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SALT WASTE PROCESSING FACILITY

COLD CHEMICALS AREA

SYSTEM DESCRIPTION

Prepared, reviewed, and accepted by:

10/29/18

Anthony Edwards
SWPF Cognizant Engineer
Date

William Bayne Brasel ORC96176.ID Digitally signed by William Bayne Brasel ORC96176.ID Date: 2019.11.05 13:48:21 -05'00'

Bill Brasel
SWPF Integration Manager
Date

11/5/19

Dr. Thomas D. Burns, Jr., P.E.
SWPF Director of Engineering
Date

This Document Affected By	
Design Change Document	Initial/Date

SUMMARY OF CHANGES

Revision No.	Date	Description of Change
0	5/20/08	Issued for Enhanced Final Design
1	06/26/15	Revise per DCN-1474. This is a complete rewrite. Revision bars are not shown.
2	10/29/19	Revise per DCN-7015, DCN-1912, DCN-2039, DCN-2101, and DCN-2272.

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ACRONYMS AND ABBREVIATIONS

%	Percent
ºF	degrees Fahrenheit
AFP	Alpha Finishing Process
amp	Ampere
ASDT	Alpha Sorption Drain Tank (TK-601)
ASP	Alpha Strike Process
AST-A	Alpha Sorption Tank-A (TK-101)
AST-B	Alpha Sorption Tank-B (TK-221)
CCA	Cold Chemicals Area
CFF	Cross-Flow Filter
Cs	Cesium
CSDT-A	Cleaning Solution Dump Tank-A (TK-103)
CSDT-B	Cleaning Solution Dump Tank-B (TK-223)
CSS	Clarified Salt Solution
CSSX	Caustic-side Solvent Extraction
DCS	Distributed Control System
DI	Deionized
DWPF	Defense Waste Processing Facility
ft	Feet/Foot
gpm	gallons per minute
HNO_3	Nitric Acid
hp	Horsepower
K^+	Potassium Ions
kW	Kilowatt
M	Molar
mhos/cm	Measure of Conductivity per Centimeter
MST	Monosodium Titanate
Na^+	Sodium Ion
NaOCl	Sodium Hypochlorite
NaOH	Sodium Hydroxide
NGS	Next Generation Solvent
P&ID	Piping and Instrumentation Diagram
pH	Hydrogen Ion Concentration
psig	Pounds per Square Inch Gauge
s.g.	Specific Gravity
SAST	Spent Acid Storage Tank (TK-127)
SDT	Solvent Drain Tank (TK-208)
SEHT	Strip Effluent Hold Tank (TK-205)
SHT	Solvent Hold Tank (TK-202)
SQL	Structured Query Language
Sr	Strontium
SSRT	Sludge Solids Receipt Tank (TK-104)
SWPF	Salt Waste Processing Facility
T/T	Tangent-Tangent (height)
TOA	Tri-n-octylamine

ACRONYMS AND ABBREVIATIONS (cont.)

WAC	Waste Acceptance Criteria
wt%	Weight Percent

DEFINITIONS/GLOSSARY

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

1.0 SCOPE

The scope of this System Description is the Cold Chemicals Area (CCA) and related equipment.

The CCA is separated into subsystems, based on the following chemicals.

- Sodium Hydroxide (NaOH) – is primarily used in the Alpha Strike Process (ASP) to adjust the sodium ion (Na^+) molarity of the salt waste feed to the Salt Waste Processing Facility (SWPF). NaOH is also used in chemical cleaning of the cross-flow filters (CFFs), in preparation of caustic wash solution for Caustic-Side Solvent Extraction (CSSX) and in preparation of caustic scrub solution for CSSX operating with Next Generation Solvent (NGS).
- Nitric Acid (HNO_3) – is used in the scrubbing and stripping stages of the CSSX process using baseline solvent. The scrubbing stages remove Na^+ and potassium ions (K^+) from the cesium (Cs)-rich solvent. The stripping stages remove the Cs from the scrubbed solvent. The Cs-rich product is transferred to the Defense Waste Processing Facility (DWPF). HNO_3 is not required for the CSSX process when operating with NGS.
- Monosodium Titanate (MST) – is used in the ASP and Alpha Finishing Process (AFP). It is added to Alpha Sorption Tank-A (AST-A) (TK-101) and Alpha Sorption Tank-B (AST-B) (TK-221) (double-strike operation) as an adsorbent for removing strontium (Sr) and actinides.
- Filter Cleaning Acid (HNO_3) – is used for chemical cleaning of the CFFs. During normal operation of the filtration systems, it is anticipated that the filter flux will decrease with time, due to fouling of the filter pores. In order to restore flux rates, the filters are cleaned with both NaOH and HNO_3 solutions.
- Baseline Solvent – is used in the CSSX process to remove Cs from the clarified salt solution (CSS). The solvent is a specialty mix of Isopar®L, with an extractant (Calix[4]arene-bis(tert-octylbenzo-crown-6 [BOBCalixC6]) at 0.007 Molar (M) concentration, a modifier (Cs-7SB) at 0.75M concentration, and a suppressant tri-n-octylamine (TOA) at 0.003M concentration.
- NGS Solvent – is used in the CSSX process to remove Cs from the clarified salt solution (CSS). The solvent is a specialty mix of Isopar®L, with an extractant (1,3-alt-25,27-bis(3,7-dimethyloctyl-1-oxy)Calix[4]arene-benzocrown-6) (MaxCalix) at 0.05M concentration, a modifier (Cs-7SB) at 0.5M concentration, and a suppressant (N,N'-Dicyclohexyl-N"-isotridecylguanidine) [DCiTG] at 0.003M concentration (Note: These concentration values are nominal and will be adjusted by increasing the modifier concentration to achieve a nominal solvent specific gravity of 0.851 in order to preclude contactor weir height adjustments within SWPF).
- Sodium Hypochlorite (NaOCl) – solution is used to prevent microbial growth in the Process Water Tank (TK-301) and process water piping.

The CCA also has a small laboratory area to the east of the CCA Receiving Dock. The non-radiological CCA Laboratory is equipped with a wet chemistry laboratory bench to verify chemical quality upon receipt of bulk deliveries and periodic assessment of process chemicals in storage. The laboratory also has a lockable storage area to provide secure storage of high-value solvent components.

The CCA system interfaces with components in the following System Descriptions:

- E-SD-J-00002, *SWPF Electrical System Description (Draft)*;
- J-SD-J-00002, *SWPF Instrumentation and Controls System Description*[1];
- M-SD-J-00005, *SWPF Utilities System Description (Draft)*;
- X-SD-J-00001, *SWPF Alpha Strike Process System Description*[2];
- X-SD-J-00002, *SWPF Caustic-side Solvent Extraction System Description*[3];
- X-SD-J-00004, *SWPF Alpha Finishing Process System Description*[4];
- X-SD-J-00005, *SWPF Drains System Description*[5];
- X-SD-J-00008, *SWPF Next Generation Solvent System Description*[6]*; and*
- X-SD-J-00009, *SWPF Caustic-side Solvent Extraction with Next Generation Solvent (NGS) System Description*[7]

- The safety analysis requirements related to system functions for this system are documented in Chapter 4 of S-SAR-J-00002, *SWPF Documented Safety Analysis*[8].
- The safety analysis requirements related to operability for this system are documented in Chapter 5 of S-SAR-J-00002[8].
- The discrete project design requirements for this system are documented in P-DB-J-00002, *Design Criteria Database*[9].

As Part of the maintenance of the SWPF Master Equipment list (see PP-EN-5042, *Master Equipment List*[10]), 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 CCA:

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

- MEL Specialty Items

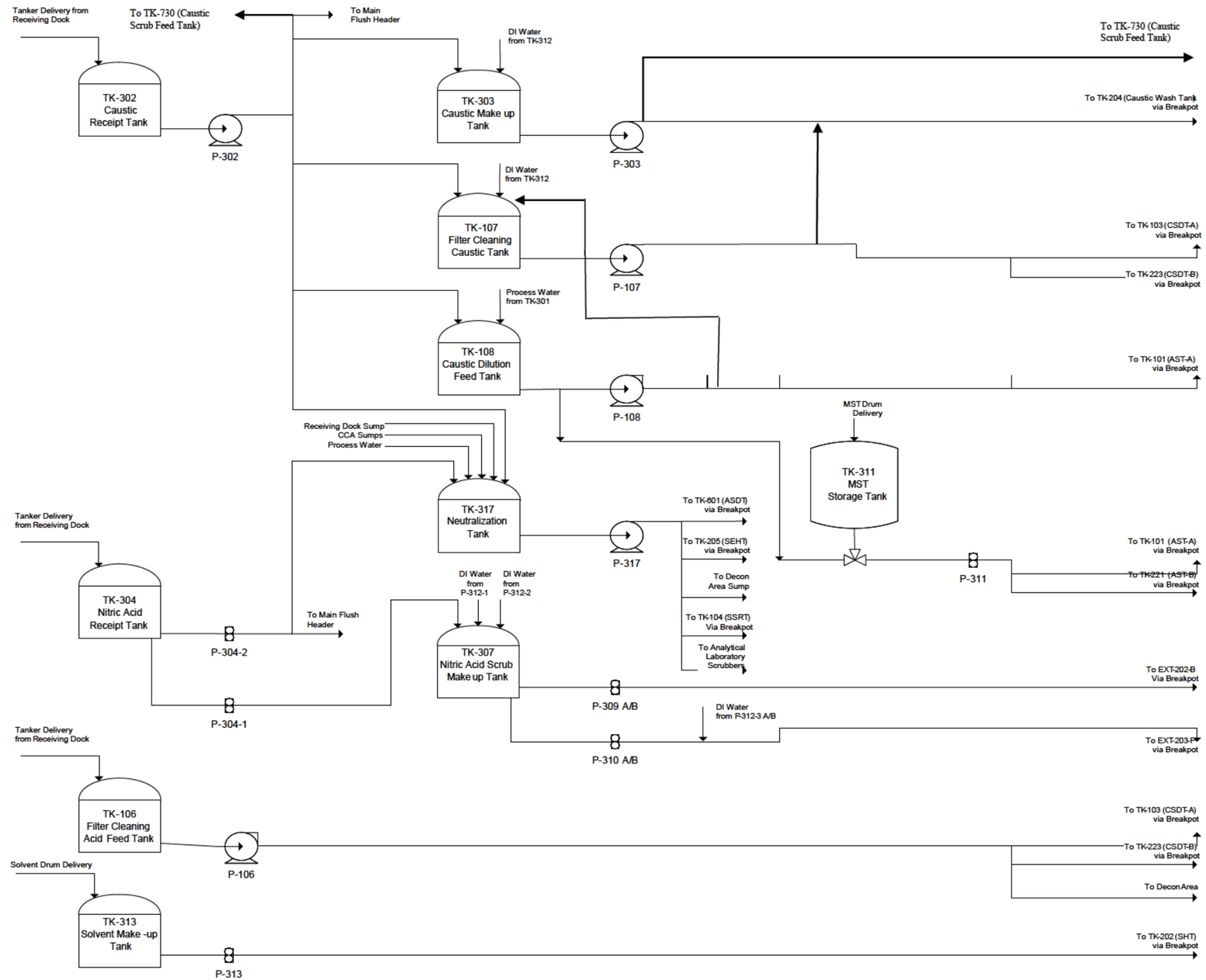
Similarly, all essential and support drawings are coded to the appropriate CSE system code (with only one code allowed per drawing). Using the following link: Drawing Category Status, a report may be generated for CCA and selecting the drawing type (Essential, Support). Reference drawings are not assigned System Codes and not required to be maintained current with facility modifications per PP-EN-5001[10] and P-CDM-J-00001, *Configuration Management Plan*[11].

2.0 GENERAL OVERVIEW

Figure 2-1 is a schematic showing the main process equipment and flow paths of the CCA systems.

The CCA receives, stores, dilutes, and transfers chemicals for use in the main processes of the SWPF. Tanker trucks deliver 50 weight percent (wt%) NaOH and 20 wt% HNO_3, via the CCA Receiving Dock. MST and solvent are supplied in 55-gallons drums. The chemicals are then transferred to their respective receipt tanks. The 50 wt% NaOH in the Caustic Receipt Tank (TK-302) is used to make less concentrated batches of NaOH in the Caustic Dilution Feed Tank (TK-108), the Filter Cleaning Caustic Tank (TK-107), the Caustic Makeup Tank (TK-303) and the Caustic Scrub Feed Tank (TK-730). The 20 wt% HNO_3 in the Nitric Acid Receipt Tank (TK-304) is used to make scrub solution in the Nitric Acid Scrub Makeup Tank (TK-307). The scrub solution is further diluted inline to make strip solution. The Neutralization Tank (TK-317) receives 50 wt% NaOH and 20 wt% HNO_3 in order to neutralize material from the CCA and Receiving Dock sumps. The Neutralization Tank (TK-317) is also used to prepare 25 percent (%) of NaOH for chemical adjustments of process vessels and to supply the analytical laboratory scrubbers.

Figure 2-1. Flow Paths of the CCA System



3.0 CAUSTIC SYSTEM DESCRIPTION

3.1 System Functions

The main uses of caustic are:

- Adjust sodium molarity of process streams in AST-A (TK-101) or the Alpha Sorption Drain Tank (ASDT) (TK-601) (see P-DB-J-00003: *SWPF Process Basis of Design*[12]);
- Neutralize contents of Strip Effluent Hold Tank (SEHT) (TK-205), Solvent Drain Tank (SDT) (TK-208) or Sludge Solids Receipt Tank (SSRT) (TK-104) (see P-DB-J-00003[12]);
- Neutralization and solution makeup in the Neutralization Tank (TK-317) (see P-DB-J-00003[12]);
- Caustic wash supply to contactors in CSSX area (see P-DB-J-00003[12]);
- Caustic or caustic scrub supply to Caustic Scrub Feed Tank (TK-730) in NGS area when operating CSSX process with NGS (see X-SD-J-00008[6]);
- Cleaning of ASP and AFP filters (see P-DB-J-00003[12]);
- Caustic supply to the Scrubber Caustic Feed Systems (SCFS-001 and SCFS-002); and
- Miscellaneous line/equipment flushes (see P-DB-J-00003[12]).

3.2 Operational Overview

A 50 wt% NaOH solution is delivered by tanker truck to the SWPF. From the Caustic Receipt Tank (TK-302), the NaOH is distributed to various tanks for use in the SWPF process. A supply is also provided to the main flush distribution header and CSSX flush header.

- Caustic Dilution Feed Tank (TK-108) – 1.66M caustic is made up by mixing process water and 50 wt% NaOH. The 1.66M caustic is used for adjusting solution molarities in AST-A (TK-101) and flushing the MST feed lines to AST-A (TK-101) and AST-B (TK-221). Additionally, the 1.66 M caustic may be transferred to TK-107 for use in filter cleaning.
- Filter Cleaning Caustic Tank (TK-107) – 0.025M or 1.0M NaOH is made up by mixing deionized (DI) water and 50 wt% NaOH. The 1.0M NaOH is used for chemical cleaning of the CFFs. The 0.025M NaOH is used for caustic scrub stages of the CSSX process when operating with NGS. Alternatively, 1.66M caustic may be transferred to TK-107 (from TK-108) and used as part of filter cleaning.
- Caustic Makeup Tank (TK-303) – 0.025M or 0.3M NaOH is made up by mixing DI water with 50 wt% NaOH. The 0.3M NaOH is used in the Caustic Wash Tank (TK-204) to make-up solutions (0.02 – 0.3M NaOH) for the caustic wash stages of the CSSX process. The 0.025M NaOH is used for caustic scrub stages of the CSSX process when operating with NGS.

- Neutralization Tank (TK-317) – 50 wt% NaOH is provided to the Neutralization Tank (TK-317) to either neutralize tank contents or to make up a batch of 25 wt% NaOH for use in adjusting the Na^+ molarity of the ASDT (TK-601) or neutralizing the SEHT (TK-205)/SSRT (TK-104)/SDT (TK-208) contents. The Drum Off/Decon Area also receives caustic from the Neutralization Tank (TK-317) for decontamination activities. The Scrubber Caustic Feed Systems (SCFS-001 and SCFS-002) are also fed from the Neutralization Tank (TK-317).

- Caustic Scrub Feed Tank (TK-730) – 0.025M NaOH is made up by mixing process water with 50 wt% NaOH. The 0.025M NaOH is used for caustic scrub stages of the CSSX process when operating with NGS.

3.3 Configuration Information

3.3.1 Description of System

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

Table 3-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M6-J-0073	*SWPF Process Building Cold Chemicals Area Receiving Dock P&ID (U)*[13]
M-M6-J-0075	*SWPF Process Building Filter Cleaning Caustic Tank TK-107 P&ID (U)*[14]
M-M6-J-0079	*SWPF Process Building Caustic Receipt Tank TK-302 P&ID (U)*[15]
M-M6-J-0124	*SWPF Process Building Caustic Dilution Feed Tank TK-108 P&ID (U)*[16]
M-M6-J-0125	*SWPF Process Building Caustic Makeup Tank TK-303 P&ID (U)*[17]
M-M5-J-0005	*SWPF Cold Chemical Makeup for Filter Cleaning and Feed Adjustment PFD (U)*[18]
M-M5-J-0010	*SWPF Cold Chemical Makeup and Process Water Tank PFD (U)*[19]

3.3.2 Major Components

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

Table 3-2. Major Components

Component	Description	
Caustic Receipt Tank (TK-302)	Capacity:	9,600 gallons (see M-CLC-J-00031: *SWPF Cold Chemicals Area Tanks Sizing Calculation*[20])
	Dimensions:	11 foot (ft) diameter x 15 ft (Tangent-Tangent [T/T] [height]) (see M-CLC-J-00031[20])
	Design features:	Vent to handle tanker truck unloading rate and air breakthrough at the end of unloading. Vent discharges to the CCA. An eductor (EDT-302) to provide mixing to ensure adequate agitation of the tank contents.
Caustic Dilution Feed Tank (TK-108)	Capacity:	9,600 gallons (see M-CLC-J-00031[20])
	Dimensions:	11ft diameter x 15 ft T/T(see M-CLC-J-00031[20])
	Design features:	Vent line that discharges to the CCA.
Filter Cleaning Caustic Tank (TK-107)	Capacity:	1,100 gallons (see M-CLC-J-00031[20])
	Dimensions:	6ft diameter x 6 ft T/T (see M-CLC-J-00031[20])
	Design features:	Vent line that discharges to the CCA.
Caustic Makeup Tank (TK-303)	Capacity:	2,500 gallons (see M-CLC-J-00031[20])
	Dimensions:	7ft diameter x 10 ft T/T (see M-CLC-J-00031[20])
	Design features:	Vent line that discharges to the CCA.
Caustic Transfer Pump (P-302)	To transfer 50 wt% NaOH to the appropriate dilution tank or main flush header.	
	Capacity:	150 gallons per minute (gpm) (see M-CLC-J-00108: *SWPF Caustic Transfer Pump Sizing Calculation, P-302*[21])
	Horsepower (hp):	75
	Design features:	P-302 has drain capability Variable frequency drive.
Caustic Receipt Tank Heater (HTR-302)	To heat and maintain 50 wt% NaOH solution at a temperature of 90 degrees Fahrenheit (°F) (see P-DB-J-00003[12]) in 50% Caustic Receipt Tank (TK-302).	
	Type:	Direct Immersion
	Heat Supply:	Electric
	Power:	50 Kilowatt (kW)
	Design features:	Heater cannot be replaced without draining the tank.
Caustic Dilution Transfer Pump (P-108)	To transfer 1.66M NaOH to AST-A (TK-101) or FCCT (TK-107)	
	Capacity:	100 gpm (see M-CLC-J-00012: *SWPF Caustic Dilution Transfer Pump Sizing Calculation, P-108*[22]).
	hp:	5
	Design features:	P-108 has drain capability.
Caustic Dilution Feed Tank Agitator (AGT-108)	To provide mixing of Caustic Dilution Feed Tank (TK-108) contents to produce a homogenous blend of 1.66M NaOH.	
	hp:	3

Table 3-2. Major Components (cont.)

Component	Description
Filter Cleaning Caustic Transfer Pump (P-107)	To transfer a batch of NaOH solution to Cleaning Solution Dump Tank-A (CSDT-A) (TK-103), Cleaning Solution Dump Tank-B (CSDT-B) (TK-223) or Caustic Scrub Feed Tank (TK-730). Capacity: 50 gpm (see M-CLC-J-00011: *SWPF Filter Cleaning Caustic Transfer Pump, P-107*[23]) hp: 5 Design features: P-107 has drain capability. Variable frequency drive.
Filter Cleaning Caustic Heater (HTR-107)	To heat and maintain contents at a temperature of 104°F in the Filter Cleaning Caustic Tank (TK-107). Type: Internal, bayonet Heat Supply: Electric Power: 50 kW Design features: Heater can be replaced without draining the tank (e.g., thermowell).
Filter Cleaning Caustic Tank Agitator (AGT-107)	To provide mixing of Filter Cleaning Caustic Tank (TK-107) contents to produce a homogenous blend. hp: 1
Caustic Makeup Transfer Pump (P-303)	To transfer NaOH solution to the Caustic Wash Tank (TK-204) or Caustic Scrub Feed Tank (TK-730). Capacity: 50 gpm (see M-CLC-J-00017: *SWPF Caustic Makeup Transfer Pump, P-303*[24]) hp: 2 Design features: P-303 has drain capability.
Caustic Makeup Tank Agitator (AGT-303)	To provide mixing of Caustic Makeup Tank (TK-303) contents to produce a homogenous blend. hp: 1

3.3.3 Stream Data

See Table 3-3 for a listing of Streams.

Table 3-3. Streams

Stream	Description
50 wt% NaOH	50 wt% NaOH is delivered by tanker truck to the CCA via the Receiving Dock. This is fed to dilution tanks for use in SWPF, the main flush header, and the CSSX flush header, if required. Properties: 1.53 specific gravity (s.g.) (M-CLC-J-00143, *SWPF Mass Balance Model Calculations as a Result of Nitric Acid Replacing Oxalic Acid*[25])
Process Water	Process water is used in the Caustic Dilution Feed Tank (TK-108) to dilute 50 wt% NaOH. Properties: 1.00 s.g. (M-CLC-J-00143[25])
DI Water	DI water is used in the Filter Cleaning Caustic Tank (TK-107) and the Caustic Makeup Tank (TK-303) to dilute 50 wt% NaOH. Properties: 1.00 s.g. (M-CLC-J-00143[25])
Dilute Caustic	1.66M NaOH solution used to adjust the molarity of liquid radioactive waste in AST-A (TK-101) from 6.44M Na^+ to 5.6M Na^+ concentration. Properties: 1.07 s.g. (M-CLC-J-00143[25])
Filter Cleaning Caustic	1.0M (or 1.66M) NaOH solution used to chemically clean the filters. Properties: 1.04 (1.07) s.g. (M-CLC-J-00143[25])
Caustic Wash	0.01 - 0.3M NaOH solution used in the wash contactors of the CSSX process. Properties: 1.01 s.g. (M-CLC-J-00143[25])
Caustic Scrub	0.025M NaOH solution used in the scrub contactors of the CSSX process when operating with NGS. Properties: 1.0 s.g. (M-CLC-J-00221, *SWPF Mass Balance model Calculations as a result of Deployment of Next Generation Solvent (NGS) Deployment*[26])

3.3.4 Physical Location and Layout

The Caustic Receipt Tank (TK-302), Caustic Makeup Tank (TK-303), Caustic Dilution Feed Tank (TK-108), Filter Cleaning Caustic Tank (TK-107), and associated pumps are surrounded by a common dike to contain any leakage from the tanks or associated piping. This diked area is called the Caustic Area and is located in the northern part of the CCA.

3.3.5 System Control Features

3.3.5.1 System Monitoring

The CCA Systems normally operate with minimal Operator intervention. Instrumentation is provided to monitor the status of the system and initiate correct action, if necessary. Remote alarm indications are provided to the Distributed Control System (DCS).

Caustic Receipt Tank (TK-302)

- Tank level is continuously monitored, using redundant instrumentation. Audible and visual high level alarms are also generated locally at the CCA Receiving Dock.
- Tank temperature is continuously monitored, using a temperature element inserted into a thermowell. Temperature is controlled by using the Caustic Receipt Tank Heater (HTR-302). Tank temperature is also monitored locally through the use of an element inserted into a thermowell.
- The Caustic Transfer Pump (P-302) has instrumentation to monitor and control pump speed and discharge pressure.
- Magnetic or mass flow meters are installed in the process line drops to the various tanks.

Caustic Dilution Feed Tank (TK-108)

- Tank level is continuously monitored.
- Tank temperature is monitored locally through the use of an element inserted into a thermowell.
- An element in the recirculation line provides density indication and controls automatic valves in the water and caustic inlet lines. The Caustic Dilution Pump (P-108) has instrumentation to monitor pump discharge pressure.
- A magnetic flow meter is installed on the discharge side of the P-108.
- The Caustic Dilution Feed Tank Agitator (AGT-108) speed is controlled by the DCS.

Filter Cleaning Caustic Tank (TK-107)

- Tank level is continuously monitored.

- Tank temperature is continuously monitored, using an element inserted into a thermowell. Temperature is controlled by using the Filter Cleaning Caustic Heater (HTR-107).
- A conductivity element controls automatic valves in the water and caustic inlet lines. The Filter Cleaning Caustic Transfer Pump (P-107) has instrumentation to monitor and control pump speed. Pump discharge pressure can be monitored from the DCS.
- A magnetic flow meter is installed on the discharge side of P-107.
- The Filter Cleaning Caustic Tank Agitator (AGT-107) speed is input by the Operator and monitored by the DCS.

Caustic Makeup Tank (TK-303)

- Tank level is continuously monitored. Tank temperature is monitored locally through the use of an element inserted into a thermowell.
- A conductivity element controls automatic valves in the water and caustic inlet lines. The Caustic Makeup Transfer Pump (P-303) has instrumentation to monitor pump discharge pressure
- The Caustic Tank Makeup Tank Agitator (AGT-303) speed is input by the Operator and monitored by the DCS.
- A magnetic flow meter is installed on the discharge side of P-303.

See Table 3-4 for a listing of instruments.

Table 3-4. System Monitoring Instruments

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
Caustic Receipt Tank (TK-302) Instruments			
LIT-2402	J-JZ-J-00058, *SWPF LI-2402 Caustic Receipt Tank Level*[27]	Caustic Receipt Tank (TK-302) Liquid Level	gallons
LIT-2412	J-JZ-J-00059, *SWPF LI-2412 Caustic Receipt Tank Level*[28]	Caustic Receipt Tank (TK-302) Liquid Level	gallons
TE-2411	J-JZ-J-00578, *SWPF TIC-2411 Caustic Receipt Tank Temperature*[29]	Caustic Receipt Tank (TK-302) Liquid Temperature	°F
P-302	n/a	Pump Status	Run/Off
FE-2425	J-JZ-J-00577, *SWPF FI-2425 NaOH to Neutralization Tank Flow*[30]	P-302 Discharge Flow Rate to the Neutralization Tank (TK-317)	gpm

Table 3-4. System Monitoring Instruments (cont.)

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
FE-2424	J-JZ-J-00576, *SWPF FI-2424 NaOH to Caustic Makeup Tank Flow*[31]	P-302 Discharge Flow Rate to the Caustic Makeup Tank (TK-303)	gpm
FE-2421	J-JZ-J-00575, *SWPF FI-2421 NaOH to Caustic Dilution Tank Flow*[32]	P-302 Discharge Flow Rate to the Caustic Dilution Feed Tank (TK-108)	gpm
FE-2420	J-JZ-J-00574, *SWPF FI-2420 NaOH to Filter Lean Caustic Tank Flow*[33]	P-302 Discharge Flow Rate to the Filter Cleaning Caustic Tank (TK-107)	gpm
PI-2413	J-JZ-J-01380, *SWPF PI-2413 Caustic Receipt Tank Xfer Pump Pressure*[34]	P-302 Discharge Pressure	Pounds per square inch gauge (psig)
HV-2410	n/a	Valve Position	Open/Closed
TI-2415	n/a	Caustic Receipt Tank Liquid Temperature	°F
Caustic Dilution Feed Tank (TK-108) Instruments			
LIT-2392	J-JZ-J-00057, *SWPF LI-2392 Caustic Dilution Feed Tank Level*[35]	Caustic Dilution Feed Tank (TK-108) Liquid Level	gallons
P-108	n/a	Pump Status	Run/Off
FE-2395	J-JZ-J-00624, *SWPF FI-2395 Caustic Dilution Xfer Flow*[36]	P-108 Discharge Flow rate to the AST-A (TK-101)	gpm
JA-2394	n/a	AGT-108 Current	Ampere (amp)
AGT-108	n/a	Agitator Status	Run/Off
SC-2394	J-JZ-J-00625, *SWPF SIC-2394 Caustic Dilution Feed Tank Agitator Speed*[37]	AGT-108 Speed	0-100%
DE-2392	J-JZ-J-00623, *SWPF DI-2392 Caustic Dilution Feed Tk Density*[38]	Caustic Dilution Feed Tank (TK-108) Liquid Density	S.g.
DV-2392A	n/a	Valve Position	Open/Closed
DV-2392B	n/a	Valve Position	Open/Closed
PI-2382	J-JZ-J-01379, *SWPF PI-2382 Caustic Dilution Xfer Pump Pressure*[39]	P-108 Discharge Pressure	psig
TI-2393	n/a	Caustic Dilution Feed Tank (TK-108) Liquid Temperature	°F

Table 3-4. System Monitoring Instruments (cont.)

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
Filter Cleaning Caustic Tank (TK-107) Instruments			
LIT-2356	J-JZ-J-00056, *SWPF LI-2356 Filter Cleaning Caustic Tank Level*[40]	Filter Cleaning Caustic Tank (TK-107) Liquid Level	gallons
TE-2352	J-JZ-J-00562, *SWPF TIC-2352 Filter Cleaning Caustic Tank Temp*[41]	Filter Cleaning Caustic Tank (TK-107) Temperature	°F
P-107	n/a	Pump Status	Run/Off
FE-2359	J-JZ-J-00560, *SWPF FI-2359 Filter Cleaning Caustic Xfer Pump Flow*[42]	P-107 Discharge Flow Rate to CSDT-A (TK-103)/ CSDT-B (TK-223)	gpm
AGT-107	n/a	Agitator Status	Run/Off
SC-2350	J-JZ-J-00561, *SWPF SIC-2350 Filter Cleaning Caustic Tk Agitator Speed*[43]	AGT-107 Speed	0-100%
JA-2350	n/a	AGT-107 Current	amp
CE-2354	J-JZ-J-00559, *SWPF CIC-2354 Filter Cleaning Caustic Tank Conductivity*[44]	Tank Liquid Conductivity	Measure of Conductivity per centimeter (mhos/cm)
CV-2354A	n/a	Valve Position	Open/Closed
CV-2354B	n/a	Valve Position	Open/Closed
PI-2357	J-JZ-J-01378, *SWPF PI-2357 Filter Cleaning Caustic Xfer Pump Pressure*[45]	P-107 Discharge pressure	psig
HV-2397	n/a	Valve Position	Open/Closed

Table 3-4. System Monitoring Instruments (cont.)

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
Caustic Makeup Tank (TK-303) Instruments			
LIT-2437	J-JZ-J-00060, *SWPF LI-2437 Caustic Makeup Tank Level*[46]	Caustic Makeup Tank (TK-303) Liquid Level	gallons
P-303	n/a	P-303 Status	Run/Off
TI-2435	n/a	Caustic Makeup Tank (TK-303) Liquid Temperature	°F
HV-2441	n/a	Valve Position	Open/Closed
CE-2430	J-JZ-J-00626, *SWPF CI-2430 Caustic Makeup Tk Conductivity*[47]	Tank Liquid Conductivity	mhos/cm
HV-2430A	n/a	Valve Position	Open/Closed
HV-2430B	n/a	Valve Position	Open/Closed
JA-2434	n/a	AGT-303 Current	amp
AGT-303	n/a	Agitator Status	Run/Off
SC-2434	J-JZ-J-00628, *SWPF SIC-2434 Caustic Makeup Tank Agitator Speed*[48]	AGT-303 Speed	0-100%
PI-2439	J-JZ-J-01381, *SWPF PI-2439 Caustic Makeup Tank Xfer Pump Pressure*[49]	P-303 discharge pressure	psig
FE-2440	J-JZ-J-00627, *SWPF FI-2440 Caustic Makeup Xfer Flow*[50]	P-303 Discharge Flow Rate	gpm

3.3.5.2 Control Functions

Table 3-5 is a list of the control loops for the Caustic System.

Table 3-5. Control Loops

Loop Number	Scale Sheet	Controlled Variable	Set Point
TIC-2411	J-JZ-J-00578[29]	Caustic Receipt Tank (TK-302) Temperature	90°F per J-JZ-J-00578[29]
TIC-2352	J-JZ-J-00562[41]	Filter Cleaning Caustic Tank (TK-107) Liquid Temperature	104°F per J-JZ-J-00562[41]
FIC-2440	J-JZ-J-00627[50]	Caustic Makeup Pump Flow	Operator-entered
FIC-2416	N/A	Caustic Transfer Pump Flow	Operator-entered

3.4 Operations

3.4.1 Initial Configuration

The caustic system supports process operations and chemical cleaning requirements of the SWPF. The Caustic Receipt Tank (TK-302) will be full of 50 wt% NaOH, the Caustic Dilution Feed Tank (TK-108) will be empty, and the Caustic Makeup Tank (TK-303) will be empty.

3.4.2 System Startup

Each tank and its associated equipment can be considered to be a subsystem and can be started up independently.

Caustic Receipt Tank (TK-302)

Equipment is started by the SWPF Operator via the control system. The tank immersion heater is started when the tank temperature contents go below the desired storage temperature and a minimum tank level has been exceeded. The pump is started when the tank level exceeds the low level. The heater operates for a set time period before the pump is started. Pump P-302 (Caustic Transfer Pump) continues to operate in recirculation mode as long as the Caustic Receipt Tank (TK-302) is above the level required for mixing.

Caustic Dilution Feed Tank (TK-108)

Batch makeup is initiated by the SWPF Operator via the control system. Initially, a set volume of process water is added to the Caustic Dilution Feed Tank (TK-108) by opening the actuated supply valve. The corresponding volume of 50 wt% NaOH, determined by ratio, is added to the Caustic Dilution Feed Tank (TK-108), also by opening the actuated supply valve.

A minimum level is required in the Caustic Dilution Feed Tank (TK-108) before the Caustic Dilution Transfer Pump (P-108) is started in recycle mode. A higher, predetermined level allows the mechanical agitator Caustic Dilution Feed Tank Agitator (AGT-108) to be operated. This level is set to ensure that the impeller blades are fully submerged. The agitator is operating continuously during this period.

Pump P-108 operates in recycle mode for a set time period, and then the solution density is monitored by a meter installed in the recirculation line. The measured value is compared with a set point value for 1.66M NaOH, and fine tuning can take place by opening either the process water or 50 wt% NaOH actuated supply valves for a set time period. A minimum time period is set before the valves can be re-opened, in order to allow sufficient time for the mini-batch addition to take effect and be monitored by the control system, thereby minimizing overshoot.

During batch makeup operations, all other discharge routes from P-108 are isolated.

Filter Cleaning Caustic Tank (TK-107)

The Filter Cleaning Caustic Tank (TK-107) is used to make up either a 0.025M or 1.0M NaOH by diluting 50 wt% NaOH with DI water. The 1.0M NaOH is made up and transferred to either CSDT-A (TK-103) or CSDT-B (TK-223) for use in chemical cleaning of the filters. The 0.025M NaOH is made up and transferred to the Caustic Scrub Feed Tank (TK-730) for use in CSSX process when operating with NGS. All equipment is manually started by the SWPF Plant Operator via the control system.

Initially, a set volume of DI water is added to the Filter Cleaning Caustic Tank (TK-107) by opening the actuated supply valve. The corresponding volume of 50 wt% NaOH, determined by ratio, is added to the tank also by opening the actuated supply valve.

A predetermined level allows the agitator to be operated and will be set to ensure that the agitator impeller is fully submerged. The agitator is operated continuously during this period.

The Filter Cleaning Caustic Tank (TK-107) contents are mixed for a predetermined period, and then the solution conductivity is monitored by a meter installed in the tank. The measured value is compared with a set point value for the desired NaOH solution concentration, and fine adjustment of the solution concentration can take place by opening either the DI water or 50 wt% NaOH supply valves for a set time period. A minimum time period is set before the valves can be re-opened, in order to allow sufficient time for the mini-batch addition to take effect and be monitored by the control system, thereby minimizing overshoot.

During batch makeup, the transfer pump P-107 (Filter Cleaning Caustic Transfer Pump) operation is inhibited.

Caustic Makeup Tank (TK-303)

The Caustic Makeup Tank (TK-303) is used to make up either a 0.025M or 0.3M NaOH by diluting 50 wt% NaOH with DI water. The 0.3M NaOH is made up and transferred to the Caustic Wash Tank (TK-204) for use in the CSSX process. The 0.025M NaOH is made up and transferred to the Caustic Scrub Feed Tank (TK-730) for use in CSSX process when operating with NGS.

The startup procedure is manually initiated by the SWPF Plant Operator via the control system. Initially, a set volume of DI water is added to the Caustic Makeup Tank (TK-303) by opening the actuated supply valve. The corresponding volume of 50 wt% NaOH, determined by ratio, is added to the Caustic Makeup Tank (TK-303), also by opening the actuated supply valve. The agitator starts at a level that ensures the impeller blades are submerged. The agitator is operated continuously during this period.

The Caustic Makeup Tank (TK-303) contents are mixed for a predetermined period, and then the solution conductivity is monitored by an instrument installed in the tank. The measured value is compared with a set point value for the desired NaOH solution concentration , and fine adjustments can take place by opening the DI water or 50 wt% NaOH supply valves for a short

set period of time. A minimum period is set before the valves can be re-opened, in order to allow sufficient time for the mini-batch addition to take effect and be monitored by the control system, thereby minimizing overshoot.

During batch makeup, the Caustic Makeup Transfer Pump (P-303) is prevented from operating.

3.4.3 Normal Operations

During normal operation, subsystems are either initiated by the SWPF Plant Operator or automatically by the control system.

Caustic Receipt Tank (TK-302)

During normal operation, Pump P-302 (Caustic Transfer Pump) operates in recirculation mode. When a downstream tank requires 50 wt% NaOH, the respective actuated supply valve is opened and 50 wt% NaOH is delivered to the required tank. The amount transferred is monitored and totalized. The actuated valve closes when the required volume has been delivered. Only one transfer is permitted at any one time.

The Caustic Receipt Tank Heater (HTR-302) installed in the tank only operates when fully submerged, and maintains the caustic temperature. All lines into and out of the Caustic Receipt Tank (TK-302) are heat-traced to ensure that the caustic stays above its freezing temperature.

A tanker truck delivers to the Caustic Receipt Tank (TK-302) via the CCA Receiving Dock. Tanker truck unloading will take place, using detailed operating procedures. An actuated isolation valve is located in the supply line to the Caustic Receipt Tank (TK-302) and only opens if sufficient tank capacity is available to receive a complete tanker truck delivery. On completion of tanker truck emptying, the valve is closed.

The process sequences for the Caustic system are included in Section 3.0 of X-PCD-J-00002, *SWPF Automation Functional Control Sequence for: Cold Chemicals Area*[51].

Caustic Dilution Feed Tank (TK-108)

The 1.66M NaOH is primarily used in AST-A (TK-101) as part of the batch makeup process when adjusting salt waste feed Na^+ molarity from 6.4M to 5.6M. During the AST-A (TK-101) batch makeup process, the control system algorithm determines the amounts of waste water recycle from ASDT (TK-601), wash water from the Wash Water Hold Tank (TK-105), and 1.66M NaOH to be added to achieve 5.6M concentration in AST-A (TK-101). The 1.66M NaOH is added via two different routes and at two different times of the addition process.

First, after MST has been added to AST-A (TK-101), a minimum volume of 1.66M NaOH is added via the MST Transfer Pump (P-311) to flush the MST and transfer line. Later, when other additions to AST-A (TK-101) are completed, the remaining required volume of 1.66M NaOH is transferred via P-108. This is done by opening the actuated valve, starting P-108, and monitoring and totalizing the flow delivered. The pump operates until a low-low level is reached in the tank, a high-high level is achieved in either AST-A (TK-101), or until the required amount of caustic

has been transferred. Additionally, 1.66M caustic may be transferred from TK-108 to TK-107 in the case where there is insufficient volume of 1.0M NaOH for filter cleaning.

Filter Cleaning Caustic Tank (TK-107)

The Filter Cleaning Caustic Tank (TK-107) may be used to makeup either a 1.0M or 0.025M NaOH solution.

The 1.0M NaOH is used in ASP and AFP for chemical cleaning of the CFFs. The Filter Cleaning Caustic Tank (TK-107) is equipped with an immersion heater to heat the tank contents to improve cleaning effectiveness of the filters. The heater is operated by the SWPF Plant Operator via the control system, and the heater is controlled by a temperature instrument located in the Filter Cleaning Caustic Tank (TK-107). A minimum level is required in the Filter Cleaning Caustic Tank (TK-107) before the heater can be started. The level will ensure that the heater is fully submerged.

Once the batch makeup is complete and the required temperature achieved, transfer is initiated by the SWPF Operator, by selecting the respective CSDT (CSDT-A [TK-103] or CSDT-B [TK-223]). The control system opens the required discharge routing valve and Pump P-107 is started. The pump operates until a low-low level is reached in the tank, a high-high level is achieved in either CSDT-A (TK-103) or CSDT-B (TK-223) or until the required amount of caustic has been transferred. If the available volume of 1.0M NaOH in TK-107 is not sufficient for filter cleaning, then the additional required caustic will be sourced from TK-108. In this case, 1.66M NaOH will be transferred from TK-108 to TK-107, and then from TK-107 to either CSDT-A or CSDT-B.

The 0.025M NaOH solution is transferred to the Caustic Scrub Feed Tank (TK-730) for use in scrub contactors when the CSSX process is operating with NGS. The heater is not operated during makeup of the 0.025M NaOH. Once the batch makeup is complete, transfer is initiated by the SWPF Operator. The control system opens the required discharge routing valve and Pump P-107 is started. The pump operates until a low-low level is reached in the tank, a high-high level is achieved in the Caustic Scrub Feed Tank (TK-730) or until the required amount of caustic has been transferred.

Caustic Makeup Tank (TK-303)

The Caustic Makeup Tank (TK-303) may be used to makeup either a 0.01 – 0.3M or 0.025M NaOH Solution.

The 0.01 – 0.3M NaOH is transferred into the Caustic Wash Tank (TK-204) for use in the caustic wash stages of the CSSX process. Once the batch makeup is complete, transfer is initiated by the SWPF Operator. The control system opens the discharge routing valve and Pump P-303 is started. The pump operates until the required amount of caustic has been transferred or a high-high level is achieved in the Caustic Wash Tank (TK-204). DI water is also used as needed to prepare a solution with a range of 0.01 – 0.3M NaOH in the Caustic Wash Tank (TK-204).

When the wash stage aqueous outlet Hydrogen Ion Concentration (pH) decreases to a predetermined level, the contents of the Caustic Wash Tank (TK-204) will be transferred to the Decontaminated Salt Solution Stilling Tank (TK-211). The wash solution will then be replaced with 0.3M NaOH provided by the Caustic Makeup Tank (TK-303). Solvent recovery is also performed by adding caustic wash from the Caustic Makeup Tank (TK-303). In addition, if the caustic wash solution from the wash contactors indicates a high gamma activity, the contents of the Caustic Wash Tank (TK-204) are transferred to the SDT (TK-208). The Caustic Wash Tank (TK-204) is then refilled with fresh caustic from the Caustic Makeup Tank (TK-303).

The 0.025M NaOH solution is transferred to the Caustic Scrub Feed Tank (TK-730) for use in scrub contactors when the CSSX process is operating with NGS. Once the batch makeup is complete, transfer is initiated by the SWPF Operator. The control system opens the required discharge routing valve and Pump P-303 is started. The pump operates until a low-low level is reached in the tank, a high-high level is achieved in the Caustic Scrub Feed Tank (TK-730) or until the required amount of caustic has been transferred.

3.4.4 Off-Normal and Recovery Operation

If a batch of caustic is received or mixed that is not at the desired concentration, the affected tank needs to be either adjusted or discarded (e.g., neutralized and drained).

The Caustic Receipt Tank (TK-302) overflow is routed directly to the CCA Caustic Sump. Other tank overflows will go into the diked area before flowing into the sump of the Caustic Area where the tanks are contained.

Table 3-6 shows equipment and component failures.

Table 3-6. Equipment and Component Failure

Condition	Detection	Immediate Action	Recovery
Caustic Receipt Tank (TK-302)			
Control Valve Failure (HV-2410)	Valve status and level indication on DCS	Stop transfer from CCA Receiving Dock	Complete repairs.
Heater Failure/Malfunction (HTR-302)	High and high-high temperature alarms (TIC-2411) Low and low-low temperature alarms (TIC-2411)	Heater shutdown. Stop any transfers out of tank.	Drain Tank and complete repairs. Drain Tank and complete repairs.
Pump Failure (P-302)	Pump status indication on DCS; low-flow alarms (FI-2420, FI-2421, FI-2424, FI-2425)	None	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

Table 3-6. Equipment and Component Failure (cont.)

Condition	Detection	Immediate Action	Recovery
Caustic Receipt Tank (TK-302) level (LIT-2402 and LIT-2412) not changing during transfer	Level Indicators (LI-2402 and LI-2412)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
High level in the Caustic Receipt Tank (TK-302) (LIT-2402 and LIT-2412)	Alarm in DCS	Perform Hold Logic for Running Sequence (Caustic Receipt).	CR Operator to investigate cause of problem.
Low level in the Caustic Receipt Tank (TK-302) (LIT-2402 and LIT-2412)	Alarm in DCS	Perform Stopping logic for Running Sequence (Caustic Distribution).	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Caustic Dilution Feed Tank (TK-108)			
Control Valve Failure (DV-2392A/B and HV-2385)	Low and low-low density alarms on DCS (DIC-2392 & HIS-2385)	Stop transfers into tank.	Complete repairs.
Pump failure (P-108)	Pump status indication and low flow alarm on DCS; (FI-2395)	None	Complete repairs.
Agitator failure (AGT-108)	Current level outside of operating range (JA-2394)	None	Drain the vessel to remove the agitator for repairs/replacement.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Process Water System status is Unavailable	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Caustic Dilution Feed Tank (TK-108) level (LIT-2392) greater than Caustic Dilution Feed Tank (TK-108) maximum working level	DCS level indication (LI-2392)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

Table 3-6. Equipment and Component Failure (cont.)

Condition	Detection	Immediate Action	Recovery
Filter Cleaning Caustic Tank (TK-107)			
Control valve failure (CV-2354A/B)	Low and low-low conductivity alarms on DCS (CIC-2354)	Stop transfers into tank.	Complete repairs.
Heater failure/malfunction (HTR-107)	High and high-high temperature alarms (TIC-2352) Low and low-low temperature alarms (TIC-2352)	Heater shutdown. Stop any transfers out of tank.	Complete repairs. Complete repairs.
Pump failure (P-107)	Pump status indication and low flow alarm on DCS; (FI-2359)	None	Complete repairs.
Agitator failure (AGT-107)	Current level outside of operating range (JA-2350)	None	Drain the vessel to remove the agitator for repairs/replacement.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
DI Water System status is Unavailable	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Filter Cleaning Caustic Tank (TK-107) high temperature (TIT-2352)	DCS level indication (TI-2352)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Filter Cleaning Caustic Tank (TK-107) level (LIT-2356) greater than Filter Cleaning Caustic Tank (TK-107) maximum working level	DCS level indication (LI-2356)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

Table 3-6. Equipment and Component Failure (cont.)

Condition	Detection	Immediate Action	Recovery
Caustic Makeup Tank (TK-303)			
Control valve failure (HV-2430A/B)	Valve status and conductivity indication on DCS (HIS-2430A/B, CIC-2430)	Stop transfers into tank.	Complete repairs.
Pump failure (P-303)	Pump status on DCS; (FI-2359)	None	Complete repairs.
Agitator failure (AGT-303)	Current level outside of operating range (JA-2434)	None	Drain the vessel to remove the agitator for repairs/replacement.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
DI Water System status is Unavailable	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Caustic Makeup Tank (TK-303) level (LIT-2437) greater than Caustic Makeup Tank (TK-303) maximum working level	DCS level indication (LI-2437)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

3.4.5 System Shutdown

Caustic Receipt Tank (TK-302)

The Caustic Transfer Pump (P-302) is shut down. The tanker delivery-actuated supply valve is closed. The tank immersion heater continues to operate, provided it is submerged to prevent the contents from freezing. The heater can be shut down by the SWPF Operator, but may require the Caustic Receipt Tank (TK-302) to be drained to prevent the contents from freezing.

Caustic Dilution Feed Tank (TK-108)

The Caustic Dilution Feed Tank Agitator (AG-108) and the Caustic Dilution Transfer pump (P-108) is shut down. The process water and 50 wt% NaOH-actuated supply valves are closed.

Filter Cleaning Caustic Tank (TK-107)

The heater is shut down, the agitator then operates for a short pre-determined period before it is stopped, and the pump is then shut down. The DI water- and 50 wt% NaOH-actuated supply valves are closed.

Caustic Makeup Tank (TK-303)

The Caustic Makeup Transfer Pump (P-303) and the agitator are stopped. The DI water- and 50 wt% NaOH-actuated supply valves are closed.

4.0 NITRIC ACID SYSTEM DESCRIPTION

4.1 System Functions

The main uses of HNO_3 are:

- Supply the strip and scrub contactors in CSSX area when the CSSX process is operating with baseline solvent (see P-DB-J-00003[12]),
- Miscellaneous line/equipment flushes (see P-DB-J-00003[12]), and
- pH adjustment of the Neutralization Tank (TK-317) and SDT (TK-208) (see P-DB-J-00003[12]).

4.2 Operational Overview

The 20 wt% HNO_3 is delivered by tanker truck to the SWPF. From the Nitric Acid Receipt Tank (TK-304), the HNO_3 is distributed to various tanks for use in the SWPF process. A supply can be provided to the main flush distribution header and CSSX flush header.

- Nitric Acid Scrub Makeup Tank (TK-307) – 0.05M HNO_3 is made up by mixing DI water with 20 wt% HNO_3. The 0.05M HNO_3 is used by the scrub stages of the CSSX process. Scrub solution is also taken from the tank and further diluted by in-line addition of DI water to 0.001M concentration for use in the strip stages of the CSSX process. HNO_3 is used as strip and scrub solutions only when the CSSX process is operating with the baseline solvent.
- Neutralization Tank (TK-317) – 20 wt% HNO_3 is provided to the Neutralization Tank (TK-317) for use in adjusting the pH of the tank contents.

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-M6-J-0073	*SWPF Process Building Cold Chemicals Area Receiving Dock P&ID (U)*[13]
M-M6-J-0080	*SWPF Process Building Nitric Acid Receipt Tank TK-304 P&ID (U)*[52]
M-M6-J-0081	*SWPF Process Building Strip Feed Pumps 310A/B P&ID (U)* [53]
M-M6-J-0082	*SWPF Process Building- Nitric Acid Scrub Makeup Tank TK-307 P&ID(U)*[54]
M-M5-J-0011	*SWPF Cold Chemical Makeup Tank PFD (U)*[55]
M-M5-J-0012	*SWPF Solvent Extraction Strip and Scrub Feed Pumps PFD (U)*[56]

4.3.2 Major Components

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

Table 4-2. Major Components

Component	Description
Nitric Acid Receipt Tank (TK-304)	Capacity: 2,500 gallons (see M-CLC-J-00031[20]) Dimensions: 7 ft diameter x 10 ft T/T (see M-CLC-J-00031[20]) Design features: Tank overflow contains a loop seal, with a manual seal water addition connection to prevent vapor release down the overflow line. A vent sized for air breakthrough at the end of tanker truck unloading. The vent discharges on the building roof to the atmosphere.
Nitric Acid Metering Pump (P-304-1)	Transfer 20 wt% HNO_3 to the Nitric Acid Scrub Makeup Tank (TK-307) (when operating CSSX with baseline solvent only). Capacity: 0.1 gpm (see M-CLC-J-00109, *SWPF Nitric Acid Metering Pump Sizing Calculation, P-304-1*[57]) hp: 0.5
Neutralization Metering Pump (P-304-2)	Transfer 20 wt% HNO_3 to either the Neutralization Tank (TK-317), the main flush header, SDT (TK-208) or the CSSX flush header. Capacity: 60 gpm (see M-CLC-J-00110, *SWPF Neutralization Metering Pump Sizing Calculation, P-304-2*[58]) hp: 7.5
Nitric Acid Scrub Makeup Tank (TK-307)	Capacity: 2,500 gallons (see M-CLC-J-00031[20]) Dimensions: 7 ft diameter x 10 ft T/T (see M-CLC-J-00031[20]) Design features: Vent line that discharges to the CCA.

Table 4-2. Major Components (cont.)

Component	Description
Nitric Acid Scrub Makeup Tank Agitator (AGT-307)	Provide mixing of Nitric Acid Scrub Makeup Tank (TK-307) contents to produce a homogenous blend of 0.05M HNO_3 (when operating CSSX with baseline solvent only). hp: 0.75
Scrub Feed Pumps (P-309A/B)	Transfer 0.05M HNO_3 to CSSX scrub contactors (when operating CSSX with baseline solvent only). Capacity: 5 gpm (see M-CLC-J-00152: *SWPF Scrub Feed Pumps Sizing Calculation, P-309A/B*[59]) hp: 1.0
Strip Feed Pumps (P-310A/B)	Transfer 0.05M HNO_3 for in-line mixing with DI water to 0.001M for use in the CSSX strip contactors (when operating CSSX with baseline solvent only). Capacity: 0.1 gpm (see M-CLC-J-00111: *SWPF Strip Feed Pumps Sizing Calculation, P-310A/B*[60]) hp: 0.5
Strip Heater (HTR-310A/B)	Provide 0.001M HNO_3 to the CSSX strip contactor at a temperature of 91°F (when operating CSSX with baseline solvent only) (see P-DB-J-00003[12]). Heat Supply: Electric Power: 10 kW

4.3.3 Stream Data

See Table 4-3 for a listing of Streams.

Table 4-3. Streams

Stream	Description
20 wt% HNO_3	20 wt% HNO_3 is delivered by tanker truck to the CCA via the Receiving Dock. Properties: 1.12 s.g. (M-CLC-J-00143[25])
DI Water	DI water is used in the Nitric Acid Scrub Makeup Tank (TK-307) to dilute 20 wt% HNO_3 to 0.05M concentration (when operating CSSX with baseline solvent only). Properties: 1.00 s.g. (M-CLC-J-00143[25])
0.05M HNO_3	0.05M HNO_3 used to scrub the Cs-rich solvent of Na^+ and K^+ from the CSSX process (when operating CSSX with baseline solvent only). Properties: 1.00 s.g. (M-CLC-J-00143[25])
0.001M HNO_3	0.001M HNO_3 used to strip Cs from the scrubbed solvent so the solvent can be recycled by the CSSX process (when operating CSSX with baseline solvent only). Properties: 1.00 s.g. (M-CLC-J-00143[25])

4.3.4 Physical Location and Layout

The Nitric Acid Scrub Makeup Tank (TK-307), Nitric Acid Receipt Tank (TK-304), and associated pumps are located in a diked area to contain any leakage from the tanks or associated piping. This diked area is called the Nitric Acid Area and is located in the northwest portion of the CCA.

4.3.5 System Control Features

4.3.5.1 System Monitoring

Nitric Acid Receipt Tank (TK-304)

- Tank level is continuously monitored, using redundant level indicators.
- The Nitric Acid Metering Pump (P-304-1) and Neutralization Metering Pump (P-304-2) have instrumentation to monitor pump speed. The pump discharge pressures can be monitored locally. The speed of each pump is controlled by the conductivity transmitter of the respective receipt tank.
- Magnetic flow meters are installed on the discharge side of each pump.

Nitric Acid Scrub Makeup Tank (TK-307)

- Tank level is continuously monitored. The flow of DI water into the Nitric Acid Scrub Makeup Tank (TK-307) is controlled by the level of the tank.
- Tank temperature can be monitored locally through the use of an element inserted into a thermowell.
- The Scrub Feed Pumps (P-309A/B) have instrumentation to monitor pump speed.
- Magnetic flow meters are installed on the discharge sides of P-309A/B. Redundant conductivity elements control the speed of HNO_3 into the Nitric Acid Scrub Makeup Tank (TK-307).
- The Nitric Acid Scrub Makeup Tank Agitator (AGT-307) speed is controlled by the DCS.

Strip Feed Pumps (P-310A/B)

- The Strip Feed Pumps (P-310A/B) have instrumentation to monitor pump speed. The discharge pressure of the pumps can be monitored locally.
- The speed of each pump is controlled by the conductivity of the downstream solution.
- Magnetic flow meters are installed downstream of Strip Heaters (HTR-310A/B). They control the flow of DI water to the Strip In-Line Mixers (MIX-310A/B) via the Strip Water Feed Pumps (P-312-3A/B).
- Redundant conductivity instruments are located downstream of each in-line mixer.

- An element inserted into a thermowell is located downstream of each heater to continuously monitor strip feed temperature. Temperature is controlled using the Strip Heaters (HTR-310A/B).

See Table 4-4 for a listing of instruments.

Table 4-4. Instruments

Equipment/Instrument Number	Scale Sheets	Monitored Variable	Indications
Nitric Acid Receipt Tank (TK-304)			
LIT-2453	J-JZ-J-00075, *SWPF LI-2453 Nitric Acid Receipt Tank Level*[61]	Nitric Acid Receipt Tank (TK-304) Liquid level	gallons
LIT-2452	J-JZ-J-00074, *SWPF LI-2452 Nitric Acid Receipt Tank Level*[62]	Nitric Acid Receipt Tank (TK-304) Liquid level	gallons
P-304-1	n/a	Pump Status	Run/Off
SC-2523	J-JZ-J-01143, *SWPF SIC-2523 Nitric Acid Metering Pump Speed*[63]	P-304-1 Speed	0-100%
FE-2466	J-JZ-J-00580, *SWPF FI-2466 Acid to Nitric Acid Scrub Make Up Tank Flow*[64]	P-304-1 Discharge Flow Rate to the Nitric Acid Scrub Makeup Tank (TK-307)	gpm
FE-2465	J-JZ-J-00579, *SWPF FI-2465 Acid to SDT or Neut. Tank Flow*[65]	P-304-2 Discharge Flow Rate to the Neutralization Tank (TK-317)/Flush Header	gpm
P-304-2	n/a	Pump Status	Run/Off
SC-6032	J-JZ-J-01209, *SWPF SIC-6032 Neutralization Metering Pump Speed*[66]	P-304-2 Speed	0-100%
HV-2451	n/a	Valve Position	Open/Closed
PI-2463	n/a	P-304-1 Discharge Pressure	psig
PI-2462	J-JZ-J-01195, *SWPF PI-2462 Neutralization Metering Pump Disch Pressure*[67]	P-304-2 Discharge Pressure	psig
HV-2464	n/a	Valve Position	Open/Closed
LG-6024	n/a	Nitric Acid Receipt Tank (TK-304) Overflow Seal Level	inches

Table 4-4. Instruments (cont.)

Equipment/Instrument Number	Scale Sheets	Monitored Variable	Indications
Nitric Acid Scrub Makeup Tank (TK-307)			
LIT-2525	J-JZ-J-00061, *SWPF LIC-2525 Nitric Acid Scrub Makeup Tank Level*[68]	Nitric Acid Scrub Makeup Tank (TK-307) Liquid Level	gallons
TI-2522	n/a	Nitric Acid Scrub Makeup Tank (TK-307) Liquid Temperature	°F
P-309A	n/a	Pump Status	Run/Off
SC-2544	J-JZ-J-01145, *SWPF SIC-2544 Scrub Feed Pump A Speed*[69]	P-309A Speed	0-100%
FE-2544	J-JZ-J-00587, *SWPF FIC-2544 Scrub Solution Flow*[70]	P-309A Discharge Flow Rate to EXT-202B	gpm
PI-2545	J-JZ-J-01196, *SWPF PI-2545 Scrub Feed Pumps Disch Pressure*[71]	P-309A Discharge Pressure	psig
FE-2547	J-JZ-J-00588, *SWPF FIC-2547 Scrub Solution Flow*[72]	P-309B Discharge Flow Rate to EXT-202B	gpm
P-309B	n/a	Pump Status	Run/Off
SC-2547	J-JZ-J-01203, *SWPF SIC-2547 Scrub Feed Pump B Speed*[73]	P-309B Speed	0-100%
PI-2546	n/a	P-309B Discharge Pressure	psig
HV-2551	n/a	Valve Position	Open/Closed
HV-2548	n/a	Valve Position	Open/Closed
JA-2524	n/a	Agitator Current	amp
AGT-307	n/a	Agitator Status	Run/Off
SC-2524	J-JZ-J-00589, *SWPF SIC-2524 Nitric Acid Scrub Makeup Tank Agitator Speed*[74]	AGT-307 Speed	0-100%
CE-2523A/B	J-JZ-J-00586, *SWPF CIC-2523 Nitric Acid Scrub Makeup Tank Conductivity*[75]	Tank Liquid Conductivity	mhos/cm

Table 4-4. Instruments (cont.)

Equipment/Instrument Number	Scale Sheets	Monitored Variable	Indications
P-310A/B			
P-310A	n/a	Pump Status	Run/Off
SC-2485	J-JZ-J-01141, *SWPF SIC-2485 Strip Feed Pump A Speed*[76]	P-310A Speed	0-100%
PI-2487	n/a	P-3101A discharge pressure	psig
CE-2485A/B	J-JZ-J-00581, *SWPF CIC-2485 Strip Solution Conductivity*[77]	Liquid conductivity	mhos/cm
FE-2483	J-JZ-J-00583, *SWPF FIC-2483 Strip Solution Flow*[78]	P-310A Discharge Flow Rate to Stripping Contactors	gpm
HV-2488	n/a	Valve Position	Open/Closed
TE-2056	J-JZ-J-00585, *SWPF TIC-2056 Strip Solution Temp*[79]	Liquid Temperature	°F
P-310B	n/a	Pump Status	Run/Off
SC-2486	J-JZ-J-01142, *SWPF SIC-2486 Strip Feed Pump B Speed*[80]	P-310B Speed	0-100%
PI-2491	n/a	P-310B Discharge Pressure	psig
CE-2486A/B	J-JZ-J-01088, *SWPF CIC-2486 Strip Solution Conductivity*[81]	Liquid conductivity	mhos/cm
FE-2484	J-JZ-J-00584, *SWPF FIC-2484 Strip Solution Flow*[82]	P-310B Discharge Flow Rate to Stripping Contactors	gpm
HV-2490	n/a	Valve Position	Open/Closed
TE-2493	n/a	Liquid Temperature	°F
HTR-310A/B	n/a	Heater Status	Run/Off

4.3.5.2 Control Functions

Table 4-5 is a listing of the control loops for the Nitric Acid System.

Table 4-5. Control Loops

Loop Number	Scale Sheet	Controlled Variable	Set Point
SIC-2523	J-JZ-J-01143[63]	P-304-1 Speed/Flow rate	Operator-entered
SIC-6032	J-JZ-J-01209[66]	P-304-2 Speed/Flow rate	Operator-entered
PIC-2460	N/A	P-304-2 Discharge Pressure	Operator-entered
CIC-2523	J-JZ-J-00586[75]	Nitric Acid Scrub Makeup Tank (TK-307) Liquid Conductivity	Operator-entered
LIC-2525	J-JZ-J-00061[68]	Nitric Acid Scrub Makeup Tank (TK-307) Liquid Level	Operator-entered
FIC-2544	J-JZ-J-00587[70]	P-309A Speed/Flow rate	Operator-entered
FIC-2547	J-JZ-J-00588[72]	P-309B Speed/Flow rate	Operator-entered
CIC-2485	J-JZ-J-00581[77]	P-310A Discharge Liquid Conductivity/ P-310A Speed/Flow rate	Operator-entered
TIC-2056	J-JZ-J-00585[79]	P-310A Discharge Liquid Temperature	91°F per J-JZ-J-00585[79]
FIC-2483	J-JZ-J-00583[78]	P-312-3A Speed /Flow rate	Operator-entered
CIC-2486	J-JZ-J-01088[81]	P-310B Discharge Liquid Conductivity/ P-310B Speed/Flow rate	Operator-entered
FIC-2484	J-JZ-J-00584[82]	P-312-3B Speed /Flow rate	Operator-entered

4.4 Operations

4.4.1 Initial Configuration

The Nitric Acid System primarily supplies the CSSX strip and scrub contactors. The Nitric Acid Scrub Makeup Tank (TK-307) will be empty and the Nitric Acid Receipt Tank (TK-304) will be full of 20 wt% HNO_3.

4.4.2 System Startup

Nitric Acid Receipt Tank (TK-304)

Equipment is started by the SWPF Operator via the control system. Metering pumps P-304-1 and P-304-2 operation is initiated if the Nitric Acid Scrub Makeup Tank (TK-307) is above a low-low level and the CSSX process is operating with baseline solvent.

Nitric Acid Scrub Makeup Tank (TK-307)

An initial batch makeup sequence is initiated by the Operator when the SWPF has been shut down or the tank is completely empty. A set volume of DI water is added to the Nitric Acid Scrub Makeup Tank (TK-307), using P-312-1. The Operator must open the manual DI water supply valve before initiating the batch makeup sequence.

Once the DI water transfer is complete, the Operator must close the manual isolation valve on the DI water supply line from P-312-1. A corresponding amount of 20 wt% HNO_3, set by volumetric ratio, is transferred from the receipt tank, using metering pump P-304-2. The Operator must open the manual cross-over valve, and close the valve to the Neutralization Tank (TK-317) before initiating the batch makeup sequence. Note during this batch addition, slightly less than the required amount of HNO_3 is added to the tank. Then, the remainder of the HNO_3 is transferred, using P-304-1. This allows the normal makeup process to make small additions of HNO_3 to the tank, minimizing concentration overshoot.

A minimum level is required in the Nitric Acid Scrub Makeup Tank (TK-307) before the Nitric Acid Scrub Makeup Tank Agitator (AGT-307) is operated. This level is set to ensure that the impeller blades are fully submerged. The Nitric Acid Scrub Makeup Tank (TK-307) contents are mixed for a pre-determined period and the solution conductivity is monitored.

The measured conductivity is compared with a set point value for 0.05M HNO_3, and fine adjustment is carried out by adding small, fixed volumes of 20 wt% HNO_3, using P-304-1.

Once a batch of 0.05M HNO_3 is made up, the sequence is terminated and the SWPF Operator initiates the normal operation makeup sequence.

4.4.3 Normal Operations

Nitric Acid Receipt Tank (TK-304)

A tanker delivery is received via the CCA Receiving Dock. Tanker truck unloading will take place, using detailed operating procedures. An actuated isolation valve is located in the supply line to the Nitric Acid Receipt Tank (TK-304) and only opens if sufficient tank capacity is available to receive a complete tanker truck delivery. On completion of tanker truck emptying, the valve is closed.

The process sequences for the Nitric Acid system are included in Section 4.0 of X-PCD-J-00002[51].

Nitric Acid Scrub Makeup Tank (TK-307)

When the CSSX process is operating with baseline solvent, HNO_3 scrub solution is continuously used by both the strip and scrub contactors.

As the Nitric Acid Scrub Makeup Tank (TK-307) only provides one day's supply of 0.05M HNO_3 to SWPF, the tank contents will be continuously maintained at a high working level.

Once an initial batch of 0.05M HNO_3 is made up, the Operator selects normal batch makeup operations via the control system. In this mode of operation, the Nitric Acid Scrub Makeup Tank (TK-307) level and solution concentration are continuously monitored and controlled.

The Nitric Acid Scrub Makeup Tank (TK-307) level is monitored and controlled by the addition of DI water by variable speed metering pump P-312-2. The speed of the pump is varied in accordance with the rate of change in tank level.

The solution conductivity of the Nitric Acid Scrub Makeup Tank (TK-307) contents is monitored with two instruments, and a difference in measured values prompts Operator investigation. This measured value is compared with a set point for 0.05M HNO_3, and 20 wt% HNO_3 is added by variable speed metering pump P-304-1.

The agitator operates continuously during normal operation.

Strip Feed Pumps (P-310A/B)

When the CSSX process is operating with baseline solvent, the Strip Feed Pumps (P-310A/B) supply 0.05M HNO_3 to an in-line mixer. The 0.05M acid is then diluted to 0.001M with DI water.

The DI water flow rate is controlled by monitoring the total flow rate downstream of the in-line mixer. The flow rate set point is adjusted by the SWPF Plant Operator via the control system, depending on the requirements and performance of the CSSX process. The DI water pump (P-312-3A/B) drive speed is then adjusted to achieve the desired flow rate.

Conductivity of the strip is also monitored by two instruments located downstream of the in-line mixer. The two readings are compared, and a difference in measured values prompts Operator investigation. A control signal is sent to the variable speed metering pump, P-310A/B. The speed of the pump is controlled to deliver the required flow rate of 0.05M HNO_3 to the in-line mixer to achieve the correct concentration of HNO_3 (0.001M).

A Strip Heater (HTR-310A/B) is installed downstream of the in-line mixer. Temperature instruments are located farther downstream near the entry into the contactors. The instruments control heater operation. The HNO_3 strip solution is heated to 91ºF to improve its stripping performance. The heater is initiated by the control system. The heating operation can only be initiated if there is strip feed flow.

4.4.4 Off-Normal and Recovery Operation

If a batch of HNO_3 is received or mixed that is not at the desired concentration, the affected tank needs to be either adjusted or discarded (e.g., neutralized and drained).

The Nitric Acid Receipt Tank (TK-304) overflow is routed directly to the CCA Nitric Acid Sump. Nitric Acid Scrub Makeup overflows will go in the diked Nitric Acid Area before flowing into the Nitric Acid Sump.

Table 4-6 is a list of equipment and component failures.

Table 4-6. Equipment and Component Failure

Condition	Detection	Immediate Action	Recovery
Nitric Acid Receipt Tank (TK-304)			
Control valve failure (HV-2451)	Level indication and alarms on DCS (LI-2453, LI-2452)	Stop transfer from CCA Dock into tank.	Complete repairs.
Pump failure (P-304-1)	Pump status on DCS; low flow alarm (FI-2466)	Stop scrub makeup	Complete repairs.
Pump failure (P-304-2)	Pump status on DCS; low flow alarm (FI-2465)	None	Complete repairs.
Control valve failure (HV-2464)	Level indication and alarms on DCS (LI-2096, LI-2123)	Stop transfer from P-304-2 to SDT (TK-208).	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Nitric Acid Receipt Tank (TK-304) level (LIT-2452 and LIT-2453) not changing during transfer	Level Indicators (LI-2452 and LI-2453)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
High level in Nitric Acid Receipt Tank (TK-304) (LIT-2452 and LIT-2453)	Alarm in DCS	Perform Hold Logic for Running Sequence (Nitric Acid Receipt).	CR Operator to investigate cause of problem.
Low level in Nitric Acid Receipt Tank (TK-304) (LIT-2452 and LIT-2453)	Alarm in DCS	Perform Stopping logic for Running Sequence (Nitric Acid Distribution).	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

Table 4-6. Equipment and Component Failure (cont.)

Condition	Detection	Immediate Action	Recovery
Nitric Acid Scrub Makeup Tank (TK-307)			
Pump failure (P-309A)	Pump status and low flow alarm on DCS; (FIC-2544)	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Pump failure (P-309B)	Pump status and low flow alarm on DCS; (FIC-2547)	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Agitator failure (AGT-307)	Current level outside of operating range (JA-2524)	None	Drain the vessel to remove the agitator for repairs/replacement.
Control valve failure (HV-2551)	Valve status on DCS	Switch to the alternate pump.	Complete repairs.
Control valve failure (HV-2548)	Valve status on DCS	Switch to the alternate pump.	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
DI Water System status is Unavailable	DCS status indication	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
Nitric Acid Scrub Makeup Tank (TK-307) level (LIT-2525) greater than Nitric Acid Scrub Makeup Tank (TK-307) maximum working level	DCS level indication (LI-2525)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Nitric Acid Receipt Tank (TK-304) low low level (LIT-2452 and LIT-2453)	DCS level indication (LI-2452 and LI-2453)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
P-310A/B			
Pump failure (P-310A)	Pump status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.
Pump failure (P-310B)	Pump status on DCS	Switch to the alternate pump (automatic switchover feature is enabled).	Complete repairs.

Table 4-6. Equipment and Component Failure (cont.)

Condition	Detection	Immediate Action	Recovery
Control valve failure (HV-2488)	Valve status on DCS (HIS-2488)	Switch to the alternate pump	Complete repairs.
Control valve failure (HV-2490)	Valve status on DCS (HIS-2490)	Switch to the alternate pump	Complete repairs.
Heater failure/malfunction (HTR-310A)	Solution temperature indication and alarm on DCS (TIC-2056)	Switch to the alternate pump	Complete repairs.
Heater failure/malfunction (HTR-310B)	Solution temperature indication and alarm on DCS (TIC-2056)	Switch to the alternate pump	Complete repairs.

4.4.5 System Shutdown

Nitric Acid Receipt Tank (TK-304)

For a normal shutdown, the metering pumps P-304-1 and P-304-2 are stopped and the tanker truck delivery-actuated supply valve is closed.

Nitric Acid Scrub Makeup Tank (TK-307)

The Nitric Acid Strip Heaters (HTR-310A/B) are shut down. The Strip Feed Pumps (P-310A/B) and Strip Water Feed Pumps (P-312-3A/B) are stopped. The Scrub Feed Pumps (P-309A/B) are also stopped.

In-feeds from the Nitric Acid Metering Pump (P-304-1) and Scrub Water Feed Pump (P-312-2) are stopped and, finally, the tank agitator is shut down.

5.0 MST SYSTEM DESCRIPTION

5.1 System Functions

The SWPF process uses MST for adsorption of Sr and actinides from the salt waste feed stream to the plant (see P-DB-J-00003[12]). Each batch of salt waste has an MST strike in AST-A (TK-101). If, after processing, Sr and actinide levels in the salt waste exceed the Saltstone Waste Acceptance Criteria (WAC), an additional MST strike is performed in AST-B (TK-221) (see P-DB-J-00003[12]).

5.2 Operational Overview

MST is delivered to the SWPF in 55-gallon drums. A drum tumbler and mechanical agitator are provided to mix and agitate the MST in the drums prior to transfer to the MST Storage Tank (TK-311). The MST is transferred to the MST Storage Tank (TK-311), using a drum pump.

MST is metered to AST-A (TK-101) and AST-B (TK-221) (during multiple-strike operation) and is controlled by the main AST batch makeup control sequences. Mixing capability is provided in the tank to ensure homogeneity and prevent settling of the MST in the tank.

MST Storage Tank (TK-311)

The MST Storage Tank (TK-311) provides approximately a two-week supply of MST when the SWPF is operating in single-strike mode. This is based on a usage of 72 gallons per batch processed in AST-A (TK-101).

The tank has a bottom discharge with a ram seal valve, and is continuously agitated in order to minimize solids settlement and potential blockage.

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-M6-J-0074	*SWPF Process Building MST Storage Tank TK-311 P&ID (U)*[83]
M-M5-J-0005	*SWPF Cold Chemical Makeup for Filter Cleaning and Feed Adjustment PFD (U)*[18]

5.3.2 Major Components

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

Table 5-2. Major Components

Component	Description
MST Drum Agitator (AGT-311-1)	To provide a means for agitating the MST drum contents, prior to drum pump transfer to the MST Storage Tank (TK-311). hp: 0.5
MST Drum Tumbler (DT-311)	To provide a means for rolling a sealed drum of MST in order to fluidize the drum contents in preparation for pump transfer to the MST Storage Tank (TK-311). hp: 1.0
MST Drum Pump (P-311-1)	To transfer MST from the supply drum to the MST Storage Tank (TK-311) and dilute caustic through the MST supply line in order to flush the line of MST into AST-A (TK-101) or AST-B (TK-221). Alternately, P-311-1 may be used to transfer MST from the supply drum to either AST-A (TK-101) or AST-B (TK-221). Capacity: 5 gpm Drive Pneumatic
MST Storage Tank (TK-311)	Capacity: 1,000 gallons (see M-CLC-J-00031[20]) Dimensions: 5 ft diameter x 7 ft [T/T] (see M-CLC-J-00031[20]) Design features: Vent line discharges to the CCA Bottom drain with ram seal valve Spray bar to spray down tank internals
MST Storage Tank Agitator (AGT-311)	To maintain 15 wt% MST in suspension in the storage tank for pump transfer to AST-A (TK-101) or AST-B (TK-221). hp: 0.75
MST Transfer Pump (P-311)	To transfer a batch of MST to either AST-A (TK-101) or AST-B (TK-221) as part of the actinide adsorption process. Capacity: 5 gpm (see M-CLC-J-00105, *SWPF MST Transfer Pump Sizing Calculation, P-311*[84]) hp: 1.0

5.3.3 Stream Data

See Table 5-3 for a listing of Streams.

Table 5-3. Streams

Stream	Description
MST	MST is added to AST-A (TK-101) and AST-B (TK-221) (double-strike operation) to act as an adsorbent for Sr and actinide removal from the salt waste. Properties: 1.06 s.g. (M-CLC-J-00143[25]) 15 wt% MST

5.3.4 Physical Location and Layout

The MST Storage Tank (TK-311) and associated pump are surrounded by a dike to contain any leakage from the tank or associated piping. The tank is located in the same diked area as the Caustic tanks (see Section 3.3.4). The MST and caustic are chemically compatible, so no adverse reactions will occur.

MST Drum Tumbler (DT-311) and MST Drum Agitator (AGT-311-1) are located outside the diked Caustic Area and southwest of the MST Storage Tank (TK-311). MST Drum Pump P-311-1 is also outside the diked area and south of the MST Storage Tank (TK-311).

5.3.5 System Control Features

5.3.5.1 System Monitoring

- Tank level is continuously monitored, using non immersion (i.e., ultrasonic) detection.
- Tank temperature is monitored locally through the use of an element inserted into a thermowell.
- The MST Transfer Pump (P-311) has instrumentation to monitor pump speed. The pump discharge pressure can be monitored locally.
- Mass flow meters are installed in each discharge line of P-311 to verify the correct flow path and amount of MST added to each of the receipt tanks.
- The MST Storage Tank Agitator (AGT-311) speed is controlled by the DCS. See Table 5-4 for a listing of instruments.

Table 5-4. Instruments

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
AGT-311-1	n/a	Drum Agitator Status	Run/Off
SC-2317	n/a	AGT-311-1 Speed	0-100%
DT-311	n/a	Drum Tumbler Status	Run/Off
SC-2318	n/a	DT-311 Speed	0-100%
LIT-2331	J-JZ-J-01167, *SWPF LAHH-2331 MST Storage Tank Local Level Alarm*[85]	MST Storage Tank (TK-311) Slurry Level	gallons
HV-2319	n/a	Valve Position	Open/Closed
HV-2320	n/a	Valve Position	Open/Closed
JA-2323	n/a	AGT-311 Current	amps
AGT-311	n/a	Agitator Status	Run/Off

Table 5-4. Instruments (cont.)

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
SC-2323	J-JZ-J-00558, *SWPF SIC-2323 MST Storage Tank Agitator Speed*[86]	AGT-311 Speed	0-100%
TI-2324	n/a	MST Storage Tank (TK-311) Slurry Temperature	°F
P-311	n/a	Pump Status	Run/Off
SC-2332	J-JZ-J-01129, *SWPF SIC-2332 MST Xfer Pump Speed*[87]	P-311 Speed	0-100%
PI-2326	J-JZ-J-01194, *SWPF PI-2326 MST Xfer Pump Disch Pressure*[88]	P-311 Discharge Pressure	psig
FE-2332	J-JZ-J-00553, *SWPF FI-2332 MST Xfer Pump Flow*[89]	P-311 Discharge Flow Rate	gpm
FE-2333	J-JZ-J-00554, *SWPF FI-2333 MST Flow to AST-A*[90]	P-311 Discharge Flow Rate to AST-A (TK-101)	gpm
FE-2329	J-JZ-J-00552, *SWPF FI-2329 MST Flow to AST-B*[91]	P-311 Discharge Flow Rate to AST-B (TK-221)	gpm
HV-2328	n/a	Valve Position	Open/Closed
HV-2327	n/a	Valve Position	Open/Closed

5.3.5.2 Control Functions

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

Table 5-5. Control Loops

Loop Number	Scale Sheet	Controlled Variable	Set Point
SIC-2332	J-JZ-J-01129[87]	P-311 Flow rate	Operator-entered

5.4 Operations

5.4.1 Initial Configuration

The MST system supplies AST-A (TK-101) and AST-B (TK-221). In order for AST-A (TK-101) or AST-B (TK-221) batch makeup to take place, the MST Storage Tank (TK-311) must contain a sufficient level to allow the MST Storage Tank agitator (AGT-311) to be operated.

5.4.2 System Startup

The MST Drum Tumbler (DT-311) is located in the warehouse. The Operator will periodically evaluate the inventory of MST in the warehouse. Based on experience and the length of time that the MST has been in storage, the Operator will determine if mixing on the MST Drum Tumbler (DT-311) is needed. If required, the Operator loads a drum of MST onto the MST Drum Tumbler (DT-311) for a set period to mix the drum and disperse the drum contents.

The Operator removes the drum lid and uses the MST Drum Agitator (AGT-311-1) to further mix the drum contents. The agitator is then removed and MST Drum Pump (P-311-1) is installed. Filling of the MST Storage Tank (TK-311) is a manual operation performed by the Operator. An audible and visible alarm is generated at the Drum Pump Station to warn the Operator that the MST Storage Tank (TK-311) is full. The Operator transfers the contents from a sufficient number of drums to maintain a sufficient level in the MST Storage Tank (TK-311) to ensure that contents can be continually mixed.

The drum tumbler, agitator, and pump are all locally operated by the Operator via start / stop pushbuttons. At the end of MST Storage Tank (TK-311) filling operations, the Operator washes down all equipment.

5.4.3 Normal Operations

The MST Storage Tank agitator (AGT-311) and transfer pump are manually initiated by the SWPF Plant Operator via the control system.

When the solution in the MST Storage Tank (TK-311) rises to a pre-determined level, the agitator is started.

Transfer of MST to either AST-A (TK-101) or AST-B (TK-221) is automatically initiated by the control system, as part of the main batch makeup operational sequences. The respective actuated isolation valve is opened and the other valve is closed. The positions of both valves are monitored by the control system. When the valve positions are confirmed, the MST Storage Tank (TK-311) isolation valve is opened and the MST Transfer Pump (P-311) is started. The flow meter totalizes the amount of MST transferred, and shuts down the pump and tank isolation valve when the required amount has been pumped. Set points are adjustable by the Operator via the control system.

After MST has been added to AST-A (TK-101) or AST-B (TK-221), a minimum volume of 1.66M NaOH is added via the MST Transfer Pump (P-311) and transfer line. This ensures that all the MST is completely flushed into AST-A (TK-101) or AST-B (TK-221). An actuated supply valve is opened to P-311, and the NaOH flow is monitored and totalized (Pump P-311 operates during this period). After the set amount of NaOH has been delivered, Pump P-311 is stopped and the actuated valve is closed.

As the level falls, an alarm is raised to warn the Operator to perform manual MST Storage Tank (TK-311) filling activities. This level is set above the agitator trip level to ensure that the agitator operates continuously.

The agitator (AGT-311) trips on low level, and the transfer pump stops on low-low level. Also, high-high level in AST-A (TK-101) or AST-B (TK-221) shuts the pump down, if discharging to that particular tank.

The process sequences for the MST system are included in Section 5.0 in X-PCD-J-00002[51].

5.4.4 Off-Normal and Recovery Operation

If an out-of-specification drum is received, it will not be transferred into the MST Storage Tank (TK-311). The drum will be resealed and stored until the contents are discarded.

The MST Storage Tank (TK-311) overflows will go in the diked Caustic Acid Area. A sump is located between the Drum Pump Station and the Drum Agitation Station. Any spills that occur during the drum agitation or transfer will be contained by a spill pallet.

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

In the case where P-311 is inoperable or otherwise unavailable, P-311-1 may be used to transfer MST from the MST supply drum to either AST-A (TK-101) or AST-B (TK-221).

Table 5-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Control valve failure (HV-2319)	Valve status on DCS (HIS-2319)	Stop flush transfer.	Complete repairs.
Control valve failure (HV-2320)	Valve status on DCS (HIS-2323)	Stop transfer out of tank.	Complete repairs.
Pump failure (P-311)	Pump status and low flow alarms on DCS (HIS-2332, FI-2332, FI-2329, FI-2333)	None.	Flush pump and complete repairs.
Agitator failure (AGT-311)	Current level outside of operating range (JA-2434)	None.	Remove the agitator for repairs/replacement.
Control valve failure (HV-2327)	Valve status on DCS (HIS-2327)	Stop transfer out of tank.	Complete repairs.
Control valve failure (HV-2328)	Valve status on DCS (HIS-2327)	Stop transfer out of tank.	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
MST Storage Tank (TK-311) high level (LIT-2331)	DCS level indication (LI-2331)	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.

5.4.5 System Shutdown

For shutdown, the MST Transfer Pump (P-311) and MST Storage Tank agitator (AGT-311) are stopped. If shutdown is for an extended period, equipment and pipe work are drained and flushed.

6.0 FILTER CLEANING ACID SYSTEM DESCRIPTION

6.1 System Functions

The main uses of HNO_3 are:

- Chemical cleaning of the CFFs (see P-DB-J-00003[12]), and
- Decontamination activities (see P-DB-J-00003[12]).

6.2 Operational Overview

The HNO_3 solution is delivered by tanker truck to the SWPF. The HNO_3 is transferred to CSDT-A (TK-103) and CSDT-B (TK-223) to be used as part of the chemical cleaning process for the CFFs. A route is also provided to the Drum Off/Decon Area for decontamination activities.

6.3 Configuration Information

6.3.1 Description of System

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

Table 6-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M6-J-0073	*SWPF Process Building Cold Chemicals Area Receiving Dock P&ID*[13]
M-M6-J-0116	*SWPF Process Building – Filter Cleaning Acid Feed Tank TK-106 P&ID (U)*[92]
M-M5-J-0005	*SWPF Cold Chemical Makeup for Filter Cleaning and Feed Adjustment PFD (U)*[18]

6.3.2 Major Components

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

Table 6-2. Major Components

Component	Description
Filter Cleaning Acid Feed Tank (TK-106)	Capacity: 4,100 gallons (see M-CLC-J-00031[20]) Dimensions: 7 ft diameter x 15 ft T/T (see M-CLC-J-00031[20]) Design features: An eductor (EDT-106) to provide mixing to ensure adequate agitation of the tank contents. Loop seal to prevent vapor emissions, with a manual seal water addition connection. The tank vent discharges to the CCA roof.
Filter Cleaning Acid Transfer Pump (P-106)	To transfer a batch of HNO_3 to either CSDT-A (TK-103) or CSDT-B (TK-223) for use in the chemical cleaning of a CFF. Capacity: 50 gpm (see M-CLC-J-00010, *SWPF Acid Transfer Pump Sizing Calculation, P-106*[93]) hp: 3.0 Design features: P-106 has drain capability.

Table 6-2. Major Components (cont.)

Component	Description
Filter Cleaning Acid Feed Tank Heater (HTR-106)	To heat and maintain solution at a temperature of 104ºF (see P-DB-J-00003[12]) in Filter Cleaning Acid Feed Tank (TK-106). Type: Direct Immersion Heat Supply: Electric Power: 50 kW Design features: Heater cannot be replaced without draining the tank.

6.3.3 Stream Data

See Table 6-3 for a listing of Streams.

Table 6-3. Streams

Stream	Description
20 wt% HNO_3	HNO_3 is delivered by tanker truck to the CCA via the Receiving Dock. Properties: 1.02 s.g. (M-CLC-J-00143[25])

6.3.4 Physical Location and Layout

The Filter Cleaning Acid Feed Tank (TK-106) and associated pump are surrounded by a dike to contain any leakage from the tank or associated piping. The Filter Cleaning Acid Feed Tank (TK-106) and associated pump are the only equipment in the Filter Cleaning Acid Area. The Filter Cleaning Acid Area is located in the northeast section of the CCA.

6.3.5 System Control Features and Interlocks

6.3.5.1 System Monitoring

- Tank level is continuously monitored. Audible and visual high-high level alarms are also generated locally at the CCA Receiving Dock.
- The Filter Cleaning Acid Transfer Pump (P-106) has instrumentation to monitor pump speed. The pump discharge pressure can be monitored locally.
- A magnetic flow meter is installed on the discharge side of P-106.
- Tank temperature is monitored locally through the use of a temperature element inserted into a thermowell. Temperature is controlled by using the Filter Cleaning Acid Feed Tank Heater (HTR-106).

See Table 6-4 for a listing of instruments.

Table 6-4. Instruments

Equipment/ Instrument Number	Scale Sheet	Monitored Variable	Indications
LIT-2306	J-JZ-J-00055, *SWPF LI-2306 Filter Cleaning Acid Tank Level*[94]	Filter Cleaning Acid Feed Tank (TK-106) Liquid Level	gallons
LIT-2300	J-JZ-J-00054, *SWPF LI-2300 Filter Cleaning Acid Tank Level*[95]	Filter Cleaning Acid Feed Tank (TK-106) Liquid Level	gallons
HV-2303	n/a	Valve Position	Open/Closed
HV-2311	n/a	Valve Position	Open/Closed
TE-2307	J-JZ-J-00600, *SWPF TI-2307 Filter Cleaning Acid Feed Tank Temperature*[96]	Filter Cleaning Acid Feed Tank (TK-106) Liquid Temperature	°F
P-106	n/a	Pump Status	Run/Off
PI-2305	J-JZ-J-01193, *SWPFPI-2305 Acid Transfer Pump Disch Pressure*[97]	P-106 Discharge Pressure	psig
FE-2308	J-JZ-J-00599, *SWPF FI-2308 Filter Cleaning Acid Xfer Flow*[98]	P-106 Discharge Flow Rate to CSDT-A (TK-103)/CSDT-B (TK-223)/Drum Off Station/Decon Area Sump	gpm
LG-6023	n/a	Filter Cleaning Acid Feed Tank (TK-106) Overflow Seal Level	inches

6.3.5.2 Control Functions

Table 3-5 is a list of the control loops for the Filter Cleaning Acid System.

Table 6-5. Control Loops

Loop Number	Scale Sheet	Controlled Variable	Set Point
TIC-2307	J-JZ-J-00600[96]	Filter Cleaning Acid Feed Tank (TK-106) Temperature	104°F per J-JZ-J-00600[96]

6.4 Operations

6.4.1 Initial Configuration

Initially, the Filter Cleaning Acid Feed Tank (TK-106) is empty and the transfer pump is not in operation.

6.4.2 System Startup

There is no equipment that requires startup for storage of the filter cleaning acid in the Filter Cleaning Acid Feed Tank (TK-106).

6.4.3 Normal Operations

Transfer of filter cleaning acid to either CSDT-A (TK-103) or CSDT-B (TK-223) is initiated by the Operator via the control system. The Operator selects the appropriate CSDT to discharge to, the actuated supply valve is opened, and the Filter Cleaning Acid Transfer Pump (P-106) discharges the Filter Cleaning Acid Feed Tank (TK-106) contents to the selected CSDT. The pump is then stopped and the supply valve closed. A high-high level in the selected CSDT stops the transfer sequence.

An alternate discharge route is also available to the Drum Off/Decon Area for decontamination/washdown. Transfer through this route is a manual operation, performed by the Operator. The transfer pump and actuated supply valve are operated in manual local mode.

The Filter Cleaning Acid Feed Tank (TK-106) includes an immersion heater to heat the tank contents to 104ºF (+/- 5ºF) to improve effectiveness of cleaning the filters. The heater is operated by the SWPF Plant Operator via the control system, and the heater is controlled by a temperature instrument located in the Filter Cleaning Acid Feed Tank (TK-106). A minimum level is required in the Filter Cleaning Acid Feed Tank (TK-106) before the heater can be started. The level will ensure that the heater is fully submerged.

A tanker truck delivers to the Filter Cleaning Acid Feed Tank (TK-106) via the CCA Receiving Dock. Tanker truck unloading will take place using detailed operating instructions. An actuated isolation valve is located in the supply line to the Filter Cleaning Acid Feed Tank (TK-106), and only opens if sufficient tank capacity is available to receive a complete tanker truck delivery. On completion of tanker truck emptying, the valve is closed.

The process sequences for the Filter Cleaning Acid system are included in Section 6.0 in X-PCD-J-00002[51].

6.4.4 Off-Normal and Recovery Operation

Filter Cleaning Acid Feed Tank (TK-106) overflows will go in the diked Filter Cleaning Acid Area.

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

Table 6-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Control valve failure (HV-2303)	Valve status and level indication on DCS (HIS-2303, LI-2300)	Stop transfer from CCA Dock.	Complete repairs.
Control valve failure (HV-2311)	Valve status on DCS (HIS-2311)	Stop transfer out of tank.	Complete repairs.
Pump failure (P-106)	Pump status and low flow alarms on DCS (HIS-2304, FI-2308)	None.	Complete repairs.
Heater failure/malfunction (HTR-106)	High and high-high temperature alarms (TIC-2307)	Heater shutdown.	Drain tank and Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Filter Cleaning Acid Feed Tank (TK-106) level (LIT-2300 and LIT-2306) not changing during transfer	Level Indicators (LI-2300 and LI-2306)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
High level in Filter Cleaning Acid Feed Tank (TK-106) (LIT-2300 and LIT-2306)	Alarm in DCS	Perform Hold Logic for Running Sequence (Caustic Receipt).	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

6.4.5 System Shutdown

The heater is shut down and then the pump is shut down. Also, the tanker truck-actuated supply valve is closed.

7.0 SOLVENT MAKEUP SYSTEM DESCRIPTION

7.1 System Functions

The CSSX process uses solvent to remove Cs from the CSS (see P-DB-J-00003[12]).

7.2 Operational Overview

The CSSX process may be operated with either baseline solvent or NGS.

Baseline solvent is a specialty mix of Isopar®L, with an extractant (BOBCalixC6) at 0.007 Molar (M) concentration, a modifier (Cs-7SB) at 0.75M concentration, and a suppressant tri-n-octylamine (TOA) at 0.003M concentration.

NGS is a specialty mix of Isopar®L, with an extractant (MaxCalix) at 0.05M concentration, a modifier (Cs-7SB) at 0.5M concentration, and a suppressant [DCiTG] at 0.003M concentration (Note: These concentration values are nominal and will be adjusted by increasing the modifier concentration to achieve a nominal solvent specific gravity of 0.851 in order to preclude contactor weir height adjustments within SWPF).

The operation of equipment described in this section is applicable to both the baseline solvent and NGS.

Solvent is delivered as a pre-mixed solution in drums to the SWPF. The drum is discharged to the Solvent Makeup Tank (TK-313), from which it is transferred to the Solvent Hold Tank (SHT) (TK-202). The solvent makeup system is only used intermittently, and is operated manually by the SWPF Operator. The Solvent Makeup Tank (TK-313) provides storage for the contents of one supply drum of solvent.

Operating experience at similar facilities has shown that the Isopar constituent of solvent is lost from the CSSX system at a higher rate than the other solvent components. If determined appropriate, drums of Isopar may be substituted for the pre-mixed solvent and added to the Solvent Hold Tank (TK-202) via the Solvent Makeup System.

7.3 Configuration Information

7.3.1 Description of System

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

Table 7-1. P&IDs and PFDs

Diagram Number	Diagram Title
M-M6-J-0083	*SWPF Process Building Solvent Makeup Tank TK-313 P&ID (U)*[99]
M-M5-J-0013	*SWPF Solvent Makeup Tank PFD (U)*[100]

7.3.2 Major Components

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

Table 7-2. Major Components

Component	Description
Solvent Drum Pump (P-313-1)	To transfer solvent from the supply drum to the Solvent Makeup Tank (TK-313). Capacity: 5 gpm Drive: Pneumatic
Solvent Makeup Tank (TK-313)	Capacity: 70 gallons (see M-CLC-J-00031[20]) Dimensions: 2 ft diameter X 3 ft T/T (see M-CLC-J-00031[20]) Design features: The Solvent Makeup Tank (TK-313) is constructed of 304L stainless steel.
Solvent Makeup Transfer Pump (P-313)	To transfer solvent from the Solvent Makeup Tank (TK-313) to the SHT (TK-202). Capacity: 5 gpm (see M-CLC-J-00112, *SWPF Solvent Makeup Transfer Pump Sizing Calculation, P-313*[101]) hp: 1.0
Solvent Makeup Tank Agitator (AGT-313)	To mix Solvent Makeup Tank (TK-313) contents and provide a homogeneous solution for transfer to the SHT (TK-202). hp: 0.25

7.3.3 Stream Data

See Table 7-3 for a listing of Streams.

Table 7-3. Streams

Stream	Description
Solvent	Solvent is provided to the CSSX process for removal of Cs from the salt waste. Properties: 0.851 s.g. (P-RPT-J-00028, *SWPF Next Generation Solvent Test Report Including a Higher Concentration Waste Demonstration*[102])

7.3.4 Physical Location and Layout

The Solvent Makeup Tank (TK-313) and associated pump are located in a diked area to contain any leakage from the tank or associated piping. The Solvent Makeup Tank (TK-313) and associated pump are the only equipment in the Solvent Area. The Solvent Area is located in the northeast section of the CCA. The Solvent Makeup Tank (TK-313) is flat-bottomed with a hinged lid; therefore, no vent or overflow is required for the tank.

7.3.5 System Control Features and Interlocks

7.3.5.1 System Monitoring

The Solvent Makeup Transfer Pump (P-313) has instrumentation to monitor pump speed. The discharge pressure can be monitored locally.

See Table 7-4 for a listing of instruments.

Table 7-4. Instruments

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
SC-2581	n/a	AGT-313 Speed	0-100%
AGT-313	n/a	Agitator Status	Run/Off
P-313	n/a	Pump Status	Run/Off
PI-2583	J-JZ-J-01197, *SWPF PI-2583 Solvent Make Up Xfer Pump Disch Pressure*[103]	P-313 discharge pressure	psig

7.3.5.2 Control Functions

There are no control loops in the Solvent Makeup System. All plant operations will be controlled by the plant control system and manually initiated by the SWPF Plant Operator.

7.4 Operations

7.4.1 Initial Configuration

An adequate stock of solvent drums must be available in order to fill the SHT (TK-202) to support SWPF plant startup. Transfer of solvent to the SHT (TK-202) is via the Solvent Makeup Tank (TK-313).

7.4.2 System Startup

The makeup system is only used when the SHT (TK-202) needs to be replenished as solvent is used in the CSSX process. The frequency of use depends on the efficiency of solvent recovery equipment in the CSSX performance, and the length of time the solvent maintains its integrity before performance is affected. The SHT (TK-202) is monitored, and the contents are regularly sampled to determine whether the solvent integrity is still acceptable.

Initially, the Operator connects the Solvent Drum Pump (P-313-1) to the supply drum and the Solvent Makeup Tank (TK-313). The plant air isolation valve is opened in order to operate the pump. The drum level is monitored by visual inspection by the SWPF Plant Operator. When

empty, the Plant Air is isolated. The isolation valve on the supply line to the Solvent Makeup Tank (TK-313) is closed.

7.4.3 Normal Operations

After the solvent has been received in the Solvent Makeup Tank (TK-313), the SWPF Operator starts the agitator. After a short period of time, sufficient to allow for mixing of the Solvent Makeup Tank (TK-313) contents (confirmed by visual inspection), the Solvent Makeup Transfer Pump (P-313) is started by the Operator to transfer the solvent to the SHT (TK-202).

7.4.4 Off-Normal and Recovery Operation

Adjustments can be made to the solvent if a drum is received that is out of specification. Capability is provided for the addition of small quantities of diluent and modifier. They may be added to the Solvent Makeup Tank (TK-313) through an opening in the tank top. Isopar®L may also be added to the Solvent Makeup Tank (TK-313), if needed.

Solvent Makeup Tank (TK-313) overflows and leaks will go in the diked Solvent Area sump.

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

Table 7-5. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Pump failure (P-313)	Pump status (HIS-2582)	Use hose connection to pump solvent.	Complete repairs.

7.4.5 System Shutdown

All equipment is shut down locally by the SWPF Operator.

8.0 SODIUM HYPOCHLORITE SYSTEM DESCRIPTION

8.1 System Functions

The SWPF process adds NaOCl to the Process Water Tank (TK-301) to prevent microbial growth such as slime bacteria, molds, and algae (see "Drinking Water Chlorination: A Review of Disinfection Practices and Issues"[104]). These organisms can cause corrosion and clogging of equipment and lines that are part of the process water distribution system. However, maintenance of initial disinfection is all that is required to prevent microbial induced corrosion.

8.2 Operational Overview

The NaOCl is delivered in containers and connected to a skid-mounted addition package for delivery into the Process Water Tank (TK-301). The drum is located outside and connected to

the addition package through the CCA building wall. A metering pump transfers NaOCl to the Process Water Tank (TK-301) on a periodic basis, in order to prevent microbial growth in the tank.

The NaOCl is transferred to the Process Water Tank (TK-301), based on the oxidation reduction potential of the tank contents. The Sodium Hypochlorite Addition System is used to maintain the hypochlorite concentration of the water received from the domestic water supply.

8.3 Configuration Information

8.3.1 Description of System

Refer to the P&ID listed in Table 8-1.

Table 8-1. P&IDs

Diagram Number	Diagram Title
M-M6-J-0142	*SWPF Process Building Sodium Hypochlorite Addition System P&ID (U)*[105]

8.3.2 Major Components

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

Table 8-2. Major Components

Component	Description
Sodium Hypochlorite Addition Pump	To transfer a quantity of NaOCl solution to the Process Water Tank (TK-301). Capacity: 0.03 gpm hp: 0.5

8.3.3 Stream Data

See Table 8-3 for a listing of Streams.

Table 8-3. Streams

Stream	Description
NaOCl	NaOCl is added to the Process Water Tank (TK-301) to control microbial and algae growth. Properties: 1.17 s.g. (M-CLC-J-00143[25]) 12.5 - 14.0 wt% available chlorine concentration (commercially available)

8.3.4 Physical Location and Layout

The Sodium Hypochlorite Addition System is located in the Process/DI Water Area. This part of the CCA is not surrounded by a dike. The system is located north of Process Water Pressure Tank (TK-305). The Sodium Hypochlorite Drum is located outside the building, near the Argon Storage Tank (TK-330).

8.3.5 System Control Features and Interlocks

8.3.5.1 System Monitoring

The Sodium Hypochlorite Addition System has a control panel with alarms. The speed of the Sodium Hypochlorite Addition Pump is controlled by the oxidation reduction potential of the Process Water Tank (TK-301).

See Table 8-4 for a listing of instruments.

Table 8-4. Instruments

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
SC-2615	n/a	P-305 Speed	0-100%
UC-2616A	n/a	Sodium Hypochlorite Addition System Status	Fault
UC-2616B	n/a	Pump Status	Run/Off

8.3.5.2 Control Functions

There are no control loops in the Sodium Hypochlorite Addition System. All plant operations will be controlled by the plant control system and manually initiated by the SWPF Plant Operator.

8.4 Operations

8.4.1 Initial Configuration

A container of NaOCl is to be available for connection to the skid-mounted package.

8.4.2 System Startup

The SWPF Plant Operator is required to manually handle the hypochlorite containers and connect them to the addition package. A container of NaOCl is connected to the skid-mounted package by a flexible hose connection. The operation is locally initiated by the Operator via a local control panel.

8.4.3 Normal Operations

An instrument unit located in the Process Water Tank (TK-301) measures the oxidation reduction potential of the water and generates high and low alarms. The metering pump operates as needed to maintain the hypochlorite content in the Process Water Tank (TK-301). Note that the incoming domestic water already contains NaOCl. The system maintains that concentration in the tank to prevent microbial growth (especially during long lay-up periods).

8.4.4 Off-Normal and Recovery Operation

If a batch of NaOCl is received that is not at the desired concentration, that container can be discarded and a new container of NaOCl can be connected to the Sodium Hypochlorite Addition System.

Table 8-5 lists conditions (failures/malfunctions) of system components and recommended actions.

Table 8-5. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Pump failure (P-305)	Fault Alarm (UA-2616A)	None.	Complete repairs.

8.4.5 System Shutdown

The metering pump is stopped by the Operator via the local control panel.

9.0 NEUTRALIZATION TANK (TK-317) SYSTEM DESCRIPTION

9.1 System Functions

The Neutralization Tank (TK-317) performs the following functions:

- Provides caustic for Na^+ adjustment of the ASDT (TK-601) (see P-DB-J-00003[12]),
- Provides caustic for neutralization of strip effluent and SSRT (TK-104) (see P-DB-J-00003[12]),
- Provides caustic for neutralization of Spent Acid Storage Tank (SAST) (TK-127),
- Provides caustic for decontamination in the Drum Off/Decon Area (see P-DB-J-00003[12]),
- Receives spills from the CCA Sumps (see P-DB-J-00003[12]),
- Provides caustic to the Scrubber Caustic Feed Systems (SCFS-001 and SCFS-002); and
- Provides caustic for pH adjustment of the SDT (TK-208) (see P-DB-J-00003[12]).

9.2 Operational Overview

The Neutralization Tank (TK-317) is used for addition of caustic to the ASDT (TK-601), SEHT (TK-205), SDT (TK-208), SAST (TK-127) or SSRT (TK-104) for chemical adjustment. Concentrated caustic is transferred to the Neutralization Tank (TK-317) and diluted to approximately 25 wt% in preparation for transfer to the ASDT (TK-601), SEHT (TK-205), SDT (TK-208), SAST (TK-127) or SSRT (TK-104). The Drum Off/Decon Area also receives caustic from the Neutralization Tank (TK-317) for decontamination activities. The Neutralization Tank (TK-317) is also used to prepare 25% NaOH to supply the analytical laboratory scrubbers.

Acid or caustic waste liquid can be transferred from the CCA collection sumps to the Neutralization Tank (TK-317). The Neutralization Tank (TK-317) has acid and caustic addition lines that allow neutralization of collected liquid in preparation for disposal or transfer. Waste can be transferred back into the process via the ASDT (TK-601), or transferred to alternate locations via a hose connection (e.g., drums, tanker, or the sewer).

9.3 Configuration Information

9.3.1 Description of System

Refer to the P&ID listed in Table 9-1.

Table 9-1. P&IDs

Diagram Number	Diagram Title
M-M6-J-0069	*SWPF Process Building Neutralization Tank P&ID (U)*[106]

9.3.2 Major Components

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

Table 9-2. Major Components

Component	Description
Neutralization Tank (TK-317)	Capacity: 500 gallons (see M-CLC-J-00031[20]) Dimensions: 4 ft diameter x 7 ft T/T (see M-CLC-J-00031[20]) Design features: Spray nozzle to spray down tank internals. Vent line that discharges to the CCA An eductor (EDT-317) to provide mixing to ensure adequate agitation of the tank contents.
Neutralization Tank Discharge Pump (P-317)	To transfer neutralized effluent or 25 wt% NaOH to ASDT (TK 601), 25 wt% NaOH to SEHT (TK-205), SAST (TK-127) and SSRT (TK-104). To transfer caustic to the Drum Off/Decon Area and SDT (TK-208). Pump recycle is provided for mixing the Neutralization Tank (TK-317) contents. Capacity: 25 gpm (see M-CLC-J-00044, *SWPF Neutralization Tank Discharge Pump, P-317*[107]) hp. 3.0 Design features: P-317 has drain capability.

9.3.3 Stream Data

See Table 9-3 for a listing of Streams.

Table 9-3. Streams

Stream	Description
50 wt% NaOH	50 wt% NaOH is delivered by tanker truck to the CCA via the Receiving Dock. Properties: 1.53 s.g. (M-CLC-J-00143[25])
20 wt% HNO_3	20 wt% HNO_3 is delivered by tanker truck to the CCA via the Receiving Dock. Properties: 1.12 s.g. (M-CLC-J-00143[25])
Neutralized Effluent	Effluent neutralized to the Operator-set pH value. Properties: 1.00 s.g. (M-CLC-J-00143[25])
25 wt% NaOH	25 wt% NaOH is made up by mixing 50 wt% NaOH and process water in volumetric ratios. Properties: 1.28 s.g. (M-CLC-J-00143[25])

9.3.4 Physical Location and Layout

The Neutralization Tank (TK-317) and associated pump are located in a dike to contain any leakage from the tank or associated piping. The Neutralization Tank (TK-317) and associated pump are the only equipment in the Neutralization Tank (TK-317) Area. The Neutralization Tank (TK-317) Area is located between the Nitric Acid Area and Caustic Area.

9.3.5 System Control Features and Interlocks

9.3.5.1 System Monitoring

- Tank level is continuously monitored. Tank temperature is continuously monitored, using an element inserted into a thermowell.
- The Neutralization Tank Discharge Pump (P-317) has instrumentation to monitor pump speed. The pump discharge pressure can be monitored locally.
- The recirculation line is equipped with instrumentation to measure and control the solution pH.

See Table 9-4 for a listing of instruments.

Table 9-4. Instruments

Equipment/Instrument Number	Scale Sheet	Monitored Variable	Indications
LIT-6030	J-JZ-J-00077, *SWPF LI-6030 Neutralization Tank Level*[108]	Neutralization Tank (TK-317) Liquid Level	gallons
AV-6032A	n/a	Valve Position	Open/Closed
AV-6032B	n/a	Valve Position	0-100%
HV-6036	n/a	Valve Position	Open/Closed
TE-6038	J-JZ-J-00551, *SWPF TI-6038 Neutralization Tank Temp*[109]	Neutralization Tank (TK-317) Liquid Temperature	°F
P-317	n/a	Pump Status	Run/Off
PI-6033	J-JZ-J-01199, *SWPF PI-6033 Neutralization Tank Discharge Pump Disch Pressure*[110]	P-317 Discharge Pressure	psig
AE-6032	n/a	Neutralization Tank (TK-317) Liquid pH	pH

9.3.5.2 Control Functions

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

Table 9-5. Control Loops

Loop Number	Scale Sheet	Controlled Variable	Set Point
AIC-6032	N/A	Tank liquid pH	Operator-entered

9.4 Operations

9.4.1 Initial Configuration

Initially, the Neutralization Tank (TK-317) is empty and the transfer pump is not in operation.

9.4.2 System Startup

The Neutralization Tank (TK-317) operation is manually initiated by the SWPF Plant Operator via the control system. The Operator initiates the required mode of operation. The Neutralization Tank (TK-317) operates in batch makeup mode when 25% NaOH is needed for the ASDT (TK-601), SEHT (TK-205), SDT (TK-208), SSRT (TK-104) or analytical laboratory scrubbers. The Neutralization Tank (TK-317) operates in neutralization mode when receiving transfers from the CCA sumps.

After the Operator initiates the 25 wt% NaOH makeup sequence, 50 wt% caustic and process water are added to the Neutralization Tank (TK-317) to achieve the desired concentration. Initially, a set volume of process water is added to the Neutralization Tank (TK-317) by opening the actuated supply valve. The corresponding volume of 50 wt% NaOH, determined by ratio, is added to the tank also by opening the actuated supply valve.

When in neutralization mode, the Operator enters the required pH set point value via the control system, and either 50 wt% NaOH or 20 wt% HNO_3 is added to the Neutralization Tank (TK-317) by actuated isolation valves. The valves open for set time periods and cannot be re-opened for a minimum period to allow sufficient time for the mini-batch addition to take effect and be monitored by the control system, thereby minimizing overshoot.

At a predetermined level, set above the eductor elevation, the Discharge Pump (P-317) is started and recycled back to the Neutralization Tank (TK-317).

9.4.3 Normal Operations

The 25 wt% NaOH is made up in the Neutralization Tank (TK-317) for transfer to the ASDT (TK-601), SEHT (TK-205), SDT (TK-208), SAST (TK-127), SSRT (TK-104) or analytical laboratory scrubbers. The Neutralization Tank (TK-317) provides a route for NaOH addition to ASDT (TK-601) to adjust the contents to 1.66M Na^+ concentration. The Neutralization Tank

(TK-317) also provides a route to the SEHT (TK-205) to adjust the strip effluent pH to meet DWPF WAC, prior to transfer. Caustic may also be transferred to the Drum Off/Decon Area for decontamination activities. Also, the pH of the SDT (TK-208) or SAST (TK-127) contents can be adjusted by caustic from the Neutralization Tank (TK-317).

The actuated isolation valves are correctly aligned, and the required chemical is transferred by Discharge Pump P-317. The Operator enters a batch volume set point into the control system, which is monitored by a totalizing flow meter. The pump is shut down when the required batch volume has been delivered.

The Neutralization Tank (TK-317) can also neutralize waste collected in the CCA sumps. When the Neutralization Tank Discharge Pump (P-317) is recirculating back to the Neutralization Tank (TK-317), the pH of the solution is measured, using an instrument located in the recirculation line. The pump is operated for a pre-determined period before the pH reading is taken to ensure that good mixing of the Neutralization Tank (TK-317) contents has taken place.

After the Neutralization Tank (TK-317) contents have been neutralized to the required pH value, the neutralized solution has discharge paths to the sanitary sewer via a hose connection or to the ASDT (TK-601). Transfer is initiated by opening the valve in the pump discharge line.

Only one discharge route can be used at any time.

The process sequences for the Neutralization Tank (TK-317) system are included in Section 7.0 in X-PCD-J-00002[51].

9.4.4 Off-Normal and Recovery Operation

The Neutralization Tank (TK-317) overflows and leaks will go into the sump of the Neutralization Tank (TK-317) Area.

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

Table 9-6. Recovery Actions

Condition	Detection	Immediate Action	Recovery
Control valve failure (HV-6036)	Valve status and level indication on DCS (HIS-6036, LI-6030)	Stop transfer from sending tank.	Complete repairs.
Control valve failure (HV-6023A)	Level indication on DCS (LI-6030)	Stop transfer from sending tank.	Complete repairs.
Control valve failure (HV-6023B)	Level indication on DCS (HIS-6036, LI-6030)	Stop transfer from sending tank.	Complete repairs.
Pump failure (P-317)	Pump status alarm on DCS (HIS-6034)	None.	Complete repairs.
Failure of commanded equipment	DCS status indication	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
High level in Neutralization Tank (TK-317) (LIT-6030)	Alarm in DCS	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
High Temperature in Neutralization Tank (TK-317) (TIT-6038)	Alarm in DCS	Perform Stopping logic for Running Sequence.	CR Operator to investigate cause of problem.
Process Water System status is Unavailable	DCS status indication	Perform Hold Logic for Running Sequence (Batch Makeup).	CR Operator to investigate cause of problem.
Low Plant Air Header Pressure	Pressure Indicator (PI-4435)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.
Low Process Building Exhaust Fan dP	Differential Pressure Indicator (PDI-4077)	Perform Hold Logic for Running Sequence.	CR Operator to investigate cause of problem.

9.4.5 System Shutdown

The actuated pump discharge valve is closed, the pump is stopped, and the NaOH-, HNO_3-, and process water-actuated supply valves are closed.

10.0 MECHANICAL AGITATOR OPERATION

Mechanical agitators in CCA are automatically operated according to the following requirements:

- Auto agitation can be started and stopped by the operator or automatically by Basic Process Control System logic.
- After an agitator has been started, the level in the tank being agitated is continuously monitored to determine when the agitator should or should not be running. A minimum operating level is used for single-bladed agitators or the lowest blade on a multi-blade agitator. Level operating bands (lower and upper limits) are specified for all other blades on multi-bladed agitators.

- For tanks with temperature control, agitation is only enabled if temperature control for the tank is enabled.

Table 10-1 summarizes the functionality of the mechanical agitators in the CCA:

Table 10-1. Mechanical Agitator Operation Summary for CCA

Agitator	Level Transmitter	Temperature Controller	Number of Blades	Operation Limits Used
AGT-107	LIT-2356	TIC-2352	1	Bottom Blade upper limit
AGT-108	LIT-2392	None	3	Bottom Blade upper limit Middle Blade lower limit Middle Blade upper limit Top Blade lower limit Top Blade upper limit
AGT-303	LIT-2437	None	1	Bottom Blade upper limit
AGT-307	LIT-2525	None	1	Bottom Blade upper limit
AGT-311	LIT-2331	None	1	Bottom Blade upper limit

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