dhec

Please file as a Record document for Construction Permit No. 20,194-I W.

Gary

WASTEWATER

FINAL APPROVAL TO PLACE INTO OPE

ISSUED TO: US DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
BUILDING 705-3C
AIKEN SC 29808

20194-IW

for the operation of a wastewater treatment/collection system permitted under Construction Permit No. 20,234-IW, dated November 1, 2018.

PROJECT NAME: SRS/SALT WASTE PROCESSING FACILITY (SWPF) Final Tie-Ins

COUNTY: Aiken

PROJECT DESCRIPTION: The Salt Waste Processing Facility (SWPF) is designed to extract and concentrate cesium, strontium, and actinides from salt wastes in the tank farms resulting in effluents that are acceptable for treatment at the Defense Waste Processing Facility (DWPF) and the Saltstone Production Facility (SPF). Attachment A provides a list of equipment.

The effluent concentrations of those constituents the wastewater treatment system is designed to remove or reduce for wastewater transferred to Tank 50 to the SPF are contained in Construction Permit No. 18,801-IW for the SPF. The solid waste from the SPF will be disposed in the Saltstone Disposal Facility (SDF) in accordance with Solid Waste Industrial Permit #025500-1603. The wastewater sent to the DWPF will be vitrified and poured into canisters that are transferred to the Glass Waste Storage Buildings.

PERMITTED FLOW: System Nominal Daily Flow: 35,840 gallons per day
System Design Capacity Flow: 185,736 gallons per day

WWTP: US DOE/SAVANNAH RIVER SITE Salt Waste Processing Facility (SWPF)

SPECIAL CONDITIONS:

1. This permit is in addition to Construction Permit No. 19,219-IW (Salt Waste Processing Facility (SWPF)), Construction Permit No. 20,194-IW (SWPF NGS Cold Chemical Feed Facility), Construction Permit No. 18,801-IW (Saltstone Production Facility (SPF)), Construction Permit No. 17,424-IW (F-Area and H-Area Tank Farms), and Construction Permit No. 16,783, Defense Waste Processing Facility.

2. The jumpers that will tie the SWPF in with the SPF and DWPF are permitted by this construction permit. There shall be no radioactive salt solution received from the High Level Waste (HLW) tanks for processing and transfer to the DWPF and/or the SPF until these jumpers have been installed and the Department has issued the Approval to Place into Operation for this construction permit.

This approval is based on the APO request letter (SRR-ESH-2019-00118) signed by Ms. Patricia M. Allen. Note that Attachment 1 is the Engineer's letter of certification (signed by Andrew R. Redwood, P.E., South Carolina Registration No. 20525).

Barry S. Mullinax

Barry S Mullinax, Engineer
(for) Environmental Affairs
AIKEN EA OFFICE

Date Issued: October 29, 2019

cc:
Bureau of Water Permitting File – Construction Permit No. 20,234-IW
Bureau of Water Permitting File – Construction Permit No. 19,219-IW
Bureau of Water Permitting File – Construction Permit No. 20,194-IW
Bureau of Water Permitting File – Construction Permit No. 18,801-IW
Bureau of Water Permitting File – Construction Permit No. 17,424-IW
Bureau of Water Permitting File – Construction Permit No. 16,783-IW
Travis Fuss, Aiken EA Office
Crystal Robertson, Aiken EA Office
Shawn M. Clarke, BOW, Columbia Office
Crystal Rippy, BOW – Columbia Office
Andrew Redwood, P.E.,SRR

Attachment A Equipment List

The equipment included in Construction Permit No. 20,234-IW is listed below:

1. Transfer Line SDP1 and Jumper 6-7(SPP2)2 for Raw Salt Solution (RSS) Transfer Line
2. Jumper 6-7(SPP3)3 for Strip Effluent (SE) Waste Transfer Line
3. Jumper 3(SPP3)15 for Monosodium Titanate Precipitate (MSTPCP) Waste Transfer Line
4. Transfer lines DSS-0077, SSP077, and WTS-SSP4 for the Decontaminated Salt Solution to Tank 50 and the Saltstone Production Facility.

AIKEN EQC OFFICE
COLUMBIA, SC 29201-1708
Phn: 803-898-4302 Fax: 803-898-4215

Serving Counties: Aiken, Barnwell, Edgefield and Saluda

Wastewater System Construction

APPROVAL TO PLACE INTO OPERATION

ISSUED TO:

US DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE
BUILDING 705-3C
AIKEN SC 29808

for the operation of a wastewater treatment/collection system permitted under Construction Permit No. 19,219-IW, dated August 6, 2008. This construction permit superseded Construction Permit No. 19,164-IW, dated January 2, 2008, that was issued for the installation of three (3) waste transfer line segments.

PROJECT NAME: SRS/SALT WASTE PROCESSING FACILITY (SWPF)

COUNTY: Aiken

PROJECT DESCRIPTION: The Salt Waste Processing Facility (SWPF) is designed to extract and concentrate cesium, strontium, and actinides from salt wastes in the tank farms resulting in effluents that are acceptable for disposal at the Defense Waste Processing Facility (DWPF) and the Saltstone Production Facility (SPF). Attachment A lists the SWPF equipment.

The effluent concentrations of those constituents the wastewater treatment system is designed to remove or reduce for wastewater transferred to Tank 50 to the SPF are contained in Construction Permit No. 18,801-IW for the SPF. The solid waste from the SPF will be disposed in the Saltstone Disposal Facility (SDF) in accordance with Solid Waste Industrial Permit #025500-1603. The wastewater sent to the DWPF will be disposed as a solid waste in canisters that are transferred to the Glass Waste Storage Buildings.

PERMITTED FLOW:

System Nominal Daily Flow: 35,840 gallons per day
System Design Capacity Flow: 185,736 gallons per day

WWTP: US DOE/SAVANNAH RIVER SITE Salt Waste Processing Facility (SWPF)

SPECIAL CONDITIONS:

1. The jumpers that will tie the SWPF in with the SPF and DWPF are permitted by Construction Permit No. 20,234-IW. There shall be no radioactive salt solution received from the HLW tanks for processing and transfer to the DWPF and/or the SPF until these jumpers have been installed and the Department has issued an Approval to Place into Operation for Construction Permit No. 20,234-IW.

2. The use of water, chemicals, and non-radioactive materials to support SWPF activities such as flushing, cleaning, startup testing, and demonstrations to validate performance of components and/or systems is allowed as long as the jumpers in Condition #1 have not been installed or the jumpers are physically isolated from the SWPF.

3. NPDES Permit No. SC0000175 allows the disposal of "scavenger" wastewater. If the wastewater is not scavenger wastewater, a written request shall be submitted to the Department describing this wastewater. No discharge of this wastewater may be performed without the written approval from the Department.

4. Note that Construction Permit No. 20,194-IW was issued for the Next Generation Solvent Cold Chemical Feed Facility. This facility is in addition to Construction Permit No. 19,219-IW that was issued for the SWPF.

This approval is based on the Engineer's letter of certification signed by James C. Somma, P.E., South Carolina Registration No. 14718 (Parsons).

Barry S. Mullinax

Date Issued: August 14, 2019

Barry S Mullinax, Engineer
(for) Environmental Affairs
AIKEN EA OFFICE

cc:
Bureau of Water Permitting File – Construction Permit No. 19,219-IW
Bureau of Water Permitting File – Construction Permit No. 20,194-IW
Bureau of Water Permitting File – Construction Permit No. 20,234-IW
Travis Fuss, Aiken EA Office
Shawn M. Clarke, BOW – Columbia
Crystal Rippy, BOW - Columbia
Crystal Robertson, Aiken EA Office
James Somma, P.E., Parsons

Attachment A for SWPF Approval to Operate (APO)

SWPF Equipment List (Drawing No. G-P1-J-00001)

PROCESS BUILDING – PROCESS EQUIPMENT

Tank Number	Tank Name
Process Cell Area	
TK-101	Alpha Sorption Tank-A (AST-A)
TK-102	Filter Feed Tank-A (FFT-A)
TK-103	Cleaning Solution Dump Tank-A (CSDT-A)
TK-104	Sludge Solids Receipt Tank (SSRT)
TK-105	Wash Water Hold Tank (WWHT)
TK-109	Salt Solution Feed Tank (SSFT)
TK-121A/B/C	Back Pulse Tank
TK-123	Washing Filter Back Pulse Tank
TK-127	**Spent Acid Storage Tank (SAST)**
TK-205	Strip Effluent Hold Tank (SEHT)
TK-208	Solvent Drain Tank
TK-235	Lab Drain Tank
TK-505	**Backup Air Receiver**
TK-506	**Backup Air Receiver**
TK-601	Alpha Sorption Drain Tank (ASDT)
Operating Deck	
TK-122	Back Pulse Charge Tank-A
TK-128	AST-A Air Pulse Agitator Charge Tank
TK-129	FFT-A Air Pulse Agitator Charge Tank
TK-131	SSRT Air Pulse Agitator Charge Tank
TK-132	SSFT Air Pulse Agitator Charge Tank
TK-133	WWHT Air Pulse Agitator Charge Tank
CSSX Tank Cell	
TK-202	Solvent Hold Tank (SHT)
TK-203	Strip Effluent Coalescer
TK-204	Caustic Wash Tank
TK-206	Ba-137 Decay Tank (BDT)
TK-211	Decontaminated Salt Solution Stilling Tank
TK-212	Strip Effluent Stilling Tank
TK-215	Strip Effluent Pump Tank
TK-217	Solvent Strip Feed Tank

Tank Number	Tank Name
CSSX Contactor Drop Area	
TK-201	Decon. Salt Solution Coalescer
Cold Chemicals Area	
TK-106	**Filter Cleaning Acid Feed Tank**
TK-107	Filter Cleaning Caustic Tank
TK-108	Caustic Dilution Feed Tank
TK-301	Process Water Tank
TK-302	Caustic Receipt Tank
TK-303	Caustic Makeup Tank
TK-304	Nitric Acid Receipt Tank
TK-305	Process Water Pressure Tank
TK-307	Nitric Acid Scrub Makeup Tank
TK-311	MST Storage Tank
TK-312	DI Water Storage Tank
TK-313	Solvent Makeup Tank
TK-314	**DI Water Expansion Tank**
TK-317	Neutralization Tank
TK-330	Argon Tank
CSSX Contactor Area	
EXT-201A-P	Solvent Extraction Contactors
EXT-202A/B	Scrub Contactors
EXT-203A-P	Stripping Contactors
EXT-204A/B	Caustic Wash Contactors
Process Filters	
FLT-102A/B/C	Alpha Sorption Filters
FLT-104	Washing Filter
Alpha Finishing Facility	
TK-207	DSS Hold Tank (DSSHT)
TK-220	Intermediate Storage Tank (IST)
TK-221	Alpha Sorption Tank - B (AST-B)
TK-222	Filter Feed Tank - B (FFT-B)
TK-223	Cleaning Solution Dump Tank - B (CSDT-B)
TK-224	MST/Sludge Transfer Tank (MSTT)
TK-225A/B/C	**Finishing Area Back Pulse Tank**
TK-228	**Alpha Finishing Drain Tank (AFDT)**
TK-233	**Back Pulse Charge Tank B**
TK-236/237	**Lab Collection Tank**
TK-604	**Low Level Drain Tank**
FLT-222A/B/C	**Alpha Sorption Filters**

PUMPS	
North ASP Pump and Valve Gallery	
P-015A	ASP Secondary Loop Pump Water Pump
P-015B	ASP Secondary Loop Pump Water Pump
P-101A/B	Alpha Sorption Tank-A Transfer Pumps
P-102-1A/B/C	Filter Feed/Solids Trans Pumps
P-102-2 A/B/C	Filter Recirculation Pumps
P-104-1	Washing FLT Feed/Sludge Solids Trans Pump
P-104-2	Washing Filter Recirculation Pump
P-110	ASP Sump Trans Pump
South ASP Pump and Valve Gallery	
P-105A/B	Wash Water Trans Pumps
P-208A/B	Solvent Drain Tank Pumps
P-601A/B	Alpha Sorption Drain TK Transfer Pumps
CSSX Pump and Valve Gallery	
P-109A/B	Salt Solution Feed Pumps
P-202A/B	Solvent Feed Pumps
P-204A/B	Caustic Wash Tank Pumps
P-205A/B	Strip Effluent Trans Pumps
P-206A/B	Ba-137 Decay Tank Trans Pumps
P-212A/B	**Strip Effluent Coalescer Feed Pumps**
P-215A/B	Strip Effluent Pump Tank Pumps
P-217A/B	Solvent Strip Feed Pumps
P-218	CSSX Tank Cell Sump Transfer Pump
Sample Pump and Valve Gallery	
SP-101	Alpha Sorption Tank-A Sample Pump
SP-102	Filter Feed Tank-A Sample Pump
SP-103	Cleaning Solution Dump Tank-A Sample Pump
SP-104	Sludge Solids Receipt Tank Sample Pump
SP-105	Wash Water Hold Tank Sample Pump
SP-109	Salt Solution Feed Tank Sample Pump
SP-205	Strip Effluent Hold Tank Sample Pump
SP-235	Lab Drain Tank Sample Pump
Drum off/Decon Area	
P-605	Decon Area Sump Pump

PUMPS (continued)	
Cold Chemicals Area	
P-106	**Acid Transfer Pump**
P-107	Filter Cleaning Caustic Trans Pump
P-108	Caustic Dilution Trans Pump
P-300	Cold Chemicals Receiving Dock Sump Pump
P-301-1	Process Water Utility Pump
P-301-2	Flush Pump
P-302	Caustic Trans Pump
P-303	Caustic Makeup Trans Pump
P-304-1	Nitric Acid Metering Pump
P-304-2	Neutralization Metering Pump
P-305A/B	Sodium Hypochlorite Addition Pump
P-309A/B	Scrub Feed Pumps
P-310A/B	Strip Feed Pumps
P-311	MST Transfer Pump
P-311-1	MST Drum Pump
P-312-1	DI Water Trans Pump
P-312-2	Scrub Water Feed Pump
P-312-3A/B	Strip Water Feed Pumps
P-313	Solvent Makeup Trans Pump
P-313-1	Solvent Drum Pump
P-317	Neutralization Tank Discharge Pump
P-318	Caustic Sump Pump
P-319	**Acid Sump Pump**
P-320	Neutralization Sump Pump
P-321	Nitric Acid Sump Pump
P-322	Water Sump Pump
P-326	Pump Seal Make-up Water Supply Pump
Alpha Finishing Facility	
P-207A/B	**DSS Hold Tank Transfer Pumps**
P-220A/B	**Intermediate Storage Tank Transfer Pumps**
P-221A/B	**Alpha Sorption Tank B Transfer Pumps**
P-222-1A/B/C	**Filter Feed/Solids Transfer Pumps**
P-222-2A/B/C	**Filter Recirculation Pumps**
P-224	**MST/Sludge Transfer Pump**
P-228	**Alpha Finishing Drain Tank Transfer Pump**
PUMPS (continued)	

P-236	**Lab Collection Tank Pump**
P-604	**Low Level Drain Tank Transfer Pump**
P-025A/B	**AFP Secondary Cooler Loop Pump**
SP-207, SP-220 – SP-224	**Sample Pumps**
P-210, P-226, P-227, P-228-1	**AFF Sump Pumps**
P-229	**Alpha Finishing Process Filter Loop Drain Pump**
AGITATORS	
AGT-107	Filter Cleaning Caustic Tank Agitator
AGT-108	Caustic Dilution Feed Tank Agitator
AGT-303	Caustic Makeup Tank Agitator
AGT-307	Nitric Acid Scrub Makeup Tank Agitator
AGT-311	MST Storage Tank Agitator
AGT-311-1	MST Drum Agitator
AGT-313	Solvent Makeup Tank Agitator
AGT-221	**Alpha Sorption Tank B Agitator**
AGT-222	**Filter Feed Tank B Agitator**
AGT-224	**MST/Sludge Transfer Tank Agitator**
LABORATORY EQUIPMENT	
GB-001 – **GB-011, GB-014**	Glove Boxes
RH-001 – RH-017	Radio Hoods
FH-001	Fume Hood
HC-001 – HC-004	Hot Cell Windows
STS-101	Sample Transfer System
ELECTRICAL SYSTEMS	
ATS-203 – ATS-205	Automatic Transfer Switch
ATS-207	Automatic Transfer Switch
ATS-208	Automatic Transfer Switch
ATS-210	Automatic Transfer Switch
MCC-**201** – MCC-206	Motor Control Center
MCC-209 – MCC-210	**Motor Control Center**
SWGR-201 – SWGR-204	Switchgear
USX-301	Uninterruptible Power Supply

INSTRUMENTATION

ICP-001 – **ICP-013**	Instrument Control Panel
ICP-014 – **ICP-016**	Instrument Control Panel
IR-001 – **IR-014, IR-016 – IR-022, IR-024, IR-026 – IR-040**	Instrument Control Rack

AIR HANDLING EQUIPMENT

ACU-001	Wall Mounted Heat Pump
AHU-001 – **AHU-006**	Air Handling Units
AHU-008 – AHU-009	Air Handling Units

Filters/Fans/Coils

CCL-401A/B	Process Vessel Vent Coolers
CCL-402A/B	Pulse Mixer Vent Coolers
FAN-401A/B	Process Vessel Vent Exhaust Fans
FAN-402A/B	Pulse Mixer Vent Exhaust Fans
FAN-001	Exhaust Fan
FAN-002	Exhaust Fan
FAN-003	Exhaust Fan on Roof
FAN-004	Exhaust Fan on Roof
FAN-007	Exhaust Fan on Roof
FAN-009	Exhaust Fan on Roof
FAN-010	Exhaust Fan on Roof
FAN-013	Exhaust Fan on Roof
FAN-014	Exhaust Fan on Roof
FAN-015	Exhaust Fan on Roof
FLT-001 – FLT-004	Exhaust Air HEPA Filters
FLT-009	Lab Exhaust Air HEPA Filter
FLT-010 – FLT-016	Cell Inlet Air HEPA Filters
FLT-017	Lab Exhaust Air HEPA Filter
FLT-020	Hot Lab Intake Filter Above Suspended Ceiling
FLT-021	Hot Cell Exhaust Air HEPA Filter
FLT-022	Hot Cell Exhaust Air HEPA Filter
FLT-023 – FLT-034	Glovebox Inlet Air HEPA Filters
FLT-240 – FLT-242	**Solvent Recovery Filters**
FLT-250	**Solvent Adjustment Filter**
FLT-301**A/B**	Process Water Cartridge Filter
FLT-401A/B	Process Vessel Vent Filters

AIR HANDLING EQUIPMENT (continued)	
FLT-402A/B/C/D	Pulse Mixer Vent Filters
HRC-001	Heat Recovery Coil
Scrubbers	
SCB-001	Scrubber
SCB-002	Scrubber
SCB-003	Hot Cell Scrubber
SCB-004	Hot Cell Scrubber
SCFS-001	**Scrubber Caustic Feed System**
SCFS-002	**Scrubber Caustic Feed System**
Separators	
SEP-001	Bldg Chilled Water Air Separator
SEP-003	Control Room Chilled Water Air Separator
SEP-005	Process Chilled Water Air Separator
SEP-007	Heat Recovery Air Separator
Pumps	
P-001A/B	Bldg Chilled Water Supply Pumps
P-003A/B	Control Room Chilled Water Pumps
P-005A/B	Process Chilled Water Supply Pumps
P-007A/B	Heat Recovery Water Pumps
Tanks	
TK-001	Bldg Chilled Wtr Exp Tank
TK-002	Bldg Chilled Wtr Chem Feed Tank
TK-003	Control Room Chilled Wtr Exp Tank
TK-004	Control Room Chilled Wtr Chem Feed Tank
TK-005	Process Chilled Wtr Exp Tank
TK-006	Process Chilled Wtr Chem Feed Tank
TK-007	Heat Recovery Bladder Exp Tank
TK-008	Heat Recovery Chemical Feed Tank
TK-015	Process Chilled Water Expansion Tank
TK-016	Chemical Bypass Feeder Tank
TK-025	**Process Chilled Water Expansion Tank**
Ventilators	
VLR-001	Gravity Roof Ventilator
VLR-002	Gravity Roof Ventilator

MISCELLANEOUS ITEMS	
BTR-001	DW Pressure Booster System
CMP-**504**	Back Up Air Receiver Compressor
DMST-401A/B	Process Vessel Vent Demisters
DMST-402A/B	Pulse Mixer Vent Demisters
FAN-005	**Exhaust Fan**
FAN-006	**Exhaust Fan**
FLT-007	**Exhaust Air HEPA Filter**
HTR-007	Domestic Water Heater/Tank
HTR-017A/B	**Strip Contactors Tempered Water Heaters**
HTR-203A/B	**Solvent Strip Feed Tempered Water Heaters**
HTR-310A/B	Strip Feed Heaters
HTR-401A/B	Process Vessel Vent Heaters
HTR-402A/B	Pulse Mixer Vent Heaters
HX-015	ASP Secondary Loop Cooler
HX-025	**AFP Secondary Loop Cooler**
HX-102A/B/C	Filter Recirculation Coolers
HX-104	Washing Filter Recirculation Cooler
HX-201	Salt Solution Feed Cooler
HX-202A/B	Solvent Feed Coolers
HX-203	**Strip Contactor Tempered Water Heat Exchanger**
HX-217A/B	Solvent **Strip Feed Heat Exchanger**
HX-222A/B/C	**Filter Recirculation Coolers**
HX-250	**Solvent Adjustment Heat Exchanger**
IX-312	DI Water Package Unit
SEP-015	Process Chiller Water Air Separator
SEP-025	**Process Chilled Water Separator**
VMP-001	Vibration Monitor Panel

dhec
Healthy People. Healthy Communities.

June 21, 2018

Frank Sheppard
US DEPT OF ENERGY SAVANNAH RIVER SITE
BUILDING 705-C
Aiken, SC 29808

Re: Construction Permit No. 20194-IW
USDOE/ SRS/ SWPF/ NGS COLD CHEM FEED
Aiken County

Dear Frank Sheppard:

Enclosed is a SC Wastewater Construction Permit for the above referenced project. Construction is to be performed in accordance with this permit and supporting engineering report, plans, and specifications approved by this Office.

This system cannot be placed into operation until final approval is granted by the appropriate Bureau of Environmental Health Services (BEHS) Regional Office. Your Regional contact is Joshua C Yon, in the MIDLANDS REGION BEHS AIKEN. This regional office should be notified when construction begins at the following address and phone number: 206 BEAUFORT ST NE, AIKEN SC 29801-4476, 803-642-1637.

Upon completion of any construction, a letter must be submitted to the BEHS Regional Office from the registered engineer certifying that the construction has been completed in accordance with the approved plans and specifications. An inspection may then be scheduled. The BEHS Regional Office will approve the system for operation upon successful completion of this project.

Sincerely,

Barry Mullinax

Barry S Mullinax
Industrial Wastewater Permitting Section
Water Facilities Permitting Division

cc: Joshua C Yon, MIDLANDS REGION BEHS AIKEN
James Somma, Usdoe, Building 705-C, AIKEN, SC 29808

Wastewater Construction Permit
Bureau of Water

Healthy People. Healthy Communities

PROJECT NAME: USDOE/ SRS/ SWPF/ NGS COLD CHEM FEED	**COUNTY:** AIKEN

PERMISSION IS HEREBY GRANTED TO:

US DEPT OF ENERGY SAVANNAH RIVER SITE
1080 Silver Bluff Rd
Aiken SC 29803

for the construction of an upgrade to an existing wastewater treatment plant in accordance with the construction plans, specifications, engineering report and the Construction Permit Application signed by James Somma, Registered Professional Engineer, S.C. Registration Number: 14718.

PROJECT DESCRIPTION: This application describes the location and configuration of the proposed Next Generation Solvent (NGS) Cold Chemical Feed Facility at the Salt Waste Processing Facility (SWPF). The Cold Chemical Feed Facility is required to support the deployment of NGS at SWPF.

The effluent will be discharged to the Salt Waste Processing Facility at a daily average rate of 7200 gallons per day.

This facility is associated with the Savannah River Site with NPDES Permit #SC0000175.

CONDITIONS: See page 2.

In accepting this permit, the owner agrees to the admission of properly authorized persons at all reasonable hours for the purpose of sampling and inspection. This is a permit for construction only and does not constitute DHEC approval, temporary or otherwise, to place the system in operation. An Approval to Place in Operation is required and can be obtained following the completion of construction by contacting the MIDLANDS REGION BEHS AIKEN at 803-642-1637. Additional permits may be required prior to construction (e.g., Stormwater).

PERMIT NUMBER:	**20194-IW**
ISSUANCE DATE:	**June 21, 2018**
EXPIRATION DATES:	**June 20, 2020** (to begin construction) **June 21, 2021** (to obtain Approval to Place in Operation)

Jeffrey P. deBessonet, P.E., Director
Water Facilities Permitting Division

BSM

CONDITIONS

1. The permittee shall maintain at the permitted facility a complete Operations and Maintenance (O&M) Manual for the wastewater treatment system. The manual shall be made available for on-site review during normal working hours. The manual shall contain operation and maintenance instructions for all equipment and appurtenances associated with the wastewater treatment system. The manual shall contain a general description of the treatment process(es), operating characteristics that will produce maximum treatment efficiency and corrective action to be taken should operating difficulties be encountered.

2. In accordance with Regulation 61-67, Standards for Wastewater Facility Construction, all wastewater treatment facilities shall be closed out within one hundred eighty (180) days when the facility is closed or the effluent disposal permit is inactivated, terminated or revoked, unless otherwise determined by the Department. Closure of wastewater treatment facilities necessitates the submittal of a closure plan and approval of the plan by the Department in accordance with R.61-82 prior to closure of any wastewater treatment unit(s).

3. If necessary, final as-built drawings shall be submitted to the Department when you submit the request for SCDHEC to perform an inspection of this facility to obtain an Approval to Place into Operation.

4. The permittee shall provide for the performance of daily treatment facility inspections by a qualified operator. The inspections shall include, but should not necessarily be limited to, areas which require visual observation to determine efficient operation and for which immediate corrective measures can be taken using the O & M manual as a guide. All inspections shall be recorded and shall include the date, time, and name of the person making the inspection, corrective measures taken, and routine equipment maintenance, repair, or replacement performed. The permittee shall maintain all records of inspections at the permitted facility as required by the permit, and the records shall be made available for on-site review during normal working hours.

5. Operators for the Salt Waste Processing Facility shall perform the daily inspections on the days when the facility is being operated. SWPF operator qualifications are established in administrative procedures.

6. This construction permit is in addition to Construction Permit No. 19,219-IW for the Salt Waste Processing Facility.

7. All waste oil and solid and hazardous waste shall be properly disposed of in accordance with the rules and regulations of the Bureau of Land and Waste Management of SCDHEC.

8. Spill prevention measures shall be taken during the facility operation and during unloading or loading activites for chemical materials.

9. If the equipment identification numbers are changed from the Parsons equipment identification numbering system to the Savannah River equipment identification numbering system, the drawings submitted in the construction permit application package shall be revised, as appropriate, and signed, sealed, and dated by an SC-registered PE. These drawings shall be submitted to the Department as a supplemental record for this construction permit.

dhec
Healthy People. Healthy Communities.

RECEIVED
JUN 15 2018
WATER FACILITIES
PERMITTING DIVISION

MEMORANDUM

June 06, 2018

RECEIVED
JUN 15 2018
WATER FACILITIES
PERMITTING DIVISION

TO: Joshua C Yon
MIDLANDS REGION BEHS AIKEN

FROM: Crystal D Rippy
Industrial Wastewater Permitting Section
Water Facilities Permitting Division

RE: Construction Permit Application
USDOE/ SRS/ SWPF/ NGS COLD CHEM FEED
Aiken County

Are you aware of any problems with, or do you have any comments on, the referenced project? Copies of the application and location map are enclosed.

Please return any comments that you may have by: June 16, 2018. An e-mail response is suitable if you prefer. If you have no comments, please just note so. Thanks.

COMMENTS:

No specific concerns

Josh Yon
Aiken EA Office

D H E C

PROMOTE PROTECT PROSPER

**South Carolina Department of Health
and Environmental Control**

Environmental Quality Control

Wastewater Application Fee
2600 Bull Street
Columbia, SC 29201

US DEPT OF ENERGY SAVANNAH RIVER SITE
1080 SILVER BLUFF RD
AIKEN SC 29803

Invoice Date: 06/06/2018
Invoice Number: QY25894-7
Invoice Amount: $400.00
Program ID: 1242453

Department Name: BOW - DOMESTIC WW PERM
Department Contact: LINDA S HARRELL
Department Phone: 803-898-4300

Qty	Description	Unit	Extended
1.00	TS => 1MGD - Modification (no expansion)	400.00	400.00
	Total		**$400.00**

South Carolina Department of Health and Environmental Control

Facility Name: US DEPT OF ENERGY SAVANNAH RIV
Program ID: 1242453
Invoice Number: QY25894-7 Amount Due: $400.00

Amount Remitted:
$

To ensure proper credit, please return this portion of the invoice with your payment to the address below or you may go to our agency's website: WWW.SC.DHEC.GOV then click on **PAY INVOICES** under **ONLINE SERVICES & TOOLS** or use the reverse side of this form for credit card payments. *Limit of $3000.00 per transaction and $1.00 convenience fee for debit/credit card payments. No limit or fee for ACH/e-checks.* Please include the invoice number on your remittance. **Payment due upon receipt, past due 30 days from invoice date. Change of address and credit card payment forms are on the reverse side.**

SC DHEC
ATTN: BUREAU OF FINANCIAL MANAGEMENT
PO BOX 100103
COLUMBIA, SC 29202-3103

dhec
Healthy People. Healthy Communities

RECEIVED
JUN 15 2018
WATER FACILITIES
PERMITTING DIVISION

June 06, 2018

Kristy Ellenberg
TO: ~~Richelle Tolton~~ – 208 Planning Contact

SUBJECT: 208 plan conformance (INFORMATION ONLY)
Recommendation NOT required

1. Project Name: USDOE/ SRS/ SWPF/ NGS COLD CHEM FEED
2. County: Aiken
3. Type of Project: WWC WWTP UPGRADE(QUALITY) -
4. Type Waste: INDUSTRIAL Volume (GPD): 7200
5. Disposal Method: US DOE/SAVANNAH RIVER SITE (NPDES SC0000175)
6. Consulting Engineer: USDOE/JAMES SOMMA
7. DHEC contact: Crystal D Rippy
   Industrial Wastewater Permitting
   Water Facilities Permitting Division
   Bureau of Water

dhec
Healthy People. Healthy Communities.

BUREAU OF WATER

June 06, 2018

JAMES SOMMA
USDOE
BUILDING 703-C
AIKEN SC 29803

Re: **USDOE/ SRS/ SWPF/ NGS COLD CHEM FEED**
Aiken County
Application Tracking # 1242453

Dear James Somma:

The Industrial Wastewater Permitting section received an engineering submittal on the above project on 05/24/2018. In accordance with R.61-30 we have reviewed your application for completeness. Based on our review, your project application package is administratively incomplete. For this reason, your project will not be in line for a technical review until you satisfy the deficiencies noted below. As a courtesy, we have logged in your project and will keep it here pending your complete response. To complete your application package, please provide the following items:

1. A SC-registered PE must sign and seal and date all plans and specifications and the **Certificate of Authorization (COA)** from the engineering firm must also be affixed near the PE seal. Please resubmit these documents with the appropriate seals. Please note: Each page of design drawings or plans must include the COA and the PE seal/signature with the date regardless of whether or not they are in a bound document that is signed, sealed, dated, and affixed with the COA.

Please return the above noted items as soon as possible. Failure to submit these items will result in significant delays in the review process.

Also, please note that any land clearing activity that is being performed in relation to this project must be permitted under the State Sediment and Erosion Control Program. For more information contact Ann Clark at (803) 898-4028.

If you have any questions, please do not hesitate to contact this office at 803-898-4300.

Sincerely,
Linda S. Harrell
Linda S Harrell
Industrial Wastewater Permitting Section
Water Facilities Permitting Division

Savannah River Remediation
AECOM | BECHTEL | CH2M | BWXT

May 23, 2018

SRR-SWPF-2018-00030
RSM Tracking No.: 10667

Mr. Barry S. Mullinax, Professional Engineer
South Carolina Department of Health and
Environmental Bureau of Water
South Carolina Department of Health and
Environmental Control
2600 Bull Street
Columbia, South Carolina 29201-1208
Savannah River Nuclear Solutions

Dear Mr. Mullinax:

CONSTRUCTION PERMIT APPLICATION – WATER/WASTEWATER FACILITIES – SALT WASTE PROCESSING FACILITY (SWPF)

On behalf of the U.S. Department of Energy and Parsons Government Services, please find the following documents attached for review and approval:

1. Construction Permit Application and Engineering Report for the SWPF – Next Generation Solvent (NGS) Cold Chemical Feed Facility (3 copies)
2. Location Maps (3 copies)
3. Signed and Sealed Engineering Reports (3 copies)
4. One Application Fee

Your timely review and processing of the construction permit application package is requested.

Should you have any questions or concerns, please feel free to contact me at (803) 208-1468.

RECEIVED
MAY 24 2018
WATER FACILITIES
PERMITTING DIVISION

KDH
Keith D. Harp
SWPF Integration Program Manager

csw/jf

c: P. A. Marks, 704-122S
S. S. Farrell, 704-122S
S. A. Stewart, 730-B
K. P. Guay, 704-125S
SWPFDCA, 704-127 S
W. F. Anderson, 766-H
K. R. Liner, 704-S
G. R. Huff, 707-18E
J. S. Kirk, 766-H
K. Smith, 766-H

dhec

Construction Permit Application
Water/Wastewater Facilities

BUREAU OF WATER

DELEGATED REVIEW PROJECT SUBMITTAL: Yes ☐ EXPEDITED REVIEW PROGRAM SUBMITTAL: Yes ☐

SELECT ONE ➧ ☐ Water Facilities ☑ Wastewater Facilities ☐ Combined Water & Wastewater Facilities

I. **Project Name:** Next Generation Solvent Cold Chemical Feed Facility **County:** Aiken

II. **Project Location** (street names, etc.): Savannah River Site, Aiken SC

III. **Project Description(s):** *Water System:* ______

RECEIVED

MAY 24 2018

Wastewater System: This application describes the location and configuration of the proposed Next Generation Solvent (NGS) Cold Chemical Feed Facility at the Salt Waste Processing Facility (SWPF).

WATER FACILITIES
PERMITTING DIVISION

Project Type (A-Z): Water: ____ Wastewater: Z *(See instructions for the appropriate project code)*

IV. ***Initial* Owner:** [Time of Application] Name/Organization: USDOE-Owner

Address: 1080 Silver Bluff Road (Attn: Frank Sheppard, Jr.) City: Aiken State: SC Zip: 29803

Phone #: (803) 643-7100 E-mail (Initial Owner): ______

V. ***Final* Owner:** [After Construction] Name/Organization: USDOE-Owner

Address: Bldg. 703-B, Room 321 (Attn: J. Demass) City: Aiken State: SC Zip: 29808

Phone #: (803) 952-8261 E-mail (Final Owner): jim.demass@srs.gov

VI. **Entity Responsible for Final Operation & Maintenance of System:**

Water System: Name: N/A Address: ______

City: ______ State: ____ Zip: ____ Phone#: ( ) ______ Fax#: ( ) ______

Wastewater System: Name: USDOE-Owner Address: Bldg. 703-B, Room 321 (Attn: J. Demass)

City: Aiken State: SC Zip: 29808 Phone#: (803) 952-8261 Fax#: ( ) ______

VII. **Engineering Firm:** Name: N/A Address: ______

City: ______ State: ____ Zip: ____ Phone #: ( ) ______ Fax #: ( ) ______

E-mail (Design Engineer): ______

VIII. **Is this project:** A) Part of a phased project? No ☑ Yes ☐. If Yes, Phase ____ of ____

B) A revision to a previously permitted project? No ☐ Yes ☑. If Yes, Permit#: 19,219-IW

Date Approved: 8/6/08 Project name (if different): Salt Waste Processing Facility

C) Submitted based on a Schedule of Compliance or Order issued by DHEC? No ☑ Yes ☐. Order #: ______

D) Anticipating funding by the State Revolving Fund (SRF)? No ☑ Yes ☐.

E) Crossing a water body (e.g., river, creek)? No ☑ Yes ☐. If Yes, Name of waterbody: ______

IX. **Are Standard Specifications approved by DHEC being used on this project?** No ☑ Yes ☐. If Yes:

Water: Date Approved: ______ Approved for whom: ______

Wastewater: Date Approved: ______ Approved for whom: ______

X. **Wastewater Systems:** A) Type: Domestic ☐ Process (Industrial) ☑ Combined (Domestic & Process) ☐

B) *Average Design Flow* 1. Project: 7,200 GPD 2. Treatment system: N/A GPD

C) *Sewers or Pretreatment* 1. Name of facility (e.g., POTW) treating the wastewater: ______

2. NPDES/ND Number of facility in Item #1: ______

Treatment Systems 3. Date Preliminary Engineering Report (PER) approved: ______

4. NPDES/ND application submitted? No ☐ Yes ☐. If Yes, Date: ______

Disposal Sites 5. Effluent Disposal Site (Description): ______

6. Sludge Disposal Site (Description): ______

XI. **Water Systems:** Project located within city limits? No ☑ Yes ☐.
Public water system providing water. Name: ______________________ System #.: ______________________
New water system (including master meter)? No ☐ Yes ☐. If Yes, System name: ______________________

XII. **Type of Submittal:** Complete **Section A (Standard)** *or* **Section B (Delegated Review Program - DRP).**

A) Standard Submittal *must* include the following:

☑ 1. A transmittal letter outlining the submittal package.
☑ 2. The **original** construction permit application, properly completed, with one (1) copy.
☑ 3. Three (3) sets of signed and sealed plans and one (1) set of construction specifications. Specifications may be omitted if approved standard specifications are on file with DHEC. Four (4) sets of plans are required for a combined submittal, if the project includes a wastewater treatment facility.
☐ 4. One (1) set of the appropriate design calculations. WASTEWATER: Design flow (based on R.61-67, Appendix A), pump station calc's. and pump curve. WATER: Recent flow test from a location near the tie-on site, design calc's. indicating pressure maintained in the distribution system during max. instantaneous demand, fire flow and flushing velocities achieved. Number/types of service connections, well record form, pumping test results, etc.
☑ 5. Three (3) copies of a detailed 8½" x 11" location map, separate from the plans.
☐ 6. Two (2) copies of construction easements unless the project owner has the right of eminent domain.
☐ 7. A letter(s) from the entity supplying water and/or providing wastewater treatment stating their willingness and ability to serve the project, (state the flow, number of lots, etc.), including pretreatment permits, if applicable.
☐ 8. A letter(s) from the entity agreeing to be responsible for the operation and maintenance (O&M) of the systems.
☑ 9. Application fee enclosed $ 400.00______. (Refer to Instructions).
☐ 10. WATER SYSTEMS: a) A letter from the local government which has potable water planning authority over the area, if applicable, in which the project is located, stating project consistency with water supply service plan for area.
b) For wells, four (4) copies of a well head protection area inventory.
c) For new wells, a viability demonstration is required in accordance with Regulation 61-58.1.B.(4).

Note: Other approvals may include 208 (wastewater only) and OCRM CZC Certification, and navigable waterway permitting. *To expedite the project review, the 208 and OCRM CZC Certification may be included with the project submittal.*

B) DRP submittal *must* include the following:

☐ 1. A transmittal letter, signed by the professional engineer representing the DRP entity, noting this is a DRP submittal. The letter should state that the project has been reviewed and complies with R.61-58 and/or R.61-67.
☐ 2. The **original** construction permit application, properly completed, with one (1) copy.
☐ 3 Two (2) sets of the signed and sealed plans.
☐ 4. One (1) set of the appropriate design calculations. WASTEWATER: Same information as required under Section XII.A.4. above. WATER: Same information as required under Section XII.A.4. above.
☐ 5. One (1) copy of a detailed 8½" x 11" location map, separate from the plans.
☐ 6. Two (2) copies of construction easements, unless the project owner has the right of eminent domain.
☐ 7. DHEC's OCRM CZC Certification (for water and/or wastewater facilities, in the eight coastal counties).
☐ 8. DHEC's Water Quality permit or conditions for placement in navigable waters, and other Agency approvals.
☐ 9. WASTEWATER SYSTEMS: a) A letter of acceptance from the entity providing the treatment of the wastewater that includes the specific flow and, when applicable, the specific number of lots being accepted.
b) A letter from the organization agreeing to be responsible for the O&M of the wastewater system.
c) The 208 Plan certification from the appropriate Council of Governments (designated 208 areas), or from DHEC on the non-designated 208 areas.
☐ 10. WATER SYSTEMS: A letter from the local government which has potable water planning authority over the area, if applicable, in which the project is located, stating project consistency with water supply service plan for area.
☐ 11. Fee of $75 for water and $75 for wastewater ($150 if combined).

Note: The DRP entity should ensure that a copy of the final approved plans are returned to the design engineer.

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
No. C01094

XIII. Construction plans, material and construction specifications, the engineering report including supporting design data and calculations are herewith submitted and made a part of this application. I have placed my signature and seal on all engineering documents submitted, signifying that I accept responsibility for the design of this system and that I have submitted a complete administrative package.

Engineer's Name (Printed): James C. Somma Signature: James Somma 5/10/18
Registered Professional Engineer
S.C. Registration Number: 14718

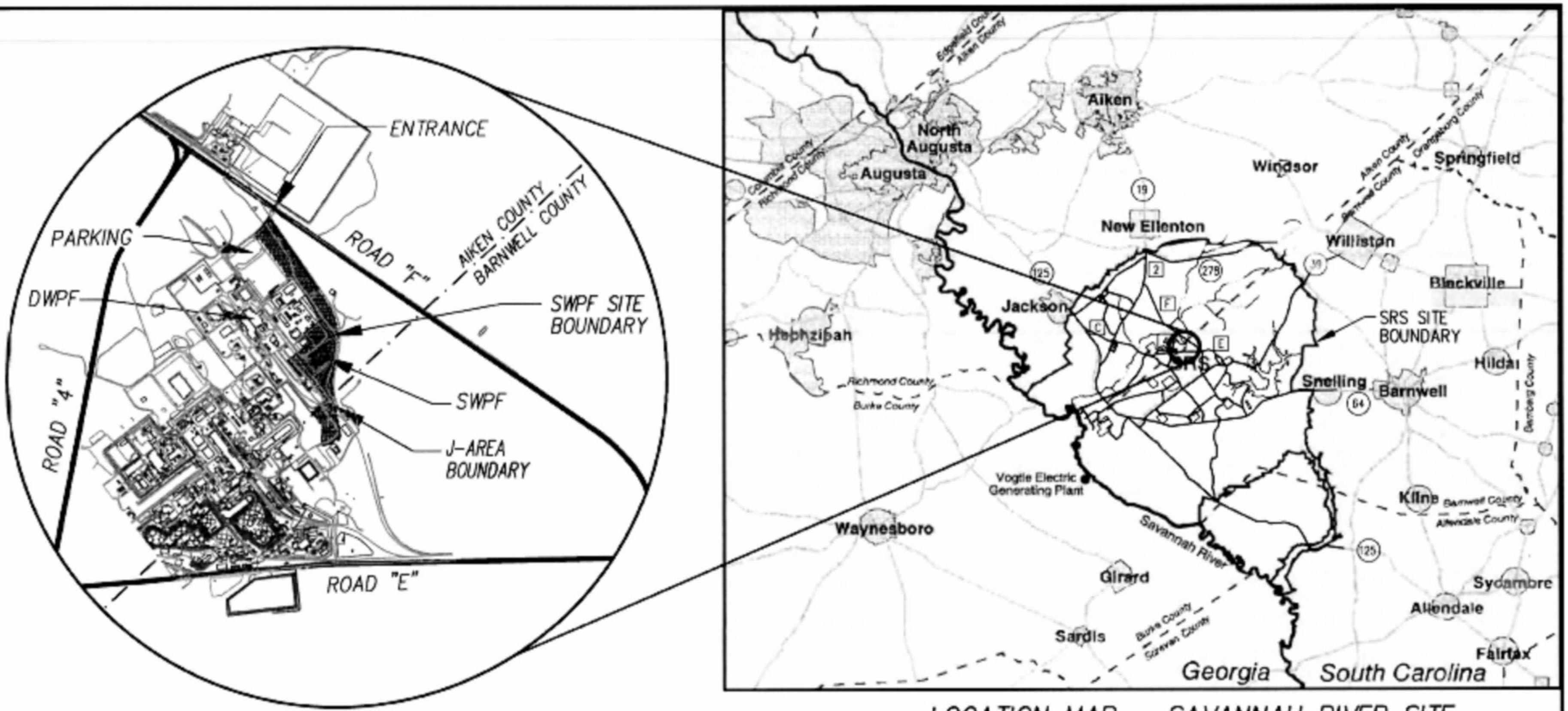
No. 14718
JAMES C. SOMMA

XIV. Prior to final approval, I will submit a statement certifying that construction is complete and in accordance with the approved plans and specifications, to the best of my knowledge, information and belief. This certification will be based upon periodic observations of construction and a final inspection for design compliance by me or a representative of this office by or under my supervision.

Engineer's Name (Printed): James C. Somma Signature: James Somma 5/10/18
Registered Professional Engineer
S.C. Registration Number: 14718

XV. I hereby make application for a permit to construct the project as described above. I have read this application and agree to the requirements and conditions and agree to the admission of properly authorized persons at all reasonable hours for the purpose of sampling and inspection.

Owner's Name (Printed): FRANK SHEPPARD Signature: Frank Sheppard
Owner's Title: SENIOR VP/SWPF PROJ. MGMT Date: 5/10/18



LOCATION MAP – SWPF

LOCATION MAP – SAVANNAH RIVER SITE

PARSONS
1080 Silver Bluff Rd. ~ Aiken, SC 29803 (803) 643–7101

UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE

SWPF

SITE LOCATION MAP

SCALE:	DRAWING No.	Sheet No.	LATEST REVISION
AS SHOWN	Site Location Map	1	1

United States Department of Energy

Savannah River Site
Aiken, South Carolina

Engineering Report

for

NGS Cold Chemical Feed Facility

Prepared By

PARSONS

1080 Silver Bluff Road
Aiken, South Carolina 29803

for the

United States Department of Energy

20,194-IW
6/21/18
Barry Mullinax
BARRY
MullinAX

Function: **Environmental Permitting**
Doc. No.: **Q-PER-J-00007**
Revision: **0**
Date: **05/10/2018**

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WATER FACILITIES
PERMITTING DIVISION

No. 14718
JAMES C. SOMMA
5/10/18

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
No. C01094

SUMMARY OF CHANGES

Revision No.	Date	Description of Change
0	05/10/2018	Developed per DMR-4365. Engineering report needed to support the Industrial Wastewater Permit for NGS Building.

TABLE OF CONTENTS

List of Figures

List of Appendices

LIST OF ACRONYMS AND ABBREVIATIONS

°F	degrees Fahrenheit
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BPCS	Basic Process Control System
CCA	Cold Chemicals Area
CCFF	Cold Chemical Feed Facility
Cs	Cesium
CSSX	Caustic-side Solvent Extraction
DOE	U.S. Department of Energy
DWPF	Defense Waste Processing Facility
ER	Engineering Report
H_3BO_3	Boric Acid
LWR	Liquid Radioactive Waste
M	Molar
Mgal	Million Gallons
NaOH	Sodium Hydroxide (Caustic)
NGS	Next Generation Solvent
SCDHEC	South Carolina Department of Health and Environmental Control
SCR	South Carolina Regulation
SRNS	Savannah River Nuclear Solutions
SRS	Savannah River Site
SWPF	Salt Waste Processing Facility
wt%	Weight Percent

1.0 ENGINEERING REPORT

This Engineering Report (ER) is being submitted pursuant to South Carolina Regulation (SCR) 61-67 (*Standards for Wastewater Facility Construction*[1]) to allow the construction of a new Next Generation Solvent (NGS) Cold Chemical Feed Facility (CCFF). This ER describes the location, industrial wastewater treatment processes, and configuration of the proposed new Salt Waste Processing Facility (SWPF) NGS CCFF at Savannah River Site (SRS).

2.0 BACKGROUND INFORMATION

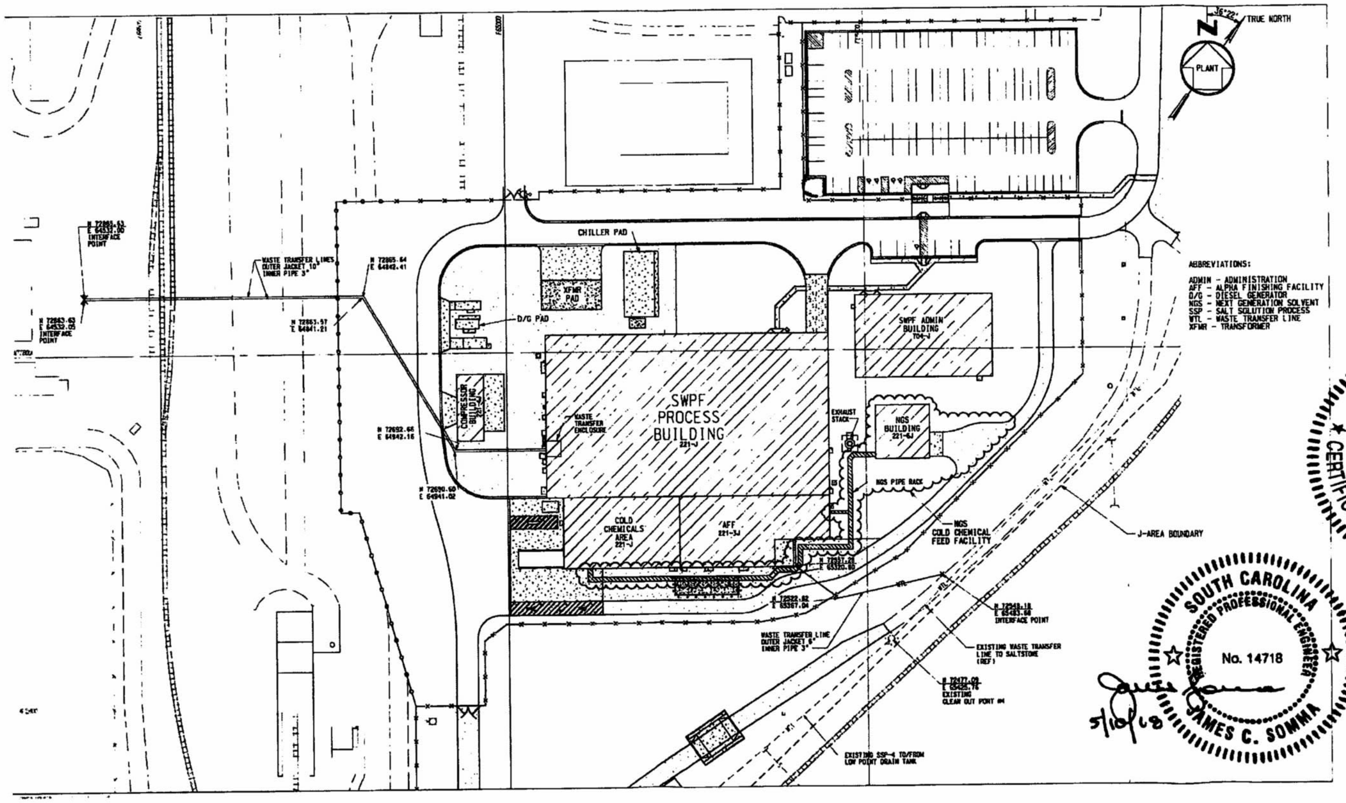
This ER describes a modification at SWPF that requires a construction permit that is in addition to the SWPF Industrial Wastewater Treatment Permit (Construction Permit No. 19219-IW) issued by South Carolina Department of Health and Environmental Control (SCDHEC). The construction of CCFF is required to support deployment of NGS at SWPF. The deployment of NGS, developed through research funded by the U.S. Department of Energy (DOE), for use at SWPF will improve the Cesium (Cs) removal from treated waste and increase the overall throughput of SWPF. The purpose of the proposed CCFF is to receive, dilute, and then transfer the chemicals to SWPF that are necessary for deployment of NGS at SWPF.

3.0 LOCATION AND FACILITY LAYOUT

The CCFF will be constructed adjacent to SWPF in J-Area at SRS, located East of the SWPF Process Building and South of the SWPF Administrative Building. See Figure 3-1 for detailed location of the CCFF.

The CCFF is divided into two diked process areas (i.e., the caustic scrub diked area and the Boric Acid [H_3BO_3] diked area) and one NGS work area that contain a total of seven process pumps, three chemical storage tanks, two process heaters, and one chemical metering pump skid. Also, each diked area is equipped with a collection sump that is piped to a common sump pump. Figure 3-2 provides a three-dimensional design view of the NGS CCFF. Appendix A provides general arrangement of CCFF equipment.

Figure 3-1. NGS Cold Chemical Feed Facility Location

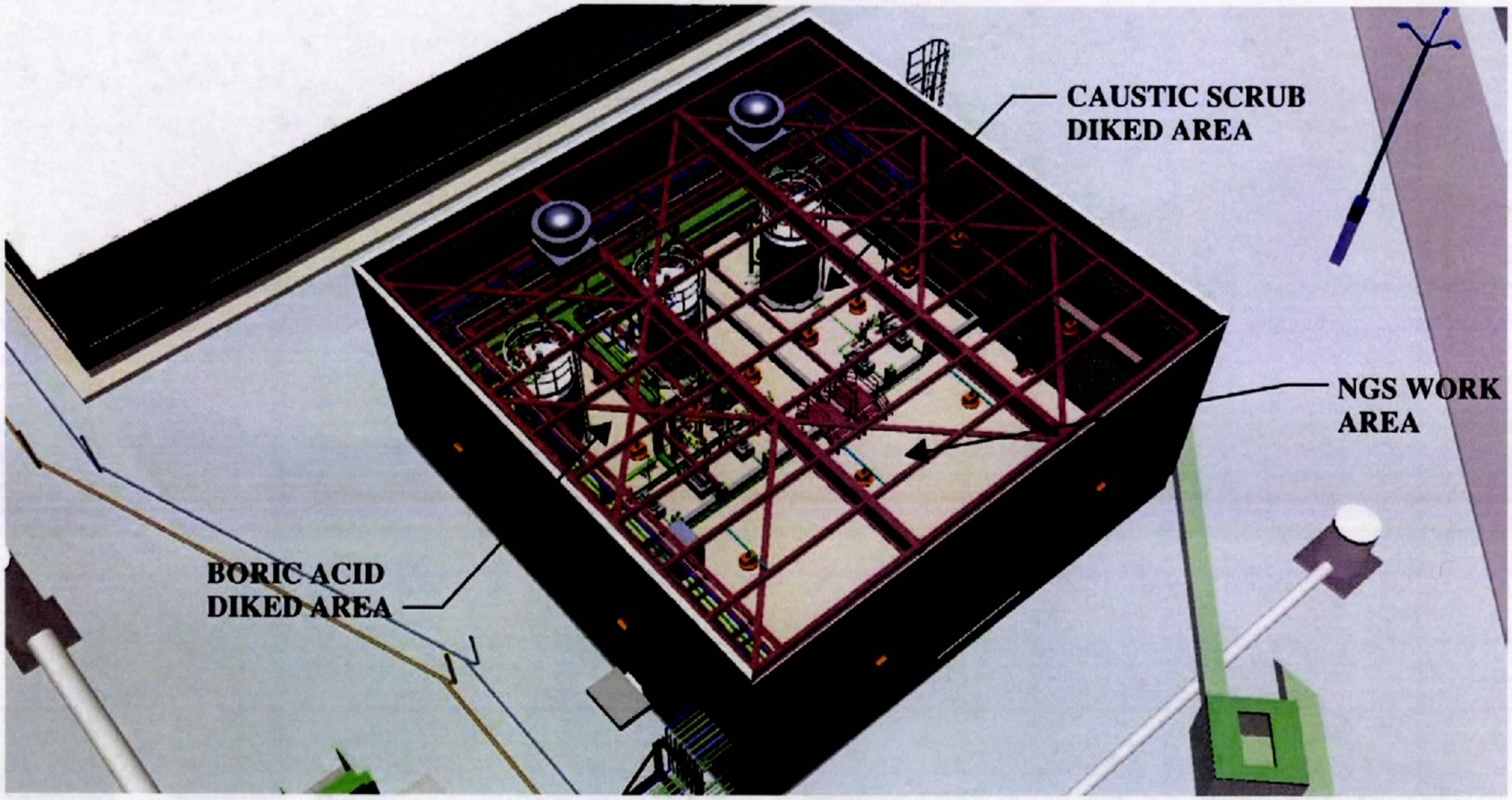


PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP INC.
No. C01094

No. 14718
JAMES C. SOMMA

5/10/18

Figure 3-2. Three Dimensional Design View of the NGS Cold Chemical Feed Facility



4.0 PROJECT DESCRIPTION

The SWPF is tasked with processing 34 Million gallons (Mgal) of liquid radioactive waste (LRW) stored as salt solution or saltcake in the SRS tank farms. One operational step in the processing of LRW is the Caustic-side Solvent Extraction (CSSX) for removal of Cs. The baseline CSSX process uses a specially engineered solvent that selectively removes Cs. As part of the CSSX process, the engineered solvent must be scrubbed for removal of impurities with 0.05 Molar (M) Nitric Acid and then stripped of Cs with 0.001M Nitric Acid.

Through research funded by the DOE, a NGS has been developed and tested to improve Cs removal and increase LRW throughput in SWPF. Deployment of NGS in the CSSX process at SWPF requires the use of different cold chemicals for scrubbing and stripping of NGS. The installation of CCFF will provide the source of these new scrubbing and stripping chemical solutions.

The scope of this modification is to install systems that will:

1. Receive and provide storage of approximately 2,500 gallons of 0.45M H_3BO_3. H_3BO_3 will be received from either a chemical tote or tanker truck.
2. Prepare and provide storage for approximately 2,500 gallons of 0.01M H_3BO_3 solution to be used as the strip solution for NGS. Process water for this dilution process will be provided from SWPF.
3. Heat the 0.01M H_3BO_3 strip solution and transfer to SWPF strip contactors.
4. Prepare and provide storage for approximately 2,500 gallons of 0.025M Caustic scrub solution. Caustic and process water required for preparation of scrub solution will be provided from SWPF.
5. Transfer the 0.025M Sodium Hydroxide (NaOH) scrub solution to the SWPF scrub contactors.

These systems will operate 24/7 in conjunction with SWPF, except for outages and times of maintenance.

5.0 PROCESS DESCRIPTION

The CCFF will store and provide chemicals to SWPF that are required for scrubbing and stripping the NGS being deployed in the SWPF CSSX process (see Appendix B through Appendix D). This facility will not process or utilize any radioactive fluids.

5.1 Boric Acid Strip Solution

The purpose of the H_3BO_3 strip solution system is to provide 0.01M H_3BO_3 to the strip stages of the CSSX process for removal of Cs from the Cs-laden solvent stream flowing through the SWPF extraction contactors.

5.1.1 Receipt of Concentrated Boric Acid

The 0.45M H_3BO_3 is normally delivered by tanker truck to the Boric Acid Strip Receipt Tank (TK-710) via the SWPF Cold Chemicals Area (CCA) Receiving Dock. Alternatively, 0.45M H_3BO_3 may be delivered directly to the CCFF via chemical totes.

5.1.2 Preparation of Boric Acid Strip Solution

H_3BO_3 strip solution is made up in the Boric Acid Strip Feed Tank (TK-720) by mixing process water with 0.45M H_3BO_3 (from the Boric Acid Strip Receipt Tank [TK-710]). Process water is provided from the existing Process Water Tank (TK-301) in SWPF.

5.1.3 Transfer of Boric Acid Strip Solution to SWPF

When the SWPF CSSX process is operating, the strip contactors continuously use the 0.01M H_3BO_3 strip solution. One of the CCFF Boric Acid Strip Feed Pumps (P-720A/B) provides the strip solution to SWPF. A Boric Acid Strip Feed Heater (HTR-720A/B), installed on the discharge side of each Boric Acid Strip Feed Pump, maintains the strip solution between 86 degrees Fahrenheit (°F) and 96°F, improving its stripping performance.

When the SWPF is out of operation for an extended period, transfer of 0.01M H_3BO_3 strip solution from CCFF to SWPF is ceased. In place of this continuous transfer, 0.45M H_3BO_3 (from the Boric Acid Strip Receipt Tank [TK-710]) is batch transferred to the existing Strip Effluent Hold Tank (TK-205) in SWPF via the Boric Acid Strip Charge Pump (P-711). The concentrated H_3BO_3 is eventually transferred from SWPF to the Defense Waste Processing Facility (DWPF) in order to support continued formulation of the DWPF glass recipe. The transfer of 0.01M H_3BO_3 strip solution resumes once SWPF operation is restarted.

5.2 Caustic Scrub Solution

The purpose of the caustic scrub solution system is to provide 0.025M NaOH to the scrub stages of the CSSX process for removal of soluble salts from the solvent stream exiting the SWPF extraction contactors.

5.2.1 Preparation of Caustic Scrub Solution

Caustic scrub is made up in the Caustic Scrub Tank (TK-730) by mixing process water with 50 weight percent (wt%) NaOH. Process water is provided from the existing Process Water Tank (TK-301) in SWPF. The 50 wt% NaOH is provided from the existing Caustic Receipt Tank (TK-302) in SWPF.

Alternatively, a dilute caustic solution can be made up in one of two existing SWPF tanks and provided to the CCFF. The dilute caustic solution may be provided from SWPF via either the Caustic Cleaning Tank (TK-107) or the Caustic Makeup Tank (TK-303) to the CCFF Caustic Scrub Tank (TK-730), where additional dilution with process water can be performed as required to create 0.025M NaOH.

5.2.2 Transfer of Caustic Scrub Solution to SWPF

When the SWPF CSSX process is operating, the scrub contactors continuously use the 0.025M NaOH scrub solution. One of the CCFF Caustic Scrub Feed Pumps (P-730A/B) provides the scrub solution to SWPF. When the SWPF is out of operation for an extended period, transfer of 0.025M NaOH scrub solution from CCFF to SWPF is ceased. The transfer of scrub solution resumes once SWPF operations is restarted.

6.0 MODIFICATION DESIGN

6.1 Piping Design

Process piping installed for the CCFF modification shall be designed, fabricated, examined, and tested in accordance with American Society of Mechanical Engineers (ASME) B31.3-2002, *Process Piping*[2] requirements.

6.2 Tank and Vessel Design

Cold chemical storage tanks (Boric Acid Strip Receipt Tank [TK-710], Boric Acid Strip Feed Tank [TK-720] and the Caustic Scrub Tank [TK-730]) shall be designed, fabricated, examined and tested in accordance with the American Petroleum Institute (API) 650, *Welded Steel Tanks for Oil Storage*[3] requirements.

Pressure vessels installed for the CCFF modification (Boric Acid Strip Feed Heaters [HTR-720A/B] and Fire Protection Water Surge Tank [TK-014]) shall be designed, fabricated, examined and tested in accordance with ASME Section VIII, Division 1, *Boiler and Pressure Vessel Code*[4] requirements.

6.3 Secondary Containment

Major process equipment within the CCFF is located within concrete diked areas that provide secondary containment for leaks resulting from equipment failure or from routine operation and maintenance activities. Each diked area is capable of containing 100% minimum of contents of the largest tank located within the diked area. The floor of each diked area is sloped to a sump, equipped with leak detection and alarm, which can be pumped to a tanker truck via NGS Sump Pump (P-740).

Chemicals for use in the CCFF are received at the SWPF CCA receiving dock, where they are unloaded from a tanker truck and transferred either directly (H_3BO_3) or indirectly (NaOH) to the CCFF. The CCA receiving dock area provides containment of chemical spills and is sloped to a sump that collects spillage for disposition by SWPF personnel. Personnel performing activities associated with receipt of CCFF chemicals will be SWPF trained and qualified operators, working to approved procedures.

6.4 Process Controls

Normal operations sequences for the CCFF are automated and are controlled/monitored by the SWPF Basic Process Control System (BPCS). The BPCS is also responsible for gathering and recording process data to provide process history from the CCFF.

7.0 OPERATIONS AND MAINTENANCE

SWPF trained and qualified operations personnel will operate the equipment per approved procedures. Normal operations will not require "hands on" activities with the equipment within the CCFF.

SWPF trained and qualified maintenance personnel will perform required maintenance of equipment per approved procedures, work orders and per equipment manufacturer Installation-Operation-Maintenance manuals.

8.0 AIR EMISSIONS

8.1 Toxic and Criteria Pollutant Emissions

Emissions from CCFF have been evaluated (see Savannah River Nuclear Solutions [SRNS]-J2210-2017-00224, *Supporting Documentation for Emission Rate Calculations for Three Tanks Located in Building Southeast of 221-J [006J, 007J, and 008J]*[5]) and it has been determined that no toxic or criteria pollutants will be emitted from each of the three tanks in CCFF. Based upon Section A, Item 19 of SCDHEC, *Bureau of Air Quality Permitting Exemption List (December 2016)*[6] these sources are considered insignificant and are not required to be documented with respect to construction permitting. Based upon Section A, Item 25 of SCDHEC *Insignificant Activities List for S.C. Regulation 61-62.70 "Title V Operating Permit Program"*[7], these tanks are considered insignificant and are not required to be included in a Title V permit application.

9.0 REFERENCES

---

[1] SCR 61-67, *South Carolina Standards for Wastewater Facility Construction*. South Carolina Department of Health and Environmental Control, Columbia, South Carolina. May 24, 2002.

[2] ASME B31.3, *Process Piping*. American Society of Mechanical Engineers, New York, New York. May 1, 2002.

[3] API 650, *Welded Steel Tanks for Oil Storage*. 11th Edition American Petroleum Institute, Washington D.C. November 1, 1998, including Addendum 1 (2008) and Addendum 2 (2009).

[4] ASME Section VIII, Division 1, *Boiler and Pressure Vessel Code*. American Society of Mechanical Engineers, New York, New York. 2004.

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[5] SRNS-J2210-2017-00224, *Supporting Documentation for Emission Rate Calculations for Three Tanks Located in Building Southeast of 221-J (006J, 007J, and 008J)*. Letter from K.A. Wolfe (SRNS) to A.R. Waller (SRNS). November 6, 2017.

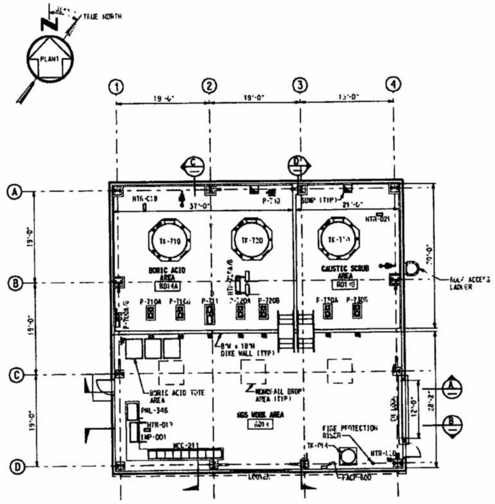
[6] SCDHEC, *Bureau of Air Quality Permitting Exemption List (December 2016)*. South Carolina Department of Health and Environmental Control. 2016. (http://www.scdhec.gov/ENVIRONMENT/DOCS/NEWEXEMPTIONS.PDF)

[7] SCDHEC *Insignificant Activities List for S.C. Regulation 61-62.70 "Title V Operating Permit Program*". South Carolina Department of Health and Environmental Control. Revised February 4, 2013. (http://www.scdhec.gov/environment/docs/air_Activities4SC.pdf)

Appendix A. CCFF General Arrangement

P-PG-J-0024, *SWPF Next Generation Solvent Building General Arrangement Plan at Elevation 98'-9" And Sections (U)*

P-PG-J-0024



PLAN AT ELEVATION 98'-9"

NEXT GENERATION SOLVENT - PROCESS EQUIPMENT

EQUIPMENT		APPROX CAPACITY (GALS)	NO	DIA	HEIGHT OF LENGTH **
BORIC ACID STRIP RECEIPT TANK	TK-710	2500	1	7'-0"	10'-0"
BORIC ACID STRIP FEED TANK	TK-720	2500	1	7'-0"	[illegible]
CAUSTIC SCRUB FEED TANK	TK-730	2500	1	7'-0"	10'-0"

** TANK HEIGHT IS MEASURED TANGENT TO BOTTOM.

NEXT GENERATION SOLVENT MONORAILS		
DESCRIPTION		CAPACITY
AGT-710 MONORAIL	MR-141	1/4 TON
AGT-720 MONORAIL	MR-142	1/4 TON
AGT-730 MONORAIL	MR-143	1/4 TON

EQUIPMENT DESIGNATIONS

PUMPS

P-700A B	BORIC ACID ADDITION PUMPS
P-710A/B	BORIC ACID STRIP TRANSFER PUMPS
P-711	BORIC ACID STRIP CHARGE PUMP
P-720A/B	BORIC ACID STRIP FEED PUMPS
P-730A/B	CAUSTIC SCRUB FEED PUMPS
P-740	NGS SUMP PUMP

AGITATORS

AGT-710	BORIC ACID STRIP RECEIPT TANK AGITATOR
AGT-720	BORIC ACID STRIP FEED TANK AGITATOR
AGT-730	CAUSTIC SCRUB FEED TANK AGITATOR

AIR HANDLING EQUIPMENT

FAN-016	EXHAUST FAN
FAN-017	EXHAUST FAN
HTR-018	UNIT HEATER
HTR-019	UNIT HEATER
HTR-020	UNIT HEATER
HTR-021	UNIT HEATER

ELECTRICAL SYSTEMS

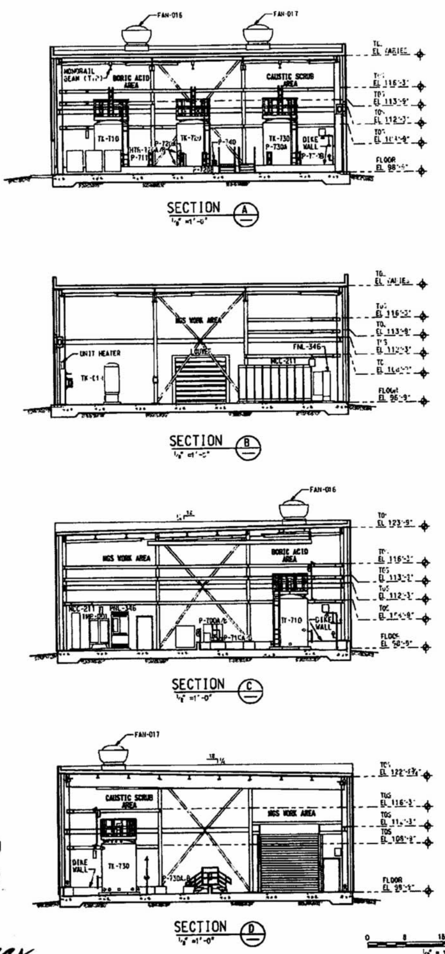
MCC-211	MOTOR CONTROL CENTER
PNL-346	POWER PANEL

INSTRUMENTATION SYSTEMS

IMP-061	INSTRUMENT MARSHALLING PANEL

MISCELLANEOUS ITEMS

HTR-720A B	BORIC ACID STRIP FEED HEATERS



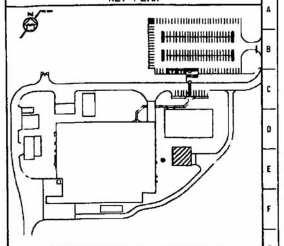
SECTION A
1/8" = 1'-0"

SECTION B
1/8" = 1'-0"

SECTION C
1/8" = 1'-0"

SECTION D
1/8" = 1'-0"

0 8 16 24 32FT
1/8" = 1'-0"



KEY PLAN

NOTES

1. FOR GENERAL NOTES, LEGEND, ABBREVIATIONS AND EQUIPMENT DESIGNATIONS SEE DRAWING C-P1-J-00001, SHEET 1 AND SHEET 2.
2. NGS BUILDING ELEVATIONS ARE BASED ON FINISH FLOOR = 98'-9". SEE CIVIL DRAWING C-CG-J-0016 FOR FINISH FLOOR ELEVATION BASED ON MEAN SEA LEVEL.
3. FLOOR SLOPE DIRECTION IS SHOWN ON THE ARCHITECTURAL DRAWINGS.

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
No. C01094

No. 14718
JAMES C. SOMMA
5/30/18

20,184-IW 6/21/18
Barry Mullinax

P PG J 0024 0

PARSONS
1080 Silver Bluff Rd. • Aiken, SC 29803 (803)643-7100

UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE

BLDG. NO.	SITE CLEARANCE NO.	PROJECT AREA NO.	DESIGN GROUP
N/A	N/A	N/A	PARSONS

SVPF
NEXT GENERATION SOLVENT BUILDING
GENERAL ARRANGEMENT
PLAN AT ELEVATION 98'-9"
AND SECTIONS

(U)

SCALE	DRAWING NO.	SHEET NO.	LATEST REVISION
NONE	P-PG-J-0024	1 OF 1	0

PROJ.	REV. NO.	DATE	REVISION	PRP'D	CHK'D	LEAD ENG	APPR'D	RE APPR'D	QA
T49600	0	12/?/17	ISSUED FOR CONSTRUCTION - CREATED PER DCN-T001	JTO	NJG	NJG	JCS	FES	1BS

SWPFE3D.BDR

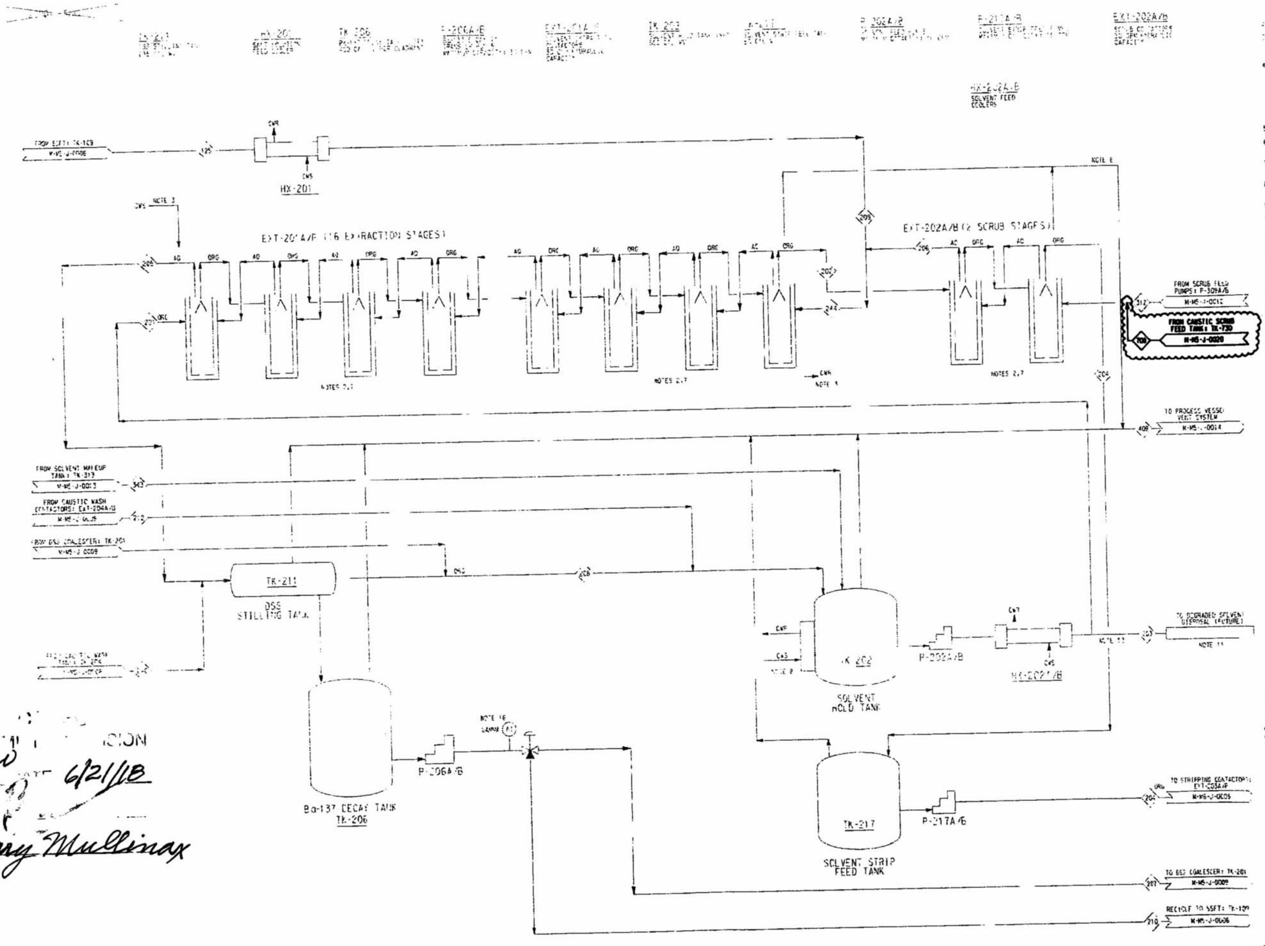
Appendix B. CCFF Process Flow Drawings

M-M5-J-0007, *SWPF Solvent Extraction and Acid Scrub PFD (U)*

M-M5-J-0008, *SWPF Solvent Stripping and Caustic Wash PFD (U)*

M-M5-J-0010, *SWPF Cold Chemical Makeup and Process Water Tank PFD (U)*

M-M5-J-0020, *SWPF Next Generation Solvent Building Cold Chemical Makeup Tanks PFD (U)*



SEE DRAWING [illegible]

2. CONTACTOR [illegible]

3. SOLVENT EXTRACTION STAGES TO BE TEMPERATURE CONTROLLED TO [illegible] FOR OPTIMAL SOLVENT EXTRACTION. COOLING WATER SUPPLY AND RETURN WILL BE PROVIDED FOR EACH CONTACTOR.

4. REFERENCE P-ESR-J-[illegible] FOR THE DETAILED SWPF BASELINE MASS BALANCE MODEL, IN WHICH OXALIC ACID IS THE FILTER CLEANING AGENT. FOR OPERATIONS WITH NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00143 FOR DETAILED FLOW DATA FOR EACH STREAM. FOR OPERATIONS WITH NGS (NEXT GENERATION SOLVENT) AND NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00221 FOR DETAILED FLOW DATA FOR EACH STREAM.

5. DELETED.

6. EACH CONTACTOR OUTLET STREAM HAS AN INDEPENDENT LINE CONNECTED TO A COMMON HEADER.

7. LINES WILL BE PROVIDED TO ALLOW FLUSHING OF CONTACTORS (NOT SHOWN).

8. TK-202 TO BE TEMPERATURE CONTROLLED TO 73°F [illegible] FOR OPTIMUM OPERATION.

9. DELETED.

10. DELETED.

11. REFER TO ICD-5, V-ESR-J-00005, FOR DISPOSAL DETAILS.

12. WHEN NOT PROVIDED IN P-ESR-J-00001, M-CLC-J-00143 OR M-CLC-J-00221, MASS FLOW CALCULATED BASED ON ROUNDED DENSITY VALUES.

13. RECIRCULATION LINE WILL BE PROVIDED TO TK-202 FOR MIXING.

14. TANK FLUSH TO BE PROVIDED FOR ALL TANKS, BUT DETAILS ARE NOT SHOWN ON DRAWINGS.

15. DELETED.

16. HIGH GAMMA READING REDIRECTS THE CDCSS FLOW BACK TO SSFT (TK-109).

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC. No. C01094

No. 14718 JAMES C. SOMMA

NOTE 4

STREAM NO.		125	201	202	203	204	205	206	207	208	209	210	244
STREAM NAME		Clarified Salt Solution	Solvent to Extraction	Extract	Degraded Solvent (Future)	Organic Scrub Effluent	CDCSS	Aqueous Scrub Effluent	CDTSS	Recovered Solvent	Cooled Clarified Salt Soln	Ba-137 Decay Tank Recycle to SSFT	Extraction Feed
Flow	GPM	21.5	7.15	7.15	7.15	7.15	22.9	1.43	22.3	1.1E-03	21.5	21.5	22.9
Mass Flow (Note 12)	LBS/HR	13421	2972	2971		2971	14138	716	14138	4.76E-01	13421	13421	14137
Density	LBS/GAL	10.43	6.93	6.93		6.93	10.29	8.3[illegible]	12.29	6.93	10.43	10.43	10.29
Temperature	°F	73	73	73		73	73	77	73	73	73	73	73
Na (M)		5.6					5.25		5.25		5.6	5.25	5.25
Extractant, 0.003M	LBS/HR		26.8	26.8		26.8							
Modifier, 0.75M	LBS/HR		508.4	5[illegible].4		508.4							
Suppressor (TiDG), 0.003M	LBS/HR		2.6	2.6		2.6							
ISOPAR	LBS/HR		2031	2030		2030							

[illegible]	0	[illegible]	CERTIFIED FOR CONSTRUCTION		NDS	DWT	CC	NES	[illegible]	JWR
[illegible]	1	03/07/06	REVISED PER DCR-0787		NDB	DWV	CC	KEB	CHT	TLP
[illegible]	2	05-03/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-07-0068 (1-10), DCN-0295 (1-11), DCN-1575 (1-15) AND DCN-0868 (10-15)		NDD	DWO	CC	WBB	WBB	RL
[illegible]	3	11/14/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-0987 (1-21)		NDD	DWV	CC	WBE	JET	RL

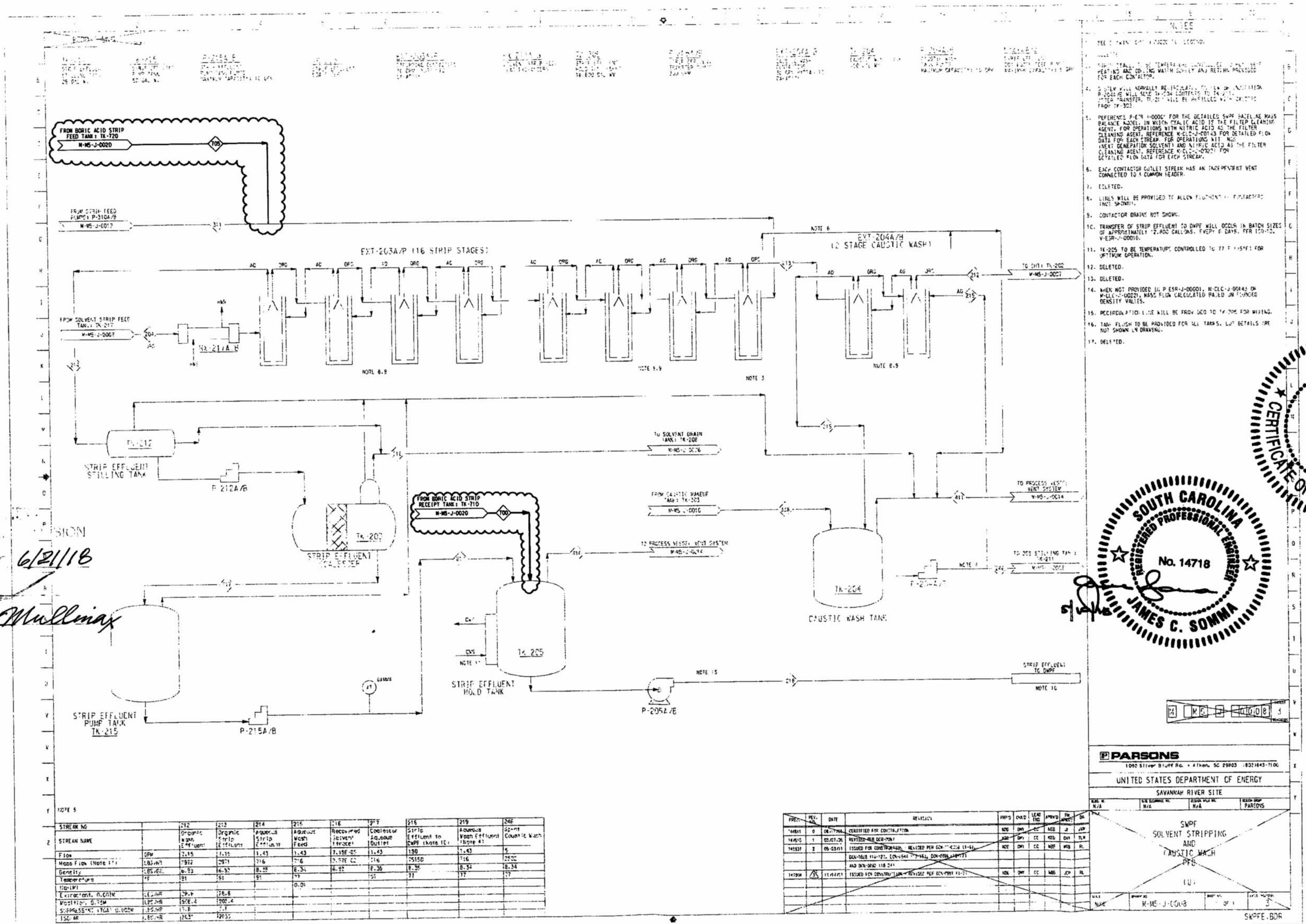
N/A N/A N/A

SWPF
SOLVENT EXTRACTION AND ACID SCRUB
PFD

(U)

M-M5-J-0007 3

20,194-IW
6/21/18
Barry Mullinax



NOTES

1. SEE [illegible] FOR LEGEND.
2. DELETED.
3. STRIP STAGES TO BE TEMPERATURE CONTROLLED [illegible] HEATING AND COOLING WATER SUPPLY AND RETURN PROVIDED FOR EACH CONTACTOR.
4. SYSTEM WILL NORMALLY RECIRCULATE. [illegible] P-204A/B WILL SEND TK-204 CONTENTS TO TK-211. AFTER TRANSFER, TK-204 WILL BE REFILLED WITH CAUSTIC FROM TK-303.
5. REFERENCE P-ESR-J-00001 FOR THE DETAILED SWPF BASELINE MASS BALANCE MODEL, IN WHICH OXALIC ACID IS THE FILTER CLEANING AGENT. FOR OPERATIONS WITH NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00143 FOR DETAILED FLOW DATA FOR EACH STREAM. FOR OPERATIONS WITH NGS (NEXT GENERATION SOLVENT) AND NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00221 FOR DETAILED FLOW DATA FOR EACH STREAM.
6. EACH CONTACTOR OUTLET STREAM HAS AN INDEPENDENT VENT CONNECTED TO A COMMON HEADER.
7. DELETED.
8. LINES WILL BE PROVIDED TO ALLOW FLUSHING OF CONTACTORS (NOT SHOWN).
9. CONTACTOR DRAINS NOT SHOWN.
10. TRANSFER OF STRIP EFFLUENT TO DWPF WILL OCCUR IN BATCH SIZES OF APPROXIMATELY 12,800 GALLONS, EVERY 6 DAYS, PER ICD-10, V-ESR-J-00010.
11. TK-205 TO BE TEMPERATURE CONTROLLED TO 77 F (±5°F) FOR OPTIMUM OPERATION.
12. DELETED.
13. DELETED.
14. WHEN NOT PROVIDED IN P-ESR-J-00001, M-CLC-J-00143 OR M-CLC-J-00221, MASS FLOW CALCULATED BASED ON ROUNDED DENSITY VALUES.
15. RECIRCULATION LINE WILL BE PROVIDED TO TK-205 FOR MIXING.
16. TANK FLUSH TO BE PROVIDED FOR ALL TANKS, BUT DETAILS ARE NOT SHOWN ON DRAWING.
17. DELETED.

NOTE 5

STREAM NO		212	213	214	215	216	217	218	219	246
STREAM NAME		Organic Wash Effluent	Organic Strip Effluent	Aqueous Strip Effluent	Aqueous Wash Feed	Recovered Solvent (trace)	Coalescer Aqueous Outlet	Strip Effluent to DWPF (Note 10)	Aqueous Wash Effluent (Note 4)	Spent Caustic Wash
Flow	GPM	7.15	7.15	1.43	1.43	7.15E-05	1.43	150	1.43	5
Mass Flow (Note 14)	LBS/HR	2972	2971	716	716	2.97E-02	716	75150	716	2502
Density	LBS/GAL	6.93	6.92	8.35	8.34	6.92	8.36	8.35	8.34	8.34
Temperature	°F	91	91	91	77		91	77	77	77
Na+(M)					0.01					
Extractant, 0.003M	LBS/HR	28.8	28.8							
Modifier, 0.75M	LBS/HR	902.4	902.4							
SUPPRESSANT (TiGA) 0.003M	LBS/HR	7.8	7.8							
ISOPAR	LBS/HR	2033	2033							

PROJ.	REV. NO.	DATE	REVISION	PRP'D	CHK'D	LEAD ENG	APRV'D	PM APRV'D	DA
144611	0	[illegible]	CERTIFIED FOR CONSTRUCTION	[illegible]	DWN	CC	MEB	JJ	[illegible]
144510	1	03/07/06	REVISED PER DCR-[illegible]	[illegible]	DWN	CC	MEB	DWN	TLM
145837	2	05-03/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-[illegible] (1-91), DCN-0928 (10-121), DCN-1544 ([illegible]), DCN-0786 ([illegible]) AND DCN-0892 (10-24)	[illegible]	DWN	CC	MBB	MFB	RL
147904	3	11/04/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-[illegible] (11-21)	NDE	DWN	CC	MBB	JEP	RL

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UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE

BLDG. NO.	SITE CLEARANCE NO.	DESIGN SPEC NO.	DESIGN GROUP
N/A	N/A	N/A	PARSONS

SWPF
SOLVENT STRIPPING
AND
CAUSTIC WASH
PFD
(U)

SCALE	DRAWING NO.	SHEET NO.	LATEST REVISION
NONE	M-M5-J-0008	1 OF 1	3

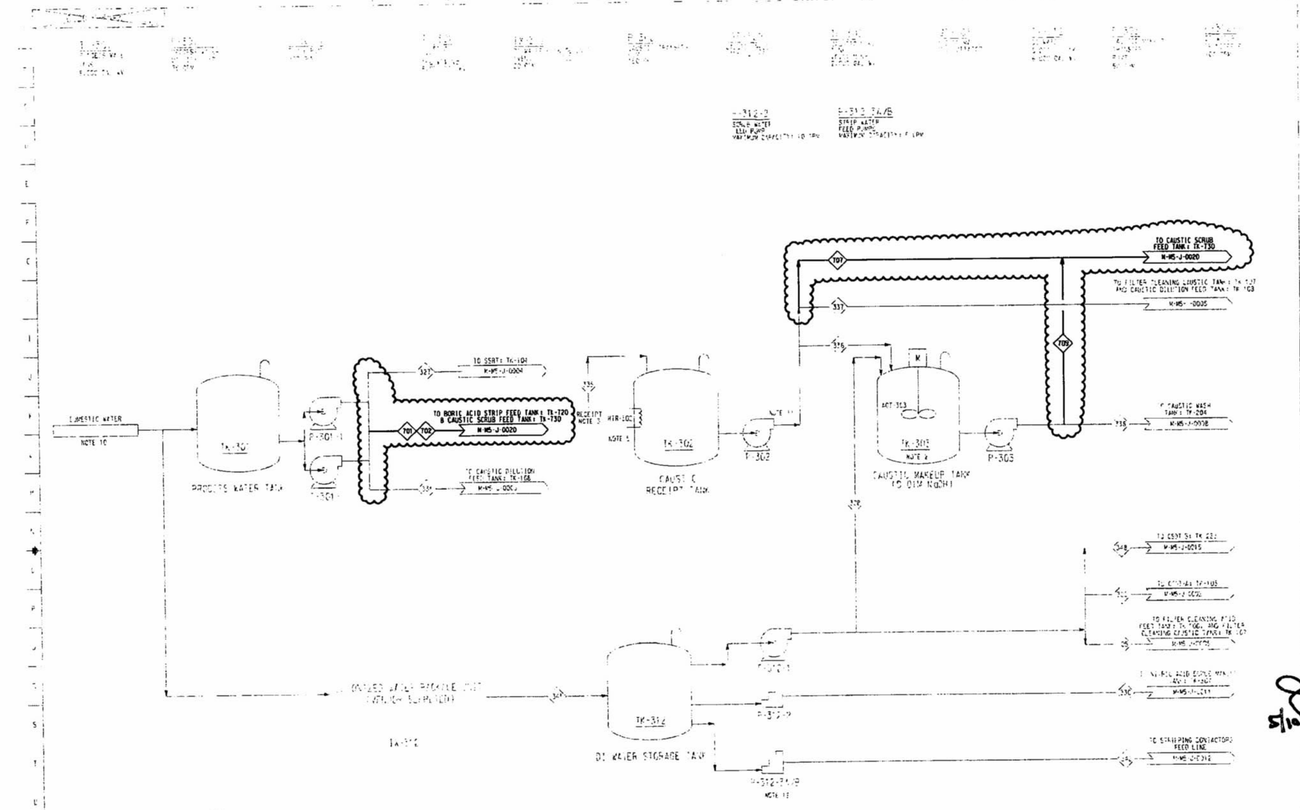
M M5 J 0008 3

SWPFE.BDR

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP, INC.
No. C01094

No. 14718
JAMES C. SOMMA

20194-IW 6/21/18
Barry Mullinax



NOTES

1. [illegible]
2. [illegible]
3. [illegible] CONTAINERS.
4. DELETED.
5. [illegible] CAUSTIC [illegible]
6. DELETED.
DELETED.
8. WHEN NOT PROVIDED IN P-ESR-J-00001, M-CLC-J-00143 OR M-CLC-J-00221, MASS FLOW CALCULATED BASED ON ROUNDED DENSITY VALUES.
9. REFERENCE P-ESR-J-00001 FOR THE DETAILED SWPF BASELINE MASS BALANCE MODEL, IN WHICH OXALIC ACID IS THE FILTER CLEANING AGENT. FOR OPERATIONS WITH NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00143 FOR DETAILED FLOW DATA FOR EACH STREAM. FOR OPERATIONS WITH NGS (NEXT GENERATION SOLVENT) AND NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00221 FOR DETAILED FLOW DATA FOR EACH STREAM.
10. REFER TO [illegible] M-ESR-J-00002, FOR DETAILS.
11. RECIRCULATION LINE WILL BE PROVIDED TO TK-302 FOR MIXING.
12. PUMP FLOW RATES CONTROLLED BY STRIP FEED CONDUCTIVITY (M-M5-[illegible]).

NOTE 9

STREAM NO		305	325	327	328	330	331	335	336	337	338	341	342	349	701	702	707	709
STREAM NAME		DI Water	DI Water	Process Water	DI Water	DI Water	Process Water	50 wt% Caustic Receipt	50 wt% Caustic	50 wt% Caustic	Dilute Caustic	DI Water	DI Water	DI Water	Process Water	Process Water	50 wt% Caustic	Caustic Scrub Feed (0.025M)
Flow	GPM	100	100	10.8	100	10	300	50	0.5	25	50	[illegible]	1.40	100	100	100	[illegible]	30
	GAL/Batch			1370	1995		7202	8000	1.65		400						[illegible]	2000
Mass Flow (Note 8)	LBS/HR	49980	49980	5395	49980	4998	149940	38340	383	19170	25020	5995	700	49980	49980	49980	153.36	15042
	LBS/Batch			11412	16651		60026	102240	13.4		3336						51.12	16650
Density	LBS/GAL	8.33	8.33	8.33	8.33	8.35	8.33	12.78	12.78	12.78	8.31	8.35	8.33	8.33	8.33	8.33	12.78	8.34
Temperature	°F	[illegible]	77	77	77	77	77	77	95	77	77	77	77	77	77	77	50	77
Water	LBS/HR	49980	49980	5395	49980	4998	149940	19170	192	9585	25010	5995	700	49980	49980	49980	76.68	15027
NaOH	LBS/HR							19170	192	10	10						76.68	15

APPROVED • SCDHEC
WATER FACILITIES PERMITTING DIVISION
PERMIT NO. 20,194-IW DATE 6/21/18
BY
PROJECT [illegible] Barry Mullinax

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP INC.
No. C01094

No. 14718
JAMES C. SOMMA
5/10/18

PROJ.	REV. NO.	DATE	REVISION	PRP'D	CHK'D	LEAD ENG	APRV'D	PM APRV'D	DA
744611	0	[illegible]	CERTIFIED FOR CONSTRUCTION	NSD	DMA	CC	KEB	JL	JWK
744910	1	03/07/[illegible]	REVISED PER DCR-C387	NSD	DMA	CC	KEB	[illegible]	TLW
745937	2	05/23/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-07-0005 [illegible]	NSD	DMA	CC	MBB	[illegible]	AL
747304	3	11/14/11	ISSUED FOR CONSTRUCTION - REVISED PER DCN-[illegible]	NSD	DMA	CC	KBB	[illegible]	AL

V-M5-J-0010 3

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UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE

BLDG. NO	SITE CLEARANCE NO.	DESIGN AREA NO	DESIGN GROUP
N/A	N/A	N/A	PARSONS

SWPF
COLD CHEMICAL MAKEUP
AND
PROCESS WATER TANK
PFD
(U)

SCALE	DRAWING NO.	SHEET NO.	REV
NONE	M-M5-J-0010	[illegible]	3

SWPF2.BDR

AGT-710
BORIC ACID STRIP
RECEIPT TANK
AGITATOR

TK-710
BORIC ACID STRIP
RECEIPT TANK
(0.45M BORIC ACID)
2,000 GAL WV

P-710A/B
BORIC ACID STRIP
TRANSFER PUMPS
5 GPM MAXIMUM CAPACITY

P-711
BORIC ACID STRIP
CHARGE PUMP
60 GPM MAXIMUM CAPACITY

AGT-720
BORIC ACID
STRIP FEED TANK
AGITATOR

TK-720
BORIC ACID
STRIP FEED TANK
(0.01M BORIC ACID)
2,000 GAL WV

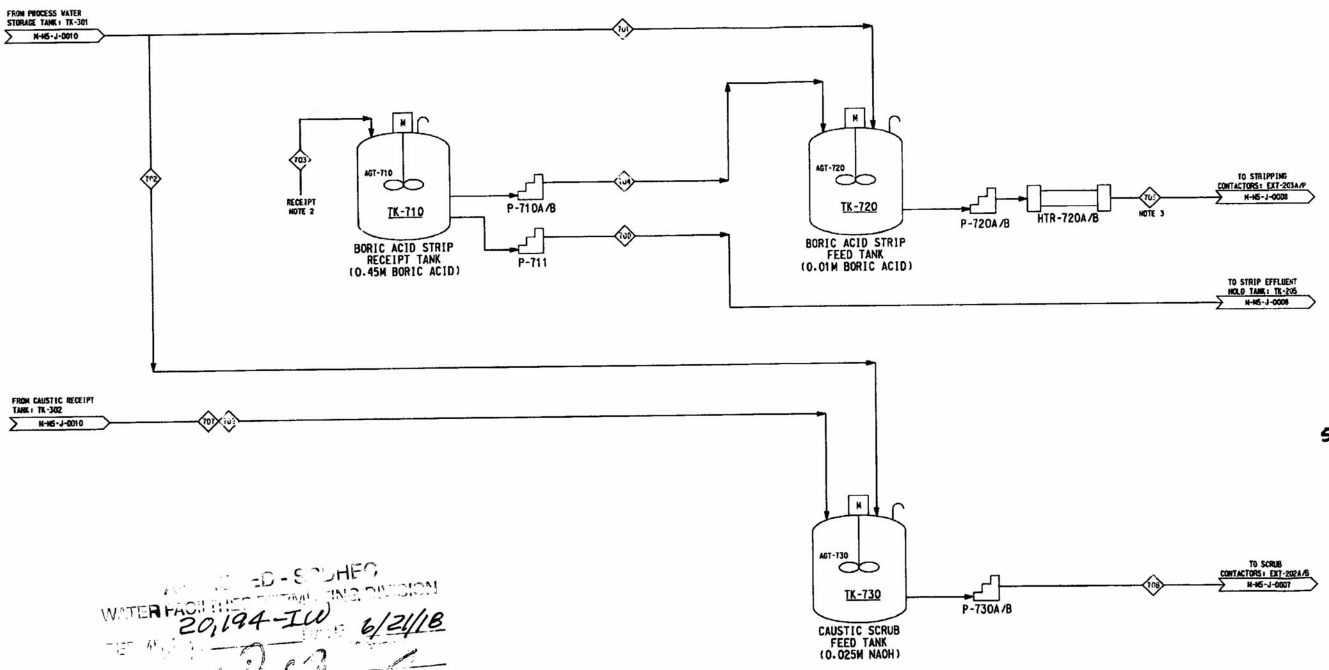
P-720A/B
BORIC ACID
STRIP FEED PUMPS
5 GPM MAXIMUM CAPACITY

HTR-720A/B
BORIC ACID
STRIP FEED HEATERS

AGT-730
CAUSTIC SCRUB
FEED TANK
AGITATOR

TK-730
CAUSTIC SCRUB
FEED TANK
(0.025 M NAOH)
2,000 GAL WV

P-730A/B
CAUSTIC SCRUB
FEED PUMPS
5 GPM MAXIMUM CAPACITY



NOTES

1. SEE DRAWING G-M1-J-00002 FOR LEGEND.
2. BORIC ACID MAY BE UNLOADED FROM PORTABLE CONTAINERS OR CCA UNLOADING.
3. TEMPERATURE OF STRIP SOLUTION CONTROLLED TO 85°F - 95°F.
4. REFERENCE P-ESR-J-00001 FOR THE DETAILED SWPF BASELINE MASS BALANCE MODEL, IN WHICH OXALIC ACID IS THE FILTER CLEANING AGENT. FOR OPERATIONS WITH NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00143 FOR DETAILED FLOW DATA FOR EACH STREAM. FOR OPERATIONS WITH NGS (NEXT GENERATION SOLVENT) AND NITRIC ACID AS THE FILTER CLEANING AGENT, REFERENCE M-CLC-J-00221 FOR DETAILED FLOW DATA FOR EACH STREAM.
5. WHEN NOT PROVIDED IN P-ESR-J-00001, M-CLC-J-00143 OR M-CLC-J-00221, MASS FLOW CALCULATED BASED ON ROUNDED DENSITY VALUES.

PARSONS INFRASTRUCTURE & TECHNOLOGY GROUP INC.
No. C01094

No. 14718
JAMES C. SOMMA

5/10/18

DCN-7000
PAGE 25 OF 39

ED - S HEC
WATER FACI ING DIVISION
20,194-IW
6/21/18
Gr. Barry Mullinax

NOTE 4

STREAM NO		700	703	704	705	708
STREAM NAME		Boric Acid (0.45M)	Boric Acid (0.45M)	Boric Acid (0.45M)	Boric Acid Strip Feed (0.01M)	Caustic Scrub Feed (0.025M)
Flow	GPM	10	50	1.4	1.43	1.43
	GAL/BATCH	2000	2000	44.4		
Mass Flow	LBS/HR	5,004	25,020	701	716	716
	LBS/BATCH	16680	16680	370.3		
Density	LBS/GAL	8.34	8.34	8.34	8.34	8.34
Temperature	°F	77	77	77	91	77
Water	LBS/HR	4864	24322	681	715.56	715.28
H3BO3	LBS/HR	140	698	20	0.44	
NaOH	LBS/HR					0.72

PROJ.	REV. NO.	DATE	REVISION	PRP'D	CHK'D	LEED ENG	APPV'D	PM APPV'D	QA
749500	A	2/28/14	ISSUED FOR NGS CONCEPTUAL DESIGN	MDD	GWY	SC			
749500	B1			MDD					

PARSONS
1080 Silver Bluff Rd. • Aiken, SC 29803 (803)643-7100

UNITED STATES DEPARTMENT OF ENERGY
SAVANNAH RIVER SITE

BLDG. NO.	SITE CLEARANCE NO.	DESIGN AREA NO.	DESIGN GROUP
N/A	N/A	N/A	PARSONS

SWPF
NEXT GENERATION SOLVENT BUILDING
COLD CHEMICAL MAKEUP TANKS
PFD
(U)

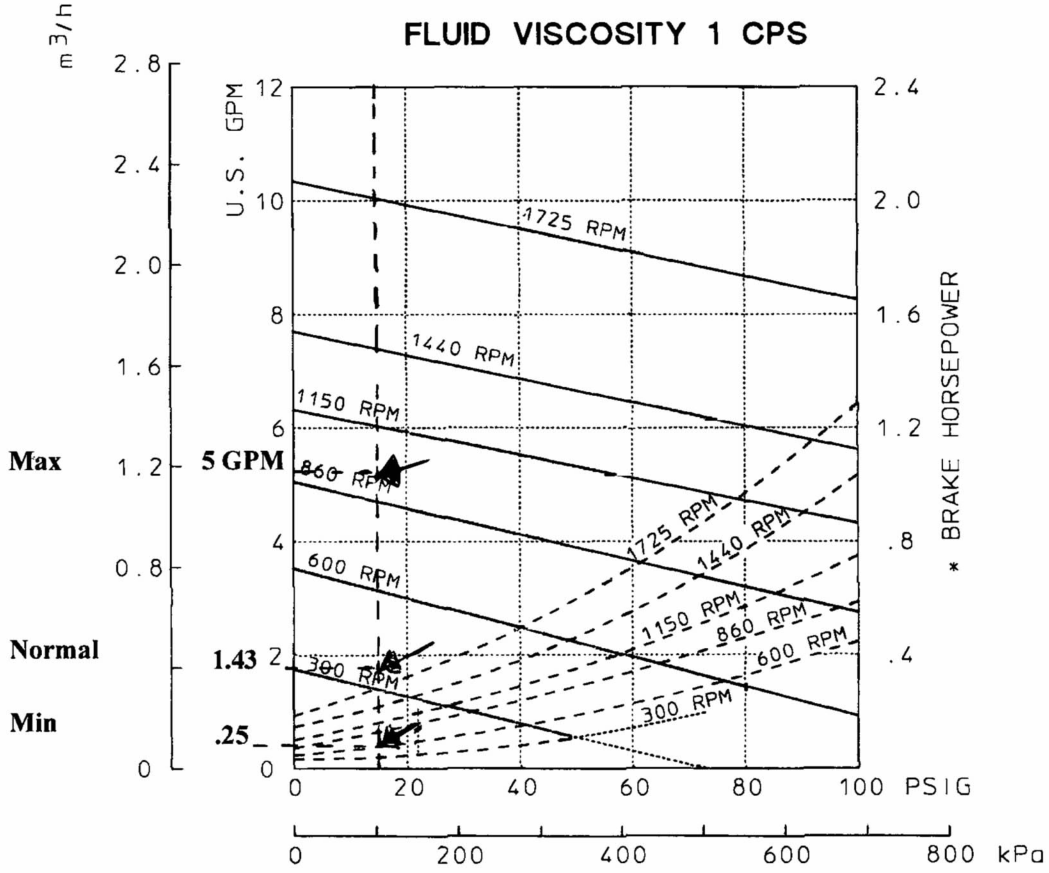
SCALE	DRAWING NO.	SHEET NO.	LATEST REVISION
NONE	M-M5-J-0020	1 OF 1	B1

SWPFE.BDR

Appendix C. CCFF Pump Performance Curves and Calculations

A01
Equipment Tag # P-710A/B
Page 1 of 4

GA/GC6 GEARCHEM PUMP
3/4" PORTS
FLUID VISCOSITY 1 CPS



15.6 PSI DIFFERENTIAL

* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

ECO PULSAFEEDER
A Unit of IDEX Corporation

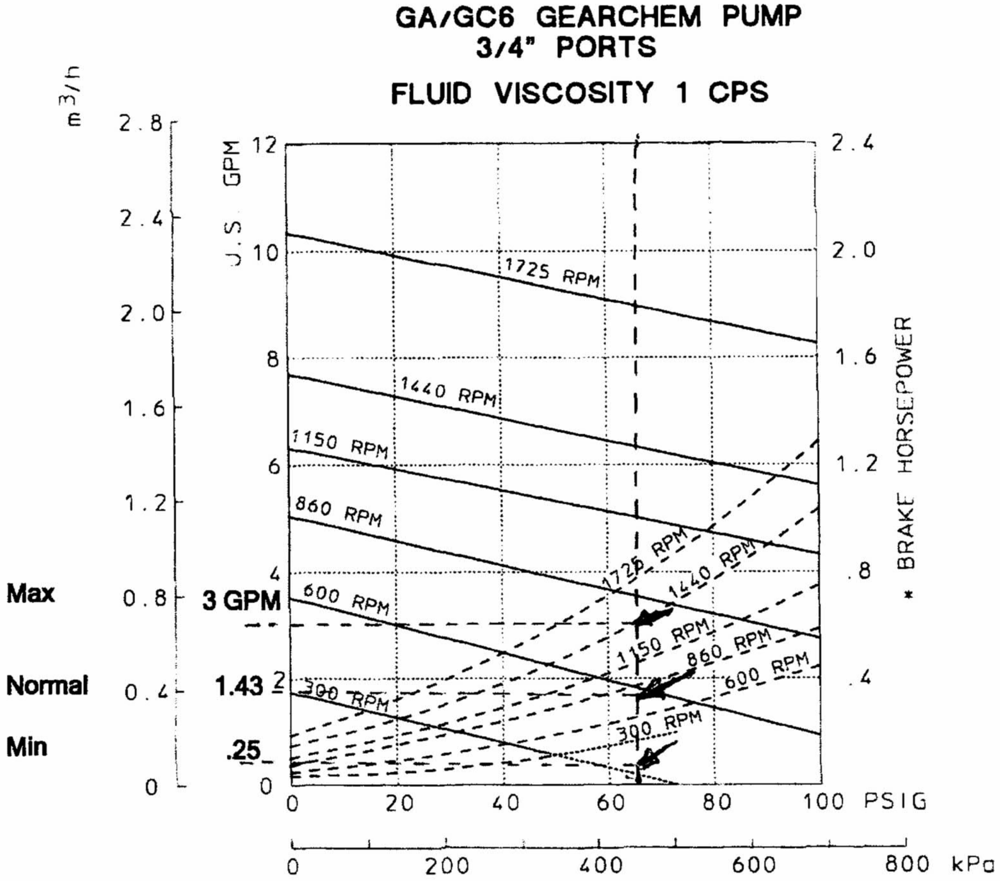
PERFORMANCE CURVE
GA / GC6

SECTION/PAGE C/G6 / 6601
EFFECTIVE 08/16/13
SUPERSEDES 12/01/97

DWN BY: PTP
DATE: 02/11/98
AE00056-001

REF	REVISION UPDATE	DATE
△	updated drawing	08/16/13

A01
Equipment Tag # P-720A/B
Page 2 of 4



GA/GC6 GEARCHEM PUMP
3/4" PORTS
FLUID VISCOSITY 1 CPS

66.2 PSI DIFFERENTIAL

* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

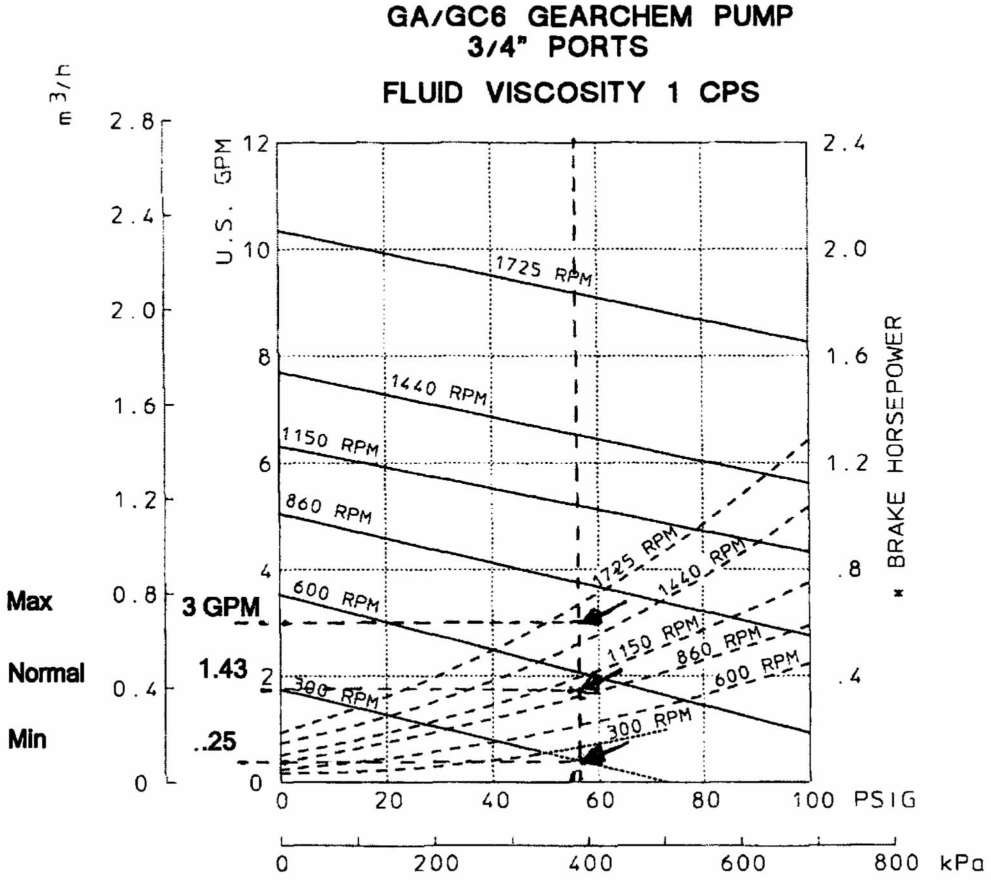
ECO PULSAFEEDER
A Unit of IDEX Corporation

PERFORMANCE CURVE
GA / GC6

			SECTION/PAGE	C/G6 / 6601
A	updated drawing	08/16/13	EFFECTIVE	08/16/13
REF	REVISION UPDATE	DATE	SUPERSEDES	12/01/97

DWN BY: PTP
DATE: 02/11/98
AE00056-001

A01
Equipment Tag # P-730A/B
Page 3 of 4



55.9 PSI DIFFERENTIAL

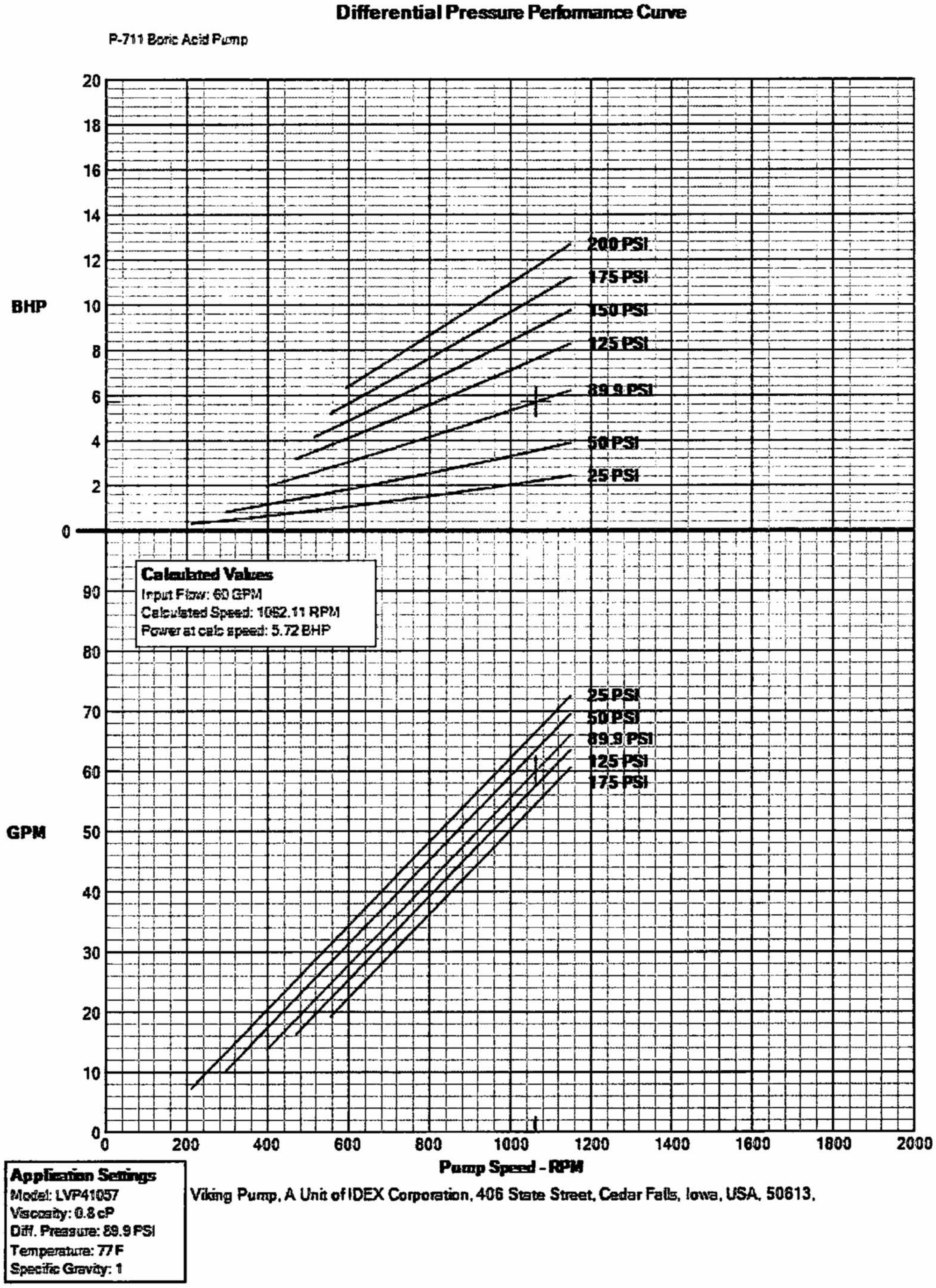
* BRAKE HORSEPOWER SHOWN AS DASHED CURVES

ECO PULSAFEEDER A Unit of IDEX Corporation
PERFORMANCE CURVE
GA / GC6

SECTION/PAGE C/G6 / 6601
EFFECTIVE 08/16/13
SUPERSEDES 12/01/97
DWN BY: PTP
DATE: 02/11/98
AE00056-001

A	updated drawing	08/16/13
REF	REVISION UPDATE	DATE

A01
Equipment Tag # P-711
Page 4 of 4



Calculated Values
Input Flow: 60 GPM
Calculated Speed: 1062.11 RPM
Power at calc speed: 5.72 BHP

Application Settings
Model: LVP41057
Viscosity: 0.8 cP
Diff. Pressure: 89.9 PSI
Temperature: 77 F
Specific Gravity: 1

Viking Pump, A Unit of IDEX Corporation, 406 State Street, Cedar Falls, Iowa, USA, 50613.

PARSONS

Calculation Cover Sheet

Project: NGS Deployment at SWPF	**Calculation No.:** M-CLC-J-00223	**Project Number:** 749600
Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B		**Sheet** 1 of 10
Software Classification: ☒ N/A	**Discipline:** Process	☐ **Preliminary** ☒ **Confirmed**

Computer Program Name ☒ N/A

- ☐ Software Quality Assurance Plan Unique Identifier______ Approval Date________
- ☐ Software Evaluation Report Unique Identifier______ Approval Date________
- ☐ Software Requirement Specification Unique Identifier______ Approval Date________
- ☐ Software Design Description Unique Identifier______ Approval Date________
- ☐ Software User Documentation Unique Identifier______ Approval Date________
- ☐ Software Verification/Validation Plan Unique Identifier______ Approval Date________
- ☐ Software Verification/Validation Report Unique Identifier______ Approval Date________
- ☐ Software Installation & Checkout Unique Identifier______ Approval Date________
- ☐ Software Change Request Unique Identifier______ Approval Date________

Version / Release No.______________________

Purpose and Objective

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Transfer Pumps, P-710A/B.

The objective of this calculation is to size pumps P-710A/B.

Summary of Conclusion

The design points is: 5 gpm & 15.17 psi differential pressure

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER No. 14718 JAMES C. SOMMA

5/10/18

Revisions

Rev. No.	**Revision Description -**
0	Issued for Use

Sign Off

Rev. No.	**Originator (Print) Sign / Date**	**Verification / Checking Method**	**Verifier / Checker (Print) Sign / Date**	**Lead Discipline Engineer (Print) Sign / Date**
0	Nicholas DesRocher 10/28/17	Independent Review/ Math Check	Donna Yarbrough 10-28-17	Cliff Conner DM YARBROUGH f CC f CC 10-28-17

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

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M-CLC-J- 00223</td></tr>
<tr><td colspan="9">Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B</td></tr>
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<tr><td>0</td><td>N. DesRocher</td><td>10/26/2017</td><td>Donna Yarbrough</td><td>10-28-17</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

1.0 Purpose and Objectives

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Transfer Pumps, P-710A/B.

The objective of this calculation is to size pumps P-710A/B.

2.0 References

2.1 P-DB-J-00006, Rev. 0, NGS Deployment at SWPF Basis of Design

2.2. DSG-MP-03, Parsons Engineering Department Design Guide: Pump Head Calculations

2.3 P-PG-J-0024, Rev. 0, SWPF Next Generation Solvent Building General Arrangement Plan at Elevation 98'-9" and Sections

2.4 Crane, Flow of Fluids through Valves, Fittings and Pipe, Technical Paper No. 410

2.5 Cameron Hydraulic Data, 19th Edition

2.6 Pump Handbook, 2nd Edition

2.7 M-M6-J-0201, Rev. 5, SWPF Next Generation Solvent Building Boric Acid Strip Receipt Tank TK-710 P&ID
M-M6-J-0202, Rev. 5, SWPF Next Generation Solvent Building Boric Acid Strip Feed Tank TK-720 P&ID

2.8 Specification 15120, Rev. 25, Piping Material Specification

2.9 M-M5-J-0020, Rev. 0, SWPF Next Generation Solvent Building Cold Chemical Makeup Tank PFD

2.10 P-PI-J-14-10005-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10005-PS200A-
P-PI-J-14-10005-02, Rev. 0, SWPF Piping Isometric 2"-BOR-10005-PS200A-
P-PI-J-14-10006-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10006-PS200A-
P-PI-J-14-10007-01, Rev. 0, SWPF Piping Isometric 3/4"-BOR-10007-PS200A-
P-PI-J-14-10008-01, Rev. 0, SWPF Piping Isometric 3/4"-BOR-10008-PS200A-
P-PI-J-14-10008-02, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10008-PS200A-
P-PI-J-14-10008-03, Rev. 0, SWPF Piping Isometric 3/4"-BOR-10008-PS200A-
P-PI-J-14-10008-04, Rev. 0, SWPF Piping Isometric 2"-BOR-10008-PS200A-

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

3.0 Inputs

3.1 Fluid Properties:

• Fluid: Boric Acid			
• Operating Temperature	77	°F	Ref. 2.9
• Viscosity	1	cP	Sec. 4.3.1
• Specific Gravity	1		Sec. 4.3.1
• Vapor Pressure	0.46	psia	Sec. 4.3.1

3.2 Service Conditions

0.45M Boric Acid for Strip Solution

3.3 Operating Conditions:

• Normal Flow Rate	1.4	gpm	Ref. 2.9
• Design Flow Rate	5	gpm	Sec. 4.3.2
• Source Pressure	14.7	psia	Ref. 2.7
• Suction Static Head From Low Level ***	-1.19	ft	
• Delivery Pressure	14.7	psia	Ref. 2.7
• Discharge Static Head ***	11.13	ft	
• Vessel PSV or Vent Setting	14.7	psia	Ref. 2.7
• Low Level **	1	ft	
• Pump Centerline **	2.19	ft	Ref. 2.10
• Flow Meter Pressure Drop	2	psi	Sec. 4.3.4
• Highest Pipe Elevation on Discharge Line **	13.32	ft	Ref. 2.10

** Elevation with respect to floor elevation (98'-9")
*** Elevation with respect to the pump centerline

4.0 Assumptions

4.1 Assumptions Containing Unverified Design

None

4.2 Assumptions Requiring Re-Verification

4.2.1 Elevations, pipe routing, and valve cvs are based on preliminary information and will be verified with final isometrics and vendor information.

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

4.3 Assumptions Not Requiring Re-Verification

4.3.1 The fluid properties of the 0.45M boric acid are assumed to be equal to the fluid properties of water.

4.3.2 The normal flow rate 1.4 gpm. For conservatism, the design flow rate is set at 5 gpm.

4.3.3 Piping is PS200A. Per Ref. 2.8 this is 304L SS, Sch 40S between sizes 1/2" and 6".

4.3.4 The pressure drop through the flow meter is assumed to be 2 psi.

5.0 Analytical Method

5.1 Suction Pressure:

Source pressure is calculated using Eq. 5.1

Suction Pressure = source pressure + the suction static head from min. suction height - the suction line losses. **Eq. 5.1**

Convert Suction Static Head from feet of liquid to psi using Eq. 5.2

$$P = SG \times \rho \times \left(\frac{g}{g_c}\right) \times h \qquad \textbf{Eq. 5.2}$$

where

ρ = density of water = 62.4 lb_m/ft^3

g = gravitational acceleration = 32.2 ft/s^2

g_c = universal constant = 32.2 $(ft - lb_m)/(lb_f - s^2)$

1 ft^2 = 144 in^2

Eq. 5.2 is simplified to Eq. 5.3:

$$P = SG \times 0.433 \times h \qquad \textbf{Eq. 5.3}$$

5.2 Net Inlet Pressure

The net inlet pressure is calculated using Eq. 5.4:

Net Inlet Pressure = suction pressure (absolute) - vapor pressure (absolute) **Eq. 5.4**

5.3 Discharge Pressure:

The discharge pressure is calculated using Eq. 5.5:

Discharge Pressure = Delivery Pressure + Discharge Static Head + Dynamic line and component losses **Eq. 5.5**

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	6-28-17					

5.4 Differential Pressure

The differential pressure is calculated using Eq. 5.6:

Differential Pressure = discharge pressure - suction pressure **Eq. 5.6**

6.0 Calculations

6.1 Suction Pressure:

Using Eq. 5.3, the suction static head from min. suction height is:

Suction Static Head from Min. Suction Height (psi) = -0.52 psi

Using Eq. 5.1, the suction pressure is:

(from Att. 9.1 - 9.2, Suction Line Loss = 0.37 psi)

Suction Pressure = 13.81 psia

6.2 Net Inlet Pressure

Using Eq. 5.4, the net inlet pressure is:

Net Inlet Pressure = 13.35 psia

6.3 Discharge Pressure:

Using Eq. 5.3, the discharge static head is converted to psi:

Discharge Static Head = 4.82 psi

Using Eq. 5.5, the discharge pressure is:

Discharge Line Loss = 7.46 psi Att. 9.3

Discharge Pressure = 28.98 psia

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Title: Boric Acid Strip Transfer Pumps Sizing Calculation, P-710A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

6.4 Differential Pressure

Using Eq. 5.6, the differential pressure is:

Differential Pressure = 15.17 psi

7.0 Results and/or Recommendations

7.1	Suction Pressure:	13.81 psia	Sec 6.1
7.2	Net Inlet Pressure:	13.35 psia	Sec 6.2
7.3	Discharge Pressure:	28.98 psia	Sec 6.3
7.4	Differential Pressure:	15.17 psi	Sec 6.4

8.0 Conclusions

The design point is: 5 gpm & 15.17 psi differential pressure

9.0 Attachments

9.1	Pump Suction Line Loss Calculation, 2"	Sheets	1
9.2	Pump Suction Line Loss Calculation, 3/4"	Sheets	1
9.3	Pump Discharge Line Loss Calculation	Sheets	1

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Subject: Pump Suction Line Loss Calculation, 2"	Sheet No. 8 of 10

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

Line Number: 2"-BOR-10005-PS200D

Fluid: Boric Acid Sec. 3.1

P&ID Number: M-M6-J-0201 Ref. 2.7

Flow Rate (Q) : 5 gpm Sec. 3.1

ISO DWG No.: P-PI-J-14-10005-01 Ref. 2.10

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1 Sec. 3.1

From: TK-710

To: 2"x3/4"

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: $7{,}638 = \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)(f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.034 [2.4]

Laminar Friction Factor f = 64/Re = 0.008 Velocity (v) = 0.478 fps [2.5]

f_t = 0.019 [2.4]

Friction Factor For This Calc. = 0.034

Item	Component	QTY	"K" Formula [2.4]	d1	d2	β^2	β^4	K
1	Entrance	1	K = 0.78					0.78
2	Pipe	82.8 in.	K = f L/d					1.36
3	Ball Valve	1	Cv = 376 [4.2.1] K= 891 d^4/Cv^2					0.12
4	Pipe Bend (45° or 90°)	1	K = 14 f_t					0.27
5	Tee Run	1	K = 20 f_t					0.38
6	Tee Branch	1	K = 60 f_t					1.14
7	Reducer	1	K = 0.5 (1- β^2) / β4	0.824	2.067	0.159	0.025	16.82
8	Total K							20.87

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 0.03 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Subject: Pump Suction Line Loss Calculation, 3/4"	Sheet No. 9 of 10

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

Line Number: 3/4"-BOR-10005-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10005-02 Ref. 2.10

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 5 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1 Sec. 3.1

From: 2"x3/4"

To: P-710A

Basis Internal Dia.(d): 0.824 in. Internal Area = 0.003703 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.002184

Reynolds Number: 19,159 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) :

$$\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)\,(f^{1/2})}\right)$$

Colebrook Friction Factor (f) : = 0.030 [2.4]

Laminar Friction Factor f = 64/Re = 0.003 Velocity (v) = 3.008 fps [2.5]

f_t = 0.025 [2.4]

Friction Factor For This Calc. = 0.030

Item	Component	QTY	"K" Formula [2.4]	d₁	d₂	β^2	β^4	K
1	Pipe	72 in.	K = f L/d					2.62
2	Ball Valve	2	Cv = 51 [4.2.1] K= 891 d^4/Cv^2					0.32
3	Pipe Bend (45° or 90°)	2	K = 14 f_t					0.70
4	Tee Run	1	K = 20 f_t					0.50
5	Tee Branch	1	K = 60 f_t					1.50
6	Total K							5.64

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ \ ft^2}{144\ in^2}\right) = 0.34$ psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00223
	Subject: Pump Discharge Line Loss Calculation	Sheet No. 10 of 10

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/26/2017	Donna Yarbrough	10-28-17					

Line Number: 1/2"-BOR-10008-PS200D

Fluid: Boric Acid Sec. 3.1

P&ID Number: M-M6-J-0201 Ref. 2.7

Flow Rate (Q) : 5 gpm Sec. 3.1

ISO DWG No.: P-PI-J-14-10008-01 to -04 Ref. 2.10

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1 Sec. 3.1

From: P-710A

To: TK-720

Basis Internal Dia.(d): 0.622 in. Internal Area = 0.00211 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.002894

Reynolds Number: $25{,}381 = \dfrac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4.000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\dfrac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\dfrac{\varepsilon/D}{3.7}\right) + \dfrac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.030 [2.4]

Laminar Friction Factor f = 64/Re = 0.003 Velocity (v) = 5.279 fps [2.5]

f_t = 0.027 [2.4]

Friction Factor For This Calc. = 0.030

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Pipe	450 in.	K = f L/d					21.7
2	Ball Valve	4	Cv = 26 [4.2.1] K= 891 d^4/Cv^2					0.79
3	Check Valve	1	K = 100 f_t					2.70
4	Pipe Bend (45° or 90°)	11	K = 14 f_t					4.16
5	Tee Run	4	K = 20 f_t					2.16
6	Expander	2	$K = (1-\beta^2)^2$	0.622	0.824	0.570		0.37
7	Reducer	2	$K = 0.5\,(1-\beta^2)$	0.622	0.824	0.570		0.43
8	Tee Branch	4	K = 60 f_t					6.48
9	Exit	1	K = 1.0					1
10	Total K							39.79

Pressure Drop: $= \dfrac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\dfrac{v^2\ \ ft^2}{144\ in^2}\right) = 7.46$ psi [2.5]

PARSONS

Calculation Cover Sheet

Project: NGS Deployment at SWPF	**Calculation No.:** M-CLC-J-00225	**Project Number:** 749600
Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B		**Sheet** 1 of 11
Software Classification: ☒ N/A	**Discipline:** Process	☐ **Preliminary** ☒ **Confirmed**

Computer Program Name ☒ N/A

☐ Software Quality Assurance Plan Unique Identifier______ Approval Date______
☐ Software Evaluation Report Unique Identifier ______ Approval Date______
☐ Software Requirement Specification Unique Identifier ______ Approval Date______
☐ Software Design Description Unique Identifier______ Approval Date______
☐ Software User Documentation Unique Identifier ______ Approval Date______
☐ Software Verification/Validation Plan Unique Identifier ______ Approval Date______
☐ Software Verification/Validation Report Unique Identifier______ Approval Date______
☐ Software Installation & Checkout Unique Identifier______ Approval Date______
☐ Software Change Request Unique Identifier ______ Approval Date______

Version / Release No.______

Purpose and Objective

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Feed Pumps, P-720A/B.

The objective of this calculation is to size pumps P-720A/B.

Summary of Conclusion

The design points is: 3 gpm & 65.74 psi differential pressure

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER
No. 14718
JAMES C. SOMMA

5/10/18

Revisions

Rev. No.	**Revision Description -**
0	Issued for Use

Sign Off

Rev. No.	**Originator (Print)** **Sign / Date**	**Verification / Checking Method**	**Verifier / Checker (Print)** **Sign / Date**	**Lead Discipline Engineer (Print)** **Sign / Date**
0	Nicholas DesRocher	Independent Review	Donna Yarbrough	Cliff Conner DYARBROUGH FCC
	11/7/17	Math Check	11-7-17	FCC 11-7-17

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project:	NGS Deployment at SWPF						Calculation No. M-CLC-J- 00225	
	Title:	Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B							
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

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Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough DO	11-7-17					

1.0 Purpose and Objectives

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Feed Pumps, P-720A/B.

The objective of this calculation is to size pumps P-720A/B.

2.0 References

2.1 P-DB-J-00006, Rev. 0, NGS Deployment at SWPF Basis of Design

2.2. DSG-MP-03, Parsons Engineering Department Design Guide: Pump Head Calculations

2.3 P-PG-J-0024, Rev. 0, SWPF Next Generation Solvent Building General Arrangement Plan at Elevation 98'-9" and Sections

2.4 Crane, Flow of Fluids through Valves, Fittings and Pipe, Technical Paper No. 410

2.5 Cameron Hydraulic Data, 19th Edition

2.6 Pump Handbook, 2nd Edition

2.7 M-M6-J-0202, Rev. 5, SWPF Next Generation Solvent Building Boric Acid Strip Feed Tank TK-720 P&ID
M-M6-J-0081, Rev. 11, SWPF Process Building Strip Feed Pumps P-310A/B P&ID as modified by DCN-7000
M-M6-J-0042 SH2, Rev. 8, SWPF Process Building Stripping Contactors EXT-203O/P P&ID

2.8 Specification 15120, Rev. 25, Piping Material Specification

2.9 M-M5-J-0020, Rev. 0, SWPF Next Generation Solvent Building Cold Chemical Makeup Tanks PFD

2.10 P-PI-J-14-10011-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10011-PS200A-
P-PI-J-14-10012-01, Rev. 0, SWPF Piping Isometric 1"-BOR-10012-PS200A-
P-PI-J-14-10013-01, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10013-PS200A-
P-PI-J-14-10014-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10014-PS200A-HCN
P-PI-J-14-10015-01, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10015-PS200A-

2.11 P-PI-J-14-10016-01, Rev. 0, SWPF Piping Isometric 1"-BOR-10016-PS200A-HCN
P-PI-J-14-10016-10, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-HCN
P-PI-J-15-10016-10, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

P-PI-J-15-10016-11, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-15-10016-12, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-15-10016-13, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-15-10016-14, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-15-10016-15, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-03-10016-01, Rev. 0, SWPF Piping Isometric 3/4"-BOR-10016-PS200A-HCN
P-PI-J-03-10016-10, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-ETN
P-PI-J-03-10016-11, Rev. 0, SWPF Piping Isometric 1/2"-BOR-10016-PS200A-HCN
P-PI-J-03-7012-03, Rev. 4, SWPF Piping Isometric 1/2"-HNO3-7012-PS200D-HCN
P-PI-J-03-7013-02, Rev. 7, SWPF Piping Isometric 3/4"-HNO3-7013-PS200D-HCN as modified by DCN-7010
P-PI-J-03-7012-10, Rev. 4, SWPF Piping Isometric 1/2"-HNO3-7012-PS200D-HCN
P-PI-J-02-7012-01, Rev. 5, SWPF Piping Isometric 1/2"-HNO3-7012-PS200D-HCN
P-PI-J-02-7012-02, Rev. 8, SWPF Piping Isometric 1-1/2"-HNO3-7012-PS200D-HCD
P-PI-J-02-7012-10, Rev. 6, SWPF Piping Isometric 3"-HNO3-7012-PS200D-HCN

2.12 P-DB-J-00004, Rev. 6, Salt Waste Processing Facility Balance of Plant Basis of Design

3.0 Inputs

3.1 Fluid Properties:

- Fluid: Boric Acid

Operating Temperature	77	°F	Ref. 2.9
Viscosity	1	cP	Sec. 4.3.1
Specific Gravity	1		Sec. 4.3.1
Vapor Pressure	0.46	psia	Sec. 4.3.1

3.2 Service Conditions

0.01M Boric Acid for Solvent Stripping

3.3 Operating Conditions:

Normal Flow Rate	1.4	gpm	Ref. 2.9
Design Flow Rate	3	gpm	Sec. 4.3.2
Source Pressure	14.7	psia	Ref. 2.7
Suction Static Head From Low Level ***	-1.19	ft	
Delivery Pressure	14.56	psia	Ref. 2.12
Discharge Static Head ***	33.06	ft	
Vessel PSV or Vent Setting	14.7	psia	Ref. 2.7
Low Level **	1	ft	
Pump Centerline **	2.19	ft	Ref. 2.10

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

3.3 Operating Conditions (cont'd):

• Flow Meter Pressure Drop	2	psi	Sec. 4.3.4
• Highest Pipe Elevation on Discharge Line **	35.25	ft	Ref. 2.11
• Heater Pressure Drop	5	psi	Sec. 4.2.1

** Elevation with respect to floor elevation (98'-9")

*** Elevation with respect to the pump centerline

4.0 Assumptions

4.1 Assumptions Containing Unverified Design

None

4.2 Assumptions Requiring Re-Verification

4.2.1 Elevations, pipe routing, valve cvs, and equipment pressure drops are based on preliminary information and will be verified with final isometrics and vendor information.

4.3 Assumptions Not Requiring Re-Verification

4.3.1 The fluid properties of the 0.01M boric acid are assumed to be equal to the fluid properties of water.

4.3.2 The normal flow rate 1.4 gpm. For conservatism, the design flow rate is set at 3 gpm.

4.3.3 Piping is PS200A. Per Ref. 2.8 this is 304L SS, Sch 40S between sizes 1/2" and 6".

4.3.4 The pressure drop through the flow meter is assumed to be 2 psi.

5.0 Analytical Method

5.1 Suction Pressure:

Source pressure is calculated using Eq. 5.1

Suction Pressure = source pressure + the suction static head from min. suction height - the suction line losses. **Eq. 5.1**

Convert Suction Static Head from feet of liquid to psi using Eq. 5.2

$$P = SG \times \rho \times \left(\frac{g}{g_c}\right) \times h$$ **Eq. 5.2**

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

where

ρ = density of water = 62.4 lb_m/ft^3

g = gravitational acceleration = 32.2 ft/s^2

g_c = universal constant = 32.2 $(ft - lb_m)/(lb_f - s^2)$

1 ft^2 = 144 in^2

Eq. 5.2 is simplified to Eq. 5.3:

$P = SG \times 0.433 \times h$ **Eq. 5.3**

5.2 Net Inlet Pressure

The net inlet pressure is calculated using Eq. 5.4:

Net Inlet Pressure = suction pressure (absolute) - vapor pressure (absolute) **Eq. 5.4**

5.3 Discharge Pressure:

The discharge pressure is calculated using Eq. 5.5:

Discharge Pressure = Delivery Pressure + Discharge Static Head + Dynamic line and component losses **Eq. 5.5**

5.4 Differential Pressure

The differential pressure is calculated using Eq. 5.6:

Differential Pressure = discharge pressure - suction pressure **Eq. 5.6**

6.0 Calculations

6.1 Suction Pressure:

Using Eq. 5.3, the suction static head from min. suction height is:

Suction Static Head from Min. Suction Height (psi) = -0.52 psi

Using Eq. 5.1, the suction pressure is:

(from Att. 9.1 & 9.2, Suction Line Loss = 0.10 psi)

Suction Pressure = 14.08 psia

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title: Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

6.2 Net Inlet Pressure

Using Eq. 5.4, the net inlet pressure is:

Net Inlet Pressure = 13.62 psia

6.3 Discharge Pressure:

Using Eq. 5.3, the discharge static head is converted to psi:

Discharge Static Head = 14.31 psi

Using Eq. 5.5, the discharge pressure is:

Discharge Line Loss = 43.95 psi Att. 9.3

Component Loss = 7.00 psi

Discharge Pressure = 79.82 psia

6.4 Differential Pressure

Using Eq. 5.6, the differential pressure is:

Differential Pressure = 65.74 psi

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project:	NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Title:	Boric Acid Strip Feed Pumps Sizing Calculation, P-720A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

7.0 Results and/or Recommendations

7.1	Suction Pressure:	14.08	psia	Sec 6.1
7.2	Net Inlet Pressure:	13.62	psia	Sec 6.2
7.3	Discharge Pressure:	79.82	psia	Sec 6.3
7.4	Differential Pressure:	65.74	psi	Sec 6.4

8.0 Conclusions

The design point is: 3 gpm & 65.74 psi differential pressure

9.0 Attachments

9.1	Pump Suction Line Loss Calculation, 1"	Sheets	1
9.2	Pump Suction Line Loss Calculation, 3/4"	Sheets	1
9.3	Pump Discharge Line Loss Calculation	Sheets	1

Calculation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00225
	Subject: Pump Suction Line Loss Calculation, 1"	Sheet No. 9 of 11

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

Line Number: 1"-BOR-10011-PS200A

P&ID Number: M-M6-J-0202 Ref. 2.7

ISO DWG No.: P-PI-J-14-10011-01 Ref. 2.10

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 3 gpm Sec.3.3

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: TK-720

To: 1"x3/4" reducer

Basis Internal Dia.(d): 1.049 in. Internal Area = 0.006002 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.001716

Reynolds Number: 9,030 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)(f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.034 [2.4]

Laminar Friction Factor f = 64/Re = 0.007 Velocity (v) = 1.114 fps [2.5]

Friction Factor For This Calc. = 0.034 f_t = 0.023 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Entrance	1	K = 0.78					0.78
2	Pipe	138 in.	K = f L/d					4.47
3	Ball Valve	2	Cv = 68 [4.2.1] K= 891 d^4/Cv^2					0.47
4	Pipe Bend (45° or 90°)	2	K = 14 f_t					0.64
5	Tee Run	1	K = 20 f_t					0.46
6	Tee Branch	1	K = 60 f_t					1.38
7	Reducer	1	K = 0.5 (1- β^2)	1.049	2.067	0.258	0.067	0.37
8	Total K							8.57

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 0.07 psi [2.5]

Calculation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF		Calculation No. M-CLC-J- 00225
	Subject: Pump Suction Line Loss Calculation, 3/4"	Sheet No. 10 of 11	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

Line Number: 3/4"-BOR-10011-PS200A

P&ID Number: M-M6-J-0202 Ref. 2.7

ISO DWG No.: P-PI-J-14-10011-01 Ref. 2.10

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 3 gpm Sec.3.3

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: 1"x3/4"

To: P-720A

Basis Internal Dia.(d): 0.824 in. Internal Area = 0.003703 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.002184

Reynolds Number: 11,496 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.033 [2.4]

Laminar Friction Factor f = 64/Re = 0.006 Velocity (v) = 1.805 fps [2.5]

Friction Factor For This Calc. = 0.033 f_t = 0.025 [2.4]

Item	Component	QTY	"K" Formula	d_1	d_2	β^2	β^4	K
1	Pipe	12 in.	K = f L/d					0.48
2	Ball Valve	1	Cv = 51 [4.2.1] K= 891 d^4/Cv^2					0.16
3	Reducer	1	K = 0.5 (1- β^2)	0.824	1.049	0.617		0.19
4	Pipe Bend (45° or 90°)	1	K = 14 f_t					0.35
5	Total K							1.18

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ \ ft^2}{144\ in^2}\right)$ = 0.03 psi [2.5]

Calculation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF		Calculation No. M-CLC-J- 00225
	Subject: Pump Discharge Line Loss Calculation		Sheet No. 11 of 11

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-7-17					

Line Number: 1/2"-BOR-10013/14/16-PS200A/-HNO3-7013/7012-PS200D **Fluid:** Boric Acid Sec. 3.1

P&ID Number: M-M6-J-0202, -0081, -0042SH2 Ref. 2.7 **Flow Rate (Q) :** 3 gpm Sec.3.3

ISO DWG No.: See Ref. 2.10 and 2.11 **Viscosity (μ):** 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: P-720A

To: SB-310

Basis Internal Dia.(d): 0.622 in. Internal Area = 0.00211 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.002894

Reynolds Number: 15,229 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)(f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.033 [2.4]

Laminar Friction Factor f = 64/Re = 0.004 Velocity (v) = 3.167 fps [2.5]

Friction Factor For This Calc. = 0.033 f_t = 0.027 [2.4]

Item	Component	QTY	"K" Formula	d_1	d_2	β^2	β^4	K
1	Pipe	11,400 in.	K = f L/d					604.82
2	Ball Valve	3	Cv = 26 [4.2.1] K= 891 d^4/Cv^2					0.59
3	Check Valve	1	K = 100 f_t					2.70
4	Pipe Bend (45° or 90°)	75	K = 14 f_t					28.35
5	Tee Run	10	K = 20 f_t					5.40
6	Tee Branch	5	K = 60 f_t					8.10
7	Reducer	1	K = 0.5 (1- β^2)	0.622	0.824	0.570		0.22
8	Exit	1	K = 1.0					1
9	Total K							651.20

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 43.95 psi [2.5]

PARSONS

Calculation Cover Sheet

Project: NGS Deployment at SWPF	**Calculation No.:** M-CLC-J-00226	**Project Number:** 749600
Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B		**Sheet** 1 of 9
Software Classification: ☒ N/A	**Discipline:** Process	☐ **Preliminary** ☒ **Confirmed**

Computer Program Name ☒ N/A

☐ Software Quality Assurance Plan Unique Identifier ______ Approval Date______
☐ Software Evaluation Report Unique Identifier ______ Approval Date______
☐ Software Requirement Specification Unique Identifier ______ Approval Date______
☐ Software Design Description Unique Identifier ______ Approval Date______
☐ Software User Documentation Unique Identifier ______ Approval Date______
☐ Software Verification Validation Plan Unique Identifier ______ Approval Date______
☐ Software Verification Validation Report Unique Identifier ______ Approval Date______
☐ Software Installation & Checkout Unique Identifier ______ Approval Date______
☐ Software Change Request Unique Identifier ______ Approval Date______

Version / Release No.______

Purpose and Objective

The purpose of this calculation is to evaluate the design criteria for the Caustic Scrub Feed Pumps, P-730A/B.

The objective of this calculation is to size pumps P-730A/B.

Summary of Conclusion

The design points is: 3 gpm & 55.40 psi differential pressure

SOUTH CAROLINA
REGISTERED PROFESSIONAL ENGINEER
No. 14718
JAMES C. SOMMA
5/10/18

Revisions

Rev. No.	**Revision Description -**
0	Issued for Use

Sign Off

Rev. No.	**Originator (Print)** **Sign / Date**	**Verification / Checking Method**	**Verifier / Checker (Print)** **Sign / Date**	**Lead Discipline Engineer (Print)** **Sign / Date**
0	Nicholas DesRocher	Independent Review	Donna Yarbrough	Cliff Conner
	11/6/17	Math Check	11-6-17	D. YARBROUGH F CC FCC 11-6-17

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B							Calculation No. M-CLC-J- 00226	
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough DO	11-6-17					

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PARSONS Engineering Calculation	Project: NGS Deployment at SWPF						Calculation No. M-CLC-J- 00226		
	Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B								
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-6-17					

1.0 Purpose and Objectives

The purpose of this calculation is to evaluate the design criteria for the Caustic Scrub Feed Pumps, P-730A/B.

The objective of this calculation is to size pumps P-730A/B.

2.0 References

2.1 P-DB-J-00006, Rev. 0, NGS Deployment at SWPF Basis of Design

2.2. DSG-MP-03, Parsons Engineering Department Design Guide: Pump Head Calculations

2.3 P-PG-J-0024, Rev. 0, SWPF Next Generation Solvent Building General Arrangement Plan at Elevation 98'-9" and Sections

2.4 Crane, Flow of Fluids through Valves, Fittings and Pipe, Technical Paper No. 410

2.5 Cameron Hydraulic Data, 19th Edition

2.6 Pump Handbook, 2nd Edition

2.7 M-M6-J-0203, Rev. 5, SWPF Next Generation Solvent Building Caustic Scrub Feed Tank TK-730 P&ID
M-M6-J-0082, Rev. 9, SWPF Process Building Nitric Acid Scrub Makeup Tank P&ID as modified by DCN-7000
M-M6-J-0038, Rev. 0, SWPF Process Building Scrub Contactors EXT-202A/B P&ID

2.8 Specification 15120, Rev. 25, Piping Material Specification

2.9 M-M5-J-0020, Rev. 0, SWPF Next Generation Solvent Building Cold Chemical Makeup Tanks PFD

2.10 P-PI-J-14-10024-01, Rev. 0, SWPF Piping Isometric 2"-NAOH-10024-PS200A-
P-PI-J-14-10024-02, Rev. 0, SWPF Piping Isometric 1"-NAOH-10024-PS200A-
P-PI-J-14-10025-01, Rev. 0, SWPF Piping Isometric 1"-NAOH-10025-PS200A-

2.11 P-PI-J-14-10026-01, Rev. 0, SWPF Piping Isometric 3/4"-NAOH-10026-PS200A-
P-PI-J-14-10027-01, Rev. 0, SWPF Piping Isometric 3/4"-NAOH-10027-PS200A-
P-PI-J-14-10027-10, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-
P-PI-J-15-10027-10, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF				Calculation No. M-CLC-J- 00226				
	Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B								
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough DY	11-6-17					

P-PI-J-15-10027-11, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-15-10027-12, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-15-10027-13, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-15-10027-14, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-15-10027-15, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-03-10027-01, Rev. 0, SWPF Piping Isometric 3/4"-NAOH-10027-PS200A-
P-PI-J-03-10027-10, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-ETN
P-PI-J-03-10027-11, Rev. 0, SWPF Piping Isometric 1/2"-NAOH-10027-PS200A-
P-PI-J-03-7037-03, Rev. 4, SWPF Piping Isometric 1/2"-HNO3-7037-PS200D- as modified by DCN-7010
P-PI-J-03-7037-10, Rev. 6, SWPF Piping Isometric 1/2"-HNO3-7037-PS200D-
P-PI-J-02-7037-01, Rev. 4, SWPF Piping Isometric 1/2"-HNO3-7037-PS200D-
P-PI-J-02-7037-02, Rev. 5, SWPF Piping Isometric 1/2"-HNO3-7037-PS200D-

2.12 P-DB-J-00004, Rev. 6, Salt Waste Processing Facility Balance of Plant Basis of Design

3.0 Inputs

3.1 Fluid Properties:

• Fluid: Dilute NaOH			
• Operating Temperature	77	°F	Ref. 2.9
• Viscosity	1	cP	Sec. 4.3.1
• Specific Gravity	1		Sec. 4.3.1
• Vapor Pressure	0.46	psia	Sec. 4.3.1

3.2 Service Conditions
Dilute (0.025M) NaOH for CSSX Scrub

3.3 Operating Conditions:

• Normal Flow Rate	1.4	gpm	Ref. 2.9
• Design Flow Rate	3	gpm	Sec. 4.3.2
• Source Pressure	14.7	psia	Ref. 2.7
• Suction Static Head From Low Level ***	-1.19	ft	
• Delivery Pressure	14.56	psia	Ref. 2.12
• Discharge Static Head ***	26.19	ft	
• Vessel PSV or Vent Setting	14.7	psia	Ref. 2.7
• Low Level **	1	ft	
• Pump Centerline **	2.19	ft	Ref. 2.10
• Flow Meter Pressure Drop	2	psi	Sec. 4.3.4

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00226
	Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
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- Highest Pipe Elevation on Discharge Line ** 28.38 ft Ref. 2.11

** Elevation with respect to floor elevation (98'-9")

*** Elevation with respect to the pump centerline

4.0 Assumptions

4.1 Assumptions Containing Unverified Design

None

4.2 Assumptions Requiring Re-Verification

4.2.1 Elevations, pipe routing, valve cvs, and equipment pressure drops are based on preliminary information and will be verified with final isometrics and vendor information.

4.3 Assumptions Not Requiring Re-Verification

4.3.1 The fluid properties of the 0.025M NaOH are assumed to be equal to the fluid properties of water.

4.3.2 The normal flow rate 1.4 gpm. For conservatism, the design flow rate is set at 3 gpm.

4.3.3 Piping is PS200A. Per Ref. 2.8 this is 304L SS, Sch 40S between sizes 1/2" and 6".

4.3.4 The pressure drop through the flow meter is assumed to be 2 psi.

5.0 Analytical Method

5.1 Suction Pressure:

Source pressure is calculated using Eq. 5.1

Suction Pressure = source pressure + the suction static head from min. suction height - the suction line losses. **Eq. 5.1**

Convert Suction Static Head from feet of liquid to psi using Eq. 5.2

$$P = SG \times \rho \times \left(\frac{g}{g_c}\right) \times h \qquad \textbf{Eq. 5.2}$$

where

ρ = density of water = 62.4 lb_m/ft^3

g = gravitational acceleration = 32.2 ft/s^2

g_c = universal constant = 32.2 $(ft - lb_m)/(lb_f - s^2)$

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF							Calculation No. M-CLC-J- 00226	
	Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B								
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-6-17					

1 ft^2 = 144 in^2

Eq. 5.2 is simplified to Eq. 5.3:

$P = SG \times 0.433 \times h$ **Eq. 5.3**

5.2 Net Inlet Pressure

The net inlet pressure is calculated using Eq. 5.4:

Net Inlet Pressure = suction pressure (absolute) - vapor pressure (absolute) **Eq. 5.4**

5.3 Discharge Pressure:

The discharge pressure is calculated using Eq. 5.5:

Discharge Pressure = Delivery Pressure + Discharge Static Head + Dynamic line and component losses **Eq. 5.5**

5.4 Differential Pressure

The differential pressure is calculated using Eq. 5.6:

Differential Pressure = discharge pressure - suction pressure **Eq. 5.6**

6.0 Calculations

6.1 Suction Pressure:

Using Eq. 5.3, the suction static head from min. suction height is:

Suction Static Head from Min. Suction Height (psi) = -0.52 psi

Using Eq. 5.1, the suction pressure is:

(from Att. 9.1, Suction Line Loss = 0.08 psi)

Suction Pressure = 14.10 psia

6.2 Net Inlet Pressure

Using Eq. 5.4, the net inlet pressure is:

Net Inlet Pressure = 13.64 psia

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00226
	Title: Caustic Scrub Feed Pumps Sizing Calculation, P-730A/B	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-6-17					

6.3 Discharge Pressure:

Using Eq. 5.3, the discharge static head is converted to psi:

Discharge Static Head = 11.34 psi

Using Eq. 5.5, the discharge pressure is:

Discharge Line Loss = 41.60 psi Att. 9.2

Discharge Pressure = 69.50 psia

6.4 Differential Pressure

Using Eq. 5.6, the differential pressure is:

Differential Pressure = 55.40 psi

7.0 Results and/or Recommendations

7.1	Suction Pressure:	14.10 psia	Sec 6.1
7.2	Net Inlet Pressure:	13.64 psia	Sec 6.2
7.3	Discharge Pressure:	69.50 psia	Sec 6.3
7.4	Differential Pressure:	55.40 psi	Sec 6.4

8.0 Conclusions

The design point is: 3 gpm & 55.40 psi differential pressure

9.0 Attachments

9.1	Pump Suction Line Loss Calculation	Sheets	1
9.2	Pump Discharge Line Loss Calculation	Sheets	1

Calculation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00226
	Subject: Pump Suction Line Loss Calculation	Sheet No. 8 of 9

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-6-17					

Line Number: 1"-NAOH-10024-PS200A
P&ID Number: M-M6-J-0203 Ref. 2.7
ISO DWG No.: P-PI-J-10024-01, -02 Ref. 2.10

Fluid: Dilute NaOH Sec. 3.1
Flow Rate (Q) : 3 gpm Sec. 3.1
Viscosity (μ): 1 cp Sec. 3.1
Specific Gravity: 1.00 Sec. 3.1

From: TK-730
To: P-730B

Basis Internal Dia.(d): 1.049 in. Internal Area = 0.006002 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]
Relative Roughness ε/D: 0.001716

Reynolds Number: 9,030 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.034 [2.4]

Laminar Friction Factor f = 64/Re = 0.007 Velocity (v) = 1.114 fps [2.5]

Friction Factor For This Calc. = 0.034 f_t = 0.023 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Entrance	1	K = 0.78					0.78
2	Pipe	130.8 in.	K = f L/d					4.24
3	Ball Valve	2	Cv = 68 [4.2.1] K= 891 d^4/Cv^2					0.47
4	Pipe Bend (45° or 90°)	3	K = 14 f_t					0.97
5	Tee Run	2	K = 20 f_t					0.92
6	Tee Branch	1	K = 60 f_t					1.38
7	Reducer	1	K = 0.5 (1- β^2)	1.049	2.067	0.258		0.37
8	Reducer	1	K = 0.5 (1- β^2) / β^4	0.824	1.049	0.617	0.381	0.50
9	Total K							9.63

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 0.08 psi [2.5]

Calculation Sheet

PARSONS Engineering Calcuilation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00226
	Subject: Pump Discharge Line Loss Calculation	Sheet No. 9 of 9

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	11/6/2017	Donna Yarbrough	11-6-17					

Line Number: 1/2"-NAOH-10027-PS200A/-HNO3-7037-PS200D **Fluid:** Dilute NaOH Sec. 3.1

P&ID Number: M-M6-J-0203, -0082, -0038 Ref. 2.7 **Flow Rate (Q) :** 3 gpm Sec. 3.1

ISO DWG No.: See Ref. 2.11 **Viscosity (μ):** 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: P-730B

To: SB-309

Basis Internal Dia.(d): 0.622 in. Internal Area = 0.00211 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]

Relative Roughness ε/D: 0.002894

Reynolds Number: 15,229 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2) \text{ Log} \left(\left(\frac{\varepsilon/D}{3.7} \right) + \frac{2.51}{(Re)(f^{1/2})} \right)$

Colebrook Friction Factor (f) : = 0.033 [2.4]

Laminar Friction Factor f = 64/Re = 0.004 Velocity (v) = 3.167 fps [2.5]

Friction Factor For This Calc. = 0.033 f_t = 0.027 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Pipe	10,800 in.	K = f L/d					573.00
2	Ball Valve	3	Cv = 26 [4.2.1] K= 891 d^4/Cv^2					0.59
3	Check Valve	2	K = 100 f_t					5.40
4	Pipe Bend (45° or 90°)	60	K = 14 f_t					22.68
5	Tee Run	10	K = 20 f_t					5.40
6	Tee Branch	5	K = 60 f_t					8.10
7	Reducer	1	K = 0.5 (1- β^2)	0.622	0.824	0.570		0.22
8	Exit	1	K = 1.0					1
9	Total K							616.4

Pressure Drop: $= \frac{K \ SG \ \rho_{H2O}}{2 \ g_c} \left(\frac{v^2 \ ft^2}{144 \ in^2} \right)$ = 41.60 psi [2.5]

PARSONS

Calculation Cover Sheet

Project: NGS Deployment at SWPF	**Calculation No.:** M-CLC-J-00224	**Project Number:** 749600
Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711		**Sheet** 1 of 15
Software Classification: ☒ N/A	**Discipline:** Process	☐ **Preliminary** ☒ **Confirmed**

Computer Program Name ☒ N/A

- ☐ Software Quality Assurance Plan Unique Identifier________ Approval Date________
- ☐ Software Evaluation Report Unique Identifier ________ Approval Date________
- ☐ Software Requirement Specification Unique Identifier ________ Approval Date________
- ☐ Software Design Description Unique Identifier________ Approval Date________
- ☐ Software User Documentation Unique Identifier ________ Approval Date________
- ☐ Software Verification/Validation Plan Unique Identifier________ Approval Date________
- ☐ Software Verification/Validation Report Unique Identifier________ Approval Date________
- ☐ Software Installation & Checkout Unique Identifier________ Approval Date________
- ☐ Software Change Request Unique Identifier ________ Approval Date________

Version / Release No.____________

Purpose and Objective

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Charge Pump, P-711.

The objective of this calculation is to size pump P-711.

Summary of Conclusion

The design points are: 60 gpm & 10.33 psi differential pressure
10 gpm & 65.07 psi differential pressure

SOUTH CAROLINA REGISTERED PROFESSIONAL ENGINEER
No. 14718
JAMES C. SOMMA

5/10/18

Revisions

Rev. No.	**Revision Description -**
0	Issued for Use

Sign Off

Rev. No.	**Originator (Print)** **Sign / Date**	**Verification /** **Checking Method**	**Verifier / Checker (Print)** **Sign / Date**	**Lead Discipline Engineer (Print)** **Sign / Date**
0	Nicholas DesRocher	Independent Review/	Donna Yarbrough	Cliff Conner ~~DM YARBROUGH~~ f CC
	10/25/17	Math Check	10-25-17	f CC 10-25-17

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

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Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

1.0 Purpose and Objectives

The purpose of this calculation is to evaluate the design criteria for the Boric Acid Strip Charge Pump, P-711.

The objective of this calculation is to size pumps P-711.

2.0 References

2.1 P-DB-J-00006, Rev. 0, NGS Deployment at SWPF Basis of Design

2.2. DSG-MP-03, Parsons Engineering Department Design Guide: Pump Head Calculations

2.3 P-PG-J-0024, Rev. 0, SWPF Next Generation Solvent Building General Arrangement Plan at Elevation 98'-9" and Sections

2.4 Crane, Flow of Fluids through Valves, Fittings and Pipe, Technical Paper No. 410

2.5 Cameron Hydraulic Data, 19th Edition

2.6 P-DB-J-00004, Rev. 5, Salt Waste Processing Facility Project Balance of Plant Basis of Design

2.7 M-M6-J-0201, Rev. 5, SWPF Next Generation Solvent Building Boric Acid Strip Receipt Tank TK-710 P&ID
M-M6-J-0202, Rev. 5, SWPF Next Generation Solvent Building Boric Acid Strip Feed Tank TK-720 P&ID
M-M6-J-0024, Rev. 6, SWPF Process Building Central Processing Area Breakpots P&ID as modified by DCN-7000

2.8 Specification 15120, Rev. 25, Piping Material Specification

2.9 M-M5-J-0020, Rev. 0, SWPF Next Generation Solvent Building Cold Chemical Makeup Tanks PFD

2.10 P-PI-J-14-10005-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10005-PS200D-
P-PI-J-14-10006-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10006-PS200D-
P-PI-J-14-10006-02, Rev. 0, SWPF Piping Isometric 2"-BOR-10006-PS200D-

2.11 P-PI-J-14-10009-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10009-PS200D-
P-PI-J-14-10009-10, Rev. 0, SWFP Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-14-10040-01, Rev. 0, SWPF Piping Isometric 2"-BOR-10040-PS200D-
P-PI-J-14-10040-02, Rev. 0, SWPF Piping Isometric 2"-BOR-10040-PS200D-
P-PI-J-15-10009-10, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

P-PI-J-15-10009-11, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-15-10009-12, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-15-10009-13, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-15-10009-14, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-15-10009-15, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-03-10009-10, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-ETN
P-PI-J-03-10009-11, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-03-10009-12, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-02-10009-01, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-01-10009-01, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-01-10009-02, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-
P-PI-J-01-10009-10, Rev. 0, SWPF Piping Isometric 1-1/2"-BOR-10009-PS200D-

2.12 51086-SDC-0008, Rev. 0, Flow Coefficients: Max Cv & Cv Curve Top Entry
00909-SDC-001, Rev. 6, Valve Drawings

2.13 Pump Handbook, 2^{nd} Edition

2.14 P-PI-J-01-7213-01, Rev. 8, SWPF Piping Isometric 3/4"-NAOH-7213-PS200D- as modified by DCN-7010
P-PI-J-01-7213-02, Rev. 5, SWPF Piping Isometric 1/2"-NAOH-7213-PS200D as modified by DCN-7010
P-PI-J-01-7213-03, Rev. 5, SWPF Piping Isometric 3/4"-NAOH-7213-PS200D-
P-PI-J-01-7213-04, Rev. 0, SWPF Piping Isometric 3/4"-NAOH-7213-PS200D-

3.0 Inputs

3.1 Fluid Properties:

• Fluid: Boric Acid			
• Operating Temperature	77	°F	Ref. 2.9
• Viscosity	1	cP	Sec. 4.3.1
• Specific Gravity	1		Sec. 4.3.1
• Vapor Pressure	0.46	psia	Sec. 4.3.1

3.2 Service Conditions
0.45M Boric Acid for Strip Solution and Concentrated Supply to DWPF

3.3 Operating Conditions:

• Design Flow Rate, to TK-720	60	gpm	Sec. 4.3.3
• Design Flow Rate, to SB-205	10	gpm	Sec. 4.3.3
• Source Pressure	14.7	psia	Ref. 2.7

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

3.3 Operating Conditions (cont'd):

• Suction Static Head From Low Level ***	-1.4	ft	
• Delivery Pressure, TK-720	14.7	psia	Ref. 2.7
• Delivery Pressure, SB-205	14.56	psia	Ref. 2.6
• Discharge Static Head, TK-720 ***	11.10	ft	
• Discharge Static Head, SB-205 ***	52.10	ft	
• Vessel PSV or Vent Setting	14.7	psia	Ref. 2.7
• Low Level **	1	ft	Ref. 2.10
• Pump Centerline **	2.4	ft	Ref. 2.10
• Flow Meter Pressure Drop	2	psi	Sec. 4.3.2
• Highest Pipe Elevation on Discharge Line, TK-720 **	13.5	ft	Ref. 2.10
• Highest Pipe Elevation on Discharge Line, SB-205 **	54.5	ft	Ref. 2.14

** Elevation with respect to floor elevation (98'-9")

*** Elevation with respect to the pump centerline

4.0 Assumptions

4.1 Assumptions Containing Unverified Design

Npne

4.2 Assumptions Requiring Re-Verification

4.2.1 Elevations, pipe routing, and valve cvs are based on preliminary information and will be verified with final isometrics and vendor information.

4.3 Assumptions Not Requiring Re-Verification

4.3.1 The fluid properties of the 0.45M boric acid are assumed to be equal to the fluid properties of water.

4.3.2 The pressure drop through the flow meter is assumed to be 2 psi.

4.3.3 Factoring in line lengths and fill volumes, the flow rate is conservatively assumed to be 60 gpm to TK-720 and 10 gpm to SB-205.

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF							Calculation No. M-CLC-J- 00224	
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711								
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

5.0 Analytical Method

5.1 Suction Pressure:

Source pressure is calculated using Eq. 5.1

Suction Pressure = source pressure + the suction static head from min. suction height - the suction line losses. **Eq. 5.1**

Convert Suction Static Head from feet of liquid to psi using Eq. 5.2

$$P = SG \times \rho \times \left(\frac{g}{g_c}\right) \times h$$ **Eq. 5.2**

where

ρ = density of water = 62.4 lb_m/ft^3

g = gravitational acceleration = 32.2 ft/s^2

g_c = universal constant = 32.2 $(ft - lb_m)/(lb_f - s^2)$

1 ft^2 = 144 in^2

Eq. 5.2 is simplified to Eq. 5.3:

$$P = SG \times 0.433 \times h$$ **Eq. 5.3**

5.2 Net Inlet Pressure

The net inlet pressure is calculated using Eq. 5.4:

Net Inlet Pressure = suction pressure (absolute) - vapor pressure (absolute) **Eq. 5.4**

5.3 Discharge Pressure:

The discharge pressure is calculated using Eq. 5.5:

Discharge Pressure = Delivery Pressure + Discharge Static Head + Dynamic line and component losses **Eq. 5.5**

5.4 Differential Pressure

The differential pressure is calculated using Eq. 5.6:

Differential Pressure = discharge pressure - suction pressure **Eq. 5.6**

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

6.0 Calculations

6.1 Suction Pressure:

Using Eq. 5.3, the suction static head from min. suction height is:
Suction Static Head from Min. Suction Height (psi) = -0.61 psi

Using Eq. 5.1, the suction pressure is:
(from Att. 9.1 Suction Line Loss = 1.35 psi) (to TK-720)
(from Att. 9.2 Suction Line Loss = 0.04 psi) (to SB-205)

Suction Pressure = 12.74 psia (to TK-720)
Suction Pressure = 14.05 psia (to SB-205)

6.2 Net Inlet Pressure

Using Eq. 5.4, the net inlet pressure is:
Net Inlet Pressure = 12.28 psia (to TK-720)
Net Inlet Pressure = 13.59 psia (to SB-205)

6.3 Discharge Pressure:

Using Eq. 5.3, the discharge static head is converted to psi:
Discharge Static Head = 4.81 psi (to TK-720)
Discharge Static Head = 22.56 psi (to SB-205)

Using Eq. 5.5, the discharge pressure is:
Discharge Line Loss = 1.56 psi (to TK-720) Att. 9.3, Att. 9.5
Discharge Line Loss = 38.00 psi (to SB-205) Att. 9.4, Att. 9.6, Att. 9.7

Discharge Pressure = 23.07 psia (to TK-720)
Discharge Pressure = 79.12 psia (to SB-205)

6.4 Differential Pressure

Using Eq. 5.6, the differential pressure is:
Differential Pressure = 10.33 psi (to TK-720)
Differential Pressure = 65.07 psi (to SB-205)

Calculation Continuation Sheet

PARSONS Engineering Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Title: Boric Acid Strip Charge Pump Sizing Calculation, P-711	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

7.0 Results and/or Recommendations

7.1	Suction Pressure:	12.74 psia	(to TK-720)	Sec 6.1
		14.05 psia	(to SB-205)	Sec 6.1
7.2	Net Inlet Pressure:	12.28 psia	(to TK-720)	Sec 6.2
		13.59 psia	(to SB-205)	Sec 6.2
7.3	Discharge Pressure:	23.07 psia	(to TK-720)	Sec 6.3
		79.12 psia	(to SB-205)	Sec 6.3
7.4	Differential Pressure:	10.33 psi	(to TK-720)	Sec 6.4
		65.07 psi	(to SB-205)	Sec 6.4

7.0 Conclusions

The design points are: 60 gpm & 10.33 psi differential pressure
10 gpm & 65.07 psi differential pressure

8.0 Attachments

8.1	Pump Suction Line Loss Calculation, 60 gpm	Sheets	1
8.2	Pump Suction Line Loss Calculation, 10 gpm	Sheets	1
8.3	Pump Discharge Line Loss Calculation, to Tee, 60 gpm	Sheets	1
8.4	Pump Discharge Line Loss Calculation, to Tee, 10 gpm	Sheets	1
8.5	Pump Discharge Line Loss Calculation, Tee to TK-720	Sheets	1
8.6	Pump Discharge Line Loss Calculation, Tee to SB-205, 1-1/2"	Sheets	1
8.7	Pump Discharge Line Loss Calculation, Tee to SB-205, 1/2"	Sheets	1

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Subject: Pump Suction Line Loss Calculation, 60 gpm	Sheet No. 9 of 15

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 2"-BOR-10006-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10006-01/-02, -10005-01 Ref. 2.10

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 60 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: TK-710

To: P-711

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: 91,653 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \mathrm{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)\,(f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.022 [2.4]

Laminar Friction Factor f = 64/Re = 0.001 Velocity (v) = 5.736 fps [2.5]

Friction Factor For This Calc. = 0.022 f_t = 0.019 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Entrance	1	K = 0.78					0.78
2	Pipe	188 in.	K = f L/d					2.00
3	Ball Valve	2	Cv = 376 [4.2.1] K= 891 d^4/Cv^2					0.23
4	Pipe Bend (45° or 90°)	3	K = 14 f_t					0.80
5	Tee Run	3	K = 20 f_t					1.14
6	Tee Branch	1	K = 60 f_t					1.14
7	Total K							6.09

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ \ ft^2}{144\ in^2}\right)$ = 1.35 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Subject: Pump Suction Line Loss Calculation, 10 gpm	Sheet No. 10 of 15

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 2"-BOR-10006-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10006-01/-02, -10005-01 Ref. 2.10

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 10 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: TK-710

To: P-711

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: $15,275 = \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)(f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.029 [2.4]

Laminar Friction Factor f = 64/Re = 0.004 Velocity (v) = 0.956 fps [2.5]

Friction Factor For This Calc. = 0.029 f_t = 0.019 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d₁	d₂	β^2	β^4	K
1	Entrance	1	K = 0.78					0.78
2	Pipe	188 in.	K = f L/d					2.64
3	Ball Valve	2	Cv = 376 [4.2.1] K= 891 d^4/Cv^2					0.23
4	Pipe Bend (45° or 90°)	3	K = 14 f_t					0.80
5	Tee Run	3	K = 20 f_t					1.14
6	Tee Branch	1	K = 60 f_t					1.14
7	Total K							6.73

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right) = 0.04$ psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF						Calculation No. M-CLC-J- 00224	
	Subject: Pump Discharge Line Loss Calculation, to Tee, 60 gpm						Sheet No. 11 of 15	

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 2"-BOR-10040-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10040-01, -02 Ref. 2.11

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 60 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: P-711

To: Tee

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: 91,653 $= \frac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.022 [2.4]

Laminar Friction Factor f = 64/Re = 0.001 Velocity (v) = 5.736 fps [2.5]

Friction Factor For This Calc. = 0.022 f_t = 0.019 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d_1	d_2	β^2	β^4	K
1	Pipe	36 in.	K = f L/d					0.38
2	Ball Valve	1	Cv = 376 [4.2.1] K= 891 d^4/Cv^2					0.12
3	Pipe Bend (45° or 90°)	1	K = 14 f_t					0.27
4	Tee Run	3	K = 20 f_t					1.14
5	Tee Branch	1	K = 60 f_t					1.14
6	Total K							0.38

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 0.08 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Subject: Pump Discharge Line Loss Calculation, to Tee, 10 gpm	Sheet No. 12 of 15

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 2"-BOR-10040-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10040-01, -02 Ref. 2.11

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 10 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: P-711

To: Tee

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: 15,275 $= \dfrac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\dfrac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\dfrac{\varepsilon/D}{3.7}\right) + \dfrac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.029 [2.4]

Laminar Friction Factor f = 64/Re = 0.004 Velocity (v) = 0.956 fps [2.5]

Friction Factor For This Calc. = 0.029 f_t = 0.019 [2.4]

Item	Component	QTY		"K" Formula [2.4]				d_1	d_2	β^2	β^4	K
1	Pipe	36	in.	K = f L/d								0.51
2	Ball Valve	1		Cv =	376	[4.2.1]	K= 891 d^4/Cv^2					0.12
3	Pipe Bend (45° or 90°)	1		K = 14 f_t								0.27
4	Tee Run	3		K = 20 f_t								1.14
5	Tee Branch	1		K = 60 f_t								1.14
6	Total K											0.51

Pressure Drop: $= \dfrac{K\ SG\ \ \rho_{H2O}}{2\ g_c}\left(\dfrac{v^2\ \ ft^2}{144\ in^2}\right)$ = 0.003 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Subject: Pump Discharge Line Loss Calculation, Tee to TK-720	Sheet No. 13 of 15

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 2"-BOR-10040-PS200D

P&ID Number: M-M6-J-0201 Ref. 2.7

ISO DWG No.: P-PI-J-14-10040-02 Ref. 2.11

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 60 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: Tee

To: TK-720

Basis Internal Dia.(d): 2.067 in. Internal Area = 0.023303 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.000871 [2.5]

Reynolds Number: 91,653 $= \frac{[50.6][Q][SG][62.4]}{[\mu][d]}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = [-2]\ \text{Log}\left(\left(\frac{\varepsilon/D}{3.7}\right) + \frac{2.51}{[Re]\ [f^{1/2}]}\right)$

Colebrook Friction Factor (f) : = 0.022 [2.4]

Laminar Friction Factor f = 64/Re = 0.001 Velocity (v) = 5.736 fps [2.5]

Friction Factor For This Calc. = 0.022 f_t = 0.019 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d₁	d₂	β^2	β^4	K
1	Pipe	300 in.	K = f L/d					3.19
2	Ball Valve	1	Cv = 376 [4.2.1] K= 891 d^4/Cv^2					0.12
3	Pipe Bend (45° or 90°)	9	K = 14 f_t					2.39
4	Exit	1	K = 1.0					1
5	Total K							6.7

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\frac{v^2\ ft^2}{144\ in^2}\right)$ = 1.48 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF	Calculation No. M-CLC-J- 00224
	Subject: Pump Discharge Line Loss Calculation, Tee to SB-205, 1-1/2"	Sheet No. 14 of 15

Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 1-1/2"-BOR-10009-PS200D

P&ID Number: M-M6-J-0201 M-M6-J-0024 Ref. 2.7

ISO DWG No.: See Ref. 2.11

Fluid: Boric Acid Sec. 3.1

Flow Rate (Q) : 10 gpm Sec. 3.1

Viscosity (μ): 1 cp Sec. 3.1

Specific Gravity: 1.00 Sec. 3.1

From: Tee

To: Reduction before SI-7015

Basis Internal Dia.(d): 1.610 in. Internal Area = 0.014138 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft

Relative Roughness ε/D: 0.001118 [2.5]

Reynolds Number: 19,611 $= \dfrac{(50.6)(Q)(SG)(62.4)}{(\mu)(d)}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\dfrac{1}{f^{1/2}} = (-2)\ \text{Log}\left(\left(\dfrac{\varepsilon/D}{3.7}\right) + \dfrac{2.51}{(Re)\ (f^{1/2})}\right)$

Colebrook Friction Factor (f) : = 0.028 [2.4]

Laminar Friction Factor f = 64/Re = 0.003 Velocity (v) = 1.576 fps [2.5]

Friction Factor For This Calc. = 0.028 f_t = 0.021 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d₁	d₂	β^2	β^4	K
1	Pipe	11,500 in.	K = f L/d					200
2	Ball Valve	2	Cv = 170 [4.2.1] K= 891 d^4/Cv^2					0.41
3	Pipe Bend (45° or 90°)	60	K = 14 f_t					23.52
4	Reducer	1	K = 0.5 (1- β^2)	1.610	2.067	0.607		0.20
5	Tee Run	2	K = 20 f_t					0.84
6	Tee Branch	5	K = 60 f_t					6.30
7	Exit	1	K = 1.0					1
8	Total K							231.27

Pressure Drop: $= \dfrac{K\ SG\ \rho_{H2O}}{2\ g_c}\left(\dfrac{v^2\ ft^2}{144\ in^2}\right)$ = 3.87 psi [2.5]

Calculation Sheet

PARSONS Engineering Information Only Calculation	Project: NGS Deployment at SWPF							Calculation No. M-CLC-J- 00224	
	Subject: Pump Discharge Line Loss Calculation, Tee to SB-205, 1/2"							Sheet No. 15 of 15	
Rev	Originator	Date	Checker	Date	Rev	Originator	Date	Checker	Date
0	N. DesRocher	10/24/2017	Donna Yarbrough	10-25-17					

Line Number: 1/2"-NAOH-7213-PS200D
P&ID Number: M-M6-J-0024 Ref. 2.7
ISO DWG No.: P-PI-J-01-7213-01, -02, -03 Ref. 2.14

Fluid: Boric Acid Sec. 3.1
Flow Rate (Q) : 10 gpm Sec. 3.1
Viscosity (μ): 1 cp Sec. 3.1
Specific Gravity: 1.00 Sec. 3.1

From: Reduction before SI-7015
To: SB-205

Basis Internal Dia.(d): 0.622 in. Internal Area = 0.00211 ft^2 = $\pi \times 0.25 \times d^2/144$

Surface Roughness (ε) : 0.00015 ft [2.5]
Relative Roughness ε/D: 0.002894

Reynolds Number: 50,763 $= \frac{[50.6][Q][SG][62.4]}{[\mu][d]}$ [2.5]

Note: Since the Reynolds Number is > 4,000, the flow is turbulent and the friction factor is calculated using the Colebrook equation.

Colebrook Equation (For Reynolds Numbers > 4,000) : $\frac{1}{f^{1/2}} = [-2] \text{ Log } \left(\left[\frac{\varepsilon/D}{3.7} \right] + \frac{2.51}{[Re]\ [f^{1/2}]} \right)$

Colebrook Friction Factor (f) : = 0.028 [2.4]

Laminar Friction Factor f = 64/Re = 0.001 Velocity (v) = 10.56 fps [2.5]

Friction Factor For This Calc. = 0.028 f_t = 0.027 [2.4]

Item	Component	QTY	"K" Formula [2.4]	d₁	d₂	β^2	β^4	K
1	Pipe	800 in.	K = f L/d					36.01
2	Ball Valve	1	Cv = 20 [2.12] K= 891 d^4/Cv^2					0.33
3	Pipe Bend (45° or 90°)	9	K = 14 f_t					3.40
4	Reducer	1	K = 0.5 (1- β^2)	0.622	1.610	0.149		0.43
5	Plug Valve, 2 way	1	Cv = 16 [2.12] K= 891 d^4/Cv^2					0.52
6	Plug Valve, 3 way	1	Cv = 9 [2.12] K= 891 d^4/Cv^2					1.65
7	Tee Run	1	K = 20 f_t					0.54
8	Tee Branch	1	K = 60 f_t					1.62
9	Exit	1	K = 1.0					1
10	Total K							45.50

Pressure Drop: $= \frac{K\ SG\ \rho_{H2O}}{2\ g_c} \left(\frac{v^2\ ft^2}{144\ in^2} \right)$ = 34.13 psi [2.5]

Appendix D. CCFF Equipment List

M-MX-J-0001, *SWPF Equipment Database (U)* (NGS only)

PARSONS
Project: SWPF
Job No.: 749478

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SWPF EQUIPMENT DATABASE (NGS ONLY)

Thursday, November 30, 2017

DISCIPLINE	EQUIPMENT IDENTIFICATION NUMBER					EQUIPMENT NAME	EQUIPMENT DESCRIPTION												CONTROL NUMBER	PROC LEVEL	PERFORM CATAGORY	FUNCTION CLASS SS, GS (Note 1)	EQUIPMENT DESCRIPTION				REMARKS	
	SITE AREA	DESIGN AREA	BLDG	FUNC. ID.	SEQ NUMBER		EQUIPMENT DESCRIPTION	CAPACITY/ DUTY (Note 5)	MATERIAL	STEAM REQ. LBM/HR	PLANT AIR REQ-SCFM	COOLING REQ (BTU/HR)	EQUIPMENT DESCRIPTION										PFD	P&ID/HVAC DRAWING	ELECTRICAL DIAGRAM	Datasheet/ Equipment Schedule Drawing/ Specification Section		
													ELECT LOAD	VOLTAGE	PHASE	FDR. TYPE	VFD/LOCAL STARTER	BACKUP POWER										
Process	J	14	221-6J	AGT	710	Boric Acid Strip Receipt Tank Agitator	Mechanical Mixer, Used to agitate TK-710 contents	NA	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08653	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0201	E-E2-J-00039	M-DS-J-00411		N
Process	J	14	221-6J	AGT	720	Boric Acid Strip Feed Tank Agitator	Mechanical Mixer, Used to agitate TK-720 contents	NA	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08653	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	E-E2-J-00039	M-DS-J-00421		N
Process	J	14	221-6J	AGT	730	Caustic Scrub Feed Tank Agitator	Mechanical Mixer, Used to agitate TK-730 contents	NA	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08653	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0203	E-E2-J-00039	M-DS-J-00431		N
HVAC	J	14	221-6J	FAN	016	NGS Building Exhaust Fan	Used to Exhaust Air from NGS Building	10,000 CFM	Aluminum	NA	NA	NA	0.75 HP	480V	3	STR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
HVAC	J	14	221-6J	FAN	017	NGS Building Exhaust Fan	Used to Exhaust Air from NGS Building	10,000 CFM	Aluminum	NA	NA	NA	0.75 HP	480V	3	STR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
HVAC	J	14	221-6J	HTR	018	Electric Unit Heater	Provide Heat to NGS Building	400 CFM	Steel	NA	NA	NA	5.0 KW	480V	3	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
HVAC	J	14	221-6J	HTR	019	Electric Unit Heater	Provide Heat to NGS Building	400 CFM	Steel	NA	NA	NA	5.0 KW	480V	3	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
HVAC	J	14	221-6J	HTR	020	Electric Unit Heater	Provide Heat to NGS Building	400 CFM	Steel	NA	NA	NA	5.0 KW	480V	3	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
HVAC	J	14	221-6J	HTR	021	Electric Unit Heater	Provide Heat to NGS Building	400 CFM	Steel	NA	NA	NA	5.0 KW	480V	3	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	TBD	E-E2-J-00039			N
Process	J	14	221-6J	HTR	720A	Boric Acid Strip Feed Heater	Electric Heater, Used to Heat Strip Feed	24 KW	304 Stainless Steel	NA	NA	NA	24 KW	480V	3	BKR	NA	NO	08654	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	E-E2-J-00039	M-DS-J-00400		N
Process	J	14	221-6J	HTR	720B	Boric Acid Strip Feed Heater	Electric Heater, Used to Heat Strip Feed	24 KW	304 Stainless Steel	NA	NA	NA	24 KW	480V	3	BKR	NA	NO	08654	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	E-E2-J-00039	M-DS-J-00400		N
Electrical	J	14	221-6J	MCC	211	NGS 480V Normal Power MCC	Motor Control Center	600 Ampere	Steel	NA	NA	NA	300 Amps	480V	3	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	NA	E-E2-J-0002	16443		N
Material Handling	J	14	221-6J	MR	141	AGT-710 Monorail	Monorail to Remove/Replace AGT-710	1/4 Ton	Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	TBD	PL-4	PC-1	GS-2	NA	NA	NA			N
Material Handling	J	14	221-6J	MR	142	AGT-720 Monorail	Monorail to Remove/Replace AGT-720	1/4 Ton	Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	TBD	PL-4	PC-1	GS-2	NA	NA	NA			N
Material Handling	J	14	221-6J	MR	143	AGT-730 Monorail	Monorail to Remove/Replace AGT-730	1/4 Ton	Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	TBD	PL-4	PC-1	GS-2	NA	NA	NA			N
Process	J	14	221-6J	P	700A	Boric Acid Addition Pump	Used for Tote/Drum Unloading	20 GPH	CPVC	NA	NA	NA	NA	120V	1	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	M-M6-J-0200	E-ES-J-00040	M-DS-J-00401		N

Legend for right-most column: [N] = New, [D] = Delete, [B] = Before, [A] = After

PARSONS
Project: SWPF
Job No.: 749478

SWPF EQUIPMENT DATABASE (NGS ONLY)

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DISCIPLINE	EQUIPMENT IDENTIFICATION NUMBER					EQUIPMENT NAME	EQUIPMENT DESCRIPTION												CONTROL NUMBER	PROC LEVEL	PERFORM CATAGORY	FUNCTION CLASS SS, GS (Note 1)	EQUIPMENT DESCRIPTION				REMARKS	
													EQUIPMENT DESCRIPTION															
	SITE AREA	DESIGN AREA	BLDG	FUNC. ID.	SEQ NUMBER		EQUIPMENT DESCRIPTION	CAPACITY/ DUTY (Note 5)	MATERIAL	STEAM REQ. LBM/HR	PLANT AIR REQ-SCFM	COOLING REQ (BTU/HR)	ELECT LOAD	VOLTAGE	PHASE	FDR. TYPE	VFD/LOCAL STARTER	BACKUP POWER					PFD	P&ID/HVAC DRAWING	ELECTRICAL DIAGRAM	Datasheet/ Equipment Schedule Drawing/ Specification Section		
Process	J	14	221-6J	P	700B	Boric Acid Addition Pump	Used for Tote/Drum Unloading	20 GPH	CPVC	NA	NA	NA	NA	120V	1	BKR	NA	NO	TBD	PL-4	PC-1	GS-2	NA	M-M6-J-0200	E-ES-J-00040	M-DS-J-00401		N
Process	J	14	221-6J	P	710A	Boric Acid Strip Transfer Pump	Pump Used to Transfer Concentrated Boric Acid to TK-720	5 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0201	E-E2-J-00039	M-DS-J-00402		N
Process	J	14	221-6J	P	710B	Boric Acid Strip Transfer Pump	Pump Used to Transfer Concentrated Boric Acid to TK-720	5 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0201	E-E2-J-00039	M-DS-J-00402		N
Process	J	14	221-6J	P	711	Boric Acid Strip Charge Pump	Pump Used to Transfer Concentrated Boric Acid to SB-205	60 GPM	316L Stainless Steel	NA	NA	NA	10 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0201	E-E2-J-00039	M-DS-J-00403		N
Process	J	14	221-6J	P	720A	Boric Acid Strip Feed Pump	Pump Used to Supply Boric Acid Strip Solution to CSSX Contactors	3 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	E-E2-J-00039	M-DS-J-00404		N
Process	J	14	221-6J	P	720B	Boric Acid Strip Feed Pump	Pump Used to Supply Boric Acid Strip Solution to CSSX Contactors	3 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	E-E2-J-00039	M-DS-J-00404		N
Process	J	14	221-6J	P	730A	Caustic Scrub Feed Pump	Pump Used to Supply Caustic Scrub Solution to CSSX Contactors	3 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0203	E-E2-J-00039	M-DS-J-00405		N
Process	J	14	221-6J	P	730B	Caustic Scrub Feed Pump	Pump Used to Supply Caustic Scrub Solution to CSSX Contactors	3 GPM	316L Stainless Steel	NA	NA	NA	1 HP	480V	3	VFD	NA	NO	08655	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0203	E-E2-J-00039	M-DS-J-00405		N
Process	J	14	221-6J	P	740	NGS Sump Pump	Pump Used to Empty Contents of NGS Building Sumps	5 GPM	316L Stainless Steel	NA	5	NA	NA	NA	NA	NA	NA	NO	08656	PL-4	PC-1	GS-2	NA	M-M6-J-0204	NA	M-DS-J-00406		N
Electrical	J	14	221-6J	PNL	346	208Y/120V Panel	Supplies 120V to Misc Loads	225 Ampere	Steel	NA	NA	NA	150 Amps	480V	3	BKR	NA	NA	TBD	PL-4	PC-1	GS-2	NA	NA	E-E2-J-00039	16442		N
Fire Protection	J	14	221-6J	TK	014	Fire Protection Water Surge Tank	Bladder type used for Fire Protection Surge Suppression	317 GAL	Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	PL-4	PC-1	GS-2	NA	M-M6-J-0097	NA	NA		N
Engineering Mechanics	J	14	221-6J	TK	710	Boric Acid Strip Receipt Tank	Tank, Used to Receive/Store Concentrated Boric Acid	2500 GAL	316L Stainless Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	08652	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0201	NA	M-DS-J-00410		N
Engineering Mechanics	J	14	221-6J	TK	720	Boric Acid Strip Feed Tank	Tank, Used for Make-Up of Dilute Boric Acid for Strip Feed	2500 GAL	316L Stainless Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	08652	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0202	NA	M-DS-J-00420		N
Engineering Mechanics	J	14	221-6J	TK	730	Caustic Scrub Feed Tank	Tank, Used for Make-Up of Dilute Caustic for Scrub Feed	2500 GAL	316L Stainless Steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	08652	PL-4	PC-1	GS-2	M-M5-J-0020	M-M6-J-0203	NA	M-DS-J-00430		N

Legend for right-most column: [N] = New, [D] = Delete, [B] = Before, [A] = After