Presentation to:
South Carolina Governor’s Nuclear Advisory Council

Jean Ridley, U.S. Department of Energy
Stuart MacVean, Savannah River Remediation

July 10, 2014
Overcoming Adversity/Distractions in Early FY14

- The Liquid Waste Program faced many challenges in the past 6 months:
  - Reduced Budget
    - Workforce restructuring
  - Lapse of Appropriations
    - Cessation of Work
    - 2 week furlough of SRR employees
  - Weather Impacts
    - Loss of Steam from cold weather resulted in outage/damage that halted work in most areas
    - Snow storm (Plant closure)
    - Historic ice storm (Plant closure)

It has been one of the most unusual periods in the Site’s history
Operational Highlights

- **Safety still a top priority:**
  - > 5 million safe work hours in total liquid waste workforce
  - > 26 million safe work hours in liquid waste construction workforce

- **Tank Closure**
  - 6 tanks operationally closed; 2 of them this year

- **Defense Waste Processing Facility (DWPF)**
  - 3,833 of 8,582 canisters poured

- **Saltstone Disposal Unit (SDU) 6 under construction**
  - First mega-vault
  - 5,888 yd$^3$ concrete poured
  - 122,479 ft$^2$ of liner installed

- **Saltstone Facility Production**
  - 16,000,000 gallons of grout containing 414 kCi dispositioned

- **Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU)**
  - 7,000,000 gallons salt waste treated
Z Area Salt Disposal Facility Update
Presentation to the GNAC

July 10, 2014

Steve Wilkerson
Defense Waste Processing Facility/Saltstone Director
Background

- Savannah River Site’s (SRR) Z Area Saltstone Facility
  - Status of Saltstone Disposal Facility Vault 4
  - Low-level radioactive contamination at Storm Water Outfall Z-01

- Actions SRR has and is taking to address these issues

September 5, 2013
Report reveals radionuclide leaks in SRS vault

The Savannah River Site has confirmed its efforts to maintain radionuclide leaks caused by cracking in a vault on Site. Vault 4 was previously used for the disposal of nuclear waste from high-level waste tanks. As of now, the vault is no longer being used to receive radioactive salt waste. Information on the leakage was uncovered after Tom Clements, a member of Friends of the Earth, filed a Freedom of Information Act request on Aug. 6.

"While SRS acted responsibly in identifying the degradation in the vault and in addressing the problems, there is concern about long-term stability of the structure and potential future radionuclide leakage," said Clements in a press release. In addition, DOE has stated that it has increased monitoring of the vault roof and will aggressively make necessary repairs to lessen potential leakage in the future. The department is also looking to modernize vault designs to increase safety levels.

"A more permanent elastic coating is targeted for installation on Vault 4 disposal unit in 2014, which will eliminate rainwater infiltration and reduce the potential for low-level radioactive contamination on the vault exterior," stated Savannah River Remediation, the Site’s liquid waste contractor. Even with efforts to manage the leaks, SRS has stated that the radionuclide leaks are below DOE regulatory standards.

See Vault p XX
Saltstone Disposal Facility (SDF)

Location of SDF at SRS

Saltstone Disposal Facility (SDF)
Cracks in Vault 4 roof allowed rainwater to migrate into the vault.

Liquid collected in the narrow annular space between the grout waste form and the vault wall.

Contaminated liquid could weep through construction joints or cracks that existed in the vault wall.
Existing Vault 4
Contamination Controls

- Prevent Rainwater Intrusion into Vault (Roof Coatings, Sealants)
- Control Rainwater Flow Path
  - Gutters on roof and weather enclosures
  - Grading to route rainwater to retention basin
- Fix Wall Contamination
- Manage Drain Water Levels Inside Vault
  - Drain water return system
  - Manage cell water level below hut level to prevent release of contamination to environment
- Containment
  - Weather enclosures up to 8’
  - Troughs to collect leakage
  - Isolate from rainwater
  - Installed Megamix coating on walls
  - Installed Xypex coating on walls
- Vault 4 is no longer in use
  - Last disposal operation in early 2012

- Several alternatives were evaluated to:
  - Eliminate rainwater infiltration to Vault 4
  - Mitigate worker and environmental risks

- Alternative selected:
  - Pour minimum “clean cap” to Vault 4 cells as necessary to establish roof dose rate <5 mrem/hr for worker exposure control
  - Install elastomeric roof covering on cells D, E, F, J, K, and L
    - Cells A, B, C, G, H, and I are already coated/sealed
  - Continue maintenance on roof and weather enclosures
  - Continue to manage drain water levels
SRR and DOE are committed to Vault 4 Stabilization Plan
  - Project fully funded and on schedule

Clean cap and elastomeric roof coating of three cells (J, K & L) scheduled in FY14
  - Roof coating material requirements determined
  - Testing of low-bleed grout mixtures completed and mix selected
    - Minimizes water introduced into cell during capping
  - Procurement of material completed
  - Capping of Cell J and K began in June 2014

Capping and coating of remaining cells (D, E & F) planned to complete by February 2015
Rainwater carried contamination from Vaults 1 and 4 area to the Storm Water drain line
  • Drain line flows to Basin No. 4

Basin No. 4 only discharges if level reaches the height of spillway
  • Feb 2013 first observed basin discharge

Spillway from Basin No. 4 flows to Storm Water Outfall Z-01
  • Low-level contamination deposited

Storm Water Outfall Z-01 flows to McQueen’s Branch
  • Sedimentation breaks installed to minimize contamination spread
Z Area Storm Water Outfall

- Sedimentation basin being expanded to 100-year storm event size
  - Excavation began on June 12, 2014
  - Expansion projected to be completed in September 2014
- Storm Water Outfall
  - Completed work to excavate spots of contaminated soil in accordance with DOE Order 458.1 and consistent with the SDF Solid Waste Permit
- Radioactive effluent monitoring at Outfall and McQueen’s Branch continues with no increases detected (sampled when liquid present)
Next Generation Solvent Update
Presentation to the GNAC

July 10, 2014

Neil Davis
Tank Farm/ETP Project Director
The Interim Salt Disposition Process at Savannah River consists of 2 processes to treat salt waste for disposition as Saltstone grout or glass:

- Actinide Removal Process (ARP) reduces the concentration of Sr-90 and actinides; and
- Modified Caustic Side Solvent Extraction Unit (MCU) reduces the concentration of Cs-137

MCU processing started in 2008 and has processed 4.2 million gallons of salt waste while achieving a Cs-137 decontamination factor (DF) of 150-200

MCU was shut down in August 2013 to deploy an improved solvent (MaxCalix) also known as Next Generation Solvent (NGS)
MCU Production

Production

Salt Processed (kgal)

Continuous Operations Outage

Outage to evaluate solids accumulation

NGS Deployed

Fiscal Year

2008 2009 2010 2011 2012 2013 2014

Savannah River Remediation

We do the right thing.
NGS was deployed in the MCU process 8/23 - 9/15/2013
This was followed by a 2 month maintenance outage overlayed by the furlough period
Processing with NGS started 12/7/2013
Initial operations were deliberate to demonstrate NGS chemistry in the plant
  • Processed 6 batches at ~7,600 gallons of salt waste per batch
Initial results showed Cs-137 DFs improved by a factor of 10
Transitioned to continuous operation with even better results
NGS deployment received a DOE Secretarial Award
Decontamination Factor

Continuous operation showed 10-100X improvement

Initial batch operation showed 10X improvement

Previous DF 150-200

NGS Cs-137 DF
MCU entered an outage on 4/7 to investigate solids accumulation in the process tanks.

Solids were determined to be primarily sodium oxalate resulting from ARP filter cleaning.

Solids were removed and processing resumed 7/9.

Long term operation expected to enable “fine tuning” the operation to maximize DF and thus further reduce the total amount of radioactive material disposed of in the State.

Information shared with Salt Waste Processing Facility counterparts.
Tank Closure Status
Presentation to the GNAC

July 10, 2014

Dan Wood
Tank Closure and Regulatory Director
Bulk Waste Removal

Heel Removal

Cooling Coil Flushing

Annulus Cleaning

Isolation & Final Sampling

Grout Tank

Operationally Closed

Tanks 5, 6, 17, 18, 19, & 20

6 tanks operationally closed

5 more active in the closure sequence

Tank 12

Concurrence received to enter sampling & analysis

Sampling complete - lab analysis in progress

Tank Closure Progress

BWR efforts and supporting other waste disposition

Will receive pumps from Tank 12

Tanks 5, 6, 17, 18, 19, & 20

Safe Storage

Tanks 1, 2, 3, 9, 14, 21, 22, 23, 24

Tank 10, 13, & 15

Tanks 4, 7, 8, & 11

Tanks 26 & 33 also in BWR (sludge) preps

Tank 5 and 6 Grouting Complete

Tanks 5, 6, 17, 18, 19, & 20

Tanks 4, 7, 8, & 11

Tanks 10, 13, & 15

BWR efforts

BWR efforts and supporting other waste disposition

Will receive pumps from Tank 12

Operationaly Closed

Concurrence received to enter sampling & analysis

Sampling complete - lab analysis in progress

Tanks 5, 6, 17, 18, 19, & 20
Recent Successes

Secretary of Energy’s 2013 Honor Award – Tank Closure

- Tanks 5 and 6 Grouting Completed
- Tank 12 Cease Waste Removal
- Tank 16 Sampling
- HTF Performance Assessment
Tank 12

- Received concurrence to enter sampling and analysis phase
- Tank ventilation modified to support drying
- Sampling activities initiated
- Sampling tools and techniques developed
- Critical path includes sampling, analysis, regulatory processes, and grouting
- Forecast completion in September 2016
  - Working to accelerate
Tank 15

- Largest sludge inventory in an Old-Style tank

- Sludge will be rehydrated to facilitate safe removal

- Four mixing pumps will be installed

- Plan to complete Bulk Waste Removal Efforts and move into Heel Removal without delay
Tank 16

- Primary and Annulus sample analyses nearing completion
- Working isolation and grout preparations
- Closure Module development underway
- Forecast completion in September 2015
- NRC Technical Evaluation Report (TER) has been received

- DOE-SR working with DOE-HQ to obtain H-Tank Farm Waste Determination approval
Background:
Primary Waste Forms

Volume

- 37.3 Million Gallons (Mgal)
  - Salt Supernate: 18.5 Mgal (50%)
  - Saltcake: 16.1 Mgal (43%)
  - Sludge: 2.7 Mgal (7%)

Curies

- 280 Million Curies (MCi)
  - Salt Supernate: 130 MCi (47%)
  - Saltcake: 12 MCi (4%)
  - Sludge: 138 MCi (49%)

Inventory values as of 2014-03-31
Background:
51 Waste Tanks, ~37M Gallons
Background:
Waste Tank Types

Type I - 750,000 gallons

Type II - 1,070,00 gallons

Type III - 1,300,000 gallons

Type IV - 1,300,000 gallons
Background:
Status of ‘Old-Style’ Tanks

14 of 24 tanks with known leak sites:
- 4 grouted
- 2 preliminary cease waste removal complete
- 2 contain mostly solids with limited amounts of free liquid
- 6 contain free liquid at levels below known leak sites

10 of 24 tanks without known leak sites:
- 2 grouted
- 2 contain mostly solids with limited amounts of free liquid
- 6 contain free liquids
System Plan Revision 19
Presentation to the GNAC

July 10, 2014

Peter Hill
System Planning Manager
Agenda

- Liquid Waste System Overview/Status
- Rev 19 Inputs & Assumptions
- Rev 19 Results
- Summary
SRS Liquid Waste Program
(status through March 2014)

We do the right thing.

Legend:
- ARP: Actinide Removal Process
- DWPF: Defense Waste Processing Facility
- MCU: Modular Caustic Side Solvent Extraction Unit
- SWPF: Salt Waste Processing Facility

Operational Goals
- Radionuclides to glass
- Chemicals to Saltstone
- Tanks closed

Legacy Liquid Waste
- 43 tanks
- 37 Mgal
- 280 MCi

51 Tanks
- 6 grouted & closed
- 2 heel removal complete
- 6 BWRE complete
- 70% empty (old style)
- 14% empty (new style)

Tanks Cleaned and Closed
- <1% radionuclides remain in tanks

Salt waste • 7.0 Mgal treated

SSPF
- <1% radionuclides to saltstone

Saltstone Disposal Facility
- SWPF (under construction)

<1% radionuclides remain in tanks

Glass Waste Storage
- >99% radionuclides to glass
- Poured 3,781 cans of projected 8,582
- 53 million curies immobilized in glass

Inert chemicals

Salt Processing Facility
- ARP
- MCU

sludge waste • 3.7 Mgal treated

Operational Goals

Radionuclides to glass
Chemicals to Saltstone
Tanks closed
Safe receipt from H-Canyon, treatment, and disposition of SRS liquid waste requires synchronization of several highly interdependent nuclear facilities and chemical operations.
Changes to System Plans are driven by:

- Advances in Technology
- Change in Sequencing
- Acceleration Opportunities
- Funding Adjustments
August 2013 inputs and assumptions (modified April 2014 & May 2014) for Rev. 19 of the Liquid Waste System Plan:

- $407.1M new Budget Authority (BA) to the LW contractor in FY14

- $430M/yr (constant dollar funding) to the LW contractor FY15-FY19
  - Includes Line Item funding, including assigned contingency, for SDUs beginning with SDU-7
  - Includes Glass Waste Storage Project (GWSP) Line Item beginning in FY15

- $525 M (in FY20 and escalated thereafter) per year until the end of the program
  - Includes $80M/yr (in FY20 and escalated thereafter) for operation of SWPF
Using these inputs, two significant impacts of the lower funding levels are realized:

• SWPF is not supported at its rated capacity upon startup
• After grouting Tanks 5, 6, 12, & 16, no tanks are grouted until 2024
Specific Results

- SWPF operations not supported at rated capacity
  - Sufficient salt batch blend tanks not available at SWPF startup
  - ARP/MCU operations limited due to funding and SDU space
  - Funding for DWPF enhancements not available until FY20 with completion in 2022
  - ELAWD II enhancements and increased staffing at Saltstone not funded until FY24
  - Inability to afford sludge waste removal at a pace sufficient to support desired canister and salt throughput
  - Limited canister storage locations prior to completion of the GWSP

- Comparison of SWPF capability versus predicted throughput modeling shows a cumulative difference of over 18 million gallons between FY19 and FY24, representing an additional two years to the Liquid Waste lifecycle

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>SWPF Capacity</th>
<th>Rev 19</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY19</td>
<td>4.625 Mgal</td>
<td>4 Mgal</td>
<td>-0.625 Mgal</td>
</tr>
<tr>
<td>FY20</td>
<td>7.2 Mgal</td>
<td>3 Mgal</td>
<td>-4.2 Mgal</td>
</tr>
<tr>
<td>FY21</td>
<td>7.2 Mgal</td>
<td>3 Mgal</td>
<td>-4.2 Mgal</td>
</tr>
<tr>
<td>FY22</td>
<td>9 Mgal</td>
<td>6 Mgal</td>
<td>-3 Mgal</td>
</tr>
<tr>
<td>FY23</td>
<td>9 Mgal</td>
<td>6 Mgal</td>
<td>-3 Mgal</td>
</tr>
<tr>
<td>FY24</td>
<td>9 Mgal</td>
<td>6 Mgal</td>
<td>-3 Mgal</td>
</tr>
<tr>
<td>Total</td>
<td>46.025 Mgal</td>
<td>28 Mgal</td>
<td>-18.025 Mgal</td>
</tr>
</tbody>
</table>
- Tank Closure Activities
  - Grouting of Tanks 5 and 6 completed in FY14
  - Grouting of Tanks 16 and 12 to be complete in FY16 (FFA date: FY15)
  - Given the Rev 19 inputs, next tank grouting occurs in 2024

- Interim Salt Processing
  - ARP/MCU operations provide tank space for preparation of sludge batches for DWPF, support of waste receipts from H-Canyon, progress towards closure of old-style tanks, and support of SWPF upon startup in 2018
  - ARP/MCU will utilize NGS
  - ARP/MCU throughput is determined by:
    - Operator staffing levels at Saltstone & ARP/MCU
    - Availability of Saltstone Disposal Unit space
    - Availability of canister storage
    - Funding to perform sludge waste retrievals
  - Salt processing at ARP/MCU will continue until 6 months prior to SWPF startup then shutdown for transfer line modifications to tie SWPF in to the Liquid Waste System

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>ARP/MCU Production Forecast (kgal)</th>
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<tbody>
<tr>
<td>FY14</td>
<td>800</td>
</tr>
<tr>
<td>FY15</td>
<td>1,500</td>
</tr>
<tr>
<td>FY16</td>
<td>1,200</td>
</tr>
<tr>
<td>FY17</td>
<td>2,000</td>
</tr>
<tr>
<td>FY18</td>
<td>1,000</td>
</tr>
</tbody>
</table>
System Plan Revision 19
Specific Results (Continued)

- **Sludge Processing**
  - DWPF canister production synchronized with ARP/MCU production
  - GWSB 2 had 822 available canister storage locations at start of FY14
  - Limited storage capacity in GWSB 2, and expected timing of the GWSP line item, limits DWPF operation until FY19
  - Bulk sludge waste retrievals and sludge batch washing and qualification are limited to just-in-time supply

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Expected Canister Production</th>
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<tbody>
<tr>
<td>FY14</td>
<td>125</td>
</tr>
<tr>
<td>FY15</td>
<td>155</td>
</tr>
<tr>
<td>FY16</td>
<td>135</td>
</tr>
<tr>
<td>FY17</td>
<td>170</td>
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<td>FY18</td>
<td>160</td>
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<td>FY19</td>
<td>275</td>
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<td>FY20</td>
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<td>FY21</td>
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<td>FY22</td>
<td>275</td>
</tr>
<tr>
<td>FY23</td>
<td>275</td>
</tr>
</tbody>
</table>
Saltstone Disposal Unit (SDU) Construction
- SDU required to support grout production and salt treatment at either ARP/MCU or SWPF
- Without available SDU space, salt treatment cannot occur
- SDU construction costs have significant impact to overall funding profile
- SDUs must be available as follows to prevent impacting planned salt processing:

<table>
<thead>
<tr>
<th>Saltstone Disposal Unit</th>
<th>Need Date</th>
</tr>
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<tbody>
<tr>
<td>SDU 6</td>
<td>May 2017</td>
</tr>
<tr>
<td>SDU 7</td>
<td>October 2021</td>
</tr>
<tr>
<td>SDU 8</td>
<td>December 2023</td>
</tr>
<tr>
<td>SDU 9</td>
<td>September 2025</td>
</tr>
<tr>
<td>Parameter</td>
<td>Revision 18</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>-------------</td>
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<tr>
<td>Final Type I, II, and IV tanks BWRE complete</td>
<td>2023</td>
</tr>
<tr>
<td>Final Type I, II, and IV tanks complete operational closure</td>
<td>2028</td>
</tr>
<tr>
<td>Complete bulk sludge treatment</td>
<td>2026</td>
</tr>
<tr>
<td>Complete bulk salt treatment</td>
<td>2028</td>
</tr>
<tr>
<td>Complete heel treatment</td>
<td>2032</td>
</tr>
<tr>
<td>SCIX for supplemental salt waste treatment</td>
<td>Yes</td>
</tr>
<tr>
<td>Next generation extractant for increased SWPF throughput</td>
<td>Yes</td>
</tr>
<tr>
<td>Maximum canister waste loading</td>
<td>40 wt%</td>
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<tr>
<td>Nominal annual canister throughput rate</td>
<td>275</td>
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<tr>
<td>Total number of cesium-only canisters produced</td>
<td>0</td>
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<tr>
<td>Radionuclides (curies) dispositioned in SDF within LW Strategy</td>
<td>Yes</td>
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Alternative Case

- Maximize salt treatment by supporting SWPF at rated capacity
  - LWSP Rev 19 § 5.1
Maximize SWPF Throughput

Scope
- DWPF Enhancements, ELAWD Phase II, SPF @ 24/7, Accelerate Sludge BWRE
- Enhance ARP/MCU production
- Accelerate SDU Construction
- Increase GWSB #1 capacity

Results

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>Rev 19 ARP/MCU</th>
<th>Alt Case ARP/MCU</th>
<th>Rev 19 SWPF</th>
<th>Alt Case SWPF</th>
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<tbody>
<tr>
<td>FY14</td>
<td>800</td>
<td>800</td>
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<td>FY15</td>
<td>1,500</td>
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<tr>
<td>FY24</td>
<td>6,000</td>
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<td>6,500</td>
<td>10,550</td>
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<table>
<thead>
<tr>
<th>Parameter</th>
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<th>Alt Case</th>
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<tr>
<td>Final Type I, II, &amp; IV tanks BWRE complete</td>
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<td>2028</td>
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<td>Final Type I, II, &amp; IV tanks grout complete</td>
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<td>2032</td>
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<tr>
<td>Complete bulk sludge treatment</td>
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<td>2030</td>
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<tr>
<td>Complete bulk salt treatment</td>
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<td>2033</td>
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<tr>
<td>Complete heel treatment</td>
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<td>2039</td>
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<tr>
<td>SCIX for supplemental salt waste treatment</td>
<td></td>
<td>No</td>
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</table>
Currently under development - Due August 15, 2014

While maintaining risk reduction, emphasize removing waste from old-style tanks and providing enhanced capability for feeding SWPF
Summary

- Lessons Learned from Rev. 19 modeling:

  - Importance of SWPF in lifecycle planning
  - Importance of near-term salt processing
  - Need for SWPF support projects
  - Need/importance of SDUs
### Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>ARP</td>
<td>Actinide Removal Process</td>
</tr>
<tr>
<td>BA</td>
<td>Budget Authority</td>
</tr>
<tr>
<td>BWR</td>
<td>Bulk Waste Removal</td>
</tr>
<tr>
<td>BWRE</td>
<td>Bulk Waste Removal Efforts</td>
</tr>
<tr>
<td>DF</td>
<td>Decontamination Factor</td>
</tr>
<tr>
<td>DOE</td>
<td>Department of Energy</td>
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<td>DOE-EM</td>
<td>Department of Energy – Environmental Management</td>
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<tr>
<td>DWPF</td>
<td>Defense Waste Processing Facility</td>
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<tr>
<td>ELAWD</td>
<td>Enhanced Low Activity Waste Disposal</td>
</tr>
<tr>
<td>ETP</td>
<td>Effluent Treatment Plant</td>
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<td>FFA</td>
<td>Federal Facilities Agreement</td>
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<td>FY</td>
<td>Fiscal Year (October 1 – September 30)</td>
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<td>GWSB</td>
<td>Glass Waste Storage Building</td>
</tr>
<tr>
<td>GWSP</td>
<td>Glass Waste Storage Project</td>
</tr>
<tr>
<td>HLW</td>
<td>High-Level Waste</td>
</tr>
<tr>
<td>LLW</td>
<td>Low-Level Waste</td>
</tr>
<tr>
<td>LW</td>
<td>Liquid Waste</td>
</tr>
<tr>
<td>LWSP</td>
<td>Liquid Waste System Plan</td>
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<tr>
<td>MCI</td>
<td>Million Curies</td>
</tr>
<tr>
<td>MCU</td>
<td>Modular Caustic-Side Solvent Extraction Unit</td>
</tr>
<tr>
<td>Mgal</td>
<td>Million Gallons</td>
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<td>NGS</td>
<td>Next Generation Solvent</td>
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<td>SCIX</td>
<td>Small Column Ion Exchange</td>
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<td>Savannah River Remediation, LLC</td>
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<td>STP</td>
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<td>Salt Waste Processing Facility</td>
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