



Savannah River Site Liquid Radioactive Waste Program

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Major Elements of Scope

- **Liquid Waste Stabilization and Disposition:**

Waste Storage

- Liquid waste storage tanks, evaporators, transfer lines, and associated equipment/facilities
- Glass Waste Storage Buildings
- Construction of additional glass waste storage

Waste Treatment

- Waste Removal from Tanks to achieve salt and sludge batches
- ARP/MCU interim salt processing
- Operation of the Salt Waste Processing Facility after facility commissioning, startup, and one year of initial operation
- Defense Waste Processing Facility
- Saltstone Production Facility
- Effluent Treatment Facility

Waste Disposal

- Saltstone Disposal Units
- Construction of additional Saltstone Disposal Units
- Tank Closures

- **Liquid Waste Program Support**



Agenda

- **Liquid Waste Program**
- **Update to Liquid Waste Facilities Performance**
 - Defense Waste Processing Facility and Glass Waste Storage
 - Saltstone Production Facility
 - Actinide Removal Facility/ Modular Caustic Side Solvent Extraction Unit
- **Contract Period Vision and Focus**
- **System Plan Revision 20 Results**
- **System Plan Revision 20 Cases**
- **System Plan Revision 20 Case 1 Update**
- **Saltstone Disposal Units Construction and Lessons Learned**
- **Tank Closure Cesium Removal Demonstration**
- **Tank Closure and Regulatory Status**
- **Long Term Vision**

Liquid Waste Program Operations

“Liquid waste at SRS is the single greatest environmental risk in South Carolina”

Program focus:

- Safely storing 36 million gallons of radioactive liquid waste
- Operating major nuclear facilities to support H-Canyon missions and to treat and disposition tank waste
 - Operating interim salt waste processing system
 - Vitrifying highly radioactive radionuclides at the Defense Waste Processing Facility (DWPF)
 - Disposing low level residuals in Saltstone Disposal Units (SDUs)
 - Constructing the Salt Waste Processing Facility (SWPF)
- Emptying, cleaning and closing waste tanks



Salt Supernate



Saltcake

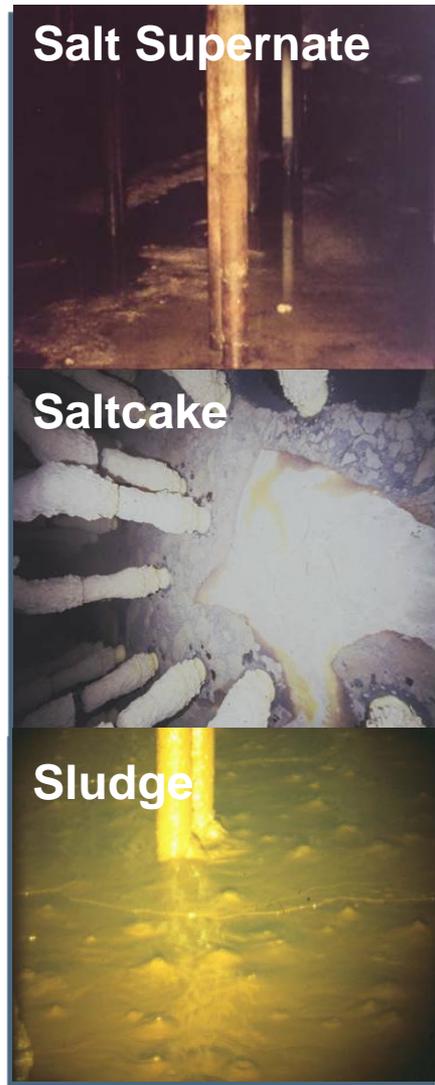
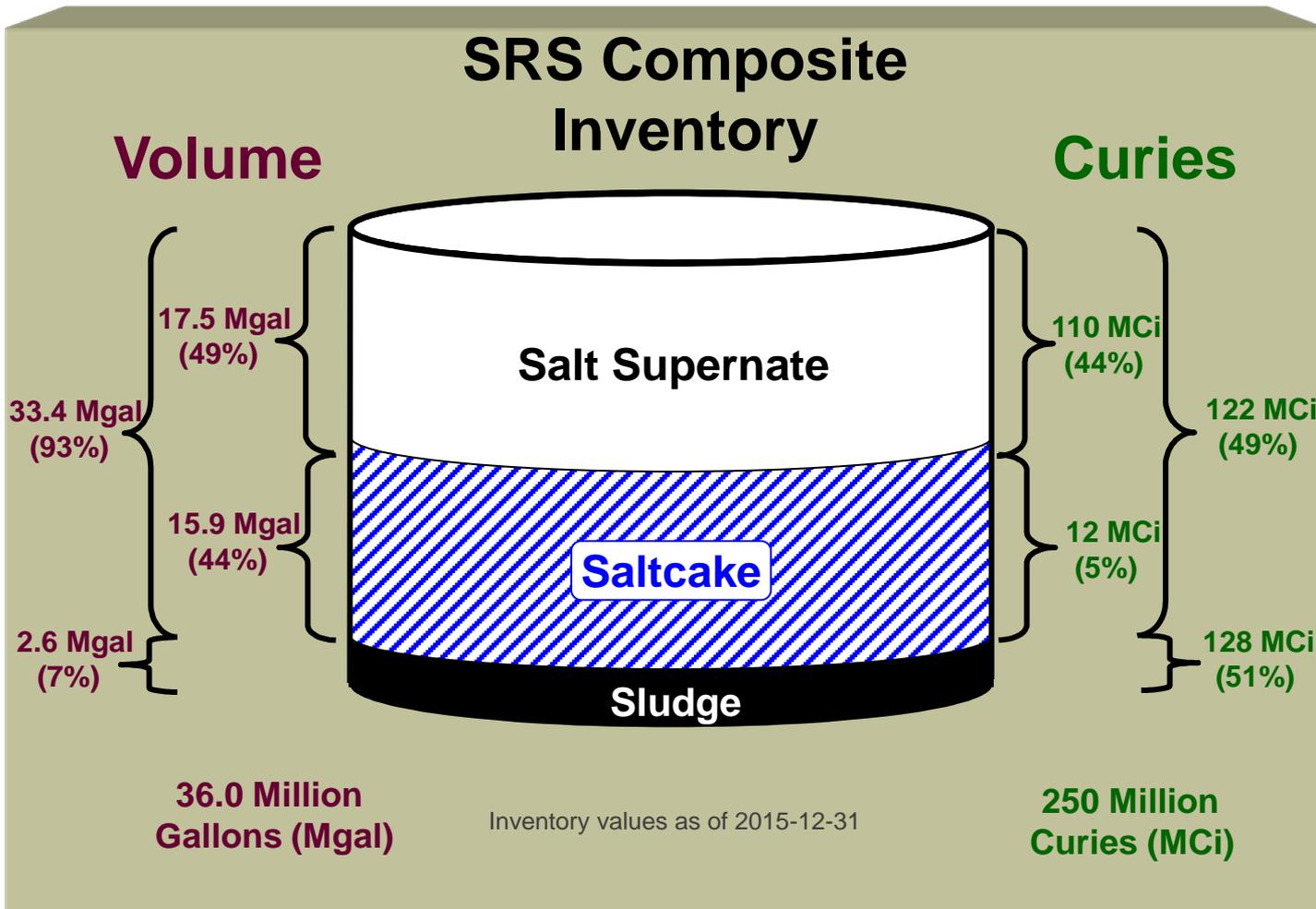


Sludge

Safely Stored Canisters



Why Do We Need a Liquid Waste Program?



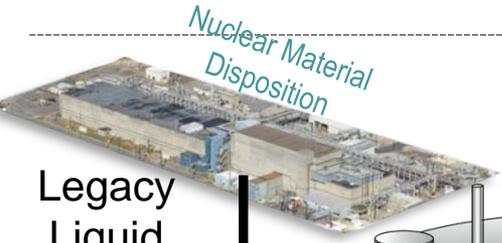
Liquid Waste Facilities Update

- **Defense Waste Processing Facility**
 - Total canister count based on System Plan Rev 20 Case 1: 8,170
 - 4,039 canisters as of 3/31
 - Total canisters poured and leak tested in FY16 as of 3/31: 69 out of goal of 150 canisters
- **Interim Storage of Canisters**
 - GWSB 2 contains 1,787 canisters (2,339 capacity) as of 3/31
 - Canister double stacking in Glass Waste Storage Building #1 continues on schedule
 - Additional Storage will be needed to be available by 2029 based on System Plan Rev 20 Case 1
- **Saltstone Production Facility**
 - Total gallons of salt solution processed in FY16 as of 3/31: 420,470 out of goal of 1.5 million gallons
 - Processed 11.04 Mgal of low-level radioactive liquid salt wastes into grout (over 19Mgal) as of 3/31 containing approximately 459 KCi of radioactivity
- **Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit**
 - Total gallons of salt waste processed FY16 as of 3/31: 380,835 out of goal of 1.5 million gallons
 - Treated 5.75 million gallons as of 3/31

Liquid Waste Program

Operational Goals

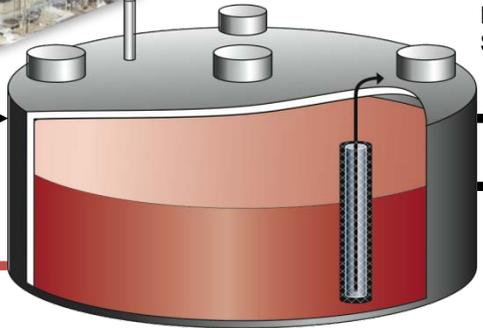
- ✓ Radionuclides to glass
- ✓ Chemicals to Saltstone
- ✓ Tanks cleaned and operationally closed



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

Legacy Liquid Waste

43 tanks
 36 Mgal
 250 MCi



Salt waste
 8.3 Mgal treated

Sludge waste
 4.0 Mgal treated

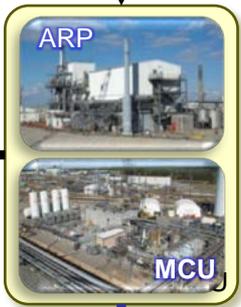


Tanks Cleaned and Closed
 <1% radionuclides remain in tanks

51 Tanks

- 7* grouted & operationally closed
- 1 heel removal complete
- 6 BWRE complete
- 64% empty (old style)
- 21% empty (new style)

* One tank closed 9/22/15



Salt Processing



Most radionuclides to glass

Poured 4,000 cans of projected 8,170 57 million curies immobilized in glass



<<1% radionuclides to saltstone

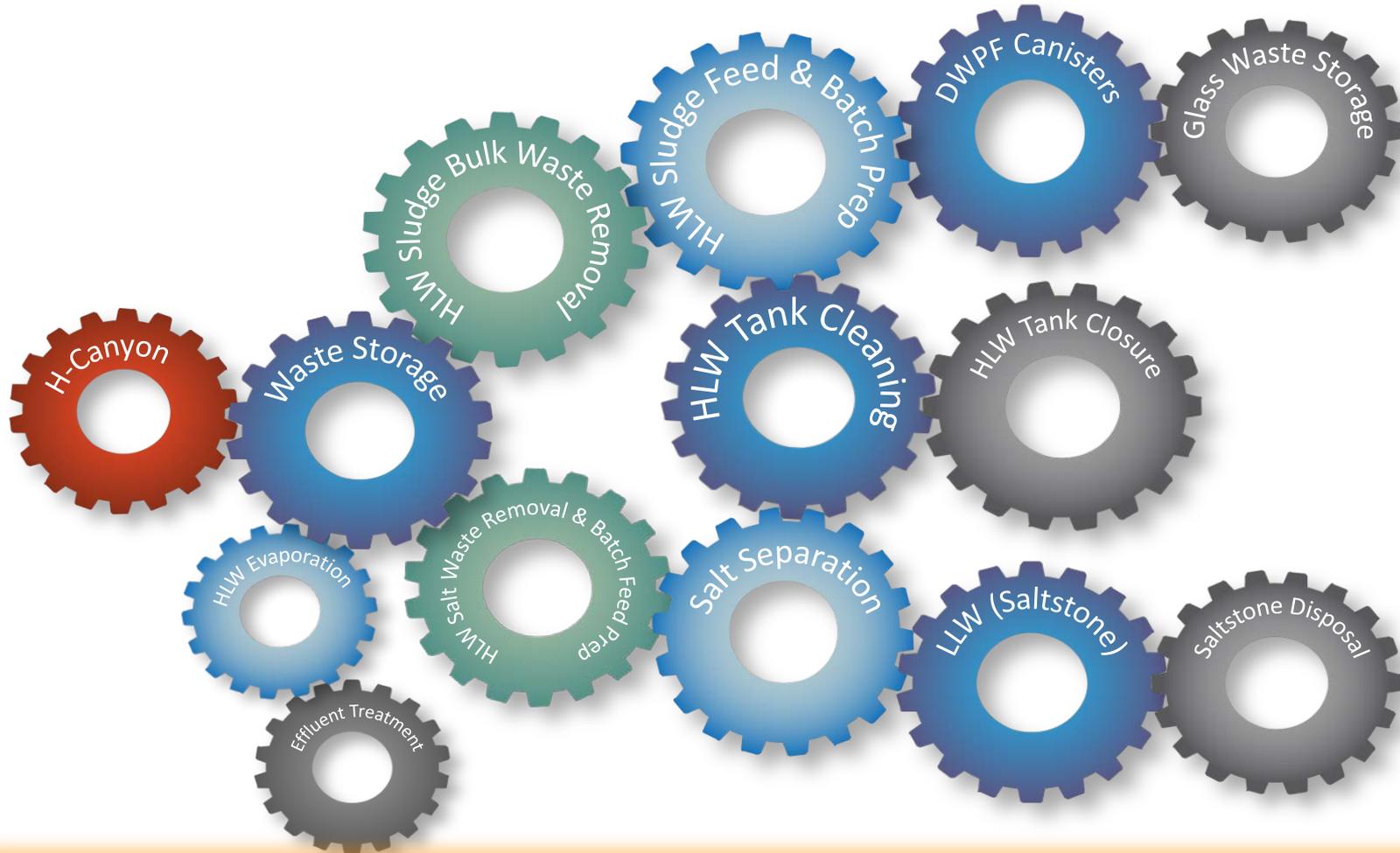
18.3 Mgal grout dispositioned containing 459 kCi



SWPF (under construction)

As of 12/31/15

Liquid Waste Program Integration



Safe storage, treatment, and disposition of SRS liquid waste requires synchronization of several highly interdependent nuclear facilities and chemical operations



Contract Period Vision and Focus

1. Complete preparation of the LW System to support and start Salt Waste Processing Facility (SWPF) radioactive operations in December 2018
2. Transition contractor management of the SWPF after the first year of operations to the new Liquid Waste Contractor
3. Achieve steady state operations of the Liquid Waste System with all components functioning



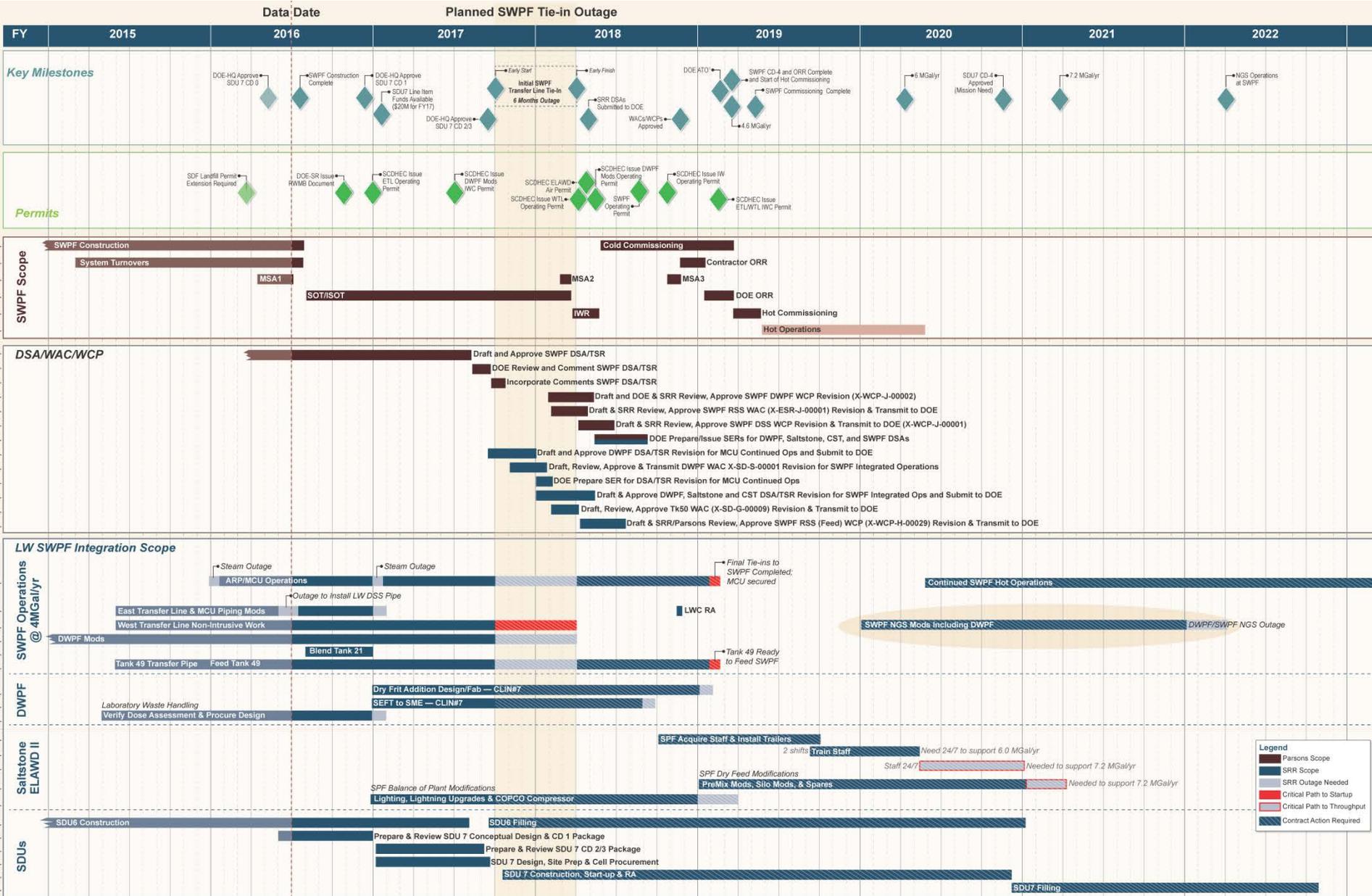
Contract Period Vision and Focus

Preparation for Change

1. Complete preparation of the LW System to support and start Salt Waste Processing Facility (SWPF) radioactive operations in December 2018
 - *Complete required modifications in the LW facilities*
 - *Integrate readiness efforts between LW facilities and SWPF*
 - *On July 1, 2017 LW facilities will enter the Tie-in Outage scheduled for 6 months*

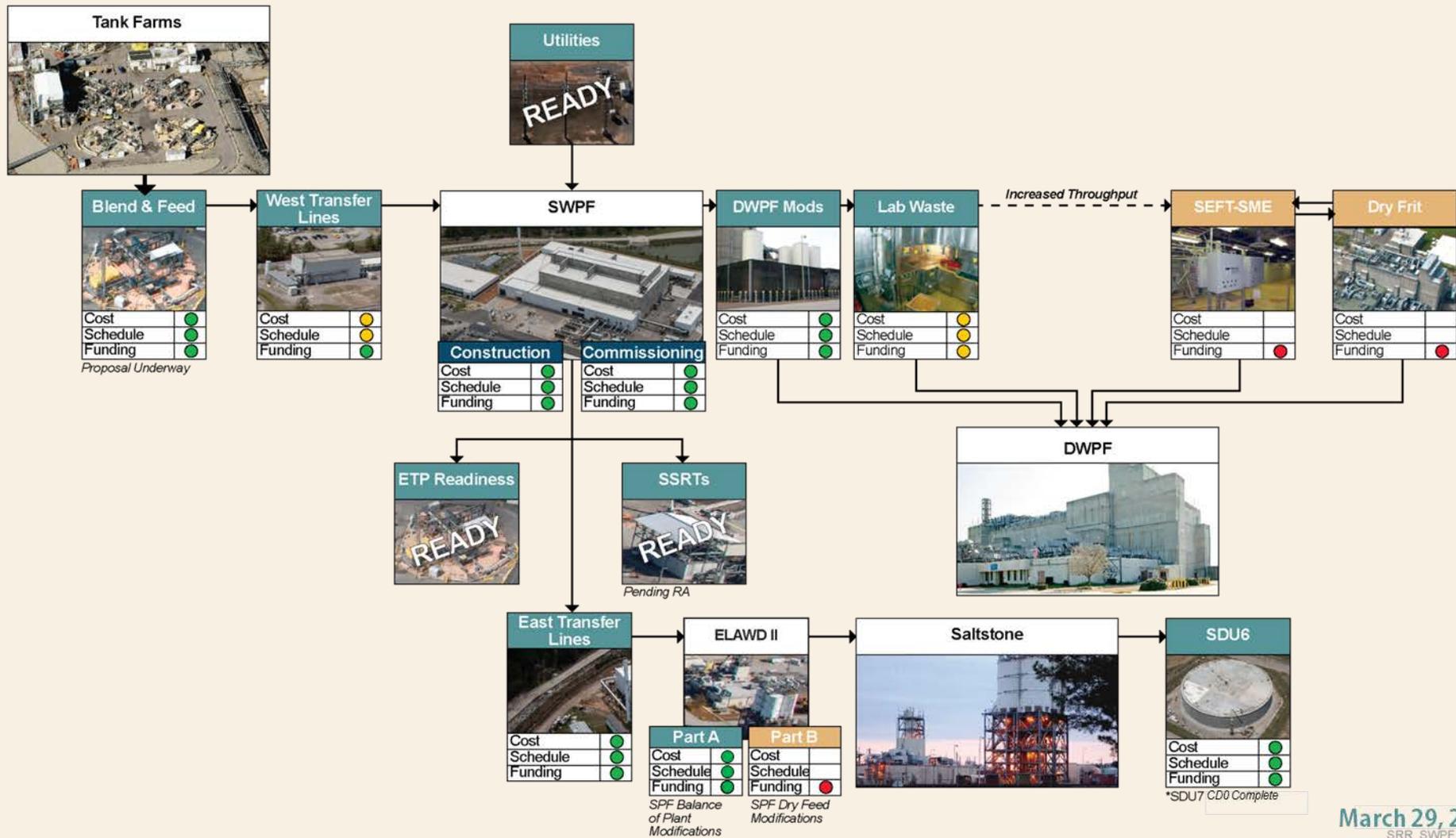


LW / SWPF Integration Support Overview Schedule



DOE ATO for SWPF will drive shutdown of MCU, DWPF, and Saltstone to allow final tie-ins of SWPF for hot commissioning to commence.

SWPF Integration with Liquid Waste



March 29, 2016
SRR_SWPF_002-16

Integration Scope to be Completed after July 1, 2017

- **Outage Scope**

- Complete the remaining 4 feet of excavation at 511S to allow SWPF tie ins
- Complete jumper modifications in 511S
- Complete tie ins of SWPF transfer lines
- Complete piping modifications to allow MCU continued Ops
- Complete Tank 49 VB work to allow feeding MCU from 49 B3 riser
- Start feeding MCU from B3
- Complete Tank 49 B5 pump modifications/installation
- Backfill the excavation at 511S
- Complete DSA work in Liquid Waste to support SWPF Operation
- Complete DSA work to allow MCU continued Ops

Integration Scope to be Completed after July 1, 2017

- **Scope to Complete Integration**
 - Restart MCU post readiness activity
 - Complete ELAWD scope (lighting upgrades)
 - Complete SEFT to SME work
 - Complete Readiness activities to support SWPF Operation
 - Complete flushes at MCU for layup
 - Secure MCU
 - Perform final tie-ins at MCU and DSS line (50-Z)
 - Additional staffing at Saltstone for 24/7 operation
 - Complete modifications at DWPF for NGS use at SWPF
 - Complete turnover and assume operation of SWPF

SWPF Integration Piping - Video



Excavation During Outage



DWPF - Low Point Pump Pit Piping
Ext. East Side (6/2/8) (44012-43)



Contract Period Vision and Focus

SWPF Integration into Liquid Waste Contract

2. Transition contractor management of the SWPF after the first year of operations to the new Liquid Waste Contractor by March 31, 2020



Salt Waste Processing Facility

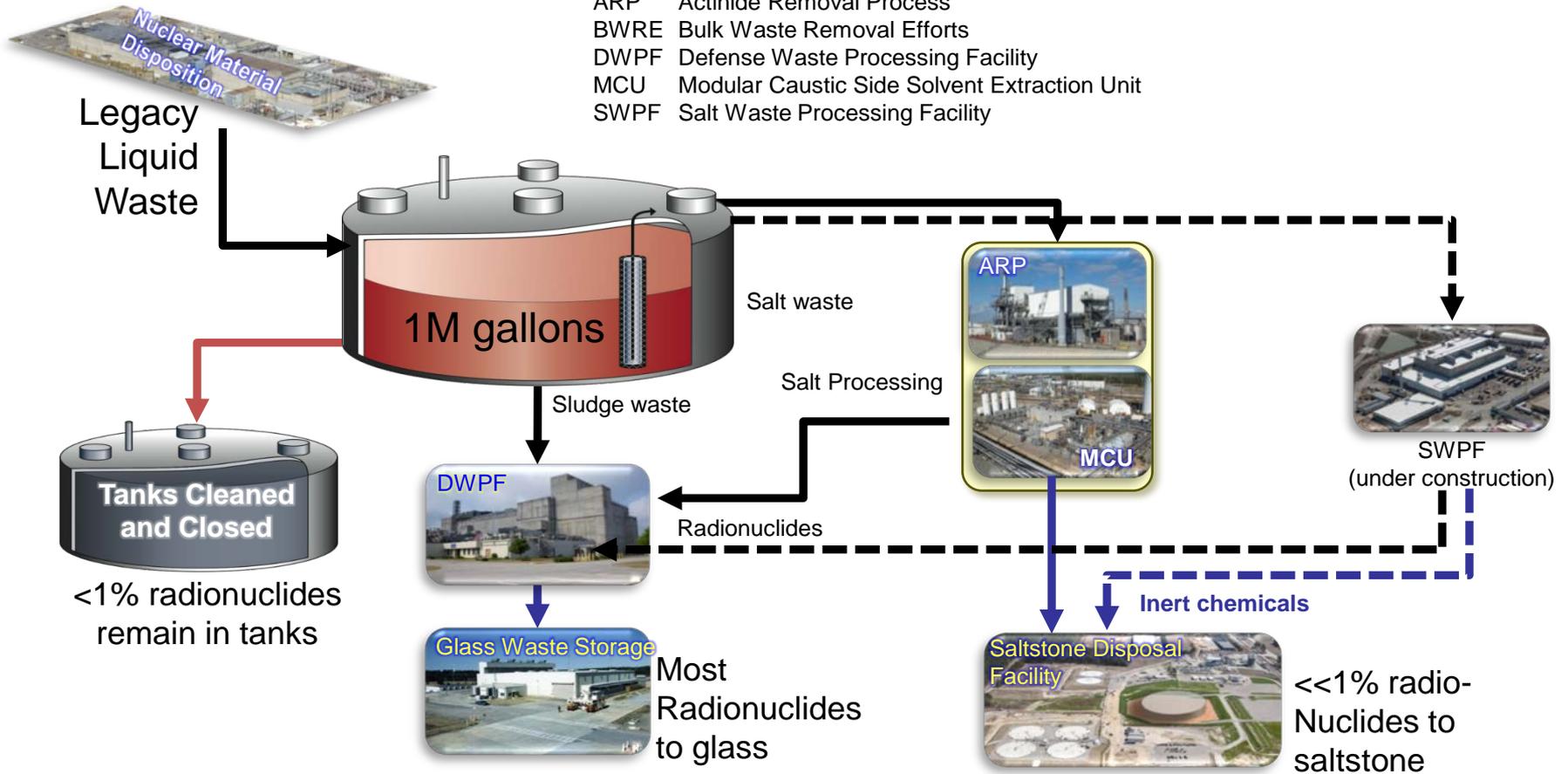


This essential facility will:

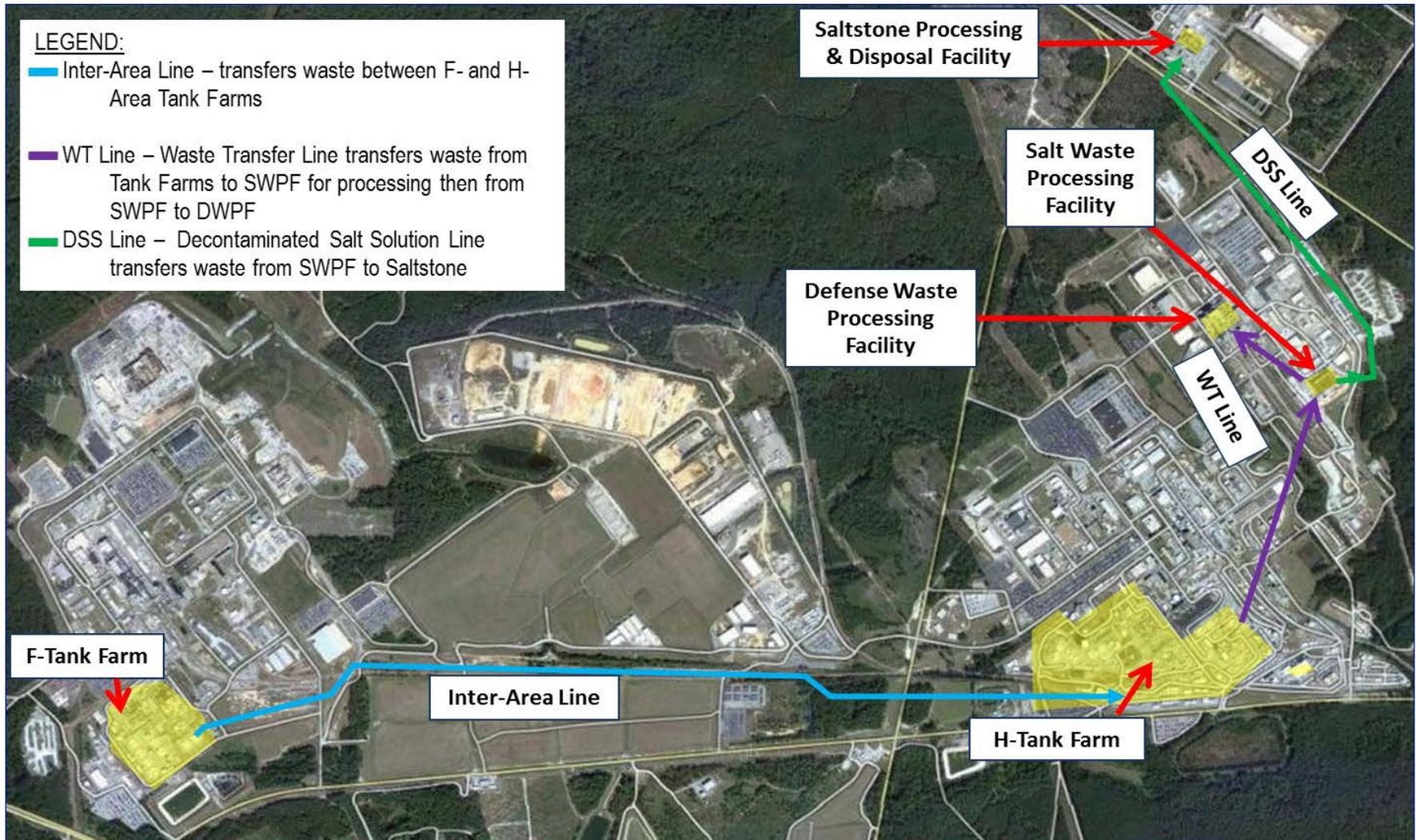
- Reduce radioactive waste volume requiring vitrification
- Utilize the same actinide and cesium removal unit processes as Interim Salt Processing Facilities (ARP/MCU)
- Process over 90% of Tank Farm liquid radioactive waste (97 Mgal. after dissolution)
- Have a nominal capacity of 6 – 9 million gallons per year



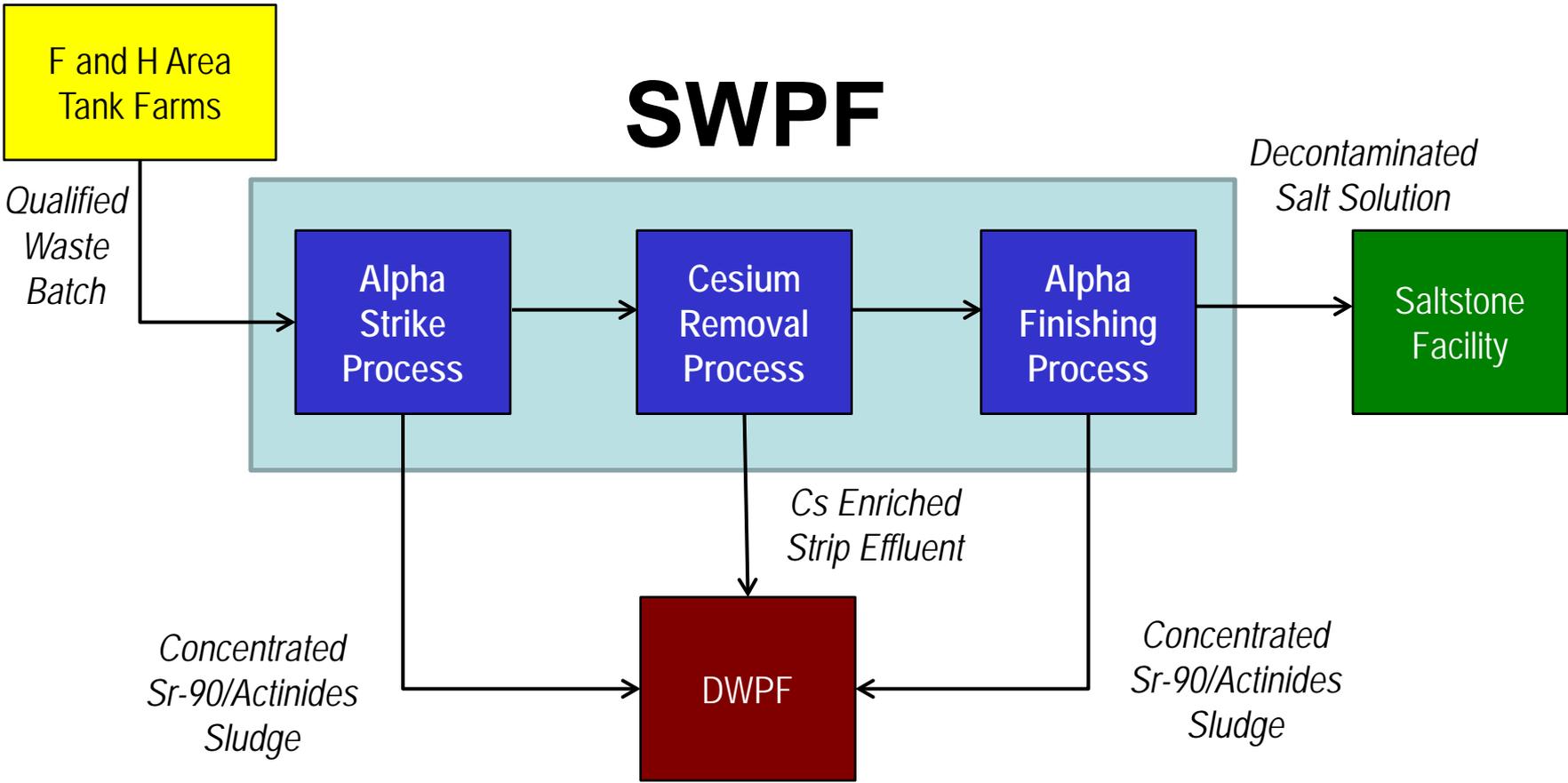
Liquid Waste Program



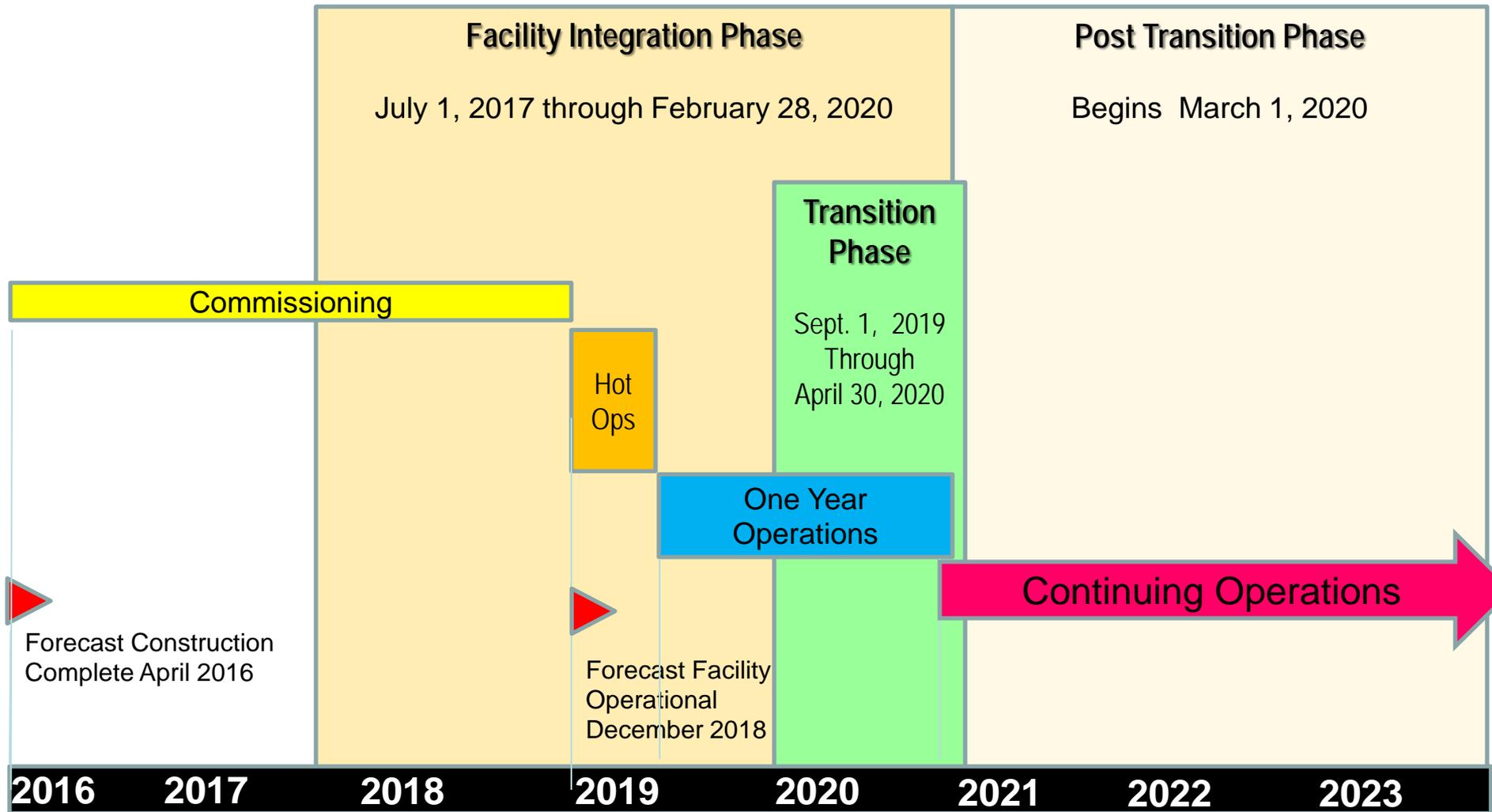
Waste Transfers



SWPF Process



SWPF Timeline



Facility Integration Phase – July 2017 through March 2020

The LW Contractor will:

- Work with the DOE Project team and SWPF Contractor throughout start-up and first year of radioactive operations to:
 - Identify necessary interfaces between the SWPF Project and the Liquid Waste system
 - Identify appropriate actions to assure the interfaces are fully addressed
 - Agree as to respective responsibilities for addressing the interfaces.
- Provide personnel to support the DOE SWPF Project Office (currently 25 FTEs)
- Obtain services via approved interface documents
- Support maintenance and execution of Interface Management Plan, Interface Control Documents, and SWPF Interface Waste Compliance Plans (WCPs) and Waste Acceptance Criteria (WAC) documents.

Facility Integration Phase – July 2017 through March 2020 (cont'd)

The LW Contractor will: (cont'd)

- Perform technical reviews of SWPF design documents to assess impact of SWPF designs on existing upstream/downstream facilities and provide feedback to the DOE.
- Function as a member of the SWPF Integrated Project Team (IPT), as well as, support informational meetings/teleconferences with the DOE and the SWPF Contractor.
- Support DOE with preparation and approval of SWPF environmental and operational permitting documentation.
- Perform SWPF tie-in activities to ensure completion by September 30, 2018 to support Salt Waste Feed to SWPF.
- Support any necessary Next Generation Solvent (NGS) implementation interface activities with the EPC Contractor

Transition Phase – September 2019 through April 2020

- Submit Operations Transition Plan no less than 6 months prior to transfer of SWPF operations to LW contractor (September 2019)
- Duration of transition is not to exceed 90 days (no earlier than December 1, 2019 based on March 1 2020 assumed transfer date)
 - Review and update Interface Control Documents, Site Labor Agreements and Functional Service Agreements
 - Develop appropriate procedures to assure a smooth transition of SWPF operations into the Liquid Waste system.
 - 250K to 500K documents to be transferred from EPC to LW Contractor Document Control
 - Complete workforce transition
- Transition date is March 1, 2020
- Turnover Facility from EPC to the LW Contractor
- Finalize Government Property inventories within 60 calendar days of SWPF transfer

Post-Transition Phase – March 1, 2020 and beyond

- Facility operates with nominal operating throughput of 7.3 m gal/yr
- Projected operating staff of approximately 200
- Annual Operations Budget of \$80-\$90M
- EPC procedures will be integrated with Site procedures

Projected Staffing	FTEs
Operations	64
Maintenance	40
Radiation Protection	17
Laboratory	24
Support	50
Total	195

Deployment of Next Generation Solvent (NGS)

- Deployment of NGS in the SWPF offers the opportunity to achieve significant improvement in both throughput and Cesium (Cs) decontamination factor as compared to the baseline flow sheet.
- NGS modifications are expected to be designed and constructed on or before early CD-4 date of December 3, 2018.
 - Support necessary interfaces with EPC contractor
- Actual introduction of NGS into the operating facility will occur after the 2nd year of SWPF operations.
- Utilization of NGS is expected to increase nominal throughput of SWPF up to 9 m gal/yr.

Contract Period Vision and Focus

Steady State Operations

3. Achieve steady state operations of the Liquid Waste System with all new components performing as planned
 - ✓ SWPF
 - ✓ TCCR in both Tank Farms
 - ✓ NGS in SWPF achieving operation rate of 9Mgal/yr



System Plan Rev 20 Results and Milestones

Table 1-1 — Results of Modeled Cases

Parameter	Revision 19	Rev 20, Case 1	Rev 20, Case 3
Date SWPF begins hot operations	Sep 2018	Dec 2018	Dec 2018
Date last LW facility turned over to D&D	2042	2041	2038
Final Type I, II, and IV tanks complete operational closure	2032	2036	2032
Complete bulk sludge treatment	2030	2031	2030
Complete bulk salt treatment	2033	2032	2030
Complete heel treatment	2039	2036	2036
TCCR for supplemental salt waste treatment	No	1 unit	2 units
Next generation extractant for increased SWPF throughput	FY22	FY22	FY21
Maximum canister weight percent (wt%) waste loading	40 wt%	40 wt%	40 wt%
Total number of canisters produced	8,582	8,170	8,210
Year supplemental canister storage required to be ready	2019	2029	2029
Radionuclides (curies) dispositioned in SDF within the amended <i>SRS LW Strategy</i>	Yes	Yes	Yes
Total number of SDUs	13	14	13

Initiate ARP/MCU Processing (<i>actual</i>)	<i>Apr 2008</i>	<i>Apr 2008</i>	<i>Apr 2008</i>
Initiate TCCR Processing	n/a	2018	2018
Initiate SWPF Processing	Sep 2018	Dec 2018	Dec 2018
– Salt Solution Processed via DDA-solely	2.8 Mgal	2.8 Mgal	2.8 Mgal
– Salt Solution Processed via ARP/MCU	11 Mgal	10 Mgal	10 Mgal
– Salt Solution Processed via TCCR	n/a	0.8 Mgal	5.3 Mgal
– Salt Solution Processed via SWPF	102 Mgal	110 Mgal	92 Mgal

Rev 20 Assumptions - Cases

- Case 1 assumes funding and SWPF startup per above
- Case 2 assumes funding per above with SWPF startup delayed until January 31, 2021
- Case 3 assumes additional funding with the December 2018 SWPF startup and prioritization of acceleration of FTF isolation with a target date of 2030.
 - Use Tank Closure Cesium Removal (TCCR) technology (1Mgal/yr)- 1 unit in each Tank Farm
 - Operate TCCR in old-style tanks up to the time of SWPF startup
 - Add actinide removal through the use of Large Tank Monosodium Titanate Strike to TCCR post SWPF startup
 - Implement NGS in SWPF in the second year of SWPF operations to run with NGS in the third year
 - Work will be prioritized as follows:
 - Empty tanks 9 through 15
 - Empty Old-style tanks in F Area
 - Empty New tanks in F Area
 - Grout F-Area tanks efficiently
 - Empty and grout Tanks 21-24
 - Reuse Tanks 21-24 until HTF Type III tanks become available to fulfill their function

Update to System Plan Rev 20 Case 1

- Since the development of assumptions and modeling of Case 1, changes in strategy have been adopted due to the 3H Evaporator Outage (failed pot)
- The 25H Evaporator function is to volume-reduce liquid wastes produced by
 - Sludge batch washing (DWPF feed), Waste tank closure, Canyon receipts
- Teams are addressing the following areas:
 - Cell cleanup and Failure analysis
 - Vessel repair and replacement options
 - Flowsheet impacts and Water management
- System Planning developed path forward
 - Assume evaporator restart in 36 months
 - Future addition of Tank 22 solids to SB9 to make Sludge Batch 9B
 - Use existing supernates for sludge transfers to reduce water additions to tank farm

Saltstone Disposal Units Construction Status and Lessons Learned

- **SDU6**

- After the Saltstone Disposal Unit 6 did not achieve leak tightness in February 2016, a Subject Matter Expert (SME) team from AECOM, CH2M, Bechtel and the U.S. Army Corps of Engineers (USACE) was formed to advise SRR on a recommended path forward.
- The final U.S. Army Corps of Engineers Laboratory report with the petrography results was received March 21, 2016.
- The reports from the various Subject Matter Experts (SME) recommending repair techniques and Lessons Learned for Saltstone Disposal Unit 6 (SDU6) were received on March 28, 2016.
- The Systems Engineering Evaluation (SEE) Report providing the repair recommendation was signed and issued on March 29, 2016.
- SEE results were presented to DOE on March 30, 2016.
- The Hydrotest will resume after agreed to repair techniques to achieve leak tightness have been made.

Saltstone Disposal Units Construction Status and Lessons Learned

- **SDU7**

- Rev 20 Case 1 need date: November 1, 2020
- FY17 Funding according to the FY17 President Budget Request: \$12,686,000
- FY2016 and FY2017 Scope
 - *FY 16*
 - Complete Conceptual Design
 - Develop Design inputs
 - Approve CD-1 Package
 - *FY17 (SRR Contract through June 30, 2017)*
 - Receive PED Funds 10/3/2016
 - Complete Site Prep Design
 - Complete Cell Design
 - Complete BOP Design
 - Initiate Site Prep Construction
 - Initiate Cell Procurement



Saltstone Disposal Units Construction Status and Lessons Learned (cont'd)

- **SDU7 (cont'd)**

- FY2016 and FY2017 Scope (cont'd)

- *FY17 (4th Quarter / New Liquid Waste Contract)*

- Start CD 2/3 Package

- Continue Site Prep Construction

- Complete Cell Procurement in anticipation of TEC Funds to initiate Construction in FY18

- Project Data Sheet included in the FY17 President Budget Request to initiate SDU7 as a capital line item in FY17

- **SDU8**

- Rev 20 Case 1 need date: October 1, 2023

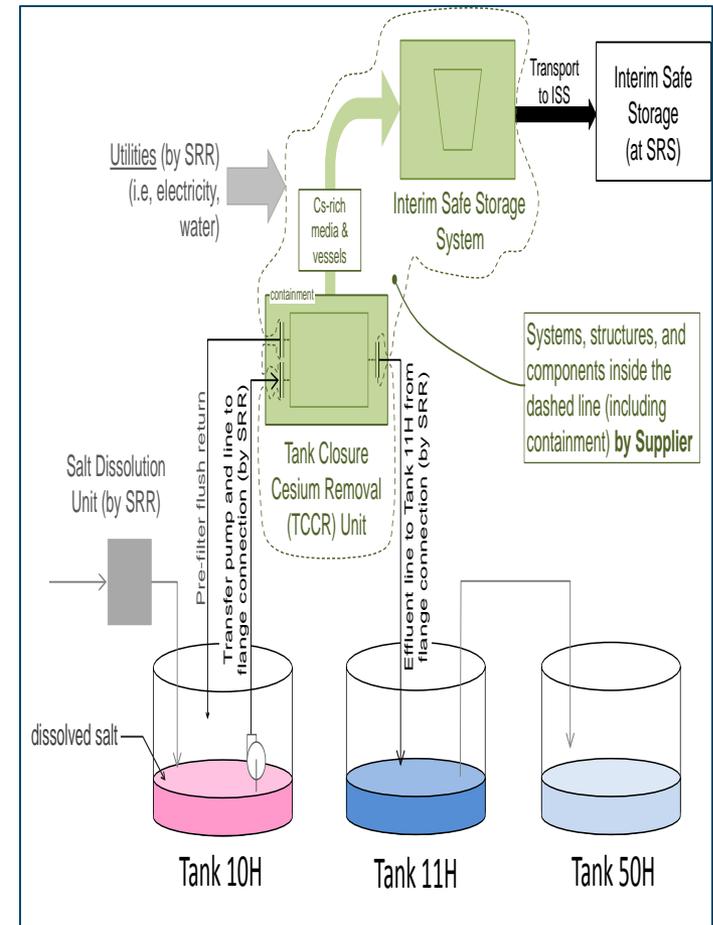
- Scheduled to start capital line item project in FY18

- Special Analysis for design optimization completed (Evaluation of Principal SDU Design Features to Inform Future Optimization, SRR-CWDA-2015-00169, Rev 0, dated December 2015)

Tank Closure Cesium Removal Demonstration

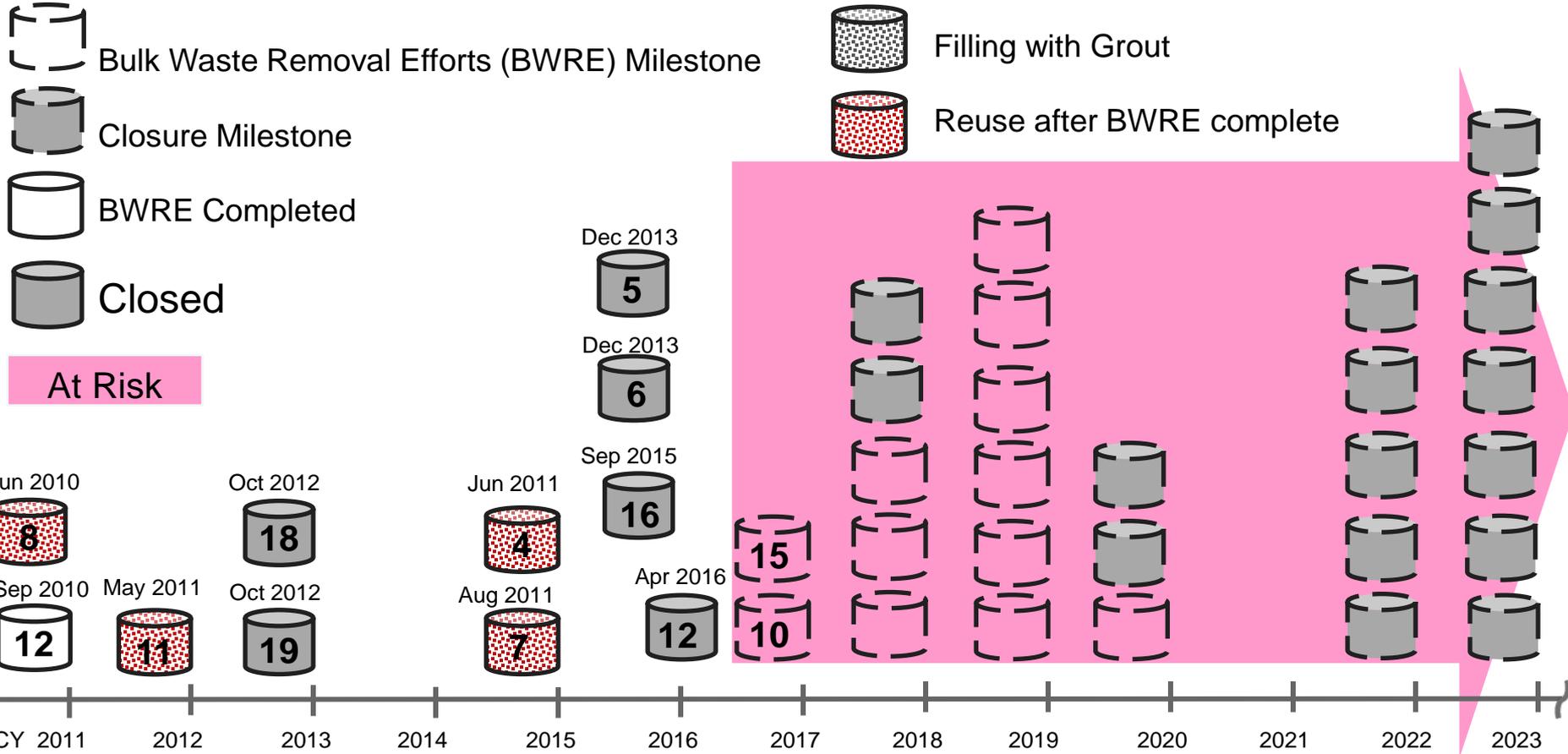
RFP for at-tank Ion Exchange technology

- Interim Storage of spent media is required
- Spent media disposal path
 - Low Level Waste (LLW) is preferred disposal path, WIR required
 - Borosilicate glass is backup disposal path (less preferred)
- Targets treatment capability in FY18



Waste Removal and Closure

Effects of Reality - FFA App. L Commitments (Nov. 2007)



SWPF Delay →

Long Term Vision

- **Safest Operation within the Complex**
 - Continuing improvements in operational practices consistent with a Nuclear Safety Culture and ISMS Principles
 - Upgraded safety basis consistent with the latest DOE directives and methodologies
- **Maximized Salt Waste Processing**
 - Seamless integration of Salt Waste Processing Facility into Liquid Waste System
 - Innovative approaches to salt processing, e.g., at-tank cesium removal
- **Increased / Sustained Waste Stabilization**
 - New or different applications of technologies to accelerate processing
 - Application of new ideas to aging Liquid Waste infrastructure
 - Continuity of skilled resources and maintenance of knowledge base in aging workforce
- **Expedited isolation and/or closure of old style tanks or groups of tanks**

Acronyms

- ARP – Actinide Removal Process
- BWRE – Bulk waste Removal Efforts
- CD – Critical Decision
- DSA – Documented Safety Analysis
- DSS – Decontaminated Salt Solution
- DWPF – Defense Waste Processing Facility
- EPC – Engineer, Procure, Construct
- FFA – Federal Facility Agreement
- GFSI – Government Furnished Services and Items
- GWSB – Glass Waste Storage Building
- ISMS – Integrated Safety Management Systems
- LW – Liquid Waste
- LWSP – Liquid Waste System Plan
- MCU – Modular Caustic Side Solvent Extraction Unit
- M & O – Management and Operating
- MST – Monosodium Titanate
- NGS – Next Generation Solvent
- SDU – Saltstone Disposal Unit
- SEFT – Strip Effluent Feed Tank
- SME – Slurry Mix Evaporator
- SRNL – Savannah River National Laboratory
- SRS – Savannah River Site
- SWPF – Salt Waste Processing Facility
- TCCR – Tank Closure Cesium Removal