also be Operator-adjusted. The extraction O/A ratio will be provided as

a display to be used as a guide (nominally 1/3). In order to improve the quality (lower Cs content) of the DSS, the flow rate of the CSS can be reduced or the flow rate of the solvent can be increased while remaining below the maximum hydraulic capacity.

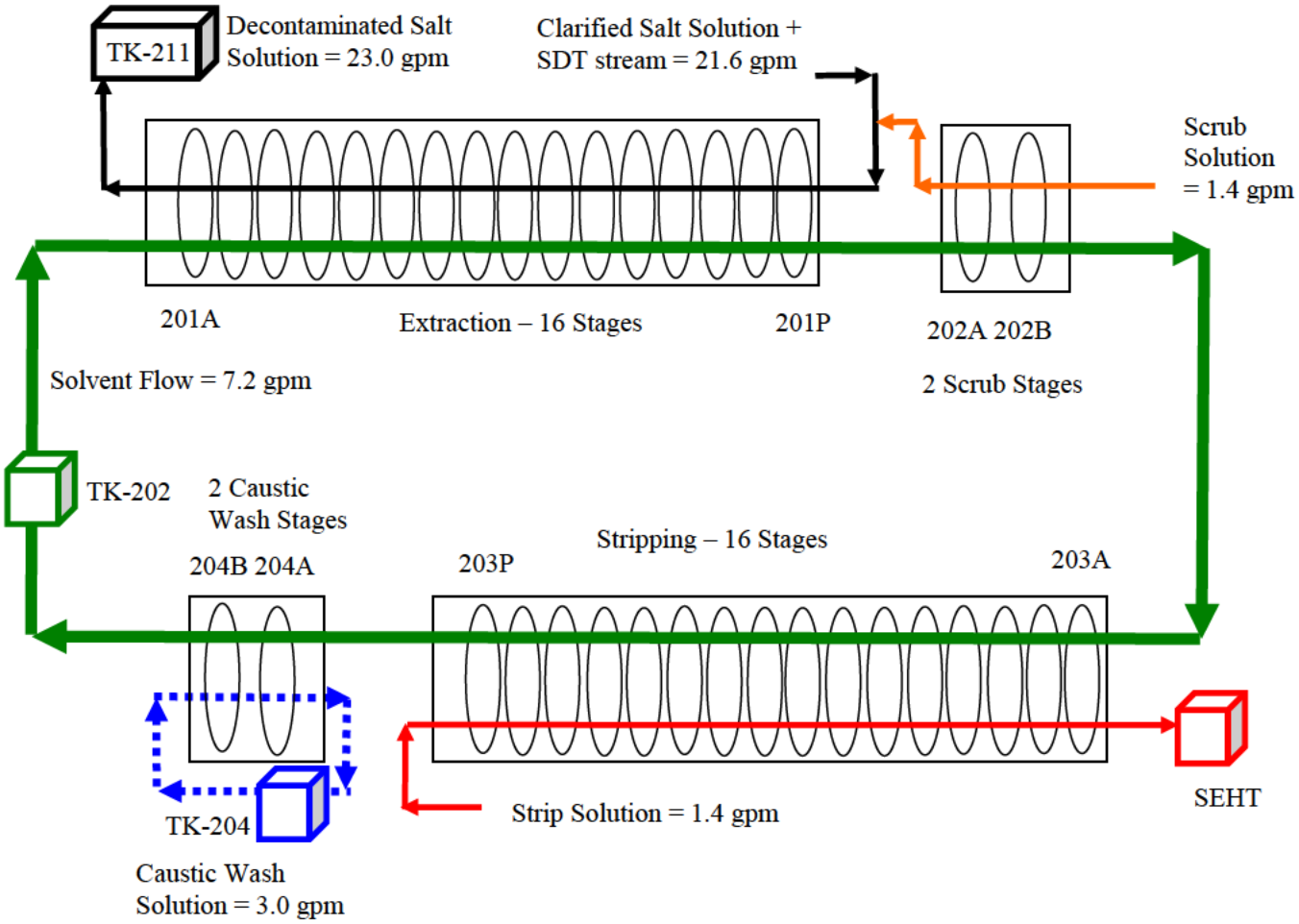
4. The strip solution flow rate will be Operator-adjusted, based on the solvent flow rate and the gamma radiation measurement of the solvent feed to EXT-201A. The stripping O/A ratio will be provided as a display to be used as a guide (nominally 5/1). In order to improve the stripping performance (lower Cs content of the caustic-washed solvent), the flow rate of the solvent can be reduced or the flow rate of the strip solution can be increased (within the maximum hydraulic capacity limit). The target CF is 15 (nominally 12 – 18). The maximum permissible CF is governed by the maximum Cs content of the strip effluent allowed in the SWPF safety analysis. The CF is adjusted by altering the solvent and strip solution flow rates (increasing the strip solution flow rate decreases the CF; increasing the solvent flow rate increases the CF). The CF can also be increased by increasing the CSS flow rate (increasing the Cs input to the system). Because the Cs content of the solvent being fed to EXT-201A (measured downstream on P-202A/B) directly impacts the performance in the extraction section, this is the primary control parameter for the stripping section. CF is a secondary control parameter that impacts the hydraulic load placed on DWPF.

See Figure 4-2. Nominal CSSX Volumetric Flows (Based on 30 gpm Extraction Contactor Hydraulic Capacity)

for an overview of the CSSX process streams.

The process sequences for the CSSX system (extraction, strip, scrub, and caustic wash contactors and related equipment) are included in Section 4.0 of X-PCD-J-00001[39].

Figure 4-2. Nominal CSSX Volumetric Flows (Based on 30 gpm Extraction Contactor Hydraulic Capacity)



4.4.4 Off-Normal and Recovery Operation

If an individual contactor fails in any of the CSSX stages, the whole contactor bank will shut down immediately, including the various pumps feeding the bank. If failure of a contactor appears imminent (based on vibration, temperature, or other indicators), a controlled system shutdown will be performed.

Personnel entry into the Contactor Operating Deck may require the contactors and related equipment to be flushed and drained. Operational experience with different feeds will dictate the amount of draining and flushing required prior to entry into the Contactor Operating Deck area.

Table 4-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 4-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
TCV failure (TV-2925 / TV-2926 / TV-2931 / TV-2929)	High or low temperature alarm on contactor aqueous stream	Monitor Cs content at exit of pumps P-206A/B. Divert stream to the SSFT (TK-109), if Cs content is trending out of spec.	Contactor bank cooling can be manually operated, using the TCV bypass valve until repairs are completed.
Contactor motor failure or vibration above normal (EXT-201A -P)	High vibration alarm (VI-9201 through VI-9216) Contactor motor fault (HIS-9201 through HIS-9216)	CSSX shutdown.	Complete repairs.
Operating equipment failure (P-109A/B)	Equipment status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.
CSSX Hard Shutdown Initiated by Operator	Operator action	Perform Hold Logic for Running Sequence.	Operator to investigate reason for hard Shutdown.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	dP Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	Operator to investigate cause of problem.

4.4.5 System Shutdown

The CSSX System is normally operated in a continuous automatic flow control mode. System shutdown sequence should be planned in advance. The normal system shutdown sequence is as listed below.

1. Ensure that the SDT (TK-208) has adequate space available for receiving the full volume of the aqueous and organic contained within the contactors and piping.
2. Switch the extraction stage aqueous inlet flow from CSS to DSS by gradually reducing the CSS flow, and then initiating and gradually increasing the DSS flow.
3. The CSSX System is operated with DSS feed for a time interval (to be determined during Commissioning) to reduce the Cs content in the aqueous and organic phases.
4. Turn off the aqueous feeds in the following order: salt solution feed, scrub solution feed, caustic wash feed.
5. Turn off the solvent flow.
6. Turn off the aqueous strip feed.
7. Turn off the contactor motors.
8. Drain the Barium Decay Tank (TK-206).

5.0 DSS SOLVENT RECOVERY

5.1 System Functions

- The general purpose of the DSS Solvent Recovery System is to recover solvent from the DSS prior to its transfer to the AFF (see P-DB-J-00003[14]).
- The BDT (TK-206) is sized and designed to allow the ^{137m}Ba to decay sufficiently before being transferred to the DSS Coalescer (TK-201) (see P-DB-J-00003[14]).

5.2 Operational Overview

DSS from the extraction stages passes through the DSS Stilling Tank (TK-211) to remove gross amounts of solvent from the DSS. The solvent recovered from the DSS flows to the SHT (TK-202), and the DSS flows to the BDT (TK-206).

The DSS gravity-flows into the BDT (TK-206). The BDT (TK-206) provides sufficient residence time for ^{137m}Ba decay. The BDT Pumps (P-206A/B) transfer DSS to the DSS Coalescer (TK-201). Alternate pathways are provided to the laboratory for sampling and analysis, or to the SSFT (TK-109) for recycle. The Cs removal is monitored by using gamma monitors.

The DSS Coalescer (TK-201) is used to remove trace amounts of solvent from the DSS. The solvent recovered from the DSS flows to the SHT (TK-202), and the DSS flows to the IST (TK-220), AST-B (TK-221), or the DSSHT (TK-207) in the AFF.

5.3 Configuration Information

5.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 5-1.

Table 5-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0009	*SWPF DSS Coalescer, DSS Hold Tank and Transfer Pumps PFD (U)*[139]
M-M6-J-0047 SH1	*SWPF Process Building Decontaminated Salt Solution Stilling Tank TK-211 P&ID (U)*[140]
M-M6-J-0047 SH2	*SWPF Process Building Ba-137 Decay TK-206 P&ID (U)*[141]
M-M6-J-0047 SH3	*SWPF Process Building Ba-137 Decay Tank Pumps P-206A/B P&ID (U)*[142]
M-M6-J-0148	*SWPF Process Building DSS Coalescer TK-201 P&ID (U)*[143]

5.3.2 Major Components

See Table 5-2 for a list of major components.

Table 5-2. Major Components

Component	Description
DSS Stilling Tank (TK-211)	Stainless steel pressure vessel that receives DSS from the extraction contactors and provides a mechanism for gross solvent recovery. Capacity: 235 gallons (see M-CLC-J-00063, *SWPF DSS Stilling Tank and Strip Effluent Stilling Tank Sizing Calculation, TK-211 and TK-212*[144]) Dimensions: 2 ft (diameter) x 10 ft (T/T) Design features: • A solvent recovery line is provided to direct solvent to the SHT (TK-202); • The DSS Stilling Tank (TK-211) is maintained under vacuum, with respect to the cell, for containment/confinement; and • The DSS Stilling Tank (TK-211) includes an air purge to dilute flammable vapors.

Table 5-2. Major Components (cont.)

Component	Description
BDT (TK-206)	Stainless steel pressure vessel that receives DSS from the DSS Stilling Tank (TK-211). [145]) Dimensions 7 ft (diameter) Design features: • The BDT (TK-206) is maintained under vacuum, with respect to the cell, for containment/confinement; • The BDT (TK-206) includes an overflow line that enters the West CSSX Tank Cell Sump (SMP-206) below the liquid level; • The BDT (TK-206) contains internal quadrants and sufficient volume to provide a holding time to allow the ^{137m}Ba to decay by a factor of 40,000 (see P-DB-J-00003[14]); and • The BDT (TK-206) includes an air purge to dilute flammable vapors.
BDT Pumps (P-206A/B)	Positive displacement pumps with VFDs that transfer the DSS to the DSS Coalescer (TK-201). Alternate pathways are to the SSFT (TK-109) and to the Laboratory for sampling. Capacity:: 30 gpm (see M-CLC-J-00102, *SWPF Ba-137 Decay Tank Transfer Pumps Sizing Calculation, P-206A/B*[146]) hp: 5.0 Design features: • The BDT Pumps have drain and flush capability.
DSS Coalescer (TK-201)	Stainless steel pressure vessel that uses a coalescing media allowing some of the entrained solvent to coalesce. Dimensions: 3 ft (diameter) x 13 ft 2 in (T/T) Design features: • A solvent recovery line is provided to direct solvent to the SHT (TK-202); • DSS Coalescer (TK-201) is maintained under vacuum, with respect to the cell, for containment/confinement; • DSS Coalescer (TK-201) includes an air purge to dilute flammable vapors; and • DSS Coalescer (TK-201) includes removable coalescing media. The media set contains 16 elements with a 3-micron pore size. The elements are 1,250 mm in length and 150 mm in diameter.

5.3.3 Stream Data

See Table 5-3 for a listing of streams.

Table 5-3. Streams

Stream	Description
DSS	DSS with small quantities of entrained solvent is received in the DSS Stilling Tank (TK-211) from EXT-201A. DSS is gravity-fed from the DSS Coalescer (TK-201) to the DSSHT (TK-207), IST (TK-220), or AST-B (TK-221). Properties 1.24 s.g. (M-CLC-J-00143[25]) 5.25M Na+ concentration (M-CLC-J-00143[25])
Solvent	Solvent is gravity-fed from the DSS Stilling Tank (TK-211) and the DSS Coalescer (TK-201) to the SHT (TK-202). Properties 0.85 s.g. at 25 °C (ORNL/TM-2002/204[52])

5.3.4 Physical Location and Layout

The DSS Stilling Tank (TK-211) is located in the West CSSX Tank Cell.

The BDT (TK-206) is located in the West CSSX Tank Cell. The BDT Pumps (P-206A/B) are located in the CSSX P&VG area. Each pump is located in a separate gallery, along with a Caustic Wash Pump (P-204 A/B) and a Solvent Feed Pump (P-202A/B). An automatic and a manual valve are located at the labyrinth wall to separate the tank and pumps.

The DSS Coalescer (TK-201) is located on the CSSX Contactor Drop Area platform.

5.3.5 System Control Features and Interlocks

5.3.5.1 System Monitoring

The DSS Solvent Recovery System has instrumentation to monitor the status of the system, provide control functions, and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The DSS Stilling Tank (TK-211) has a bubbler level instrument.

The BDT (TK-206) has a bubbler level instrument in each quadrant. When the pumps are enabled, a level controller is used to control the speed of the BDT Pumps (P-206A/B).

A magnetic flow meter is installed on the discharge side of pumps to monitor the flow rate. Redundant radiation monitors (gamma) are provided to monitor the radiation level in the DSS as it exits the BDT (TK-206). Pump discharge is diverted to the DSS Coalescer (TK-201) (primary) or the SSFT (TK-109), using a three-way valve. A portion of the pump discharge is diverted to the laboratory for sampling, using a flow control valve (see X-SD-J-00006[8]).

The DSS Coalescer (TK-201) has a bubbler level instrument to monitor the level in the tank. The DSS Coalescer (TK-201) has a pressure differential instrument to monitor the coalescer media for fouling.

See Table 5-4 for a listing of instruments.

Table 5-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-206A	M-M6-J-0047 SH3[142]	N/A	Pump Status	Run/Off
P-206B	M-M6-J-0047 SH3[142]	N/A	Pump Status	Run/Off
HV-1901	M-M6-J-0047 SH2[141]	N/A	Quadrant D Inlet Valve Position	Open/Closed
HV-1902	M-M6-J-0047 SH2[141]	N/A	Quadrant C Inlet Valve Position	Open/Closed
HV-1903	M-M6-J-0047 SH2[141]	N/A	Quadrant B Inlet Valve Position	Open/Closed
HV-1904	M-M6-J-0047 SH2[141]	N/A	Quadrant A Inlet Valve Position	Open/Closed
HV-1905	M-M6-J-0047 SH2[141]	N/A	Quadrant A Lab Return Valve Position	Open/Closed
HV-1906	M-M6-J-0047 SH2[141]	N/A	Quadrant B Lab Return Valve Position	Open/Closed
HV-1907	M-M6-J-0047 SH2[141]	N/A	Quadrant C Lab Return Valve Position	Open/Closed
HV-1908	M-M6-J-0047 SH2[141]	N/A	Quadrant D Lab Return Valve Position	Open/Closed
HV-1909	M-M6-J-0047 SH2[141]	N/A	Quadrant A Outlet Valve Position	Open/Closed
HV-1910	M-M6-J-0047 SH2[141]	N/A	Quadrant B Outlet Valve Position	Open/Closed
HV-1911	M-M6-J-0047 SH2[141]	N/A	Quadrant C Outlet Valve Position	Open/Closed
HV-1912	M-M6-J-0047 SH2[141]	N/A	Quadrant D Outlet Valve Position	Open/Closed
LIT-2160	M-M6-J-0047 SH1[140]	J-JZ-J-0035, *SWPF LI-2160 DSS Stilling Tank Level*[147]	DSS Stilling Tank (TK-211) level	Gallons
LIT-2161	M-M6-J-0148[143]	J-JZ-J-0041, *SWPF LI-2161 DSS Coalescer Level*[148]	DSS Coalescer (TK-201) level	Gallons
FE-2162	M-M6-J-0047 SH3[142]	J-JZ-J-00453, *SWPF FIC-2162 BDT Xfer Pump A Flow*[149]	Flow rate (P-206A discharge)	gpm, Total Gallons

Table 5-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
FV-2162	M-M6-J-0047 SH3[142]	J-JZ-J-00453[149]	Valve Position (P-206A discharge)	0 – 100%
RE-2163	M-M6-J-0047 SH3[142]	J-JZ-J-00457, *SWPF RI-2163 BDT Cs Concentration P-206A*[150]	DSS stream gamma level (P-206A)	^{137}Cs Curies per gallon (Ci/gal)
RE-2164	M-M6-J-0047 SH3[142]	J-JZ-J-00458, *SWPF RI-2164 BDT Cs Concentration P-206A*[151]	DSS stream gamma level (P-206A)	^{137}Cs Ci/gal
LIT-2165	M-M6-J-0047 SH2[141]	J-JZ-J-0046, *SWPF LI-2165 BDT Quadrant B Level*[152]	BDT (TK-206) Quadrant B level	Gallons
LIT-1913	M-M6-J-0047 SH2[141]	J-JZ-J-0044, *SWPF LI-1913 BDT Quadrant C Level*[153]	BDT (TK-206) Quadrant C level	Gallons
LIT-1914	M-M6-J-0047 SH2[141]	J-JZ-J-0045, *SWPF LI-1914 BDT Quadrant D Level*[154]	BDT (TK-206) Quadrant D level	Gallons
LIT-2166	M-M6-J-0047 SH2[141]	J-JZ-J-0047, *SWPF LI-2166 BDT Quadrant A Level*[155]	BDT (TK-206) Quadrant A level	Gallons
SC-2166A	M-M6-J-0047 SH3[142]	J-JZ-J-01120, *SWPF SIC-2166A BDT Xfer Pump A Speed*[156]	P-206A Speed	0 – 100%
SC-2166B	M-M6-J-0047 SH3[142]	J-JZ-J-01121, *SWPF SIC-2166B BDT Xfer Pump B Speed*[157]	P-206B Speed	0 – 100%
LIT-2167	M-M6-J-0148[143]	J-JZ-J-01083, *SWPF LI-2167 DSS Coalescer Loop Seal to AFF*[158]	DSS Coalescer Loop Seal to AFF level	Inches
RE-2169	M-M6-J-0047 SH3[142]	J-JZ-J-00459, *SWPF RI-2169 BDT Cs Concentration P-206B*[159]	DSS stream gamma level (P-206B)	^{137}Cs Ci/gal
RE-2170	M-M6-J-0047 SH3[142]	J-JZ-J-00460, *SWPF RI-2170 BDT Cs Concentration P-206B*[160]	DSS stream gamma level (P-206B)	^{137}Cs Ci/gal
HV-2180	M-M6-J-0047 SH3[142]	N/A	P-206A Isolation Valve Position	Open/Closed
HV-2181	M-M6-J-0047 SH3[142]	N/A	Valve Position (P-206B discharge)	A-C/B-C/ Intermediate Off position
FE-2182	M-M6-J-0047 SH3[142]	J-JZ-J-00455, *SWPF FIC-2182 BDT Xfer Pump A Sample Flow*[161]	Flow rate to Laboratory (P-206A)	gpm
FV-2182	M-M6-J-0047 SH3[142]	J-JZ-J-00455[161]	Valve Position	0 – 100%
HV-2183	M-M6-J-0047 SH3[142]	N/A	Drain Valve position	Open/Closed
HV-2184	M-M6-J-0047 SH3[142]	N/A	Valve Position (P-206A discharge)	A-C/B-C/ Intermediate Off position

Table 5-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
HV-2185	M-M6-J-0047 SH3[142]	N/A	Drain Valve Position	Open/Closed
HV-2186	M-M6-J-0047 SH3[142]	N/A	P-206B Isolation Valve Position	Open/Closed
FE-2187	M-M6-J-0047 SH3[142]	J-JZ-J-00456, *SWPF FIC-2187 BDT Xfer Pump B Sample Flow*[162]	Flow rate to Laboratory (P-206B)	gpm
FV-2187	M-M6-J-0047 SH3[142]	J-JZ-J-00456[162]	Valve Position	0 – 100%
HV-2188	M-M6-J-0047 SH3[142]	N/A	Drain Valve Position	Open/Closed
HV-2189	M-M6-J-0047 SH3[142]	N/A	Drain Valve Position	Open/Closed
FE-2193	M-M6-J-0047 SH3[142]	J-JZ-J-00454, *SWPF FIC-2193 BDT Xfer Pump B Flow*[163]	Flow rate (P-206B discharge)	gpm, total gallons
FV-2193	M-M6-J-0047 SH3[142]	J-JZ-J-00454[163]	Valve Position (P-206B discharge)	0 – 100%
PDIT-2222	M-M6-J-0148[143]	J-JZ-J-01084, *SWPF PDI-2222 DSS Coalescer Media dP*[164]	DSS Coalescer (TK-201) Vapor space dP	Inches water vacuum
PIT-2292	M-M6-J-0047 SH3[142]	J-JZ-J-01189, *SWPF PI-2292 BDT Xfer Pump A Disch Pressure*[165]	P-206A Discharge Pressure	psig
PIT-2293	M-M6-J-0047 SH3[142]	J-JZ-J-01190, *SWPF PI-2293 BDT Xfer Pump B Disch Pressure*[166]	P-206B Discharge Pressure	psig
VE-9253B/C	M-M6-J-0047 SH3[142]	N/A	P-206A Vibration	Cycles/second Inches/sec
VE-9258B/C	M-M6-J-0047 SH3[142]	N/A	P-206B Vibration	Cycles/second Inches/sec

5.3.5.2 Control Functions

See Table 5-5 for a listing of control loops.

Table 5-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
LIC-2166A	M-M6-J-0047 SH2[141]	N/A	BDT Discharge Quadrant Level	Operator-entered
LIC-2166B	M-M6-J-0047 SH2[141]	N/A	BDT Discharge Quadrant Level	Operator-entered
SIC-2166A	M-M6-J-0047 SH3[142]	J-JZ-J-01120[156]	P-206A Pump Speed/ Pump flow rate	Operator-entered, manual operation
SIC-2166B	M-M6-J-0047 SH3[142]	J-JZ-J-01121[157]	P-206B Pump Speed/ Pump flow rate	Operator-entered, manual operation
FIC-2182	M-M6-J-0047 SH3[142]	J-JZ-J-00455[161]	P-206A discharge flow rate to Laboratory	Operator-entered
FIC-2187	M-M6-J-0047 SH3[142]	J-JZ-J-00456[162]	P-206B discharge flow rate to Laboratory	Operator-entered

5.4 Operations

5.4.1 Initial Configuration

The DSS Stilling Tank (TK-211), BDT (TK-206), and DSS Coalescer (TK-201) are empty. The BDT pumps are off.

5.4.2 System Startup

DSS from the extraction contactor EXT-201A is gravity-fed to the DSS Stilling Tank (TK-211). The CSSX System is operated until an inventory is established in the DSS Stilling Tank (TK-211) and the BDT (TK-206). The BDT Pumps (P-206A/B) are started (the pump-out rate is approximately the same as the total aqueous feed to the extraction contactors). The BDT Pumps transfer the DSS into the DSS Coalescer (TK-201) (level increases until the DSS overflows the aqueous weir).

See Section 4.4.2 for a detailed description of the CSSX System Startup.

5.4.3 Normal Operations

DSS from the extraction contactor EXT-201A gravity-flows to the DSS Stilling Tank (TK-211). Small amounts of solvent are entrained with the aqueous phase from the extraction stages. In the DSS Stilling Tank (TK-211), the heavier aqueous phase underflows a baffle, overflows a weir, and gravity-drains to the BDT (TK-206). The lighter solvent phase gravity-drains via a standpipe to the SHT (TK-202). The DSS Stilling Tank (TK-211) is primarily intended to remove gross amounts of solvent from the DSS. The DSS Stilling Tank (TK-211) provides separation of the aqueous and organic phases and prevents large quantities of solvent from entering the BDT (TK-206) in the event of a process upset.

The aqueous stream at the discharge of EXT-201A contains very little Cs, but still contains an appreciable amount of ^{137m}Ba. The ^{137m}Ba is responsible for the high gamma radiation dose rate

associated with ^{137}Cs. The BDT (TK-206) is designed to ensure sufficient time for ^{137m}Ba present in the waste stream to decay by a factor of 40,000 (see P-DB-J-00003[14]). The BDT (TK-206) has four quadrants. The feed stream is alternated between the quadrants. During normal operations, one quadrant is being filled, two quadrants are stagnant (allowing time for ^{137m}Ba decay) and the remaining quadrant is being pumped out. The flow rate of the quadrant being pumped out is maintained approximately equal to the flow rate of DSS into the quadrant being filled. Once the filling quadrant reaches a pre-determined level (full), the appropriate quadrant valves change position and the quadrant that was just emptied becomes the filling quadrant. The quadrant that had been held stagnant for the longest time period becomes the discharge quadrant. The four quadrants of the tank are sized to allow the ^{137m}Ba present in the waste stream to decay sufficiently before being subsequently transferred to the DSS Coalescer (TK-201) (see M-CLC-J-00049[145] and S-CLC-J-00124, *SWPF Barium Decay Tank (BDT) Radiological Design Analysis*[167]).

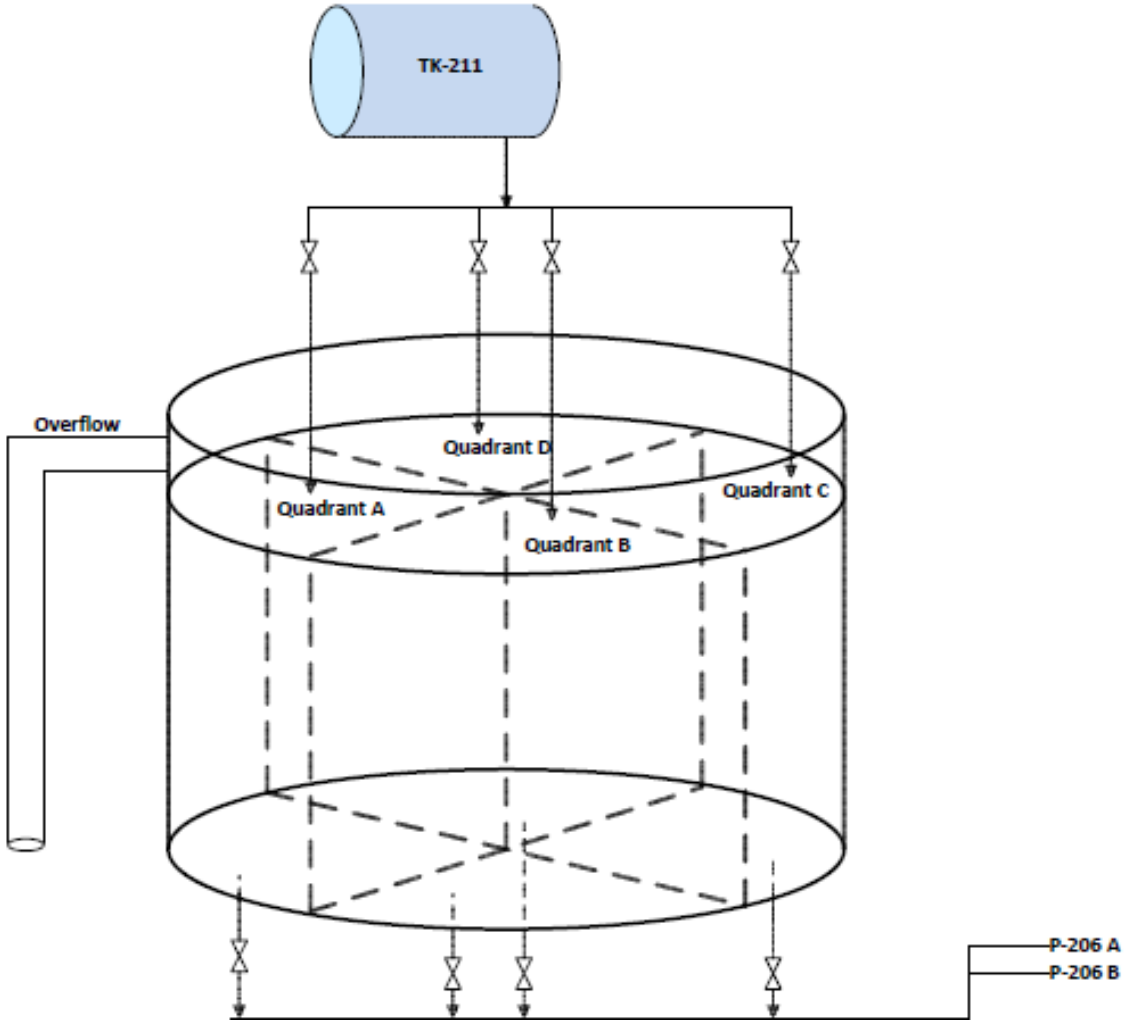
Each quadrant of the BDT (TK-206) is provided with a level detector that provides a control signal to adjust the BDT Transfer Pump (P-206A/B) speed when the quadrant is the discharge quadrant. One of the two BDT Transfer Pumps (P-206A/B) is normally used to transfer the DSS to the DSS Coalescer (TK-201). Two in-line gamma monitors are installed downstream of the BDT Transfer pumps to monitor the ^{137}Cs daughter product, ^{137m}Ba concentration. The gamma monitors are used to ensure that the DSS has been decontaminated sufficiently to meet the Saltstone Facility requirements and to protect facility workers in the unshielded downstream areas (DSS Coalescer area, AFF). The DSS stream is diverted back to the SSFT (TK-109) upon a high gamma indication and during CSSX startup.

The DSS Coalescer (TK-201) is located in an unshielded contact maintenance area. The DSS Coalescer (TK-201) recovers solvent with installed coalescing media. A portion of the entrained solvent will coalesce on the media surface and separate from the aqueous. Efficiency of the entrained solvent recovery depends on the size of the entrained solvent particles, the difference in the solvent and aqueous densities, and the flow rate through the coalescer (speed of fluid movement). In the DSS Coalescer, the heavier aqueous phase underflows a baffle, overflows a weir, and then gravity-drains to the AFF. The gravity drain line to the AFF includes a loop seal with level indication. The lighter solvent phase gravity-drains via a standpipe to the SHT (TK-202).

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

See Figure 5-1. BDT (TK-206) Schematic for a schematic of the BDT (TK-206).

Figure 5-1. BDT (TK-206) Schematic



5.4.4 Off-Normal and Recovery Operation

The control sequence for the BDT (TK-206) includes the option to operate the tank with one quadrant disabled. When operating with one quadrant disabled, the CSS flow rate into CSSX will need to be reduced.

Personnel entry into the West CSSX Tank Cell may require the BDT (TK-206), Caustic Wash Tank (TK-204), SHT (TK-202), Strip Effluent Coalescer (TK-203), Strip Effluent Coalescer Feed Pumps (P-212A/B) and related equipment to be flushed and drained.

Personnel entry into the P&VG labyrinth may require the BDT Pump, Caustic Wash Pump, Solvent Feed Pump, and related piping located in the labyrinth to be flushed and drained.

Table 5-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 5-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
DSS Stilling Tank (TK-211) Discharge aqueous line plugged.	Increase in the SHT (TK-202) level	Shut down CSSX process.	Chemical cleaning of the DSS Stilling Tank (TK-211).
BDT Pump failure (P-206A/B)	Pump status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
BDT Pump Low Flow (P-206A/B)	Low flow alarm (FI-2162 / FI-2193)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping (and associated Caustic Wash pump and Solvent Feed Pump piping) may need to be flushed and drained prior to P&VG labyrinth entry.
DSS Coalescer (TK-201) media plugged. (The coalescer media is expected to require periodic replacement.)	High alarm on PDI-2222 (DSS Coalescer (TK-201) media dP)	Controlled shutdown of the CSSX process	The coalescer will be drained and the vessel head removed to provide access to the media.
Failure of commanded equipment	DCS status indication	Perform Stopping logic for Running Sequence.	Operator to investigate cause of problem.
Dwell Timer is not complete for the BDT (TK-206) section to be drained.	DCS sequence failure	Perform Stopping logic for Running Sequence.	Operator to investigate cause of problem.
All BDT (TK-206) sections exceed the maximum section level	DCS level indication (LI-1913, LI-1914, LI-2165 and LI-2166)	Perform Stopping logic for Running Sequence.	Operator to investigate cause of problem.

5.4.5 System Shutdown

In order to shut down the CSSX process, feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. Once the extraction contactors are stopped, the BDT Pumps (P-206A/B) are stopped.

See Section 4.4.5 for a detailed description of the CSSX System Shutdown.

6.0 SHT (TK-202)

6.1 System Functions

The SHT System serves as a solvent reservoir (see P-DB-J-00003[14]).

The SHT System cools the organic solvent and feeds it to the CSSX process (see P-DB-J-00003[14]).

6.2 Operational Overview

The SHT (TK-202) is the solvent reservoir that collects solvent from the solvent outlet of the wash stages and various solvent recovery sources. SHT (TK-202) is equipped with an external cooling water coil (1/2 pipe) with a TCV. The solvent feed cooler (HX-202) is also used to cool the organic solvent to 73 ±5°F prior to entering EXT-201A.

Pumps P-202A/B are used to transfer the solvent to the extraction contactors at a controlled rate. There are alternate routes provided to transfer spent solvent to the Drum Off Station for disposal and to the laboratory for sampling and analysis. Pumps P-202A/B are also used to provide the fluid flow for the mixing eductor (EDT-202).

6.3 Configuration Information

6.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 6-1.

Table 6-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0007	*SWPF Solvent Extraction and Acid Scrub PFD (U)*[40]
M-M6-J-0046 SH1	*SWPF Process Building Solvent Hold Tank TK-202 P&ID (U)*[168]
M-M6-J-0046 SH2	*SWPF Process Building Solvent Feed Pumps P-202A/B P&ID (U)*[169]
M-M6-J-0170	*SWPF Process Building Solvent Feed Coolers HX-202A/B P&ID (U)*[170]

6.3.2 Major Components

See Table 6-2 for a list of major components.

Table 6-2. Major Components

Component	Description
SHT (TK-202)	Stainless steel pressure vessel that serves as a solvent reservoir to collect solvent from the solvent outlet of the wash stages.[171] Capacity to Overflow: 720 gallons (see M-CLC-J-00086[171]) Dimensions: 5 ft (diameter) x 5 ft 5 inch (T/T) Design features: • The SHT (TK-202) includes an external cooling coil (1/2 pipe) which, in conjunction with HX-202A/B, controls the solvent feed stream temperature fed to the extraction contactors at 73 ±5°F; • The SHT (TK-202) includes an eductor (EDT-202) to provide mixing to ensure adequate agitation of the tank contents; • The SHT (TK-202) includes a solvent composition adjustment funnel used to modify the solvent composition; • The SHT (TK-202) is maintained under vacuum, with respect to the cell, for containment/confinement; • The SHT (TK-202) includes an overflow line that enters the West CSSX Tank Cell Sump (SMP-206) below the liquid level; and • Inlet lines for the SHT (TK-202) are 1/2 pipe dip legs.
Solvent Feed Pumps (P-202A/B)	Positive displacement pumps with VFDs that provide a controlled solvent feed to the extraction contactors. Alternate pathways are to the SHT Eductor, Drum Off Station, or Laboratory. Capacity:: 40 gpm (see M-CLC-J-00101, *SWPF Solvent Feed Pumps Sizing Calculation, P-202A/B*[172]) hp: 5.0 Design features: • The Solvent Feed Pumps (P-202A/B) have drain and flush capability.
Solvent Feed Coolers (HX-202A/B)	Heat exchangers used to cool the solvent feed stream to the extraction contactors. Rating: 30,000 Btu/hr (see M-CLC-J-00142, *SWPF SHT Cooling Jacket Sizing Calculation*[173]) Design features: • The Solvent Feed Coolers are shell and tube heat exchangers.

6.3.3 Stream Data

See Table 6-3 for a listing of streams.

Table 6-3. Streams

Stream	Description
Solvent	Solvent is gravity-fed from the DSS Stilling Tank (TK-211) and the DSS Coalescer (TK-201) to the SHT (TK-202). Fresh solvent is transferred from the Solvent Make-up Tank (TK-313). Solvent is received in the SHT (TK-202) from the Caustic Wash Contactors (EXT-204B). Solvent is fed to the extraction contactors, using the Solvent Feed Pumps (P-202A/B). Properties 0.85 s.g. at 25 °C (ORNL/TM-2002/204[52])

6.3.4 Physical Location and Layout

The SHT (TK-202) is located in the West CSSX Tank Cell in the CPA. The Solvent Feed Pumps (P-202A/B) are located in the CSSX P&VG area. Each pump is located in a separate gallery, along with a Caustic Wash Pump (P-204 A/B) and a BDT Pump (P-206A/B). An automatic and a manual valve are located at the labyrinth wall to separate the tank and pumps. The piping is arranged for the system to gravity-drain to the Solvent Feed Pumps (P-202A/B). The Solvent Feed Coolers (HX-202A/B) are located in the same gallery with the related Solvent Feed Pump.

6.3.5 System Control Features and Interlocks

6.3.5.1 System Monitoring

The SHT system has instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The SHT (TK-202) has a bubbler level instrument to monitor the level in the tank. The SHT (TK-202) also has density instruments installed as part of the bubblers to measure the density of tank contents. The SHT (TK-202) has a thermowell and temperature element installed in the tank to monitor the temperature of tank contents. The SHT (TK-202) includes external cooling water coils with a TCV.

The Solvent Feed Pumps (P-202A/B) have instrumentation to monitor and control the pump speed. A mass flow meter is installed on the discharge side of pumps in order to monitor the flow rate from the SHT (TK-202) to the Extraction Contactor (EXT-201A). This meter is also used to monitor solvent density and temperature. Pump discharge is normally sent to EXT-201A (primary) or to the Drum Off Station, using isolation valves. A portion of the pump discharge can be diverted to the laboratory for sampling, using an isolation valve (see X-SD-J-00006[8]). A portion of the pump discharge can also be diverted to the SHT Eductor (EDT-202) for mixing, using an isolation valve.

The temperature at the exit of the Solvent Feed Coolers (HX-202A/B) is monitored. A TCV is adjusted to control the flow of cooling water to the cooler.

See Table 6-4 for a listing of instruments.

Table 6-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-202A	M-M6-J-0046 SH2[168]	N/A	Pump Status	Run/Off
P-202B	M-M6-J-0046 SH2[169]	N/A	Pump Status	Run/Off
TV-1522	M-M6-J-0170[170]	N/A	Valve Position	0-100% Open
TV-1526	M-M6-J-0170[170]	N/A	Valve Position	0-100% Open
RE-2035	M-M6-J-0046 SH2[169]	J-JZ-J-00451, *SWPF RI-2035 Solvent Pump A Cs Concentration*[174]	Solvent gamma level (P-202A)	^{137}Cs Ci/gal
TE-2134	M-M6-J-0046 SH1[168]	J-JZ-J-00446, *SWPF TIC-2134 SHT Temp*[175]	SHT (TK-202) Liquid Temperature	°F
TV-2134A	M-M6-J-0046 SH1[168]	J-JZ-J-00446[175]	Valve Position	0-100% Open
TV-2134B	M-M6-J-0046 SH1[168]	J-JZ-J-00446[175]	Valve Position	0-100% Open
FE-2137	M-M6-J-0046 SH2[169]	J-JZ-J-00447, *SWPF FIC-2137 Solvent Feed Pump B Sample Flow*[176]	Flow rate (P-202B flow to Laboratory)	gpm
FV-2137	M-M6-J-0046 SH2[169]	J-JZ-J-00447[176]	Valve Position	0 – 100%
FE-2138	M-M6-J-0046 SH2[169]	J-JZ-J-00448, *SWPF FIC-2138 Solvent Feed Pump A Sample Flow*[177]	Flow rate (P-202A flow to Laboratory)	gpm
FV-2138	M-M6-J-0046 SH2[169]	J-JZ-J-00448[177]	Valve Position	0 – 100%
LIT-2139	M-M6-J-0046 SH1[168]	J-JZ-J-0022, *SWPF LI-2139 SHT Level*[178]	SHT (TK-202) level	Gallons
DIT-2139	M-M6-J-0046 SH1[168]	J-JZ-J-00445, *SWPF DI-2139 SHT Density*[179]	SHT (TK-202) Liquid Density	s.g.
FE-2140	M-M6-J-0170[170]	J-JZ-J-00802, *SWPF FIC-2140 Solvent Feed Pump A Flow*[180]	Flow rate (P-202A main flow) and O/A ratio, using P-109A/B discharge flow rate	gpm O/A ratio
FV-2140	M-M6-J-0170[170]	J-JZ-J-00802[180]	Valve Position	0 – 100%
SC-2140	M-M6-J-0046 SH2[169]	J-JZ-J-01117, *SWPF SIC-2140 Solvent Feed Pump A Speed*[181]	P-202A Speed	0 – 100%
FE-2143	M-M6-J-0046 SH2[169]	J-JZ-J-00890, *SWPF FIC-2143 Solvent Feed Pump A Recirc Flow*[182]	Flow rate (P-202A flow to EDT-202)	gpm
FV-2143	M-M6-J-0046 SH2[169]	J-JZ-J-00890[182]	Valve Position	0 – 100%
RE-2146	M-M6-J-0046 SH2[169]	J-JZ-J-00452, *SWPF RI-2146 Solvent Pump B Cs Concentration*[183]	Solvent gamma level (P-202B)	^{137}Cs Ci/gal

Table 6-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
HV-2150	M-M6-J-0170[170]	N/A	Valve Position (route to Drum Off Station)	Open/Closed
HV-2157	M-M6-J-0170[170]	N/A	Valve Position (route to Drum Off Station)	Open/Closed
HV-2232	M-M6-J-0046 SH2[169]	N/A	P-202A Isolation Valve Position	Open/Closed
HV-2234	M-M6-J-0046 SH2[169]	N/A	P-202B Isolation Valve Position	Open/Closed
FE-2235	M-M6-J-0046 SH2[169]	N/A	Flow rate (P-202B flow to EDT-202)	gpm
FV-2235	M-M6-J-0046 SH2[169]	N/A	Valve Position	0 – 100%
HV-2236	M-M6-J-0046 SH2[169]	N/A	Drain Valve Position	Open/Closed
HV-2237	M-M6-J-0046 SH2[169]	N/A	Drain Valve Position	Open/Closed
HV-2238	M-M6-J-0046 SH2[169]	N/A	Drain Valve Position	Open/Closed
HV-2239	M-M6-J-0046 SH2[169]	N/A	Drain Valve Position	Open/Closed
FE-2248	M-M6-J-0170[170]	J-JZ-J-00803, *SWPF FIC-2248 Solvent Feed Pump B Flow*[184]	Flow rate (P-202B main flow) and O/A ratio, using P-109A/B discharge flow rate	gpm O/A ratio
FV-2248	M-M6-J-0170[170]	J-JZ-J-00803[184]	Valve Position	0 – 100%
SC-2248	M-M6-J-0046 SH2[169]	J-JZ-J-01125, *SWPF SIC-2248 Solvent Feed Pump B Speed*[185]	P-202B Speed	0 – 100%
PIT-2242	M-M6-J-0046 SH2[169]	N/A	P-202A Sample Loop Pressure	psig
PIT-2243	M-M6-J-0046 SH2[169]	N/A	P-202B Sample Loop Pressure	psig
VE-9252B/C	M-M6-J-0046 SH2[169]	N/A	P-202A Vibration	Cycles/second Inches/sec
VE-9257B/C	M-M6-J-0046 SH2[169]	N/A	P-202B Vibration	Cycles/second Inches/sec

6.3.5.2 Control Functions

See Table 6-5 for a listing of control loops.

Table 6-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
TIC-2140	M-M6-J-0170[170]	J-JZ-J-01081, *SWPF TIC-2140 Solvent Feed Pump A Temp*[186]	Solvent Temperature (HX-202A exit)	73°F
TIC-2248	M-M6-J-0170[170]	J-JZ-J-00804, *SWPF TIC-2248 Solvent Feed Pump B Temp*[187]	Solvent Temperature (HX-202B exit)	73°F
TIC-2134	M-M6-J-0046 SH1[168]	J-JZ-J-00446[175]	SHT (TK-202) Temperature	73°F
FIC-2137	M-M6-J-0046 SH2[169]	J-JZ-J-00447[176]	P-202B discharge flow rate to Laboratory	Operator-entered
FIC-2138	M-M6-J-0046 SH2[169]	J-JZ-J-00448[177]	P-202A discharge flow rate to Laboratory	Operator-entered
FIC-2140	M-M6-J-0170[170]	J-JZ-J-00802[180]	P-202A Discharge flow rate	Operator-entered
SIC-2140	M-M6-J-0046 SH2[169]	J-JZ-J-01117[181]	P-202A Pump Speed/Pump flow rate	Operator-entered, manual operation
FIC-2248	M-M6-J-0170[170]	J-JZ-J-00803[184]	P-202B discharge flow rate	Operator-entered
SIC-2248	M-M6-J-0046 SH2[169]	J-JZ-J-01125[185]	P-202B Pump Speed/Pump flow rate	Operator-entered, manual operation

6.4 Operations

6.4.1 Initial Configuration

The SHT (TK-202) has an inventory of solvent. The solvent is transferred from the Solvent Make-up Tank (TK-313), using the Solvent Make-up Transfer Pump (P-313). The Solvent Feed Pumps (P-202A/B) are off.

6.4.2 System Startup

The CSSX process starts up with Pump P-109A or B feeding DSS to the Extraction Contactors EXT-201A/P. Once the DSS, strip, and caustic wash streams are established, the solvent flow is initiated.

See Section 4.4.2 for a detailed description of the CSSX System Startup.

6.4.3 Normal Operations

The SHT (TK-202) is the solvent reservoir. The main solvent flow into the SHT (TK-202) is by gravity-flow from the last wash contactor (EXT-204B). There is also a small amount of solvent recovered from the DSS Stilling Tank (TK-211) and the DSS Coalescer (TK-201) that flows into the SHT (TK-202). The SHT (TK-202) is equipped with a cooling jacket to cool the solvent down to 73 $\pm$ 5°F for the extraction process. The Solvent Feed Pumps (P-202A/B) and the Solvent Strip Feed Tank Pumps (P-217A/B) are used to pump the solvent in a loop through the extraction contactors, scrub contactors, stripping contactors, and caustic wash contactors and then back to the SHT (TK-202). After the scrub contactors, the solvent is heated to 91 $\pm$ 5°F prior to entering the stripping contactors. The SHT (TK-202) is also equipped with a mixing eductor to improve cooling and provide tank homogeneity. The SHT eductor is driven by a side stream off the main process stream and is normally operated concurrently with feeding the contactors.

Concentration of the solvent components (diluent, extractant, modifier, and suppressant) can be determined by sampling and analysis of SHT (TK-202) contents. Solvent composition can be adjusted by adding diluent, extractant, modifier, or suppressant to the SHT (TK-202). Solvent and routine diluent additions to the SHT (TK-202) will normally be made via the Solvent Make-up Tank (TK-313) and the Solvent Make-up Transfer Pump (P-313). The solvent composition adjustment funnel (located on the CSSX Tank Cell Operating Deck) will normally be used to make small liquid additions (modifier, suppressant, small quantities of diluent and small quantities of diluent with extractant) directly to the SHT (TK-202).

The extractant has a limited solubility in the diluent. Another alternative for adding extractant to the solvent uses FLT-250. In order to raise the extractant concentration, the solvent can be pumped through the sample loop in the Laboratory Hot Cell. The solvent flow will pass through a filter (FLT-250) that holds the extractant. Because the extractant is a wax-like substance, a sintered metal filter basket is used to hold the material. The solvent will flow through the filter basket and will dissolve the extractant and raise the concentration.

The sample loop filter (FLT-250) can also be used as a continuous filter for the solvent. The solvent system can be configured so that a side stream of solvent can flow through the sample loop, pass through the filter (FLT-250), and the filter will collect solids that have formed in the solvent. The continuous filtering of the solvent can be accomplished while the CSSX system is operating. A pressure indication is provided on the sample loop piping to monitor the filter pressure drop. This pressure reading will indicate when the filter is becoming plugged.

SHT Transfer Pumps (P-202A/B) feed solvent from the SHT (TK-202) to the organic inlet of Extraction Contactor EXT-201A at a nominal rate of 7.2 gpm. The solvent flow control set point is an Operator input (see Section 4.4.3 for a discussion of O/A ratios and the impact of solvent flow rates on extraction and stripping performance). The P-202A/B pump speed is controlled by the flow meter to the process (feed to the extraction contactor bank). The flow control valve in the sample loop line is placed in a fixed position (configurable) which maintains flow through the sample loop when its associated pump is operating. The SHT Transfer Pumps (P-202A/B) also transfer solvent to the laboratory for sampling and provide the required flow for the SHT eductor. A Solvent Feed Cooler (HX-202A/B) ensures that the solvent is cooled to 73°F prior to

entering the extraction process. The solvent returns to the SHT (TK-202) by gravity-flow from wash contactor EXT-204B.

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

6.4.4 Off-Normal and Recovery Operation

Personnel entry into the West CSSX Tank Cell may require the BDT (TK-206), Caustic Wash Tank (TK-204), SHT (TK-202), Strip Effluent Coalescer (TK-203), Strip Effluent Coalescer Feed Pumps (P-212A/B) and related equipment to be drained and flushed.

Personnel entry into the P&VG labyrinth may require the BDT Pump, Caustic Wash Pump, Solvent Feed Pump, and related piping located in the labyrinth to be drained and flushed.

Disposal of degraded solvent can be performed by transferring the contents of the SHT (TK-202) to the Drum Off Station.

Table 6-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 6-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
SHT (TK-202) TCV failure (TV-2134)	High or Low temperature alarm	None	Tank cooling can be manually operated, using the TCV bypass valve until repairs are completed.
Solvent Feed Pump failure (P-202A/B)	Pump status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Solvent Feed Pump Low Flow (P-202A/B)	Low flow alarm (FIC-2140 / FIC-2148)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping (and associated Caustic Wash pump and BDT pump and related piping) may need to be flushed and drained prior to P&VG labyrinth entry.
Solvent Feed Cooler TCV failure (TV-1522/ TV-1526)	High or Low temperature alarm	Switch to alternate duty equipment (P-202A / P-202B)	Cooling can be manually operated, using the TCV bypass valve until repairs are completed.

6.4.5 System Shutdown

In order to shut down the CSSX process, feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS.

See Section 4.4.5 for a detailed description of the CSSX System Shutdown.

7.0 SCRUB CONTACTORS

7.1 System Functions

The general purpose of the scrub contactors is to scrub the solvent with 0.05M HNO_3 to remove soluble salts (e.g., Na, K, Al, iron [Fe], and mercury [Hg]) (see P-DB-J-00003[14]).

7.2 Operational Overview

The CSSX scrub contactors are centrifugal contactors that scrub the solvent of soluble salts (e.g., Na, K, Al, Fe, and Hg) by contacting the solvent with 0.05M HNO_3. Scrubbing the metal ions from the organic prevents transfer of these ions to the strip solution. This reduces the concentration of such metal ions being sent to DWPF as part of the strip effluent stream. Contacting the organic stream with the dilute acid also has the effect of neutralizing any caustic carryover from the extraction stages. Neutralization of the caustic carryover is necessary to ensure stable operation of the strip stages.

The operator sets the flow rate (nominal scrub O/A ratio of 5/1). The DCS controls the flow rate of scrub solution, based on the specified setpoint. Solvent feed to the system is gravity-fed from the first Extraction Contactor, EXT-201P. The scrubbed solvent is then directed to the strip contactors EXT-203A/P via the Solvent Strip Feed Tank (TK-217).

7.3 Configuration Information

7.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 7-1.

Table 7-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0007	*SWPF Solvent Extraction and Acid Scrub PFD (U)*[40]
M-M6-J-0038	*SWPF Process Building Scrub Contactors EXT-202A/B P&ID (U)*[188]

7.3.2 Major Components

See Table 7-2 for a list of major components.

Table 7-2. Major Components

Component	Description
Scrub Contactors (EXT-202A/B)	Centrifugal contactors that continuously contact scrub solution (0.05M HNO_3) and organic phase (process solvent) in a counter-current fashion. Centrifugal contactors are equipped with VFD motors for rotor speed control. Capacity: 12.0 gpm (hydraulic) hp: 10.0 Design Features: • Each contactor is equipped with a VFD that allows the contactor to be started/stopped and speed of the rotor to be controlled by the DCS; • The scrub contactors have a removable sleeve in the annular space to reduce the volume of the mixing zone. The sleeve also reduces the nominal hydraulic throughput. Each contactor can handle a hydraulic throughput of up to 12.0 gpm; • The contactors can be safely operated dry; • Each contactor is equipped with a system for CIP flushing of the rotor and inside of the housing; and • Each inter-stage line is vented to the process vessel vent header. This ensures that the solution gravity-drains from one stage to the next without creating pressure differentials between contactor stages. Proper venting of the gravity-drain system from one contactor to the next is essential for hydraulic operation of the contactors. Flush capability is provided for the vent piping. • Each contactor is equipped with a labyrinth seal to prevent process fluid contacting the rotor bearings. The labyrinth seal requires an air purge that is supplied from the Plant Air system. • Each contactor is equipped with a heavy phase weir for phase separation. The weir size for each contactor location is provided below. Process Location — Weir Size EXT-202A — 4.7-inch EXT-202B — 4.5-inch

7.3.3 Stream Data

See Table 7-3 for a listing of streams.

Table 7-3. Streams

Stream	Description
Scrub Solution	Scrub solution is fed to the Scrub Contactor EXT-202B from the Scrub Feed Pumps (P-309A/B). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.05M HNO_3 concentration (M-CLC-J-00143[25])
Solvent	Solvent is gravity-fed to EXT-202A from the extraction contactors. Properties 0.85 s.g. at 25 °C (ORNL/TM-2002/204[52])
Used Scrub Solution	Used scrub solution is gravity-fed to the Extraction Contactor EXT-201P. Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.05M HNO_3 concentration (M-CLC-J-00143[25])
Scrubbed Solvent	Scrubbed solvent is gravity-fed to the Solvent Strip Feed Tank (TK-217). Properties 0.85 s.g. (ORNL/TM-2002/204[52])

7.3.4 Physical Location and Layout

The Scrub Contactors (EXT-202A/B) are located on the Contactor Operating Deck in the CPA.

7.3.5 System Control Features and Interlocks

7.3.5.1 System Monitoring

The Scrub Contactors (EXT-202A/B) have instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS. The contactor rotation speed is set by using the DCS speed controller. Each contactor is individually controlled. The temperature of the aqueous stream exiting Scrub Contactor (EXT-202A) is also monitored.

See Table 7-4 for a listing of instruments.

Table 7-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SC-9217	M-M6-J-0038[188]	N/A	Contactor Speed (EXT-202A)	rpm
SE-9217	M-M6-J-0038[188]	N/A	Contactor Speed (EXT-202A)	rpm
VE-9217	M-M6-J-0038[188]	J-JZ-J-00322, *SWPF VA-9217 EXT-202A Vibration*[189]	Vibration (EXT-202A)	Cycles/second Inches/second

Table 7-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9217A	M-M6-J-0038[188]	J-JZ-J-00314, *SWPF TI-9217A EXT-202A Motor Top Bearing Temp*[190]	Motor Top bearing temperature	°F
TE-9217B	M-M6-J-0038[188]	J-JZ-J-00316, *SWPF TI-9217B EXT-202A Motor Bottom Bearing Temp*[191]	Motor Bottom bearing temperature	°F
TE-9217C	M-M6-J-0038[188]	J-JZ-J-00318, *SWPF TI-9217C Ext-202A Rotor Top Bearing Temp*[192]	Rotor Top bearing temperature	°F
TE-9217D	M-M6-J-0038[188]	J-JZ-J-00320, *SWPF TI-9217D EXT-202A Rotor Bottom Bearing Temp*[193]	Rotor Bottom bearing temperature	°F
SC-9218	M-M6-J-0038[188]	N/A	Contactor Speed (EXT-202B)	rpm
SE-9218	M-M6-J-0038[188]	N/A	Contactor Speed (EXT-202B)	rpm
VE-9218	M-M6-J-0038[188]	J-JZ-J-00323, *SWPF VA-9218 EXT-202B Vibration*[194]	Vibration (EXT-202B)	Cycles/second Inches/second
TE-9218A	M-M6-J-0038[188]	J-JZ-J-00315, *SWPF TI-9218A EXT-202B Motor Top Bearing Temp*[195]	Motor Top bearing temperature	°F
TE-9218B	M-M6-J-0038[188]	J-JZ-J-00317, *SWPF-TI-9218B EXT-202B Motor Bottom Bearing Temp*[196]	Motor Bottom bearing temperature	°F
TE-9218C	M-M6-J-0038[188]	J-JZ-J-00319, *SWPF-TI-9218C EXT-202B Rotor Top Bearing Temp*[197]	Rotor Top bearing temperature	°F
TE-9218D	M-M6-J-0038[188]	J-JZ-J-00321, *PF-TI-9218D EXT-202B Rotor Bottom Bearing Temp*[198]	Rotor Bottom bearing temperature	°F
TE-2930	M-M6-J-0038[188]	J-JZ-J-00313, *SWPF TI-2930 EXT-202A/B Aqueous Outlet Temp*[199]	Aqueous stream temperature at exit of EXT-202A	°F

7.3.5.2 Control Functions

None.

7.4 Operations

7.4.1 Initial Configuration

The scrub contactors are flushed, drained, and not operating.

7.4.2 System Startup

The CSSX process starts up, with Pump P-109A or B feeding DSS to the Extraction Contactors EXT-201A/P. The scrub solution is transferred from the Nitric Acid Scrub Make-up Tank (TK-307), using the P-309A/B pumps in the Cold Chemicals Area (CCA).

See Section 4.4.2 for a detailed description of the Extraction Contactor System Startup, which includes a discussion of the scrub contactors.

7.4.3 Normal Operations

The scrub section consists of two centrifugal contactors. Scrub solution is fed to Scrub Contactor EXT-202B from the CCA, using the P-309A/B pumps. The nominal scrub solution flow rate is 1.4 gpm. The flow rate for scrub solution feed to the scrub stages is controlled, based on an Operator-selected flow rate. The nominal O/A ratio is 5/1. Prior to entering EXT-202B, the scrub solution flows through a breakpot to provide a positive break from the CCA and the hot processing area. From EXT-202B, the scrub solution moves down the contactor bank to EXT-202A, contacting the process solvent in counter-current fashion. As the scrub solution contacts the solvent, it removes the weakly extracted impurities (e.g., K and Na) and trace levels of Al, Fe, and Hg from the loaded solvent. This scrubbing operation serves to reduce the amounts of these metals that are sent to DWPF via the strip effluent stream. The acid solution used in the scrub stages also neutralizes any hydroxide carryover into the scrub stages. Removal of these metals and neutralization of the hydroxide is essential to allow stable operation of the stripping stages. Because the strip stages employ a weakly acidic solution, introduction of caustic into the strip stages would likely result in significant H^+ ion concentration (pH) shifts, which could adversely affect process operability. Only a small amount of Cs is removed from the solvent by the scrub solution, which is high enough in nitrate to keep the Cs in the organic phase. The stripping solution; in contrast, is lower in nitrate content and allows the Cs to readily transfer from the solvent to the stripping solution. The scrub solution exits the scrub section at EXT-202A and mixes with the CSS feed. The solvent enters the scrub section at EXT-202A and moves up the contactor bank to EXT-202B. At EXT-202B, the scrubbed solvent leaves the scrub section (still loaded with Cs). The solvent gravity-flows into the Solvent Strip Feed Tank (TK-217).

See Section 4.4.3 for a detailed description of the CSSX Normal Operation.

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

7.4.4 Off-Normal and Recovery Operation

Personnel entry into the Contactor Operating Deck may require the contactors and related equipment to be flushed and drained.

Contactor motor failure or high vibration indication will require CSSX System Shutdown. If failure of a contactor appears imminent based on vibration, temperature, or other indicators, a controlled system shutdown will be performed.

Table 7-5 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 7-5. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Contactor motor failure or vibration above normal (EXT-202A / B)	High vibration alarm (VI-9217 / VI-9218) Contactor motor fault (HIS-9217 / HIS-9218)	Shutdown of the CSSX process.	Complete repairs.

7.4.5 System Shutdown

In order to shut down the CSSX process, feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. The solvent flow and scrub solution flow are terminated.

See Section 4.4.5 for a detailed description of CSSX System Shutdown.

8.0 STRIP CONTACTORS

8.1 System Functions

The general purpose of the strip contactors is to strip Cs from the solvent with 0.001M HNO_3 (see P-DB-J-00003[14]).

8.2 Operational Overview

The Solvent Strip Feed Tank (TK-217) provides a positive head pressure for the Strip Solvent Feed Pumps. Solvent Heat Exchangers HX-217A/B heat the solvent to 91 ± 5ºF.

The 16 CSSX strip contactors are centrifugal contactors that strip Cs from the solvent by contacting the solvent with 0.001M HNO_3. The Cs is released by the extractant (BOBCalixC6) into the strip solution. The Cs-enriched strip solution is sent to the SEHT (TK-205).

The strip solution flow rate (see X-SD-J-00003[5]) is controlled, based on an Operator-selected flow rate. The Operator adjusts the strip solution flow rate primarily based on the stripping contactors performance (indicated by the gamma radiation measurement of the stripped solvent).

Solvent is fed to Stripping Contactor, EXT-203A, by the Solvent Strip Feed Tank Pumps (P-217A/B). The stripped solvent is gravity-fed from EXT-203P to the Caustic Wash Contactors (EXT-204A/B).

8.3 Configuration Information

8.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 8-1.

Table 8-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0008	*SWPF Solvent Stripping and Caustic Wash PFD (U)*[200]
M-M6-J-0039 SH1	*SWPF Process Building Stripping Contactors EXT-203A/B P&ID (U)*[201]
M-M6-J-0039 SH2	*SWPF Process Building Stripping Contactors EXT-203C/D P&ID (U)*[202]
M-M6-J-0040 SH1	*SWPF Process Building Stripping Contactors EXT-203E/F P&ID (U)*[203]
M-M6-J-0040 SH2	*SWPF Process Building Stripping Contactors EXT-203G/H P&ID (U)*[204]
M-M6-J-0041 SH1	*SWPF Process Building Stripping Contactors EXT-203I/J P&ID (U)*[205]
M-M6-J-0041 SH2	*SWPF Process Building Stripping Contactors EXT-203K/L P&ID (U)*[206]
M-M6-J-0042 SH1	*SWPF Process Building Stripping Contactors EXT-203M/N P&ID (U)*[207]
M-M6-J-0042 SH2	*SWPF Process Building Stripping Contactors EXT-203O/P P&ID (U)*[208]
M-M6-J-0060 SH1	*SWPF Process Building Solvent Strip Feed Tank TK-217 P&ID (U)*[209]
M-M6-J-0060 SH2	*SWPF Process Building Solvent Strip Feed Tank Pumps P-217A/B P&ID (U)*[210]
M-M6-J-0060 SH3	*SWPF Process Building Solvent Strip Feed Tank Heat Exchangers HX-217A/B (U)*[211]
M-M6-J-0177	*SWPF Process Building Strip Contactors Tempered Water Units HTR-203A/B P&ID (U)*[212]
M-M6-J-0178	*SWPF Process Building Strip Contactors Solvent Strip Feed Tempered Water Units HTR-017A/B P&ID (U)*[213]

8.3.2 Major Components

See Table 8-2 for a list of major components.

Table 8-2. Major Components

Component	Description
Solvent Strip Feed Tank (TK-217)	Stainless steel pressure vessel that collects solvent from the discharge of the last Scrub Contactor (EXT-202B) [214]) Capacity to Overflow: 60 gallons (see M-CLC-J-00047[214]) Dimensions: 1 ft-6 inch (diameter) x 4 ft-11 inch (T/T) Design features: • The Solvent Strip Feed Tank (TK-217) is equipped with an air purge to prevent the accumulation of flammable vapors; • The Solvent Strip Feed Tank (TK-217) is maintained under vacuum, with respect to the cell, for containment / confinement; • The Solvent Strip Feed Tank (TK-217) includes an overflow line that enters the East CSSX Tank Cell Sump (SMP-217) below the liquid level; • The Solvent Strip Feed Tank (TK-217) includes an elevated bottom outlet line for the solvent stream. The elevated outlet pipe allows any entrained aqueous liquid to accumulate in the bottom of the tank; and • The Solvent Strip Feed Tank (TK-217) includes a bottom outlet line to drain accumulated aqueous to the SDT (TK-208).
Solvent Strip Feed Pumps (P-217A/B)	Positive displacement pumps with VFDs that provide a controlled solvent feed to the strip contactors. Alternate pathway is to the Laboratory. Capacity:: 15 gpm (see M-CLC-J-00103, *SWPF Solvent Strip Feed Pumps Sizing Calculation, P-217A/B*[215]) hp: 2.0 Design features: • The Solvent Strip Feed Pumps (P-217A/B) have drain and flush capability.
Solvent Strip Feed Heat Exchangers (HX-217A/B)	Maintains the solvent feed to the strip contactors at 91 ± 5°F. Design features: • Heat exchangers are shell and tube type. • Capacity: 28,000 Btu/hr
Strip Contactors Tempered Water Heat Exchanger (HX-203)	Provides cooling as needed to maintain the strip contactors at 91 ± 5°F. Design features: • Heat exchanger is shell and tube type. Capacity: 68,000 Btu/hr
Strip Contactors Tempered Water Heaters (HTR-203A/B)	Provides heat as needed to maintain the strip contactors at 91 ± 5°F. Power: 30 Kilowatts (kW) Design features: • Heaters are electric joule-heated units.
Strip Solvent Feed Tempered Water Heaters (HTR-017A/B)	Provides heat as needed for the Solvent Strip Feed Heat Exchangers (HX-217A/B) and Solvent Adjustment Heat Exchanger (HX-250). Power: 30 Kilowatts (kW) Design features: • Heaters are electric joule-heated units.

Table 8-2. Major Components (cont.)

Component	Description
Strip Contactors (EXT-203A/P)	Centrifugal contactors that continuously contact strip solution (0.001M HNO_3) and organic phase (process solvent) in a counter-current fashion. Centrifugal contactors are equipped with VFD motors for rotor speed control. Capacity: 12.0 gpm (hydraulic) hp: 10.0 Design features: • Each contactor is equipped with a VFD that allows the contactor to be started/stopped and speed of the rotor to be controlled by the DCS; • The strip contactors have a sleeve in the annular space to reduce the volume of the mixing zone. The sleeve also reduces the nominal hydraulic throughput. Each contactor can handle a hydraulic throughput of up to 12.0 gpm; • The contactors can be safely operated dry; • Each contactor is equipped with a system for CIP flushing of the rotor and inside of the housing; • Each contactor is equipped with a heated water jacket. The heated water is distributed from the tempered water system (a closed-loop system). The return from the contactor jackets is recycled back to the tempered water skids for reheating. • Each inter-stage line is vented to the process vessel vent header. This ensures that the solution gravity-drains from one stage to the next without creating pressure differentials between contactor stages. Proper venting of the gravity-drain system from one contactor to the next is essential for hydraulic operation of the contactors. Flush capability is provided for the vent piping. • Each contactor is equipped with a labyrinth seal to prevent process fluid contacting the rotor bearings. The labyrinth seal requires an air purge that is supplied from the Plant Air system. • Each contactor is equipped with a heavy phase weir for phase separation. The weir size for each contactor location is provided below. Process Location — Weir Size EXT-203A — 4.8-inch EXT-203B — 4.8-inch EXT-203C — 4.8-inch EXT-203D — 4.8-inch EXT-203E — 4.8-inch EXT-203F — 4.8-inch EXT-203G — 4.7-inch EXT-203H — 4.7-inch EXT-203I — 4.7-inch EXT-203J — 4.7-inch EXT-203K — 4.7-inch EXT-203L — 4.7-inch EXT-203M — 4.7-inch EXT-203N — 4.7-inch EXT-203O — 4.7-inch EXT-203P — 4.8-inch

8.3.3 Stream Data

See Table 8-3 for a listing of streams.

Table 8-3. Streams

Stream	Description
Strip Solution	Strip solution is transferred to EXT-203P from the Nitric Acid Strip Make-up Pumps (P-310A/B). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.001M HNO_3 concentration (M-CLC-J-00143[25])
Solvent	Solvent is transferred to EXT-203A from the Solvent Strip Feed Tank Pumps (P-217A/B). Stripped solvent is gravity-fed to the first Caustic Wash Contactors (EXT-204A/B). Properties 0.85 s.g. at 25 °C (ORNL/TM-2002/204[52])
Strip Effluent	Strip effluent is gravity-fed to the Strip Effluent Stilling Tank (TK-212). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.001M HNO_3 concentration (M-CLC-J-00143[25])

8.3.4 Physical Location and Layout

The Strip Contactors (EXT-203A/P) are located on the Contactor Operating Deck in the CPA.

The Solvent Strip Feed Tank (TK-217) is located in the East CSSX Tank Cell. The Solvent Strip Feed Tank Pumps (P-217A/B) are located in the CSSX P&VG area. Each pump is located in a separate gallery, along with a Strip Effluent Pump Tank Pump (P-215 A/B). An automatic and a manual valve are located at the labyrinth wall to separate the tank and pumps. The piping is arranged for the system to gravity-drain to the Solvent Strip Feed Tank Pumps (P-217A/B). The Solvent Heat Exchangers (HX-217A/B) are located in the same gallery with the related Solvent Strip Feed Tank Pump.

8.3.5 System Control Features and Interlocks

8.3.5.1 System Monitoring

The Strip Contactors (EXT-203A/P) have instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The Strip Contactors (EXT-203A/P) have speed indication and vibration monitors with alarms to monitor the contactor operation. The contactor rotation speed is set by using the DCS speed controller. Each contactor is individually controlled. The contactors include a heated water jacket. Each set of four contactors includes a TCV on the common cooling water return line. The temperature of the aqueous stream exiting every fourth contactor is monitored and used to control the cooling water flow for the set of four contactors.

The Solvent Strip Feed Tank (TK-217) has a bubbler level instrument to monitor the level in the tank. The Solvent Strip Feed Tank (TK-217) also has a bubbler level instrument to monitor the solvent/aqueous interface in the tank.

The Solvent Strip Feed Pumps (P-217A/B) have instrumentation to monitor and control the pump speed. When the pumps are enabled, a level controller is used to control the speed of the Solvent Strip Feed Tank Pumps (P-217A/B) to maintain the level in the Solvent Strip Feed Tank (TK-217) within a control band. A mass flow meter is installed on the discharge side of pumps in order to monitor the flow rate to Strip Contactor (EXT-203A). A portion of the pump discharge can be diverted to the laboratory for sampling using an isolation valve (see X-SD-J-00006[8]).

The temperature at the exit of the Solvent Heat Exchangers (HX-217A/B) is monitored. A temperature controller is adjusted to control the heat exchangers. The hot water supply to the Solvent Heat Exchangers (HX-217A/B) is provided by the Strip Solvent Feed Tempered Water Heaters (HTR-017A/B). The Strip Solvent Feed Tempered Water Heaters (HTR-017A/B) also provide the hot water for the Solvent Adjustment Heat Exchanger (HX-250). Temperature, radiation level, and flow at the exit of the Strip Solvent Feed Tempered Water Heaters (HTR-017A/B) are monitored.

Temperature and flow at the exit of the Strip Contactors Tempered Water Heaters (HTR-203A/B) is monitored.

See Table 8-4 for a listing of instruments.

Table 8-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-217A	M-M6-J-0060 SH2[210]	N/A	Pump Status	Run/Off
P-217B	M-M6-J-0060 SH2[210]	N/A	Pump Status	Run/Off
TE-2032	M-M6-J-0041 SH1[205]	J-JZ-J-00342, *SWPF TIC-2032 EXT-203 I-L Aqueous Temp*[216]	Aqueous stream temperature at exit of EXT-203I	°F
TV-2032	M-M6-J-0041 SH2[206]	J-JZ-J-00342[216]	Valve Position	0-100% Open
SC-9219	M-M6-J-0039 SH1[201]	N/A	Contactor Speed (EXT-203A)	rpm
SC-9220	M-M6-J-0039 SH1[201]	N/A	Contactor Speed (EXT-203B)	rpm
SC-9221	M-M6-J-0039 SH2[202]	N/A	Contactor Speed (EXT-203C)	rpm
SC-9222	M-M6-J-0039 SH2[202]	N/A	Contactor Speed (EXT-203D)	rpm
SC-9223	M-M6-J-0040 SH1[203]	N/A	Contactor Speed (EXT-203E)	rpm

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SC-9224	M-M6-J-0040 SH1[203]	N/A	Contactor Speed (EXT-203F)	rpm
SC-9225	M-M6-J-0040 SH2[204]	N/A	Contactor Speed (EXT-203G)	rpm
SC-9226	M-M6-J-0040 SH2[204]	N/A	Contactor Speed (EXT-203H)	rpm
SC-9227	M-M6-J-0041 SH1[205]	N/A	Contactor Speed (EXT-203I)	rpm
SC-9228	M-M6-J-0041 SH1[205]	N/A	Contactor Speed (EXT-203J)	rpm
SC-9229	M-M6-J-0041 SH2[206]	N/A	Contactor Speed (EXT-203K)	rpm
SC-9230	M-M6-J-0041 SH2[206]	N/A	Contactor Speed (EXT-203L)	rpm
SC-9231	M-M6-J-0042 SH1[207]	N/A	Contactor Speed (EXT-203M)	rpm
SC-9232	M-M6-J-0042 SH1[207]	N/A	Contactor Speed (EXT-203N)	rpm
SC-9233	M-M6-J-0042 SH2[208]	N/A	Contactor Speed (EXT-203O)	rpm
SC-9234	M-M6-J-0042 SH2[208]	N/A	Contactor Speed (EXT-203P)	rpm
SE-9219	M-M6-J-0039 SH1[201]	N/A	Contactor Speed (EXT-203A)	rpm
SE-9220	M-M6-J-0039 SH1[201]	N/A	Contactor Speed (EXT-203B)	rpm
SE-9221	M-M6-J-0039 SH2[202]	N/A	Contactor Speed (EXT-203C)	rpm
SE-9222	M-M6-J-0039 SH2[202]	N/A	Contactor Speed (EXT-203D)	rpm
SE-9223	M-M6-J-0040 SH1[203]	N/A	Contactor Speed (EXT-203E)	rpm
SE-9224	M-M6-J-0040 SH1[203]	N/A	Contactor Speed (EXT-203F)	rpm
SE-9225	M-M6-J-0040 SH2[204]	N/A	Contactor Speed (EXT-203G)	rpm
SE-9226	M-M6-J-0040 SH2[204]	N/A	Contactor Speed (EXT-203H)	rpm
SE-9227	M-M6-J-0041 SH1[205]	N/A	Contactor Speed (EXT-203I)	rpm

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SE-9228	M-M6-J-0041 SH1[205]	N/A	Contactor Speed (EXT-203J)	rpm
SE-9229	M-M6-J-0041 SH2[206]	N/A	Contactor Speed (EXT-203K)	rpm
SE-9230	M-M6-J-0041 SH2[206]	N/A	Contactor Speed (EXT-203L)	rpm
SE-9231	M-M6-J-0042 SH1[207]	N/A	Contactor Speed (EXT-203M)	rpm
SE-9232	M-M6-J-0042 SH1[207]	N/A	Contactor Speed (EXT-203N)	rpm
SE-9233	M-M6-J-0042 SH2[208]	N/A	Contactor Speed (EXT-203O)	rpm
SE-9234	M-M6-J-0042 SH2[208]	N/A	Contactor Speed (EXT-203P)	rpm
VE-9219	M-M6-J-0039 SH1[201]	J-JZ-J-00408, *SWPF VA-9219 EXT-203A Vibration*[217]	Vibration (EXT-203A)	Cycles/second Inches/second
VE-9220	M-M6-J-0039 SH1[201]	J-JZ-J-00409, *SWPF VA-9220 EXT-203B Vibration*[218]	Vibration (EXT-203B)	Cycles/second Inches/second
VE-9221	M-M6-J-0039 SH2[202]	J-JZ-J-00410, *SWPF VA-9221 EXT-203C Vibration*[219]	Vibration (EXT-203C)	Cycles/second Inches/second
VE-9222	M-M6-J-0039 SH2[202]	J-JZ-J-00411, *SWPF VA-9222 EXT-203D Vibration*[220]	Vibration (EXT-203D)	Cycles/second Inches/second
VE-9223	M-M6-J-0040 SH1[203]	J-JZ-J-00412, *SWPF VA-9223 EXT-203E Vibration*[221]	Vibration (EXT-203E)	Cycles/second Inches/second
VE-9224	M-M6-J-0040 SH1[203]	J-JZ-J-00413, *SWPF VA-9224 EXT-203F Vibration*[222]	Vibration (EXT-203F)	Cycles/second Inches/second
VE-9225	M-M6-J-0040 SH2[204]	J-JZ-J-00414, *SWPF VA-9225 EXT-203G Vibration*[223]	Vibration (EXT-203G)	Cycles/second Inches/second
VE-9226	M-M6-J-0040 SH2[204]	J-JZ-J-00415, *SWPF VA-9226 EXT-203H Vibration*[224]	Vibration (EXT-203H)	Cycles/second Inches/second
VE-9227	M-M6-J-0041 SH1[205]	J-JZ-J-00416, *SWPF VA-9227 EXT-203I Vibration*[225]	Vibration (EXT-203I)	Cycles/second Inches/second
VE-9228	M-M6-J-0041 SH1[205]	J-JZ-J-00417, *SWPF VA-9228 EXT-203J Vibration*[226]	Vibration (EXT-203J)	Cycles/second Inches/second

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
VE-9229	M-M6-J-0041 SH2[206]	J-JZ-J-00418, *SWPF VA-9229 EXT-203K Vibration*[227]	Vibration (EXT-203K)	Cycles/second Inches/second
VE-9230	M-M6-J-0041 SH2[206]	J-JZ-J-00419, *SWPF VA-9230 EXT-203L Vibration*[228]	Vibration (EXT-203L)	Cycles/second Inches/second
VE-9231	M-M6-J-0042 SH1[207]	J-JZ-J-00420, *SWPF VA-9231 EXT-203M Vibration*[229]	Vibration (EXT-203M)	Cycles/second Inches/second
VE-9232	M-M6-J-0042 SH1[207]	J-JZ-J-00421, *SWPF VA-9232 EXT-203N Vibration*[230]	Vibration (EXT-203N)	Cycles/second Inches/second
VE-9233	M-M6-J-0042 SH2[208]	J-JZ-J-00422, *SWPF VA-9233 EXT-203O Vibration*[231]	Vibration (EXT-203O)	Cycles/second Inches/second
VE-9234	M-M6-J-0042 SH2[208]	J-JZ-J-00423, *SWPF VA-9234 EXT-203P Vibration*[232]	Vibration (EXT-203P)	Cycles/second Inches/second
TE-9219A	M-M6-J-0039 SH1[201]	J-JZ-J-00344, *SWPF TI-9219A EXT-203A Motor Top Bearing Temp*[233]	Motor Top bearing temperature	°F
TE-9220A	M-M6-J-0039 SH1[201]	J-JZ-J-00345, *SWPF TI-9220A EXT-203B Motor Top Bearing Temp*[234]	Motor Top bearing temperature	°F
TE-9221A	M-M6-J-0039 SH2[202]	J-JZ-J-00346, *SWPF TI-9221A EXT-203C Motor Top Bearing Temp*[235]	Motor Top bearing temperature	°F
TE-9222A	M-M6-J-0039 SH2[202]	J-JZ-J-00347, *SWPF TI-9222A EXT-203D Motor Top Bearing Temp*[236]	Motor Top bearing temperature	°F
TE-9223A	M-M6-J-0040 SH1[203]	J-JZ-J-00348, *SWPF TI-9223A EXT-203E Motor Top Bearing Temp*[237]	Motor Top bearing temperature	°F
TE-9224A	M-M6-J-0040 SH1[203]	J-JZ-J-00349, *SWPF TI-9224A EXT-203F Motor Top Bearing Temp*[238]	Motor Top bearing temperature	°F
TE-9225A	M-M6-J-0040 SH2[204]	J-JZ-J-00350, *SWPF TI-9225A EXT-203G Motor Top Bearing Temp*[239]	Motor Top bearing temperature	°F
TE-9226A	M-M6-J-0040 SH2[204]	J-JZ-J-00351, *SWPF TI-9226A EXT-203H Motor Top Bearing Temp*[240]	Motor Top bearing temperature	°F

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9227A	M-M6-J-0041 SH1[205]	J-JZ-J-00352, *SWPF TI-9227A EXT-203I Motor Top Bearing Temp*[241]	Motor Top bearing temperature	°F
TE-9228A	M-M6-J-0041 SH1[205]	J-JZ-J-00353, *SWPF TI-9228A EXT-203J Motor Top Bearing Temp*[242]	Motor Top bearing temperature	°F
TE-9229A	M-M6-J-0041 SH2[205]	J-JZ-J-00354, *SWPF TI-9229A EXT-203K Motor Top Bearing Temp*[243]	Motor Top bearing temperature	°F
TE-9230A	M-M6-J-0041 SH2[206]	J-JZ-J-00355, *SWPF TI-9230A EXT-203L Motor Top Bearing Temp*[244]	Motor Top bearing temperature	°F
TE-9231A	M-M6-J-0042 SH1[207]	J-JZ-J-00356, *SWPF TI-9231A EXT-203M Motor Top Bearing Temp*[245]	Motor Top bearing temperature	°F
TE-9232A	M-M6-J-0042 SH1[207]	J-JZ-J-00357, *SWPF TI-9232A EXT-203N Motor Top Bearing Temp*[246]	Motor Top bearing temperature	°F
TE-9233A	M-M6-J-0042 SH2[208]	J-JZ-J-00358, *SWPF TI-9233A EXT-203O Motor Top Bearing Temp*[247]	Motor Top bearing temperature	°F
TE-9234A	M-M6-J-0042 SH2[208]	J-JZ-J-00359, *SWPF TI-9234A EXT-203P Motor Top Bearing Temp*[248]	Motor Top bearing temperature	°F
TE-9219B	M-M6-J-0039 SH1[201]	J-JZ-J-00360, *SWPF TI-9219B EXT-203A Motor Bottom Bearing Temp*[249]	Motor Bottom bearing temperature	°F
TE-9220B	M-M6-J-0039 SH1[201]	J-JZ-J-00361, *SWPF TI-9220B EXT-203B Motor Bottom Bearing Temp*[250]	Motor Bottom bearing temperature	°F
TE-9221B	M-M6-J-0039 SH2[202]	J-JZ-J-00362, *SWPF TI-9221B EXT-203C Motor Bottom Bearing Temp*[251]	Motor Bottom bearing temperature	°F
TE-9222B	M-M6-J-0039 SH2[202]	J-JZ-J-00363, *SWPF TI-9222B EXT-203D Motor Bottom Bearing Temp*[252]	Motor Bottom bearing temperature	°F
TE-9223B	M-M6-J-0040 SH1[203]	J-JZ-J-00364, *SWPF TI-9223B EXT-203E Motor Bottom Bearing Temp*[253]	Motor Bottom bearing temperature	°F
TE-9224B	M-M6-J-0040 SH1[203]	J-JZ-J-00365, *SWPF TI-9224B EXT-203F Motor Bottom Bearing Temp*[254]	Motor Bottom bearing temperature	°F

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9225B	M-M6-J-0040 SH2[204]	J-JZ-J-00366, *SWPF TI-9225B EXT-203G Motor Bottom Bearing Temp*[255]	Motor Bottom bearing temperature	°F
TE-9226B	M-M6-J-0040 SH2[204]	J-JZ-J-00367, *SWPF TI-9226B EXT-203H Motor Bottom Bearing Temp*[256]	Motor Bottom bearing temperature	°F
TE-9227B	M-M6-J-0041 SH1[205]	J-JZ-J-00368, *SWPF TI-9227B EXT-203I Motor Bottom Bearing Temp*[257]	Motor Bottom bearing temperature	°F
TE-9228B	M-M6-J-0041 SH1[205]	J-JZ-J-00369, *SWPF TI-9228B EXT-203J Motor Bottom Bearing Temp*[258]	Motor Bottom bearing temperature	°F
TE-9229B	M-M6-J-0041 SH2[206]	J-JZ-J-00370, *SWPF TI-9229B EXT-203K Motor Bottom Bearing Temp*[259]	Motor Bottom bearing temperature	°F
TE-9230B	M-M6-J-0041 SH2[206]	J-JZ-J-00371, *SWPF TI-9230B EXT-203L Motor Bottom Bearing Temp*[260]	Motor Bottom bearing temperature	°F
TE-9231B	M-M6-J-0042 SH1[207]	J-JZ-J-00372, *SWPF TI-9231B EXT-203M Motor Bottom Bearing Temp*[261]	Motor Bottom bearing temperature	°F
TE-9232B	M-M6-J-0042 SH1[207]	J-JZ-J-00373, *SWPF TI-9232B EXT-203N Motor Bottom Bearing Temp*[262]	Motor Bottom bearing temperature	°F
TE-9233B	M-M6-J-0042 SH2[208]	J-JZ-J-00374, *SWPF TI-9233B EXT-203O Motor Bottom Bearing Temp*[263]	Motor Bottom bearing temperature	°F
TE-9234B	M-M6-J-0042 SH2[208]	J-JZ-J-00375, *SWPF TI-9234B EXT-203P Motor Bottom Bearing Temp*[264]	Motor Bottom bearing temperature	°F
TE-9219C	M-M6-J-0039 SH1[201]	J-JZ-J-00376, *SWPF TI-9219C EXT-203A Rotor Top Bearing Temp*[265]	Rotor Top bearing temperature	°F
TE-9220C	M-M6-J-0039 SH1[201]	J-JZ-J-00377, *SWPF TI-9220C EXT-203B Rotor Top Bearing Temp*[266]	Rotor Top bearing temperature	°F
TE-9221C	M-M6-J-0039 SH2[202]	J-JZ-J-00378, *SWPF TI-9221C EXT-203C Rotor Top Bearing Temp*[267]	Rotor Top bearing temperature	°F
TE-9222C	M-M6-J-0039 SH2[202]	J-JZ-J-00379, *SWPF TI-9222C EXT-203D Rotor Top Bearing Temp*[268]	Rotor Top bearing temperature	°F

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9223C	M-M6-J-0040 SH1[203]	J-JZ-J-00380, *SWPF TI-9223C EXT-203E Rotor Top Bearing Temp*[269]	Rotor Top bearing temperature	°F
TE-9224C	M-M6-J-0040 SH1[203]	J-JZ-J-00381, *SWPF TI-9224C EXT-203F Rotor Top Bearing Temp*[270]	Rotor Top bearing temperature	°F
TE-9225C	M-M6-J-0040 SH2[204]	J-JZ-J-00382, *SWPF TI-9225C EXT-203G Rotor Top Bearing Temp*[271]	Rotor Top bearing temperature	°F
TE-9226C	M-M6-J-0040 SH2[204]	J-JZ-J-00383, *SWPF TI-9226C EXT-203H Rotor Top Bearing Temp*[272]	Rotor Top bearing temperature	°F
TE-9227C	M-M6-J-0041 SH1[205]	J-JZ-J-00384, *SWPF TI-9227C EXT-203I Rotor Top Bearing Temp*[273]	Rotor Top bearing temperature	°F
TE-9228C	M-M6-J-0041 SH1[205]	J-JZ-J-00385, *SWPF TI-9228C EXT-203J Rotor Top Bearing Temp*[274]	Rotor Top bearing temperature	°F
TE-9229C	M-M6-J-0041 SH2[206]	J-JZ-J-00386, *SWPF TI-9229C EXT-203K Rotor Top Bearing Temp*[275]	Rotor Top bearing temperature	°F
TE-9230C	M-M6-J-0041 SH2[206]	J-JZ-J-00387, *SWPF TI-9230C EXT-203L Rotor Top Bearing Temp*[276]	Rotor Top bearing temperature	°F
TE-9231C	M-M6-J-0042 SH1[207]	J-JZ-J-00388, *SWPF TI-9231C EXT-203M Rotor Top Bearing Temp*[277]	Rotor Top bearing temperature	°F
TE-9232C	M-M6-J-0042 SH1[207]	J-JZ-J-00389, *SWPF TI-9232C EXT-203N Rotor Top Bearing Temp*[278]	Rotor Top bearing temperature	°F
TE-9233C	M-M6-J-0042 SH2[208]	J-JZ-J-00390, *SWPF TI-9233C EXT-203O Rotor Top Bearing Temp*[279]	Rotor Top bearing temperature	°F
TE-9234C	M-M6-J-0042 SH2[208]	J-JZ-J-00391, *SWPF TI-9234C EXT-203P Rotor Top Bearing Temp*[280]	Rotor Top bearing temperature	°F
TE-9219D	M-M6-J-0039 SH1[201]	J-JZ-J-00392, *SWPF TI-9219D EXT-203A Rotor Bottom Bearing Temp*[281]	Rotor Bottom bearing temperature	°F
TE-9220D	M-M6-J-0039 SH1[201]	J-JZ-J-00393, *SWPF TI-9220D EXT-203B Rotor Bottom Bearing Temp*[282]	Rotor Bottom bearing temperature	°F

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-9221D	M-M6-J-0039 SH2[202]	J-JZ-J-00394, *SWPF TI-9221D EXT-203C Rotor Bottom Bearing Temp*[283]	Rotor Bottom bearing temperature	°F
TE-9222D	M-M6-J-0039 SH2[202]	J-JZ-J-00395, *SWPF TI-9222D EXT-203D Rotor Bottom Bearing Temp*[284]	Rotor Bottom bearing temperature	°F
TE-9223D	M-M6-J-0040 SH1[203]	J-JZ-J-00396, *SWPF TI-9223D EXT-203E Rotor Bottom Bearing Temp*[285]	Rotor Bottom bearing temperature	°F
TE-9224D	M-M6-J-0040 SH1[203]	J-JZ-J-00397, *SWPF TI-9224D EXT-203F Rotor Bottom Bearing Temp*[286]	Rotor Bottom bearing temperature	°F
TE-9225D	M-M6-J-0040 SH2[204]	J-JZ-J-00398, *SWPF TI-9225D EXT-203G Rotor Bottom Bearing Temp*[287]	Rotor Bottom bearing temperature	°F
TE-9226D	M-M6-J-0040 SH2[204]	J-JZ-J-00399, *SWPF TI-9226D EXT-203H Rotor Bottom Bearing Temp*[288]	Rotor Bottom bearing temperature	°F
TE-9227D	M-M6-J-0041 SH1[205]	J-JZ-J-00400, *SWPF TI-9227D EXT-203I Rotor Bottom Bearing Temp*[289]	Rotor Bottom bearing temperature	°F
TE-9228D	M-M6-J-0041 SH1[205]	J-JZ-J-00401, *SWPF TI-9228D EXT-203J Rotor Bottom Bearing Temp*[290]	Rotor Bottom bearing temperature	°F
TE-9229D	M-M6-J-0041 SH2[206]	J-JZ-J-00402, *SWPF TI-9229D EXT-203K Rotor Bottom Bearing Temp*[291]	Rotor Bottom bearing temperature	°F
TE-9230D	M-M6-J-0041 SH2[206]	J-JZ-J-00403, *SWPF TI-9230D EXT-203L Rotor Bottom Bearing Temp*[292]	Rotor Bottom bearing temperature	°F
TE-9231D	M-M6-J-0042 SH1[207]	J-JZ-J-00404, *SWPF TI-9231D EXT-203M Rotor Bottom Bearing Temp*[293]	Rotor Bottom bearing temperature	°F
TE-9232D	M-M6-J-0042 SH1[207]	J-JZ-J-00405, *SWPF TI-9232D EXT-203N Rotor Bottom Bearing Temp*[294]	Rotor Bottom bearing temperature	°F
TE-9233D	M-M6-J-0042 SH2[208]	J-JZ-J-00406, *SWPF TI-9233D EXT-203O Rotor Bottom Bearing Temp*[295]	Rotor Bottom bearing temperature	°F
TE- 9234D	M-M6-J-0042 SH2[208]	J-JZ-J-00407, *SWPF TI-9234D EXT-203P Rotor Bottom Bearing Temp*[296]	Rotor Bottom bearing temperature	°F

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-2042	M-M6-J-0042 SH1[207]	J-JZ-J-00343, *SWPF TIC-2042 EXT-203 M-P Aqueous Temp*[297]	Aqueous stream temperature at exit of EXT-203M	°F
TV-2042	M-M6-J-0042 SH2[208]	J-JZ-J-00343[297]	Valve Position	0-100% Open
LIT-2151	M-M6-J-0060 SH1[209]	J-JZ-J-0049, *SWPF LIC-2151 Solvent Strip Feed Tank Level*[298]	Solvent Strip Feed Tank (TK-217) level	Gallons
LIT-2152	M-M6-J-0060 SH1[209]	J-JZ-J-0050, *SWPF LI-2152 Solvent Strip Feed Tank Aqueous Level*[299]	Solvent Strip Feed Tank Aqueous (TK-217) level	Gallons
SC-2151A	M-M6-J-0060 SH2[210]	J-JZ-J-01118, *SWPF SIC-2151A Solvent Strip Feed Pump A Speed*[300]	Speed (P-217A)	0 – 100%
SC-2151B	M-M6-J-0060 SH2[210]	J-JZ-J-01119, *SWPF SIC-2151B Solvent Strip Feed Pump B Speed*[301]	Speed (P-217B)	0 – 100%
VE-9259B/C/D	M-M6-J-0060 SH2[210]	N/A	P-217A Vibration	Cycles/second Inches/sec
VE-9261B/C/D	M-M6-J-0060 SH2[210]	N/A	P-217B Vibration	Cycles/second Inches/sec
LIT-2152	M-M6-J-0060 SH1[209]	J-JZ-J-0050[299]	Solvent Strip Feed Tank (TK-217) level	Gallons
FE-2153	M-M6-J-0060 SH2[210]	J-JZ-J-00526, *SWPF FI-2153 Solvent Strip Feed Pump A Flow*[302]	Flow rate (P-217A)	gpm
TE-2154	M-M6-J-0060 SH3[211]	J-JZ-J-00530, *SWPF TIC-2154 Solvent Strip Feed Pump A Temp*[303]	Solvent Temperature (HTR-217A exit)	°F
HV-2171	M-M6-J-0060 SH2[210]	N/A	P-217A Isolation Valve Position	Open/Closed
HV-2173	M-M6-J-0060 SH2[210]	N/A	P-217B Isolation Valve Position	Open/Closed
HV-2175	M-M6-J-0060 SH2[210]	N/A	Drain Valve position	Open/Closed
HV-2176	M-M6-J-0060 SH2[210]	N/A	Drain Valve Position	Open/Closed
HV-2177	M-M6-J-0060 SH2[210]	N/A	Drain Valve Position	Open/Closed
HV-2178	M-M6-J-0060 SH2[210]	N/A	Drain Valve Position	Open/Closed

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
FE-2179	M-M6-J-0060 SH2[210]	J-JZ-J-00527, *SWPF FI-2179 Solvent Strip Feed Pump B Flow*[304]	Flow rate (P-217B)	gpm
FE-2191	M-M6-J-0060 SH2[210]	J-JZ-J-00528, *SWPF FIC-2191 Solvent Trip Feed Pump A Sample Flow*[305]	Flow rate to Laboratory (P-217A)	gpm
FV-2191	M-M6-J-0060 SH2[210]	J-JZ-J-00528[305]	Valve Position	0-100% Open
HV-2192	M-M6-J-0060 SH1[209]	N/A	Valve Position	Open/Closed
FE-2195	M-M6-J-0060 SH2[210]	J-JZ-J-00529, *SWPF FIC-2195 Solvent Strip Feed Pump B Sample Flow*[306]	Flow rate to Laboratory (P-217B)	gpm
FV-2195	M-M6-J-0060 SH2[210]	J-JZ-J-00529[306]	Valve Position	0-100% Open
TE-2196	M-M6-J-0060 SH3[211]	J-JZ-J-00531, *SWPF TIC-2196 Solvent Strip Feed Pump B Temp*[307]	Solvent Temperature (HTR-217B exit)	°F
TE-2960	M-M6-J-0039 SH1[201]	J-JZ-J-00340, *SWPF TIC-2960 EXT-203 A-D Aqueous Temp*[308]	Aqueous stream temperature at exit of EXT-203A	°F
TV-2960	M-M6-J-0039 SH2[202]	J-JZ-J-00340[308]	Valve Position	0-100% Open
TE-2966	M-M6-J-0040 SH1[203]	J-JZ-J-00341, *SWPF TIC-2966 EXT-203 E-H Aqueous Temp*[309]	Aqueous stream temperature at exit of EXT-203E	°F
TV-2966	M-M6-J-0040 SH2[204]	J-JZ-J-00341[309]	Valve Position	0-100% Open
PIT-2294	M-M6-J-0060 SH2[210]	N/A	P-217A Discharge pressure	psig
PIT-2295	M-M6-J-0060 SH2[210]	N/A	P-217B Discharge pressure	psig
HV-2148	M-M6-J-0060 SH3[211]	N/A	HX-217A Drain Valve Position	Open/Closed
HV-2149	M-M6-J-0060 SH3[211]	N/A	HX-217A Drain Valve Position	Open/Closed
HV-2158	M-M6-J-0060 SH3[211]	N/A	HX-217B Drain Valve Position	Open/Closed
HV-2159	M-M6-J-0060 SH3[211]	N/A	HX-217B Drain Valve Position	Open/Closed
TV-2196	M-M6-J-0060 SH3[211]	J-JZ-J-00531[307]	Valve Position	0-100% Open
TV-2154	M-M6-J-0060 SH3[211]	J-JZ-J-00530[303]	Valve Position	0-100% Open
FV-2153	M-M6-J-0060 SH3[211]	N/A	Valve Position	0-100% Open
FV-2179	M-M6-J-0060 SH3[211]	N/A	Valve Position	0-100% Open

Table 8-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
TE-2588	M-M6-J-0177[212]	J-JZ-J-00811, *SWPF TIC-2588 Strip Contactors Tempered Water Temp*[310]	Strip Contactors Tempered Water Temperature	°F
TV-2588	M-M6-J-0177[212]	J-JZ-J-00811[310]	Valve Position	0-100% Open
FE-2590	M-M6-J-0177[212]	J-JZ-J-00810, *SWPF FI-2590 Strip Contactors Tempered Water Flow*[311]	Strip Contactors Tempered Water Flow	gpm
FV-2590	M-M6-J-0177[212]	J-JZ-J-00810[311]	Valve Position	0-100% Open
FE-2565	M-M6-J-0178[213]	J-JZ-J-00812, *SWPF FI-2565 Solvent Strip Feed Tempered Water Flow*[312]	Solvent Strip Feed Tempered Water Flow	gpm
FV-2565	M-M6-J-0178[213]	J-JZ-J-00812[312]	Valve Position	0-100% Open
TE-2563	M-M6-J-0178[213]	J-JZ-J-00814, *SWPF TI-2563 Strip Feed Tempered Water Temp*[313]	Strip Feed Tempered Water Temperature	°F
RE-2564	M-M6-J-0178[213]	J-JZ-J-00813, *SWPF RI-2564 Solvent Strip PHW Loop Radiation Monitor*[314]	Solvent Strip Process Hot Water Loop Radiation Level	mRem/hr

8.3.5.2 Control Functions

See Table 8-5 for a listing of control loops.

Table 8-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
TIC-2032	M-M6-J-0041 SH1[205]	J-JZ-J-00342[216]	Aqueous stream temperature, EXT-203I	91°F
TIC-2042	M-M6-J-0042 SH1[207]	J-JZ-J-00343[297]	Aqueous stream temperature, EXT-203M	91°F
LIC-2151A	M-M6-J-0060 SH1[209]	J-JZ-J-0049[298]	Solvent Strip Feed Tank (TK-217) level	Operator-entered
LIC-2151B	M-M6-J-0060 SH1[209]	N/A	Solvent Strip Feed Tank (TK-217) level	Operator-entered
TIC-2154	M-M6-J-0060 SH3[211]	J-JZ-J-00530[303]	Solvent Temperature (HTR-217B exit)	91°F
FIC-2191	M-M6-J-0060 SH2[210]	J-JZ-J-00528[305]	P-217A Discharge flow rate to Laboratory	Operator-entered
FIC-2195	M-M6-J-0060 SH2[210]	J-JZ-J-00529[306]	P-217B Discharge flow rate to Laboratory	Operator-entered
TIC-2196	M-M6-J-0060 SH3[211]	J-JZ-J-00531[307]	Solvent Temperature (HTR-217B exit)	91°F
TIC-2960	M-M6-J-0039 SH1[201]	J-JZ-J-00340[308]	Aqueous stream temperature, EXT-203A	91°F
TIC-2966	M-M6-J-0040 SH1[203]	J-JZ-J-00341[309]	Aqueous stream temperature, EXT-203E	91°F
SIC-2151A	M-M6-J-0060 SH2[210]	J-JZ-J-01118[300]	P-217A Pump Speed/Pump flow rate	Operator-entered, manual operation
SIC-2151B	M-M6-J-0060 SH2[210]	J-JZ-J-01119[301]	P-217B Pump Speed/Pump flow rate	Operator-entered, manual operation
TIC-2588	M-M6-J-0177[212]	J-JZ-J-00811[310]	Strip Contactors Tempered Water Temperature	115°F

8.4 Operations

8.4.1 Initial Configuration

The strip contactors are flushed, drained, and not operating.

8.4.2 System Startup

The strip solution flow is established by using pumps P-310A/B (Strip Feed Pumps) and P-312-3A/B (Strip Water Feed Pumps) (see X-SD-J-00003[5]). The remainder of the CSSX process then starts up, with Pump P-109A or B feeding DSS to the Extraction Contactors EXT-201A/P.

See Section 4.4.2 for a detailed description of the Extraction Contactor System Startup, which includes a discussion of the strip contactors.

8.4.3 Normal Operations

The scrubbed solvent gravity-flows to the Solvent Strip Feed Tank (TK-217). The Solvent Strip Feed Tank (TK-217) includes a standpipe on the normal discharge line. This standpipe allows entrained aqueous to accumulate in the bottom of the tank. Periodically, the accumulated aqueous solution is drained to the SDT (TK-208), using a separate discharge line on the bottom of the tank. The solvent entering the Solvent Strip Feed Tank (TK-217) is pumped by one of the Solvent Strip Feed Pumps (P-217A/B) through the associated Solvent Heater (HTR-217A/B) to Stripping Contactor (EXT-203A. The solvent flow control set point is based on the operating level in the Solvent Strip Feed Tank (TK-217). The strip contactors consist of 16 centrifugal contactors arranged in a counter-current cascade (i.e., the organic and aqueous move through the units in different directions). The process solvent enters the contactor bank at EXT-203A and moves up the contactor bank through EXT-203P. The Cs stripping operation is primarily driven by the difference in nitrate concentration between the aqueous and organic phases. The stripping solution is 0.001M HNO_3. The low nitrate ion concentration in the aqueous phase shifts the equilibrium to favor the transfer of the Cs ion from the solvent to the aqueous phase (strip solution). As the solvent moves up the series of contactors, more Cs is stripped from the solvent by the dilute HNO_3 solution. The strip feed rate is controlled to a nominal O/A ratio of 5:1 to achieve a nominal CF value of 15. The CF is defined as Cs concentration in the strip effluent/Cs concentration in the waste feed. The stripped solvent (i.e., solvent essentially devoid of Cs) exits the strip section at EXT-203P and goes to the first Caustic Wash Contactor (EXT-204A). At EXT-203A, the strip solution exits the contactor bank containing essentially all of the Cs and is referred to as strip effluent.

The effectiveness of the strip solution at removing Cs is also related to the temperature of the solution. Cs removal is improved with higher temperatures. The temperature of the solvent and strip solution feed streams (see X-SD-J-00003[5]) is controlled (set point of 91°F). Each strip contactor has a heated water jacket to maintain process solutions at the appropriate temperature (approximately 91°F). The aqueous strip effluent stream containing essentially all of the Cs is gravity-fed to the Strip Effluent Stilling Tank (TK-212) to recover any entrained solvent.

The P-217A/B pump speed is controlled by the flow meter to the process. The flow control valve in the sample loop line is placed in a fixed position (configurable) which maintains flow through the sample loop when its associated pump is operating.

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

8-2. Strip Contactors Tempered Water Units Schematic

for schematics of the Strip Contactors Solvent Strip Feed Tempered Water Units and the Strip Contactors Tempered Water Units.

Figure 8-1. Strip Contactors Solvent Strip Feed Tempered Water Units Schematic

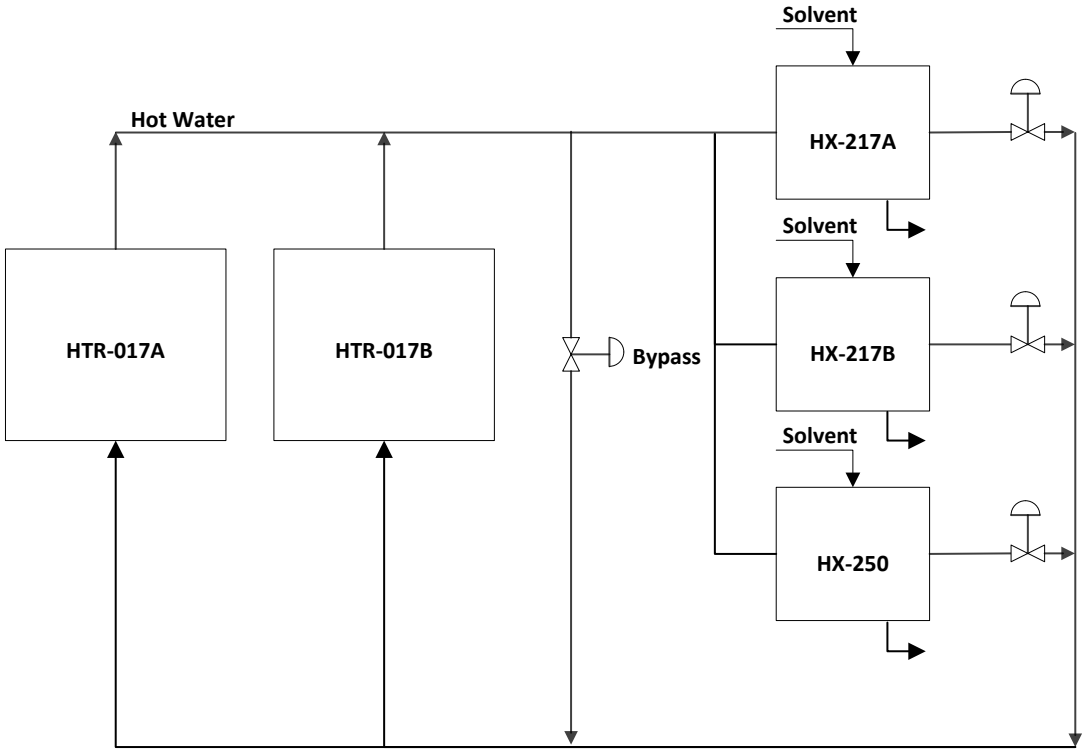
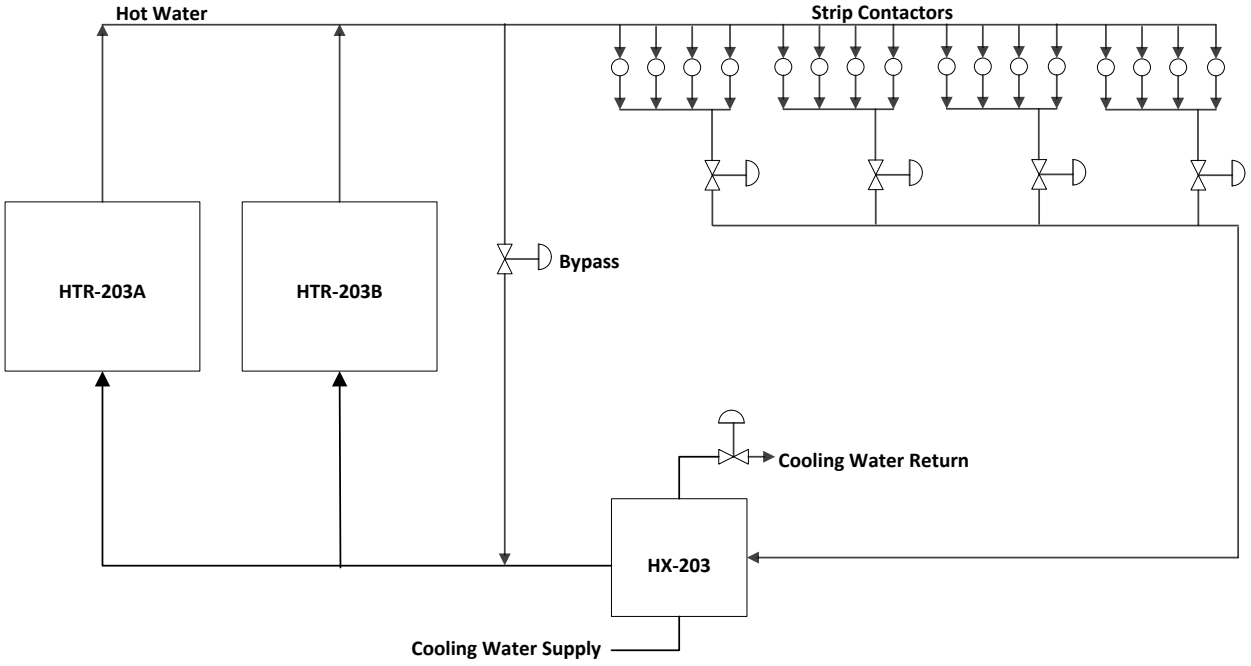


Figure 8-2. Strip Contactors Tempered Water Units Schematic



8.4.4 Off-Normal and Recovery Operation

Personnel entry into the Contactor Operating Deck may require the contactors and related equipment to be drained and flushed.

Personnel entry into the East CSSX Tank Cell is not expected.

Personnel entry into the P&VG labyrinth may require the Solvent Strip Feed Pump, Strip Effluent Pump Tank Pump, and related piping located in the labyrinth to be drained and flushed.

Contactor motor failure or high vibration indication will require CSSX System Shutdown. If failure of a contactor appears imminent (based on vibration, temperature, or other indicators), a controlled system shutdown will be performed.

Table 8-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 8-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
TCV failure (TV-2960 / TV-2966 / TV-2032 / TV-2042)	High or Low temperature alarm on contactor aqueous stream	Monitor solvent Cs content at exit of Pumps P-202A/B (SHT [TK-202]) and DSS Cs content at discharge of P-206A/B (BDT [TK-206]). Divert DSS stream to the SSFT (TK-109), if Cs content is trending out-of-spec.	Contactor bank cooling can be operated manually, using the TCV bypass valve until repairs are completed.
Contactor motor failure or vibration above normal (EXT-203A - P)	High vibration alarm (VI-9219 through VI-9234) Contactor motor fault (HIS-9219 through HIS-9234)	CSSX shutdown.	Complete repairs. The contactors may require flushing and draining prior to entry into the Contactor Operating Deck.
Solvent Strip Feed Tank Pump failure (P-217A/B)	Pump/Equipment status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Solvent Strip Feed Tank Pump Low Flow (P-217A/B)	Low flow alarm (FI-2153 / FI-2179)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping (and associated Strip Effluent Pump Tank Pump and associated piping) will be flushed and drained prior to P&VG labyrinth entry.

8.4.5 System Shutdown

In order to shut down the CSSX process, feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. The solvent flow, strip solution, and scrub solution flows are terminated.

See Section 4.4.5 for a detailed description of the Extraction Contactor System Shutdown, which includes a discussion of the strip contactors.

9.0 CAUSTIC WASH CONTACTORS, CAUSTIC WASH TANK (TK-204), AND PUMPS

9.1 System Functions

- The Caustic Wash Tank (TK-204) and Pumps supply caustic wash solution to the Caustic Wash Contactors (EXT-204A/B) (see P-DB-J-00003[14]).
- The purpose of the Caustic Wash Contactors is to remove impurities in the solvent with 0.01 – 0.3M NaOH and adjust the pH of any aqueous materials entrained in the solvent exiting the acidic strip stages (see P-DB-J-00003[14]).

9.2 Operational Overview

The CSSX Caustic Wash Contactors are a pair of centrifugal contactors that remove impurities in the solvent by contacting the solvent with 0.01 – 0.3M NaOH. Solvent feed to the system is gravity-fed from the last strip contactor (EXT-203P). The caustic wash solution flow rate (see X-SD-J-00003[5]) is controlled, based on an Operator-selected setpoint. The DCS is used to monitor the relative O/A ratio. The washed solvent gravity-drains to the SHT (TK-202).

9.3 Configuration Information

9.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 9-1.

Table 9-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0008	*SWPF Solvent Stripping and Caustic Wash PFD (U)*[200]
M-M6-J-0043 SH1	*SWPF Process Building Caustic Wash Contactors EXT-204A/B P&ID (U)*[315]
M-M6-J-0043 SH2	*SWPF Process Building Caustic Wash Tank TK-204 P&ID (U)*[316]
M-M6-J-0043 SH3	*SWPF Process Building Caustic Wash Pumps P-204A/B P&ID (U)*[317]

9.3.2 Major Components

See Table 9-2 for a list of major components.

Table 9-2. Major Components

Component	Description
Caustic Wash Tank (TK-204)	Stainless steel pressure vessel that provides a reservoir for the caustic wash solution. Capacity to Overflow: 500 gallons (see M-CLC-J-00047[214]) Dimensions: 4 ft (diameter) x 5 ft-9 inch (T/T) Design features: • The Caustic Wash Tank (TK-204) includes a solvent recovery weir and line to allow solvent removal and gravity-drain to the SDT (TK-208); • The Caustic Wash Tank (TK-204) is maintained under vacuum, with respect to the cell, for containment/confinement; • The Caustic Wash Tank (TK-204) includes an overflow line that enters the West CSSX Tank Cell Sump (SMP-206) below the liquid level; and • The Caustic Wash Tank (TK-204) is equipped with an air purge to prevent the accumulation of flammable vapors.
Caustic Wash Pumps (P-204A/B)	Positive displacement pumps with VFDs that provide a controlled caustic wash solution feed to the wash contactors. Alternate pathway is to the Laboratory, SDT (TK-208) (high-gamma wash solution), and DSS Stilling Tank (TK-211) (spent wash solution) Capacity: 10 gpm (see M-CLC-J-00100, *SWPF Caustic Wash Pumps Sizing Calculation, P-204A/B*[318]) hp: 2.0 Design features: • The Caustic Wash Pumps (P-204A/B) have drain and flush capability.

Table 9-2. Major Components (cont.)

Component	Description
Caustic Wash Contactors (EXT-204A/B)	Centrifugal contactors that continuously contact caustic wash solution (0.01 – 0.3M NaOH) and organic phase (process solvent) in a counter-current fashion. Centrifugal contactors are equipped with VFD motors for rotor speed control. Capacity: 12.0 gpm (hydraulic) hp: 10.0 Design features: • Each contactor is equipped with a VFD that allows the contactor to be started/stopped and speed of the rotor to be controlled by the DCS; • The Caustic Wash Contactors have a sleeve in the annular space to reduce the volume of the mixing zone. The sleeve also reduces the nominal hydraulic throughput. Each contactor can handle a hydraulic throughput of up to 12.0 gpm; • The contactors can be safely operated dry; • Each contactor is equipped with a system for CIP flushing of the rotor and inside of the housing; and • Each inter-stage line is vented to the process vessel vent header. This ensures that the solution gravity-drains from one stage to the next without creating pressure differentials between contactor stages. Proper venting of the gravity-drain system from one contactor to the next is essential for hydraulic operation of the contactors. Flush capability is provided for the vent piping. • Each contactor is equipped with a labyrinth seal to prevent process fluid contacting the rotor bearings. The labyrinth seal requires an air purge that is supplied from the Plant Air system. • Each contactor is equipped with a heavy phase weir for phase separation. The weir size for each contactor location is provided below. Process Location — Weir Size EXT-204A — 4.7-inch EXT-204B — 4.7-inch

9.3.3 Stream Data

See Table 9-3 for a listing of streams.

Table 9-3. Streams

Stream	Description
Caustic Wash Solution	Caustic wash solution is transferred to the Caustic Wash Contactors (EXT-204A/B) with the Caustic Wash Pumps (P-204A/B). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.01 – 0.3M NaOH concentration (M-CLC-J-00143[25])
Solvent	Solvent is gravity-fed to EXT-204A from the Strip Contactors (EXT-203P). Washed solvent is gravity-fed to the SHT (TK-202). Properties 0.85 s.g at 25 °C. (ORNL/TM-2002/204[52])
Spent Caustic Wash Solution	Spent caustic wash solution is transferred to the DSS Stilling Tank (TK-211) with the Caustic Wash Pumps (P-204A/B) Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.01 – 0.3M NaOH concentration (M-CLC-J-00143[25])

9.3.4 Physical Location and Layout

The Caustic Wash Contactors (EXT-204A/B) are located on the Contactor Operating Deck in the CPA.

The Caustic Wash Tank (TK-204) is located in the West CSSX Tank Cell in the CPA. The Caustic Wash Pumps (P-204A/B) are located in the CSSX P&VG area. Each pump is located in a separate gallery, along with a Solvent Feed Pump (P-202A/B) and a BDT Pump (P-206A/B). Piping is arranged for the system to gravity-drain to the Caustic Wash Pumps (P-204A/B).

9.3.5 System Control Features and Interlocks

9.3.5.1 System Monitoring

The Caustic Wash Contactors (EXT-204A/B), Caustic Wash Tank (TK-204), and Caustic Wash Pumps (P-204A/B) have instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The Caustic Wash Contactors (EXT-204A/B) have speed indication and vibration monitors with alarms to monitor the contactor operation. The Caustic Wash Contactor rotation speed is set by using the DCS speed controller. Each contactor is individually controlled. The caustic wash solution pH and temperature are monitored prior to the solution returning to the Caustic Wash Tank (TK-204). The pH of the caustic wash solution is used to determine when replacement of the solution is required.

The Caustic Wash Tank (TK-204) has a bubbler level instrument to monitor the level in the tank.

The Caustic Wash Pumps (P-204A/B) have instrumentation to monitor and control the pump speed. A magnetic flow meter is installed on the discharge side of pumps in order to monitor the flow rate from the Caustic Wash Tank (TK-204). Flow rate to the Caustic Wash Contactor (EXT-204B) is set by pump speed. A gamma monitor is provided to monitor the radiation level

in the caustic wash solution. Pump discharge is normally sent to EXT-204B (primary) or to the DSS Stilling Tank (TK-211) or the SDT (TK-208), using isolation valves. A portion of the pump discharge can be diverted to the laboratory for sampling, using an isolation valve (see X-SD-J-00006[8]).

See Table 9-4 for a listing of instruments.

Table 9-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-204A	M-M6-J-0043 SH3[317]	N/A	Pump Status	Run/Off
P-204B	M-M6-J-0043 SH3[317]	N/A	Pump Status	Run/Off
SC-2018	M-M6-J-0043 SH3[317]	J-JZ-J-01109, *SWPF SIC-2018 Caustic Wash Tank Pump B Speed*[319]	P-204B Speed	0 – 100%
FE-2018	M-M6-J-0043 SH3[317]	J-JZ-J-00438, *SWPF FIC-2018 Caustic Wash Tank Pump B Flow*[320]	Flow rate (P-204B main)	gpm
FV-2018	M-M6-J-0043 SH3[317]	J-JZ-J-00438[320]	Valve Position	0-100% Open
HV-2061	M-M6-J-0043 SH1[315]	N/A	Solvent Weir Valve Position	Open/Closed
TE-2062	M-M6-J-0043 SH1[315]	J-JZ-J-00427, *SWPF TI-2062 EXT-204A/B Caustic Wash Temp*[321]	Aqueous stream temperature at exit of EXT-204A	°F
AE-2068	M-M6-J-0043 SH1[315]	J-JZ-J-00424, *SWPF AI-2068 EXT-204A/B Caustic Wash pH*[322]	Aqueous stream pH at exit of EXT-204A	pH
SC-9235	M-M6-J-0043 SH1[315]	N/A	Contactor Speed (EXT-204A)	rpm
SE-9235	M-M6-J-0043 SH1[315]	N/A	Contactor Speed (EXT-204A)	rpm
VE-9235	M-M6-J-0043 SH1[315]	J-JZ-J-00436, *SWPF VA-9235 EXT-204A Vibration*[323]	Vibration (EXT-204A)	Cycles/second Inches/second
TE-9235A	M-M6-J-0043 SH1[315]	J-JZ-J-00428, *SWPF TI-9235A EXT-204A Motor Top Bearing Temp*[324]	Motor Top bearing temperature	°F
TE-9235B	M-M6-J-0043 SH1[315]	J-JZ-J-00430, *SWPF TI-9235B EXT-204A Motor Bot Bearing Temp*[325]	Motor Bottom bearing temperature	°F
TE-9235C	M-M6-J-0043 SH1[315]	J-JZ-J-00432, *SWPF TI-9235C EXT-204A Rotor Top Bearing Temp*[326]	Rotor Top bearing temperature	°F
TE-9235D	M-M6-J-0043 SH1[315]	J-JZ-J-00434, *SWPF TI-9235D EXT-204A Rotor Bottom Bearing Temp*[327]	Rotor Bottom bearing temperature	°F
SC-9236	M-M6-J-0043 SH1[315]	N/A	Contactor Speed (EXT-204B)	rpm

Table 9-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SE-9236	M-M6-J-0043 SH1[315]	N/A	Contactor Speed (EXT-204B)	rpm
VE-9236	M-M6-J-0043 SH1[315]	J-JZ-J-00437, *SWPF VA-9236 EXT-204B Vibration*[328]	Vibration (EXT-204B)	Cycles/second Inches/second
TE-9236A	M-M6-J-0043 SH1[315]	J-JZ-J-00429, *SWPF TI-9236A EXT-204B Motor Top Bearing Temp*[329]	Motor Top bearing temperature	°F
TE-9236B	M-M6-J-0043 SH1[315]	J-JZ-J-00431, *SWPF TI-9236B EXT-204B Motor Bottom Bearing Temp*[330]	Motor Bottom bearing temperature	°F
TE-9236C	M-M6-J-0043 SH1[315]	J-JZ-J-00433, *SWPF TI-9236C EXT-204B Rotor Top Bearing Temp*[331]	Rotor Top bearing temperature	°F
TE-9236D	M-M6-J-0043 SH1[315]	J-JZ-J-00435, *SWPF TI-9236D EXT-204B Rotor Bottom Bearing Temp*[332]	Rotor Bottom bearing temperature	°F
LIT-2071	M-M6-J-0043 SH2[316]	J-JZ-J-0024, *SWPF LI-2071 Caustic Wash Tank Level*[333]	Caustic Wash Tank (TK-204) Level	Gallons
HV-2072	M-M6-J-0043 SH3[317]	N/A	P-204A Isolation Valve Position	Open/Closed
HV-2073	M-M6-J-0043 SH3[317]	N/A	Valve Position (P-204B divert to SDT (TK-208))	Open/Closed
HV-2074	M-M6-J-0043 SH3[317]	N/A	P-204B Isolation Valve Position	Open/Closed
FE-2075	M-M6-J-0043 SH3[317]	J-JZ-J-00440, *SWPF FIC-2075 Caustic Wash Tank Pump B Sample Flow*[334]	Flow rate (P-204B to Laboratory)	gpm
FV-2075	M-M6-J-0043 SH3[317]	J-JZ-J-00440[334]	Valve Position	0-100% Open
HV-2076	M-M6-J-0043 SH3[317]	N/A	Drain Valve Position	Open/Closed
HV-2077	M-M6-J-0043 SH3[317]	N/A	Drain Valve Position	Open/Closed
HV-2078	M-M6-J-0043 SH3[317]	N/A	Drain Valve Position	Open/Closed
HV-2079	M-M6-J-0043 SH3[317]	N/A	Valve Position	A-C/B-C/ Intermediate Off position

Table 9-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
SC-2080	M-M6-J-0043 SH3[317]	J-JZ-J-01110, *SWPF SIC-2080 Caustic Wash Tank Pump A Speed*[335]	P-204A Speed	0 – 100%
FE-2080	M-M6-J-0043 SH3[317]	J-JZ-J-00439, *SWPF FIC-2080 Caustic Wash Tank Pump A Flow*[336]	Flow rate (P-204A main)	gpm
FV-2080	M-M6-J-0043 SH3[317]	J-JZ-J-00439[336]	Valve Position	0-100% Open
RE-2082	M-M6-J-0043 SH3[317]	J-JZ-J-00442, *SWPF RI-2082 Caustic Wash Pump A Cs Concentration*[337]	Caustic wash stream gamma level (P-204A)	^{137}Cs Ci/gal
HV-2083	M-M6-J-0043 SH3[317]	N/A	Drain Valve Position	Open/Closed
FE-2084	M-M6-J-0043 SH3[317]	J-JZ-J-00441, *SWPF FIC-2084 Caustic Wash Pump A Sample Flow*[338]	Flow rate (P-204A to Laboratory)	gpm
FV-2084	M-M6-J-0043 SH3[317]	J-JZ-J-00441[338]	Valve Position	0-100% Open
HV-2085	M-M6-J-0043 SH3[317]	N/A	Valve Position (P-204A divert to SDT (TK-208))	Open/Closed
HV-2086	M-M6-J-0043 SH3[317]	N/A	Valve Position	A-C/B-C/ Intermediate Off position
RE-2089	M-M6-J-0043 SH3[317]	J-JZ-J-00443, *SWPF RI-2089 Caustic Wash Pump B Cs Concentration*[339]	Caustic wash stream gamma level (P-204B)	^{137}Cs Ci/gal
VE-9251B/C	M-M6-J-0043 SH3[317]	N/A	P-204A Vibration	Cycles/second Inches/sec
VE-9256B/C	M-M6-J-0043 SH3[317]	N/A	P-204B Vibration	Cycles/second Inches/sec
HV-2060	M-M6-J-0043 SH1[315]	N/A	pH Loop Drain Valve Position	Open/Closed
PIT-2016	M-M6-J-0043 SH3[317]	N/A	P-204A Discharge pressure	psig
PIT-2017	M-M6-J-0043 SH3[317]	N/A	P-204B Discharge pressure	psig

9.3.5.2 Control Functions

See Table 9-5 for a listing of control loops.

Table 9-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
FIC-2018	M-M6-J-0043 SH3[317]	J-JZ-J-00438[320]	P-204B Discharge flow rate	Operator-entered
FIC-2080	M-M6-J-0043 SH3[317]	J-JZ-J-00439[336]	P-204A Discharge flow rate	Operator-entered
SIC-2018	M-M6-J-0043 SH3[317]	J-JZ-J-01109[319]	P-204A Pump Speed/Pump flow rate	Operator-entered, manual operation
SIC-2080	M-M6-J-0043 SH3[317]	J-JZ-J-01110[335]	P-204B Pump Speed/Pump flow rate	Operator-entered, manual operation
FIC-2084	M-M6-J-0043 SH3[317]	J-JZ-J-00441[338]	P-204A Discharge flow rate to Laboratory	Operator-entered
FIC-2075	M-M6-J-0043 SH3[317]	J-JZ-J-00440[334]	P-204B Discharge flow rate to Laboratory	Operator-entered

9.4 Operations

9.4.1 Initial Configuration

The Caustic Wash Contactors are drained, flushed, and not operating. The Caustic Wash Tank (TK-204) is empty.

9.4.2 System Startup

NaOH (0.3M) is transferred into the Caustic Wash Tank (TK-204) from the Caustic Make-up Tank (TK-303) and diluted with deionized (DI) water (0.01 – 0.3M NaOH) as needed (see X-SD-J-00003[5]). The Caustic Wash Contactors (EXT-204A/B) are started and caustic wash solution flow is established by using the P-204A/B pumps. The CSSX process then starts up, with Pump P-109A or B feeding DSS to the Extraction Contactors EXT-201A/P.

See Section 4.4.2 for a detailed description of the Extraction Contactor System Startup, which includes a discussion of the Caustic Wash Contactors.

9.4.3 Normal Operations

The Caustic Wash Tank (TK-204) supplies caustic wash solution to the wash contactors (EXT-204A/B). The caustic wash solution is contacted counter-current with stripped solvent in the centrifugal contactors. The suppressant and modifier contained in the solvent degrade over time. The suppressant (TOA) forms dioctylamine and the modifier (Cs-7SB) forms a phenolic compound. The caustic wash stage is intended to remove these decomposition products and other impurities to maintain performance of the solvent. A wash solution concentration of 0.01 – 0.3M NaOH was chosen because the concentration is effective at removing organic acids (see WSRC-

RP-99-00006[137] and P-RPT-J-00020, *SWPF Test Report: Cross-flow Filter and Caustic-Side Solvent Extraction Integrated Test*[340]). The caustic wash supply will be from TK-303 (0.3M NaOH). The operating caustic wash pump (P-204A/B) will operate at a flow control set point (nominal O/A ratio of 2.5:1). This corresponds to a nominal solvent flow rate of 7.2 gpm and a caustic wash flow rate of 3.0 gpm. After contacting the solvent, the caustic wash solution gravity-flows back to the Caustic Wash Tank (TK-204).

The pH of the caustic wash solution will gradually decrease during operation, due to acid carryover from the strip section. When the caustic wash solution from the wash contactors indicates a low pH (value to be determined during Commissioning), the tank contents are transferred to the AFF via the DSS Stilling Tank (TK-211). If the caustic wash solution from the wash contactors indicates a high gamma activity (value to be determined during Commissioning), the tank contents are transferred to the SDT (TK-208). In either case, the contents of the Caustic Wash Tank (TK-204) are purged and the Caustic Wash Tank (TK-204) is refilled with fresh caustic wash solution from the Caustic Make-up Tank (TK-303) at 0.3M NaOH and diluted with DI water, as required. The CSSX System will normally continue to operate (without caustic wash solution flow) during the purge and re-fill operation.

The P-204A/B pump speed is controlled by the flow meter to the process. The flow control valve in the sample loop line is placed in a fixed position (configurable) which maintains flow through the sample loop when its associated pump is operating.

See Section 4.4.3 for a detailed description of the CSSX Normal Operation, which includes a discussion of the Caustic Wash Contactors.

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

9.4.4 Off-Normal and Recovery Operation

Personnel entry into the Contactor Operating Deck may require the contactors and related equipment to be drained and flushed.

The Caustic Wash Tank (TK-204) includes a solvent recovery weir and line to allow solvent removal and gravity-drain to the SDT (TK-208). In order to perform a solvent recovery operation, the level in the Caustic Wash Tank (TK-204) is raised slowly by adding fresh caustic wash solution or flushwater. The fluid in the Caustic Wash Tank (TK-204) will flow over the solvent recovery overflow weir and gravity-drain to the SDT (TK-208). The fluid will be allowed to flow to the SDT (TK-208) until the available solvent is recovered. Then, the addition of liquid to the Caustic Wash Tank (TK-204) is terminated. The Caustic Wash Tank (TK-204) level is returned to within the normal operating range by purging some caustic wash solution to the SDT (TK-208) or the DSS Stilling Tank (TK-211), depending on the gamma radiation level of the caustic wash solution.

Personnel entry into the West CSSX Tank Cell may require the BDT (TK-206), Caustic Wash Tank (TK-204), SHT (TK-202), Strip Effluent Coalescer (TK-203), Strip Effluent Coalescer Feed Pumps (P-212A/B) and related equipment to be flushed and drained.

Personnel entry into the P&VG labyrinth may require the BDT Pump, Caustic Wash Pump, Solvent Feed Pump, and related piping located in the labyrinth to be drained and flushed.

Table 9-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 9-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Contactor motor failure or vibration above normal (EXT-204A/B)	High vibration alarm (VI-9235 / VI-9236) Contactor motor fault (HIS-9235 / HIS-9236)	Controlled shutdown of the CSSX process.	Complete repairs.
Caustic Wash Pump failure (P-204A/B)	Pump status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Caustic Wash Pump Low Flow (P-204A/B)	Low flow alarm (FI-2080 / FI-2018)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping (and associated BDT Pump and the Solvent Feed Pump piping) may need to be flushed and drained prior to P&VG labyrinth entry.

9.4.5 System Shutdown

In order to shut down the CSSX process, the feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. The solvent flow, scrub solution, strip solution, and caustic wash solution flows are terminated.

See Section 4.4.5 for a detailed description of the CSSX System Shutdown.

10.0 STRIP EFFLUENT SOLVENT RECOVERY

10.1 System Functions

- The general purpose of the Strip Effluent Solvent Recovery System is to recover solvent from the strip effluent, prior to its transfer to the SEHT (TK-205) (see P-DB-J-00003[14]).

10.2 Operational Overview

Strip effluent from the strip stages passes through the Strip Effluent Stilling Tank (TK-212) to remove gross amounts of solvent. The solvent recovered from the strip effluent flows to the SDT (TK-208) and the strip effluent is pumped to the Strip Effluent Coalescer (TK-203) using the

Strip Effluent Coalescer Feed Pumps (P-212A/B). The strip effluent may gravity flow to the Strip Effluent Coalescer (TK-203), when the coalescer media dP is low.

The Strip Effluent Coalescer (TK-203) is used to remove trace amounts of solvent from the strip effluent. The solvent recovered from the strip effluent flows to the SDT (TK-208), and the strip effluent flows to the Strip Effluent Pump Tank (TK-215).

The Strip Effluent Pump Tank Pumps (P-215A/B) transfer strip effluent to the SEHT (TK-205). An alternate pathway is provided to the laboratory for sampling and analysis.

10.3 Configuration Information

10.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 10-1.

Table 10-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0008	*SWPF Solvent Stripping and Caustic Wash PFD (U)*[200]
M-M6-J-0122 SH1	*SWPF Process Building Strip Effluent Stilling Tank TK-212 P&ID (U)*[341]
M-M6-J-0122 SH2	*SWPF Process Building Strip Effluent Pump Tank TK-215 P&ID (U)*[342]
M-M6-J-0123	*SWPF Process Building Strip Effluent Pump Tank Pumps P-215A/B P&ID (U)*[343]

10.3.2 Major Components

See Table 10-2 for a list of major components.

Table 10-2. Major Components

Component	Description
Strip Effluent Stilling Tank (TK-212)	Stainless steel pressure vessel that receives strip effluent from the strip contactors and provides a mechanism for solvent recovery. Capacity: 29 gallons (see M-CLC-J-00063[144]) Dimensions: 1 ft (diameter) x 6 ft T/T Design features: • A solvent recovery line is provided to direct solvent to the SDT (TK-208); • Strip Effluent Stilling Tank (TK-212) is maintained under vacuum, with respect to the cell, for containment / confinement; and • Strip Effluent Stilling Tank (TK-212) includes an air purge to dilute flammable vapors.
Strip Effluent Coalescer Feed Pumps (P-212A/B)	Positive displacement pumps with VFDs that transfer the Strip Effluent to the Strip Effluent Coalescer (TK-203). Capacity: 5 gpm hp: 1.0 Design features: The Strip Effluent Coalescer Feed Pumps (P-212A/B) have drain and flush capability.
Strip Effluent Coalescer (TK-203)	Stainless steel pressure vessel that uses media to allow some of the entrained solvent to coalesce. The solvent is sent to the SDT (TK-208). Dimensions: 1 ft (diameter) x 9 ft 1 in Top/T Design features: • A solvent recovery line is provided to direct solvent to the SDT (TK-208); • Strip Effluent Coalescer (TK-203) is maintained under vacuum, with respect to the cell, for containment / confinement; • Strip Effluent Coalescer (TK-203) includes an air purge to dilute flammable vapors; and • Strip Effluent Coalescer (TK-203) includes removable coalescing media. • The media is 1 element with a 3-micron pore size. The element is 1,000 mm in length and 120 mm in diameter.
Strip Effluent Pump Tank (TK-215)	Stainless steel pressure vessel that receives strip effluent from the Strip Effluent Stilling Tank (TK-212). Capacity: 50 gallons (see M-CLC-J-00047[214].) Capacity to Overflow: 60 gallons (see M-CLC-J-00047[214]) Dimensions: 1 ft-6 inch (diameter) x 4 ft-11 inch T/T Design features: • The Strip Effluent Pump Tank (TK-215) is maintained under vacuum, with respect to the cell, for containment / confinement; • The Strip Effluent Pump Tank (TK-215) includes an overflow line that enters the East CSSX Tank Cell Sump (SMP-217) below the liquid level; and • The Strip Effluent Pump Tank (TK-215) includes an air purge to dilute flammable vapors.

Table 10-2. Major Components **(cont.)**

Component	Description
Strip Effluent Pump Tank Pumps (P-215A/B)	Positive displacement pumps with VFDs that transfer the Strip Effluent to the SEHT (TK-205). Alternate pathways are to the Laboratory for sampling. Capacity: 10 gpm (see M-CLC-J-00114, *SWPF Strip Effluent Pump Tank Pumps Sizing Calculation, P-215A/B*[344]) hp: 2.0 Design features: • The Strip Effluent Pump Tank Pumps (P-215A/B) have drain and flush capability.

10.3.3 Stream Data

See Table 10-3 for a listing of streams.

Table 10-3. Streams

Stream	Description
Strip Effluent Solution	Strip effluent solution is received in the Strip Effluent Stilling Tank (TK-212) from EXT-203A. Strip effluent is gravity-fed from the Strip Effluent Coalescer (TK-203) to the Strip Effluent Pump Tank (TK-215) and pumped to the SEHT (TK-205). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.001M HNO_3 concentration (M-CLC-J-00143[25])
Solvent	Solvent is gravity-fed from the Strip Effluent Stilling Tank (TK-212) and the Strip Effluent Coalescer (TK-203) to the SDT (TK-208). Properties 0.85 s.g. at 25 °C (ORNL/TM-2002/204[52])

10.3.4 Physical Location and Layout

The Strip Effluent Stilling Tank (TK-212) and Strip Effluent Coalescer (TK-203) are located in the East CSSX Tank Cell. The head of the Strip Effluent Coalescer (TK-203) is located in and accessible from the West CSSX Tank Cell. A platform is provided in the West CSSX Tank Cell to support media removal activities.

The Strip Effluent Coalescer Feed Pumps (P-212A/B) are located in the West CSSX Tank Cell.

The Strip Effluent Pump Tank (TK-215) is located in the East CSSX Tank Cell. The Strip Effluent Pump Tank Pumps (P-215A/B) are located in the CSSX P&VG area. An automatic and a manual valve are located at the labyrinth wall to separate the tank and pumps. The piping is arranged for the system to gravity-drain to the Strip Effluent Pump Tank Pumps (P-215A/B). Each pump is located in a separate gallery, along with a Solvent Strip Feed Pump (P-217 A/B).

10.3.5 System Control Features and Interlocks

10.3.5.1 System Monitoring

The Strip Effluent Solvent Recovery System has instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The Strip Effluent Stilling Tank (TK-212) has a bubbler level instrument to monitor the level in the stilling section of the tank. A second bubbler level instrument is used to monitor the level downstream of the overflow weir. This level instrument is used to control the speed for the Strip Effluent Coalescer Feed Pumps (P-212A/B).

The Strip Effluent Coalescer (TK-203) has a bubbler level instrument to monitor the level in the tank. The Strip Effluent Coalescer (TK-203) has a pressure differential instrument to monitor the coalescer media for plugged.

The Strip Effluent Pump Tank (TK-215) has a bubbler level instrument to monitor the level in the tank. The level indication is used to control the speed of the Strip Effluent Pump Tank Pump.

The Strip Effluent Pump Tank Pumps (P-215A/B) have instrumentation to monitor and control the pump speed. When the Strip Effluent Pump Tank Pumps (P-215A/B) are enabled, a level controller is used to control the speed of the pumps to maintain the level in Strip Effluent Pump Tank (TK-215) within a control band. A magnetic flow meter is installed on the discharge side of pumps, in order to monitor the flow rate from the Strip Effluent Pump Tank (TK-215). A radiation monitor (gamma) is provided to monitor the radiation level in the strip effluent solution. Pump discharge is sent to the SEHT (TK-205). A portion of the pump discharge can be diverted to the laboratory for sampling, using an isolation valve (see X-SD-J-00006[8]).

See Table 10-4 for a listing of instruments.

Table 10-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-215A	M-M6-J-0123[343]	N/A	Pump Status	Run/Off
P-215B	M-M6-J-0123[343]	N/A	Pump Status	Run/Off
P-212A	M-M6-J-0122 SH1[341]	N/A	Pump Status	Run/Off
P-212B	M-M6-J-0122 SH1[341]	N/A	Pump Status	Run/Off
SC-2268A	M-M6-J-0122 SH1[341]	J-JZ-J-01126, *SWPF SIC-2268A Strip Effluent Coalescer Feed Pump A Speed*[345]	P-212A Speed	0 – 100%
SC-2268B	M-M6-J-0122 SH1[341]	J-JZ-J-01127, *SWPF SIC-2268B Strip Effluent Coalescer Feed Pump B Speed*[346]	P-212B Speed	0 – 100%

Table 10-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
PIT-2023	M-M6-J-0122 SH1[341]	N/A	P-212A/B Discharge pressure	psig
PDIT-2049	M-M6-J-0122 SH2[342]	J-JZ-J-00616, *SWPF PDI-2049 Strip Effluent Coalescer Media dP*[347]	Strip Effluent Coalescer (TK-203) media dP	Inches water vacuum
FE-2057	M-M6-J-0123[343]	J-JZ-J-00617, *SWPF FIC-2057 SEPT Pump A Sample Flow*[348]	Flow rate to Laboratory (P-215A)	gpm
FV-2057	M-M6-J-0123[343]	J-JZ-J-00617[348]	Valve Position	0-100% Open
FE-2065	M-M6-J-0123[343]	J-JZ-J-00618, *SWPF FIC-2065 SEPT Pump B Sample Flow*[349]	Flow rate to Laboratory (P-215B)	gpm
FV-2065	M-M6-J-0123[343]	J-JZ-J-00618[349]	Valve Position	0-100% Open
LIT-2100	M-M6-J-0122 SH2[342]	J-JZ-J-0048, *SWPF LIC-2100 Strip Effluent Pump Tank Level*[350]	Strip Effluent Pump Tank (TK-215) level	Gallons
SC-2100A	M-M6-J-0123[343]	J-JZ-J-01114, *SWPF SIC-2100A SEPT Pump A Speed*[351]	P-215A Speed	0 – 100%
SC-2100B	M-M6-J-0123[343]	J-JZ-J-01115, *SWPF SIC-2100B SEPT Pump B Speed*[352]	P-215B Speed	0 – 100%
HV-2101	M-M6-J-0123[343]	N/A	P-215A Isolation Valve Position	Open/Closed
HV-2102	M-M6-J-0123[343]	N/A	P-215B Isolation Valve Position	Open/Closed
HV-2103	M-M6-J-0123[343]	N/A	Drain Valve position	Open/Closed
HV-2104	M-M6-J-0123[343]	N/A	Drain Valve Position	Open/Closed
LIT-2106	M-M6-J-0122 SH1[341]	J-JZ-J-0042, *SWPF LI-2106 Strip Effluent Stilling Tank Level*[353]	Strip Effluent Stilling Tank (TK-212) level	Gallons
HV-2107	M-M6-J-0123[343]	N/A	Drain Valve Position	Open/Closed
HV-2108	M-M6-J-0123[343]	N/A	Drain Valve Position	Open/Closed
FE-2109	M-M6-J-0123[343]	J-JZ-J-00619, *SWPF FIC-2109 SEPT Pump A Flow*[354]	Flow rate (P-215A discharge)	gpm, total gallons
FV-2109	M-M6-J-0123[343]	J-JZ-J-00619[354]	Valve Position	0-100% Open

Table 10-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
LIT-2110	M-M6-J-0122 SH1[341]	J-JZ-J-0043, *SWPF LI-2110 Strip Effluent Stilling Tank Level*[355]	Strip Effluent Stilling Tank (TK-212) level	Gallons
LIT-2111	M-M6-J-0122 SH2[342]	J-JZ-J-0023, *SWPF LI-2111 Strip Effluent Coalescer Level*[356]	Strip Effluent Coalescer (TK-203) level	Gallons
RE-2214	M-M6-J-0123[343]	J-JZ-J-00621, *SWPF RI-2214 Strip Effluent Pump B Cs Concentration*[357]	Strip Effluent stream gamma level (P-215B)	^{137}Cs Ci/gal
RE-2217	M-M6-J-0123[343]	J-JZ-J-00622, *SWPF RI-2217 Strip Effluent Pump A Cs Concentration*[358]	Strip Effluent stream gamma level (P-215A)	^{137}Cs Ci/gal
FE-2221	M-M6-J-0123[343]	J-JZ-J-00620, *SWPF FIC-2221 SEPT Pump B Flow*[359]	Flow rate (P-215B discharge)	gpm, total gallons
FV-2221	M-M6-J-0123[343]	J-JZ-J-00620[359]	Valve Position	0-100% Open
LIT-2224	M-M6-J-0122 SH2[342]	J-JZ-J-00893, *SWPF LI-2224 Strip Effluent Coalescer Drain Header Loop Seal Level*[360]	Solvent Line trap level	inches
HV-2246	M-M6-J-0122 SH1[341]	N/A	P-212A Isolation Valve Position	Open/Closed
HV-2251	M-M6-J-0122 SH1[341]	N/A	Drain Valve Position	Open/Closed
HV-2252	M-M6-J-0122 SH1[341]	N/A	Drain Valve Position	Open/Closed
HV-2259	M-M6-J-0122 SH1[341]	N/A	P-212B Isolation Valve Position	Open/Closed
HV-2265	M-M6-J-0122 SH1[341]	N/A	Drain Valve Position	Open/Closed
HV-2266	M-M6-J-0122 SH1[341]	N/A	Drain Valve Position	Open/Closed
HV-2271	M-M6-J-0122 SH1[341]	N/A	P-212A/B Discharge Isolation Valve Position	A-C/B-C/ Intermediate Off position
HV-2267	M-M6-J-0122 SH1[341]	N/A	Bypass Valve Position	Open/Closed
VE-9260B/C/D	M-M6-J-0123[343]	N/A	P-215A Vibration	Cycles/second Inches/sec
VE-9262B/C/D	M-M6-J-0123[343]	N/A	P-215B Vibration	Cycles/second Inches/sec

Table 10-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
VE-9280B/C	M-M6-J-0122 SH1[341]	N/A	P-212A Vibration	Cycles/second Inches/sec
VE-9281B/C	M-M6-J-0122 SH1[341]	N/A	P-212B Vibration	Cycles/second Inches/sec
PIT-2006	M-M6-J-0123[343]	J-JZ-J-01176, *SWPF PI-2006 SEPT Pump A Disch Pressure*[361]	P-215A Discharge Pressure	psig
PIT-2007	M-M6-J-0123[343]	J-JZ-J-01177, *SWPF PI-2007 SEPT Pump B Disch Pressure*[362]	P-215B Discharge Pressure	psig

10.3.5.2 Control Functions

See Table 10-5 for a listing of control loops.

Table 10-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
FIC-2057	M-M6-J-0123[343]	J-JZ-J-00617[348]	P-215A discharge flow rate to laboratory	Operator-entered
FIC-2065	M-M6-J-0123[343]	J-JZ-J-00618[349]	P-215B discharge flow rate to laboratory	Operator-entered
LIC-2100A	M-M6-J-0122 SH2[342]	J-JZ-J-0048[350]	Strip Effluent Pump Tank (TK-215) well Level	Operator-entered
LIC-2100B	M-M6-J-0122 SH2[342]	N/A	Strip Effluent Pump Tank (TK-215) well Level	Operator-entered
LIC-2106A	M-M6-J-0122 SH1[341]	J-JZ-J-0042[353]	Strip Effluent Stilling Tank (TK-212) Level	Operator-entered
LIC-2106B	M-M6-J-0122 SH1[341]	N/A	Strip Effluent Stilling Tank (TK-212) Level	Operator-entered
SIC-2268A	M-M6-J-0122 SH1[341]	J-JZ-J-01126, *SWPF SIC-2268A Strip Effluent Coalescer Feed Pump A Speed*[363]	P-212A Pump Speed/Pump flow rate	Operator-entered

Table 10-5. Control Loops (cont.)

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
SIC-2268B	M-M6-J-0122 SH1[341]	J-JZ-J-01127[346]	P-212B Pump Speed/Pump flow rate	Operator-entered
SIC-2100A	M-M6-J-0123[343]	J-JZ-J-01114[351]	P-215A Pump Speed/Pump flow rate	Operator-entered
SIC-2100B	M-M6-J-0123[343]	J-JZ-J-01115[352]	P-215B Pump Speed/Pump flow rate	Operator-entered

10.4 Operations

10.4.1 Initial Configuration

The Strip Effluent Stilling Tank (TK-212), Strip Effluent Coalescer (TK-203), and Strip Effluent Pump Tank (TK-215) are empty. The Strip Effluent Pump Tank Pumps are off.

10.4.2 System Startup

Strip effluent from the Strip Contactors (EXT-203A/P) is gravity-fed to the Strip Effluent Stilling Tank (TK-212). The strip effluent solution is the Cs-containing aqueous stream that exits Stripping Contactor EXT-203A. The CSSX System is operated until an inventory is established in the Strip Effluent Stilling Tank (TK-212) and the Strip Effluent Coalescer (TK-203) (level increases until the strip effluent overflows the aqueous weirs). The aqueous stream exiting the Strip Effluent Stilling Tank (TK-212) normally gravity flows to the Strip Effluent Coalescer (TK-203). When the level downstream of the overflow weir in the Strip Effluent Stilling Tank (TK-212) exceeds a setpoint (indicating an increased dP at the Strip Effluent Coalescer (TK-203) media), P-212A/B will be used to pump this aqueous stream. The aqueous stream from the Strip Effluent Coalescer (TK-203) gravity-flows to the Strip Effluent Pump Tank (TK-215). The Strip Effluent Pump Tank Pumps (P-215A/B) are started at a flow rate to maintain a constant level in the Strip Effluent Pump Tank (TK-215) (the pump-out rate is approximately the same as the strip solution feed to the strip contactors, 1.4 gpm). The Strip Effluent Pump Tank Pumps (P-215A/B) transfer the strip effluent solution into the SEHT (TK-205).

See Section 4.4.2 for a detailed description of the CSSX System Startup.

10.4.3 Normal Operations

The Strip Effluent Stilling Tank (TK-212) receives strip effluent from the CSSX process (EXT-203A). Small amounts of solvent are entrained with the aqueous phase from the strip stages. In the Strip Effluent Stilling Tank (TK-212), the heavier aqueous phase underflows a baffle, overflows a weir, and gravity-drains to the Strip Effluent Coalescer (TK-203). The lighter

solvent phase gravity-drains via a standpipe to the SDT (TK-208). The Strip Effluent Stilling Tank (TK-212) is primarily intended to remove gross amounts of solvent. The stilling tank provides separation of the aqueous and organic phases and prevents large quantities of solvent from entering the Strip Effluent Coalescer (TK-203) in the event of a process upset. When the level downstream of the overflow weir in the Strip Effluent Stilling Tank (TK-212) exceeds a setpoint (indicating an increased dP at the Strip Effluent Coalescer (TK-203) media), P-212A/B will be used to pump this aqueous stream.

The Strip Effluent Coalescer (TK-203) recovers solvent with installed coalescing media. A portion of the entrained solvent will coalesce on the media surface and separate from the aqueous. The efficiency of the entrained solvent recovery is dependent on the size of the entrained solvent particles, the difference in the solvent and aqueous densities, and the flow rate through the coalescer (speed of fluid movement). In the coalescer, the heavier aqueous phase underflows a baffle, overflows a weir, and gravity-drains to the Strip Effluent Pump Tank (TK-215). The lighter solvent phase gravity-drains via a standpipe to the SDT (TK-208). This drain line includes a loop seal with level indication. In the strip contactors, the Cs is stripped from the solvent by the strip solution. The ^{137m}Ba (decay product of ^{137}Cs) is not extracted in the extraction section. The ^{137m}Ba is used to measure ^{137}Cs concentration via gamma activity. This requires that the ^{137m}Ba and ^{137}Cs be in equilibrium. Over time, the ^{137}Cs and ^{137m}Ba will re-establish an equilibrium state. The Strip Effluent Pump Tank (TK-215) provides some residence time for the ^{137m}Ba in-growth to occur.

The Strip Effluent Pump Tank (TK-215) is provided with a level detector that provides a control signal to adjust the Strip Effluent Pump Tank Pump (P-215A/B) speed to maintain the tank level set point. One of the two Strip Effluent Pump Tank Pumps (P-215A/B) is used to transfer the strip effluent to the SEHT (TK-205), where it is stored pending transfer to DWPF. An in-line gamma monitor is installed downstream of the pumps to monitor the ^{137}Cs daughter product ^{137m}Ba concentration. The gamma monitors are used to monitor the approximate Cs content of the strip effluent in order to ensure that the maximum limit is not exceeded (e.g., shielding basis, H_2 generation basis). The reading is approximate since sufficient time has not passed for the ^{137m}Ba and ^{137}Cs to be in equilibrium.

The P-215A/B pump speed is controlled by the flow meter to the process. The flow control valve in the sample loop line is placed in a fixed position (configurable) which maintains flow through the sample loop when its associated pump is operating.

The process sequences for the CSSX system are included in Section 4.0 of X-PCD-J-00001[39].

10.4.4 Off-Normal and Recovery Operation

Personnel entry into the East CSSX Tank Cell is not expected.

Personnel entry into the West CSSX Tank Cell may require the BDT (TK-206), Caustic Wash Tank (TK-204), SHT (TK-202), Strip Effluent Coalescer (TK-203), Strip Effluent Coalescer Feed Pumps (P-212A/B) and related equipment to be flushed and drained.

Personnel entry into the P&VG labyrinth will require the Strip Effluent Pump Tank Pump, Solvent Strip Feed Pump, and related piping located in the labyrinth to be drained and flushed.

Table 10-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 10-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Strip Effluent Stilling Tank (TK-212) discharge aqueous line plugged	Increase in the SDT (TK-208) level	Shut down CSSX process	Chemical cleaning of the Strip Effluent Stilling Tank (TK-212).
Strip Effluent Coalescer Feed Pump failure (P-212A/B)	Pump/Equipment status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Strip Effluent Pump Tank pump failure (P-215A/B)	Pump/Equipment status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Strip Effluent Pump Tank pump Low Flow (P-215A/B)	Rapid increase in Strip Effluent Pump Tank (TK-215) level (LIC-2100)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping (and associated Solvent Strip Feed Pump piping) may need to be flushed and drained prior to P&VG labyrinth entry.
Strip Effluent Coalescer (TK-203) media plugged. (The coalescer media is expected to require periodic replacement.)	High alarm on PDI-2049 (Strip Effluent Coalescer (TK-203) media dP)	Controlled shutdown of the CSSX process.	The coalescer will be drained and the vessel head removed to provide access to the media. The head of the Strip Effluent Coalescer (TK-203) is located in and accessible from the West CSSX Tank Cell.

10.4.5 System Shutdown

In order to shut down the CSSX process, the feed to the Extraction Contactors EXT-201A/P is changed from CSS to DSS. Once the contactors are stopped, the Strip Effluent Coalescer Feed Pumps (P-212A/B), and the Strip Effluent Pump Tank Pumps (P-215A/B) are stopped.

See Section 4.4.5 for a detailed description of the CSSX System Shutdown.

11.0 SEHT (TK-205) AND PUMPS

11.1 System Functions

The general purpose of the SEHT (TK-205) and Pumps System is to collect strip effluent and transfer the solution to DWPF (see P-DB-J-00003[14]).

11.2 Operational Overview

The SEHT (TK-205) collects strip effluent solution from the stripping contactors via the Strip Effluent Pump Tank Pumps (P-215A/B). External cooling coils maintain the tank contents within a range of 77 ± 5ºF. Means are provided to support sampling of the SEHT (TK-205) contents (see X-SD-J-00006[8]). Pumps P-205A/B are used to transfer the strip effluent to DWPF. Pumps P-205A/B are also used to provide the fluid flow for the mixing eductor (EDT-205).

11.3 Configuration Information

11.3.1 Description of System

Refer to P&IDs and PFDs listed in Table 11-1.

Table 11-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M5-J-0001	*SWPF Simplified Process Flow Schematic (U)*[15]
M-M5-J-0008	*SWPF Solvent Stripping and Caustic Wash PFD (U)*[200]
M-M6-J-0032	*SWPF Process Building Strip Effluent Hold Tank TK-205 P&ID (U)*[364]
M-M6-J-0033	*SWPF Process Building Strip Effluent Transfer Pumps P-205A/B P&ID (U)*[365]

11.3.2 Major Components

See Table 11-2 for a list of major components.

Table 11-2. Major Components

Component	Description
SEHT (TK-205)	Stainless steel pressure vessel that receives strip effluent from P-215A/B and provides sufficient capacity for SWPF processing requirements (7 days' production). [366]) Capacity to Overflow: 19,900 gallons (see M-CLC-J-00033[366]) Diameter: 14 ft (diameter) x 16 ft-10 inch (T/T) Design features: • The SEHT (TK-205) is equipped with an eductor to ensure adequate agitation of the tank contents; • The SEHT (TK-205) is maintained under vacuum, with respect to the cell, for containment/confinement; • The SEHT (TK-205) includes an overflow line that enters the SEHT Cell Sump (SMP-205) below the liquid level; • The SEHT (TK-205) includes a solvent recovery weir and line to allow solvent removal and gravity-drain to the SDT (TK-208); • The SEHT (TK-205) is equipped with external cooling coils to cool and maintain the tank contents at 77 ± 5°F; • The SEHT (TK-205) is equipped with an air purge to prevent the accumulation of flammable vapors; and • The SEHT (TK-205) is equipped with a chemical addition line used to transfer dilute caustic or HNO_3 from the Neutralization Tank (TK-317).
Strip Effluent Transfer Pumps (P-205A/B)	Centrifugal pumps with VFDs that transfer the strip effluent to DWPF. Capacity: 300 gpm (see M-CLC-J-00013, *SWPF Strip Effluent Transfer Pumps Sizing Calculation, P-205A/B*[367]) hp: 50 Design features: • The Strip Effluent Transfer Pumps (P-205A/B) have drain and flush capability.

11.3.3 Stream Data

See Table 11-3 for a listing of streams.

Table 11-3. Streams

Stream	Description
Strip Effluent Solution	Strip effluent solution is received in the SEHT (TK-205) from the Strip Effluent Pump Tank Pumps (P-215A/B). Strip effluent is transferred from the SEHT (TK-205) to DWPF with the Strip Effluent Transfer Pumps (P-205A/B). Properties 1.0 s.g. (M-CLC-J-00143[25]) 0.001M HNO_3 concentration (M-CLC-J-00143[25])

11.3.4 Physical Location and Layout

The SEHT (TK-205) is located in the SEHT Cell in the CPA. The Strip Effluent Transfer Pumps (P-205A/B) are located in the CSSX P&VG area. An automatic and a manual valve are located at the labyrinth wall to separate the tank and pumps. The Strip Effluent Transfer Pumps (P-205A/B) have automatic pump casing drain valves.

11.3.5 System Control Features and Interlocks

11.3.5.1 System Monitoring

The SEHT system has instrumentation to monitor the status of the system and initiate corrective actions, if necessary. Remote indications are provided to the DCS.

The SEHT (TK-205) has two redundant bubbler level instruments to monitor the level in the tank. The SEHT (TK-105) has a thermowell and temperature element installed in the tank to monitor the temperature of the tank contents. The SEHT (TK-205) includes an external cooling water coil (1/2 pipe) with a TCV. The SEHT (TK-205) includes a pressure differential instrument to monitor the relative pressure in the tank vapor space. The ^{137}Cs concentration in the strip effluent is monitored via area radiation monitors located in the P-205A/B P&VG.

The SEHT Transfer Pumps (P-205A/B) have instrumentation to monitor and control the pump speed. A mass flow meter is installed on the discharge side of pumps in order to monitor the flow rate from the SEHT (TK-205). Total flow rate is set by Strip Effluent Transfer Pump (P-205A/B) speed. Pump discharge is routed to DWPF via the Waste Transfer Enclosure (WTE). The pump discharge can also be sent to the Strip Effluent Tank Eductor (EDT-205) for tank mixing.

See Table 11-4 for a listing of instruments.

Table 11-4. Instruments

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
P-205A	M-M6-J-0033[365]	N/A	Pump Status	Run/Off
P-205B	M-M6-J-0033[365]	N/A	Pump Status	Run/Off
LIT-1502	M-M6-J-0032[364]	J-JZ-J-0025, *SWPF LI-1502 SEHT Level*[368]	SEHT (TK-205) Level	Gallons
LIT-1503	M-M6-J-0032[364]	J-JZ-J-0026, *SWPF LI-1503 SEHT Level*[369]	SEHT (TK-205) Level	Gallons
TE-1504	M-M6-J-0032[364]	J-JZ-J-00206, *SWPF TIC-1504 SEHT Temp*[370]	SEHT (TK-205) liquid Temperature	°F
TV-1504A	M-M6-J-0032[364]	J-JZ-J-00206[370]	Valve Position	0-100% Open
TV-1504B	M-M6-J-0032[364]	J-JZ-J-00206[370]	Valve Position	0-100% Open
TV-1504C	M-M6-J-0032[364]	J-JZ-J-00206[370]	Valve Position	0-100% Open
HV-1538	M-M6-J-0033[365]	N/A	P-205A Isolation Valve Position	Open/Closed
HV-1539	M-M6-J-0033[365]	N/A	Flush Valve Position	A-C/B-C/A-B position
HV-1542	M-M6-J-0033[365]	N/A	P-205B Isolation Valve Position	Open/Closed
HV-1543	M-M6-J-0033[365]	N/A	Flush Valve Position	A-C/B-C/A-B position
HV-1546	M-M6-J-0033[365]	N/A	Drain Valve position	Open/Closed
HV-1547	M-M6-J-0033[365]	N/A	Drain Valve Position	Open/Closed
SC-1550	M-M6-J-0033[365]	J-JZ-J-01072, *SWPF SIC-1550 Strip Effluent Xfer Pump B Speed*[371]	P-205B Speed	0 – 100%
PIT-1551	M-M6-J-0033[365]	N/A	P-205A/B Discharge Pressure	psig
HV-1552	M-M6-J-0033[365]	N/A	Valve Position	Open/Closed
SC-1553	M-M6-J-0033[365]	J-JZ-J-01073, *SWPF SIC-1553 Strip Effluent Xfer Pump A Speed*[373]	P-205A Speed	0 – 100%
FE-1553	M-M6-J-0033[365]	J-JZ-J-00207, *SWPF FIC-1553 Strip Effluent Xfer Pumps Flow*[374]	Flow rate (P-205A/B)	gpm
HV-1553	M-M6-J-0033[365]	N/A	Valve Position (P-205A/B to eductor)	A-C/B-C position
HV-1557	M-M6-J-0033[365]	N/A	Valve Position	Open/Closed

Table 11-4. Instruments (cont.)

Equipment/ Instrument Number	P&ID	Scale Sheet	Monitored Variable	Indications
PDIT-4532	M-M6-J-0032[364]	J-JZ-J-00205, *SWPF PDI-4532 SEHT Vacuum*[375]	SEHT (TK-205) Vapor space to Cell dP	Inches water vacuum
VE-9255A/B/C/D	M-M6-J-0033[365]	N/A	P-205A Vibration	Cycles/second Inches/sec
VE-9254A/B/C/D	M-M6-J-0033[365]	N/A	P-205B Vibration	Cycles/second Inches/sec
RE-2215	M-M6-J-0033[365]	J-JZ-J-00209, *SWPF RI-2215 Strip Effluent Cs Concentration*[376]	Strip Effluent stream gamma level (Room)	^{137}Cs Ci/gal
RE-2216	M-M6-J-0033[365]	J-JZ-J-00210, *SWPF RI-2216 Strip Effluent Cs Concentration*[377]	Strip Effluent stream gamma level (Room)	^{137}Cs Ci/gal

11.3.5.2 Control Functions

See Table 11-5 for a listing of control loops.

Table 11-5. Control Loops

Loop Number	P&ID	Scale Sheet	Controlled Variable	Set point
TIC-1504	M-M6-J-0032[364]	J-JZ-J-00206[370]	SEHT (TK-205) temperature	77°F
FIC-1553	M-M6-J-0033[365]	J-JZ-J-00207[374]	P-205A/B Discharge flow rate	Operator-entered
SIC-1553	M-M6-J-0033[365]	J-JZ-J-01073[373]	P-205A Pump Speed/Pump flow rate	Operator-entered
SIC-1550	M-M6-J-0033[365]	J-JZ-J-01072[371]	P-205B Pump Speed/Pump flow rate	Operator-entered

11.4 Operations

11.4.1 Initial Configuration

The SEHT (TK-205) is empty. The Strip Effluent Transfer Pumps are off.

11.4.2 System Startup

The strip effluent solution enters the SEHT (TK-205) from the stripping contactors via the Strip Effluent Pump Tank Pumps (P-215A/B). When the SEHT (TK-205) reaches a pre-determined

level, a transfer to DWPF is initiated. The Strip Effluent Transfer Pumps are used to transfer the contents to the DWPF Strip Effluent Feed Tank.

11.4.3 Normal Operations

The SEHT (TK-205) collects the strip effluent for storage, sampling, and transfer to the DWPF. The tank is equipped with an eductor (EDT-205) to allow mixing of the tank contents. Flow to the eductor is provided by one of the Strip Effluent Transfer Pumps (P-205A/B). The tank will normally be mixed, unless the tank level is below the minimum setpoint for the eductor operation. Mixing will be required to maintain tank homogeneity, support the measurement by the area radiation monitors (setpoints are based on full piping) and ensure a uniform temperature distribution.

The ^{137}Cs concentration in the SEHT (TK-205) is approximately 15 times higher than the CSS feed (CF of 15). The concentration of ^{137}Cs in the SEHT (TK-205) will generate sufficient heat to require tank cooling; therefore, SEHT (TK-205) will be cooled by chilled water circulated through the tank cooling coils. The external cooling coils (three zones) ensure that the tank temperature is within acceptable limits for transfer to DWPF. One of two Strip Effluent Transfer Pumps (P-205A/B) will be used to transfer strip effluent to the DWPF via the WTE. The ^{137}Cs concentration in the strip effluent is monitored via area radiation monitors located in the P-205A/B P&VG.

The process sequences for the SEHT system are included in Section 5.0 of X-PCD-J-00001[39].

11.4.4 Off-Normal and Recovery Operation

The SEHT (TK-205) includes a solvent recovery weir and line to allow solvent removal and gravity-drain to the SDT (TK-208). In order to perform a solvent recovery operation, the level in the SEHT (TK-205) is raised slowly, using strip effluent feed or flushwater addition. The fluid in the SEHT (TK-205) will flow over the solvent recovery overflow weir and gravity-drain to the SDT (TK-208). The fluid will be allowed to flow to the SDT (TK-208) until the available solvent is recovered. Then, the addition of liquid to the SEHT (TK-205) is terminated and the tank level is returned to within the normal operating range by performing a transfer to the DWPF.

The SEHT (TK-205) includes a dedicated sample pump inlet line that can be used to de-inventory the tank. The sample pump is used to transfer the heel from SEHT (TK-205) to the SDT (TK-208). This evolution is only expected to occur to recover solvent, in support of extended outages, or at the end of facility operations.

The SEHT (TK-205) includes a chemical addition line used to transfer dilute caustic from the Neutralization Tank. This transfer path can be used to adjust the pH of the SEHT (TK-205) contents, if required.

Personnel entry into the P&VG labyrinth will require the SEHT (TK-205)-related equipment located in the labyrinth to be drained and flushed.

Table 11-6 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 11-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
SEHT (TK-205) TCV failure (TV-1504A/B/C)	High temperature alarm	Controlled CSSX shutdown (terminate generation of strip effluent).	Tank cooling can be manually operated, using the TCV bypass valve until repairs are completed.
Strip Effluent Transfer Pump failure (P-205A/B)	Pump/Equipment status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Strip Effluent Transfer Pump Low Flow (P-205A/B)	Low flow alarm (FIC-1553)	Switch to the alternate duty pump.	The alternate duty pump can be used until repairs are completed. The failed pump and associated piping will be flushed and drained prior to P&VG labyrinth entry.
Failure of commanded equipment	DCS status indication	Perform Stopping Logic for Running Sequence.	Operator to investigate cause of problem.
SEHT (TK-205) Level (LIT-1502 and LIT-1503) increasing or not changing during transfer.	SEHT (TK-205) Level indication (LI-1502 and LI-1503)	Perform Stopping Logic for Running Sequence.	Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Stopping Logic for Running Sequence.	Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	DP Indicator (PDI-4077)	Perform Stopping Logic for Running Sequence.	Operator to investigate cause of problem.

11.4.5 System Shutdown

The Strip Effluent Transfer Pumps are stopped in order to terminate the transfer to DWPF.

12.0 REFERENCES

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[18] M-M6-J-0031, *SWPF Process Building Salt Solution Feed Pumps P-109A/B P&ID (U).* Parsons, Aiken, South Carolina.

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[21] M-CLC-J-00094, *SWPF SSFT Pulse Mixer Sizing Calculation*, Revision 2. Parsons, Aiken, South Carolina.

[22] M-CLC-J-00099, *SWPF Salt Solution Feed Pumps Sizing Calculation, P-109A/B*, Revision 2. Parsons, Aiken, South Carolina.

[23] M-DS-J-00014, *SWPF Salt Solution Feed Cooler HX-201*. Parsons, Aiken, South Carolina.

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[25] M-CLC-J-00143, *SWPF Mass Balance Model Calculations as a Result of Nitric Acid Replacing Oxalic Acid*, Revision 1. Parsons, Aiken, South Carolina.

[26] J-JZ-J-0018, *SWPF LI-1390 SSFT Level*. Parsons, Aiken, South Carolina.

[27] J-JZ-J-00198, *SWPF DI-1390 SSFT Density*. Parsons, Aiken, South Carolina.

[28] J-JZ-J-00201, *SWPF TIC-1394 SSFT Temp*. Parsons, Aiken, South Carolina.

[29] J-JZ-J-0019, *SWPF LI-1395 SSFT Level*. Parsons, Aiken, South Carolina.

[30] J-JZ-J-00199, *SWPF DI-1395 SSFT Density*. Parsons, Aiken, South Carolina

[31] J-JZ-J-00202, *SWPF AI-1459 CSSX Feed Turbidity*. Parsons, Aiken, South Carolina.

[32] J-JZ-J-00203, *SWPF AI-1460, CSSX Feed Turbidity*. Parsons, Aiken, South Carolina.

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[222] J-JZ-J-00413, *SWPF VA-9224 EXT-203F Vibration*. Parsons, Aiken, South Carolina.

[223] J-JZ-J-00414, *SWPF VA-9225 EXT-203G Vibration*. Parsons, Aiken, South Carolina.

[224] J-JZ-J-00415, *SWPF VA-9226 EXT-203H Vibration*. Parsons, Aiken, South Carolina.

[225] J-JZ-J-00416, *SWPF VA-9227 EXT-203I Vibration*. Parsons, Aiken, South Carolina.

[226] J-JZ-J-00417, *SWPF VA-9228 EXT-203J Vibration*. Parsons, Aiken, South Carolina.

[227] J-JZ-J-00418, *SWPF VA-9229 EXT-203K Vibration*. Parsons, Aiken, South Carolina.

[228] J-JZ-J-00419, *SWPF VA-9230 EXT-203L Vibration*. Parsons, Aiken, South Carolina.

[229] J-JZ-J-00420, *SWPF VA-9231 EXT-203M Vibration*. Parsons, Aiken, South Carolina.

[230] J-JZ-J-00421, *SWPF VA-9232 EXT-203N Vibration*. Parsons, Aiken, South Carolina.

[231] J-JZ-J-00422, *SWPF VA-9233 EXT-203O Vibration*. Parsons, Aiken, South Carolina.

[232] J-JZ-J-00423, *SWPF VA-9234 EXT-203P Vibration*. Parsons, Aiken, South Carolina.

[233] J-JZ-J-00344, *SWPF TI-9219A EXT-203A Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[234] J-JZ-J-00345, *SWPF TI-9220A EXT-203B Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[235] J-JZ-J-00346, *SWPF TI-9221A EXT-203C Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[236] J-JZ-J-00347, *SWPF TI-9222A EXT-203D Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[237] J-JZ-J-00348, *SWPF TI-9223A EXT-203E Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[238] J-JZ-J-00349, *SWPF TI-9224A EXT-203F Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[239] J-JZ-J-00350, *SWPF TI-9225A EXT-203G Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[240] J-JZ-J-00351, *SWPF TI-9226A EXT-203H Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[241] J-JZ-J-00352, *SWPF TI-9227A EXT-203I Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[242] J-JZ-J-00353, *SWPF TI-9228A EXT-203J Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[243] J-JZ-J-00354, *SWPF TI-9229A EXT-203K Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[244] J-JZ-J-00355, *SWPF TI-9230A EXT-203L Motor Top Bearing Temp* Parsons, Aiken, South Carolina.

[245] J-JZ-J-00356, *SWPF TI-9231A EXT-203M Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[246] J-JZ-J-00357, *SWPF TI-9232A EXT-203N Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[247] J-JZ-J-00358, *SWPF TI-9233A EXT-203O Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[248] J-JZ-J-00359, *SWPF TI-9234A EXT-203P Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[249] J-JZ-J-00360, *SWPF TI-9219B EXT-203A Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[250] J-JZ-J-00361, *SWPF TI-9220B EXT-203B Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[251] J-JZ-J-00362, *SWPF TI-9221B EXT-203C Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[252] J-JZ-J-00363, *SWPF TI-9222B EXT-203D Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[253] J-JZ-J-00364, *SWPF TI-9223B EXT-203E Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[254] J-JZ-J-00365, *SWPF TI-9224B EXT-203F Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[255] J-JZ-J-00366, *SWPF TI-9225B EXT-203G Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[256] J-JZ-J-00367, *SWPF TI-9226B EXT-203H Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[257] J-JZ-J-00368, *SWPF TI-9227B EXT-203I Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[258] J-JZ-J-00369, *SWPF TI-9228B EXT-203J Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[259] J-JZ-J-00370, *SWPF TI-9229B EXT-203K Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[260] J-JZ-J-00371, *SWPF TI-9230B EXT-203L Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[261] J-JZ-J-00372, *SWPF TI-9231B EXT-203M Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[262] J-JZ-J-00373, *SWPF TI-9232B EXT-203N Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[263] J-JZ-J-00374, *SWPF TI-9233B EXT-203O Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[264] J-JZ-J-00375, *SWPF TI-9234B EXT-203P Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[265] J-JZ-J-00376, *SWPF TI-9219C EXT-203A Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[266] J-JZ-J-00377, *SWPF TI-9220C EXT-203B Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[267] J-JZ-J-00378, *SWPF TI-9221C EXT-203C Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[268] J-JZ-J-00379, *SWPF TI-9222C EXT-203D Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[269] J-JZ-J-00380, *SWPF TI-9223C EXT-203E Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[270] J-JZ-J-00381, *SWPF TI-9224C EXT-203F Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[271] J-JZ-J-00382, *SWPF TI-9225C EXT-203G Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[272] J-JZ-J-00383, *SWPF TI-9226C EXT-203H Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[273] J-JZ-J-00384, *SWPF TI-9227C EXT-203I Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[274] J-JZ-J-00385, *SWPF TI-9228C EXT-203J Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[275] J-JZ-J-00386, *SWPF TI-9229C EXT-203K Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[276] J-JZ-J-00387, *SWPF TI-9230C EXT-203L Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[277] J-JZ-J-00388, *SWPF TI-9231C EXT-203M Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[278] J-JZ-J-00389, *SWPF TI-9232C EXT-203N Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[279] J-JZ-J-00390, *SWPF TI-9233C EXT-203O Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[280] J-JZ-J-00391, *SWPF TI-9234C EXT-203P Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[281] J-JZ-J-00392, *SWPF TI-9219D EXT-203A Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[282] J-JZ-J-00393, *SWPF TI-9220D EXT-203B Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[283] J-JZ-J-00394, *SWPF TI-9221D EXT-203C Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[284] J-JZ-J-00395, *SWPF TI-9222D EXT-203D Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[285] J-JZ-J-00396, *SWPF TI-9223D EXT-203E Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[286] J-JZ-J-00397, *SWPF TI-9224D EXT-203F Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[287] J-JZ-J-00398, *SWPF TI-9225D EXT-203G Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[288] J-JZ-J-00399, *SWPF TI-9226D EXT-203H Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[289] J-JZ-J-00400, *SWPF TI-9227D EXT-203I Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[290] J-JZ-J-00401, *SWPF TI-9228D EXT-203J Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[291] J-JZ-J-00402, *SWPF TI-9229D EXT-203K Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[292] J-JZ-J-00403, *SWPF TI-9230D EXT-203L Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[293] J-JZ-J-00404, *SWPF TI-9231D EXT-203M Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[294] J-JZ-J-00405, *SWPF TI-9232D EXT-203N Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[295] J-JZ-J-00406, *SWPF TI-9233D EXT-203O Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[296] J-JZ-J-00407, *SWPF TI-9234D EXT-203P Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[297] J-JZ-J-00343, *SWPF TIC-2042 EXT-203 M-P Aqueous Temp*. Parsons, Aiken, South Carolina.

[298] J-JZ-J-0049, *SWPF LIC-2151 Solvent Strip Feed Tank Level*. Parsons, Aiken, South Carolina.

[299] J-JZ-J-0050, *SWPFLI-2152 Solvent Strip Feed Tank Aqueous Level*. Parsons, Aiken, South Carolina.

[300] J-JZ-J-01118, *SWPF SIC-2151A Solvent Strip Feed Pump A Speed*. Parsons, Aiken, South Carolina.

[301] J-JZ-J-01119, *SWPF SIC-2151B Solvent Strip Feed Pump B Speed*. Parsons, Aiken, South Carolina.

[302] J-JZ-J-00526, *SWPF FI-2153 Solvent Strip Feed Pump A Flow*. Parsons, Aiken, South Carolina.

[303] J-JZ-J-00530, *SWPF TIC-2154 Solvent Strip Feed Pump A Temp*. Parsons, Aiken, South Carolina.

[304] J-JZ-J-00527, *SWPF FI-2179 Solvent Strip Feed Pump B Flow*. Parsons, Aiken, South Carolina.

[305] J-JZ-J-00528, *SWPF FIC-2191 Solvent Trip Feed Pump A Sample Flow*. Parsons, Aiken, South Carolina.

[306] J-JZ-J-00529, *SWPF FIC-2195 Solvent Strip Feed Pump B Sample Flow*. Parsons, Aiken, South Carolina.

[307] J-JZ-J-00531, *SWPF TIC-2196 Solvent Strip Feed Pump B Temp*. Parsons, Aiken, South Carolina.

[308] J-JZ-J-00340, *SWPF TIC-2960 EXT-203 A-D Aqueous Temp*. Parsons, Aiken, South Carolina.

[309] J-JZ-J-00341, *SWPF TIC-2966 EXT-203 E-H Aqueous Temp*. Parsons, Aiken, South Carolina.

[310] J-JZ-J-00811, *SWPF TIC-2588 Strip Contactors Tempered Water Temp*. Parsons, Aiken, South Carolina.

[311] J-JZ-J-00810, *SWPF FI-2590 Strip Contactors Tempered Water Flow*. Parsons, Aiken, South Carolina.

[312] J-JZ-J-00812, *SWPF FI-2565 Solvent Strip Feed Tempered Water Flow*. Parsons, Aiken, South Carolina.

[313] J-JZ-J-00814, *SWPF TIC-2563 Strip Feed Tempered Water Temp*. Parsons, Aiken, South Carolina.

[314] J-JZ-J-00813, *SWPF RI-2564 Solvent Strip PHW Loop Radiation Monitor*. Parsons, Aiken, South Carolina.

[315] M-M6-J-0043 SH1, *SWPF Process Building Caustic Wash Contactors EXT-204A/B P&ID (U)*. Parsons, Aiken, South Carolina.

[316] M-M6-J-0043 SH2, *SWPF Process Building Caustic Wash Tank TK-204 P&ID (U)*. Parsons, Aiken, South Carolina.

[317] M-M6-J-0043 SH3, *SWPF Process Building Caustic Wash Pumps P-204A/B P&ID (U)*. Parsons, Aiken, South Carolina.

[318] M-CLC-J-00100, *SWPF Caustic Wash Pumps Sizing Calculation, P-204A/B*, Revision 1. Parsons, Aiken, South Carolina.

[319] J-JZ-J-01109, *SWPF SIC-2018 Caustic Wash Tank Pump B Speed*. Parsons, Aiken, South Carolina.

[320] J-JZ-J-00438, *SWPF FIC-2018 Caustic Wash Tank Pump B Flow*. Parsons, Aiken, South Carolina.

[321] J-JZ-J-00427, *SWPF TI-2062 EXT-204A/B Caustic Wash Temp*. Parsons, Aiken, South Carolina.

[322] J-JZ-J-00424, *SWPF AI-2068 EXT-204A/B Caustic Wash pH*. Parsons, Aiken, South Carolina.

[323] J-JZ-J-00436, *SWPF VA-9235 EXT-204A Vibration*. Parsons, Aiken, South Carolina.

[324] J-JZ-J-00428, *SWPF TI-9235A EXT-204A Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[325] J-JZ-J-00430, *SWPF TI-9235B EXT-204A Motor Bot Bearing Temp*. Parsons, Aiken, South Carolina.

[326] J-JZ-J-00432, *SWPF TI-9235C EXT-204A Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[327] J-JZ-J-00434, *SWPF TI-9235D EXT-204A Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[328] J-JZ-J-00437, *SWPF VA-9236 EXT-204B Vibration*. Parsons, Aiken, South Carolina.

[329] J-JZ-J-00429, *SWPF TI-9236A EXT-204B Motor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[330] J-JZ-J-00431, *SWPF TI-9236B EXT-204B Motor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[331] J-JZ-J-00433, *SWPF TI-9236C EXT-204B Rotor Top Bearing Temp*. Parsons, Aiken, South Carolina.

[332] J-JZ-J-00435, *SWPF TI-9236D EXT-204B Rotor Bottom Bearing Temp*. Parsons, Aiken, South Carolina.

[333] J-JZ-J-0024, *SWPF LI-2071 Caustic Wash Tank Level*. Parsons, Aiken, South Carolina.

[334] J-JZ-J-00440, *SWPF FIC-2075 Caustic Wash Tank Pump B Sample Flow*. Parsons, Aiken, South Carolina.

[335] J-JZ-J-01110, *SWPF SIC-2080 Caustic Wash Tank Pump A Speed*. Parsons, Aiken, South Carolina.

[336] J-JZ-J-00439, *SWPF FIC-2080 Caustic Wash Tank Pump A Flow*. Parsons, Aiken, South Carolina.

[337] J-JZ-J-00442, *SWPF RI-2082 Caustic Wash Pump A Cs Concentration*. Parsons, Aiken, South Carolina.

[338] J-JZ-J-00441, *SWPF FIC-2084 Caustic Wash Pump A Sample Flow*. Parsons, Aiken, South Carolina.

[339] J-JZ-J-00443, *SWPF RI-2089 Caustic Wash Pump B Cs Concentration*. Parsons, Aiken, South Carolina.

[340] P-RPT-J-00020, *SWPF Test Report: Cross-flow Filter and Caustic-Side Solvent Extraction Integrated Test*. Parsons, Aiken, South Carolina.

[341] M-M6-J-0122 SH1, *SWPF Process Building Strip Effluent Stilling Tank TK-212 P&ID (U)*. Parsons, Aiken, South Carolina.

[342] M-M6-J-0122 SH2, *SWPF Process Building Strip Effluent Pump Tank TK-215 P&ID (U)*. Parsons, Aiken, South Carolina.

[343] M-M6-J-0123, *SWPF Process Building Strip Effluent Pump Tank Pumps P-215A/B P&ID (U)*. Parsons, Aiken, South Carolina.

[344] M-CLC-J-00114, *SWPF Strip Effluent Pump Tank Pumps Sizing Calculation, P-215A/B*, Revision 1. Parsons, Aiken, South Carolina.

[345] J-JZ-J-01126, *SWPF SIC-2268A Strip Effluent Coalescer Feed Pump A Speed*. Parsons, Aiken, South Carolina.

[346] J-JZ-J-01127, *SWPF SIC-2268B Strip Effluent Coalescer Feed Pump B Speed*. Parsons, Aiken, South Carolina.

[347] J-JZ-J-00616, *SWPF PDI-2049 Strip Effluent Coalescer Media dP*. Parsons, Aiken, South Carolina.

[348] J-JZ-J-00617, *SWPF FIC-2057 SEPT Pump A Sample Flow*. Parsons, Aiken, South Carolina.

[349] J-JZ-J-00618, *SWPF FIC-2065 SEPT Pump B Sample Flow*. Parsons, Aiken, South Carolina.

[350] J-JZ-J-0048, *SWPF LIC-2100 Strip Effluent Pump Tank Level*. Parsons, Aiken, South Carolina.

[351] J-JZ-J-01114, *SWPF SIC-2100A SEPT Pump A Speed*. Parsons, Aiken, South Carolina.

[352] J-JZ-J-01115, *SWPF SIC-2100B SEPT Pump B Speed*. Parsons, Aiken, South Carolina.

[353] J-JZ-J-0042, *SWPF LI-2106 Strip Effluent Stilling Tank Level*. Parsons, Aiken, South Carolina.

[354] J-JZ-J-00619, *SWPF FIC-2109 SEPT Pump A Flow*. Parsons, Aiken, South Carolina.

[355] J-JZ-J-0043, *SWPF LI-2110 Strip Effluent Stilling Tank Level*. Parsons, Aiken, South Carolina.

[356] J-JZ-J-0023, *SWPF LI-2111 Strip Effluent Coalescer Level*. Parsons, Aiken, South Carolina.

[357] J-JZ-J-00621, *SWPF RI-2214 Strip Effluent Pump B Cs Concentration*. Parsons, Aiken, South Carolina.

[358] J-JZ-J-00622, *SWPF RI-2217 Strip Effluent Pump A Cs Concentration*. Parsons, Aiken, South Carolina.

[359] J-JZ-J-00620, *SWPF FIC-2221 SEPT Pump B Flow*. Parsons, Aiken, South Carolina.

[360] J-JZ-J-00893, *SWPF LI-2224 Strip Effluent Coalescer Drain Header Loop Seal Level*. Parsons, Aiken, South Carolina.

[361] J-JZ-J-01176, *SWPF PI-2006 SEPT Pump A Disch Pressure*. Parsons, Aiken, South Carolina.

[362] J-JZ-J-01177, *SWPF PI-2007 SEPT Pump B Disch Pressure*. Parsons, Aiken, South Carolina.

[363] J-JZ-J-01126, *SWPF SIC-2268A Strip Effluent Coalescer Feed Pump A Speed*. Parsons, Aiken, South Carolina.

[364] M-M6-J-0032, *SWPF Process Building Strip Effluent Hold Tank TK-205 P&ID (U*. Parsons, Aiken, South Carolina.

[365] M-M6-J-0033, *SWPF Process Building Strip Effluent Transfer Pumps P-205A/B P&ID (U*. Parsons, Aiken, South Carolina.

[366] M-CLC-J-00033, *SWPF Strip Effluent Hold Tank Sizing Calculation, TK-205*. Parsons, Aiken, South Carolina.

[367] M-CLC-J-00013, *SWPF Strip Effluent Transfer Pumps Sizing Calculation, P-205A/B.* Parsons, Aiken, South Carolina.

[368] J-JZ-J-0025, *SWPF LI-1502 SEHT Level*. Parsons, Aiken, South Carolina.

[369] J-JZ-J-0026, *SWPF LI-1503 SEHT Level*. Parsons, Aiken, South Carolina.

[370] J-JZ-J-00206, *SWPF TIC-1504 SEHT Temp*. Parsons, Aiken, South Carolina.

[371] J-JZ-J-01072, *SWPF SIC-1550 Strip Effluent Xfer Pump B Speed*. Parsons, Aiken, South Carolina.

[373] J-JZ-J-01073, *SWPF SIC-1553 Strip Effluent Xfer Pump A Speed*. Parsons, Aiken, South Carolina.

[374] J-JZ-J-00207, *SWPF FIC-1553 Strip Effluent Xfer Pumps Flow*. Parsons, Aiken, South Carolina.

[375] J-JZ-J-00205, *SWPF PDI-4532 SEHT Vacuum*. Parsons, Aiken, South Carolina.

[376] J-JZ-J-00209, *SWPF RI-2215 Strip Effluent Cs Concentration*. Parsons, Aiken, South Carolina.

[377] J-JZ-J-00210, *SWPF RI-2216 Strip Effluent Cs Concentration*. Parsons, Aiken, South Carolina.