



Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, South Carolina 29802

JUL 19 2018

Ms. Susan B. Fulmer, P. G., Manager
Federal Remediation Section
Division of Site Assessment, Remediation and Revitalization
Bureau of Land and Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Mr. Jon Richards
Savannah River Site Remedial Project Manager
Superfund Division
U. S. Environmental Protection Agency, Region 4
61 Forsyth Street, SW
Atlanta, GA 30303

Dear Ms. Fulmer and Mr. Richards:

SUBJECT: Extension Request for Completion of Bulk Waste Removal Efforts for One Tank by 8/31/18 (SEMS Number: 89)

In accordance with the terms of Section XXXI of the Savannah River Site Federal Facility Agreement (FFA), the U.S. Department of Energy (DOE) is submitting an extension request to the schedule established pursuant to FFA Section IX(E)(1). This schedule is further identified as Item 5 in FFA Appendix L, *Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18*. In the FFA Appendix L 2017 Update to the *Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18 (signed 11/19/07)*, Item 5 was modified to read "DOE shall complete bulk waste removal efforts for one tank (Tank 15H) by 10/31/17 and bulk waste removal efforts for one tank (Tank 10H) by 8/31/18". Specifically, the schedule sought to be extended is completion of bulk waste removal efforts (BWRE) for one tank (Tank 10H) by 8/31/2018. As described in the enclosures, DOE's current schedule for completing BWRE in Tank 10H extends beyond 8/31/2018. The subject request is submitted for your review and approval.

On June 20, 2018, DOE and Savannah River Remediation (SRR) provided the enclosed presentation to South Carolina Department of Health and Environmental Control (SCDHEC) and U. S. Environmental Protection Agency (EPA), which included a history and status of the Tank 10H Project. Tank 10H was previously chosen to demonstrate a potential new, innovative, and first-of-a-kind deployment of an at-tank ion exchange technology known as the Tank Closure Cesium Removal (TCCR) for treatment of high-level waste tank salt waste. DOE remains committed to removal of waste from Tank 10H. However, as explained in both enclosures, emergent technical issues have impacted our ability to fully meet this schedule for demonstration of this technology.

EXTENSION SOUGHT: "DOE shall complete bulk waste removal efforts for one tank (Tank 15H) by 10/31/17 and bulk waste removal efforts for one tank (Tank 10H) by 8/31/18" as shown

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in FFA Appendix E.1: Deliverable Commitment Dates and Milestone Commitment Dates for Fiscal Year 2018 and Item 5 in Appendix L and subsequent update.

LENGTH OF EXTENSION: The extension requested would read: “*DOE shall complete bulk waste removal efforts for one tank (Tank 15H) by 10/31/2017 and one tank (Tank 10H) by 11/30/2019*”.

CAUSES OF EXTENSION: This extension is being sought under the following terms of the FFA:

Section XXXI.A: “*Either a timetable and deadline or a schedule, including schedules within a work plan shall be extended upon receipt of timely request for extension and when good cause exists for the requested extension.*” and

Section XXXI.B, “*Good cause exists for an extension when sought in regard to:*

5. A delay caused by additional work agreed to by the parties.

6. “Any other event or series of events, including but not limited to new technical information or technological barriers mutually agreed to by the Parties as constituting good cause.”

DOE seeks agreement from the SCDHEC and EPA that, as described in the enclosures, *force majeure*, good cause, and implementation of new innovative technology exist and these circumstances justify the extension of Appendix L, Item 5, as subsequently updated, specific to Tank 10H.

The TCCR unit has been designed, fabricated, tested, and shipped to the H-Area Tank Farm. It is being readied for deployment at Tank 10H. TCCR uses a commercially available cesium removal ion exchange technique, which is a new innovative technology for “at tank” treatment of the high-level waste tank salt waste and does not require, nor impact, salt waste treatment using the existing interim salt disposition process caustic solvent extraction method (Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit). The saltcake in Tank 10H will be dissolved and subsequently removed from Tank 10H and transferred to the TCCR unit for treatment. The treated salt waste discharged from TCCR will be sent to Tank 11H prior to disposition at Saltstone Disposal Facility.

Specifically, an extension to 11/30/2019 to complete bulk waste removal efforts for Tank 10H is based on the following emergent technical issues encountered:

- unanticipated pluggage of the TCCR pre-filters during Facility Acceptance Testing which impacted delivery and receipt of the TCCR unit;
- unknown chemistry impacts associated with heat generation rates within the ion exchange columns resulting in
 - more extensive sampling, analysis, and verification testing during operation of the TCCR unit which will increase the schedule duration for treating the salt waste and

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- more extensive Safety Basis development than originally anticipated which has impacted the schedule for initiation of TCCR operations, including physical modification of the ion exchange columns to include a “water jacket” for the purpose of heat dissipation associated with the radiological decay of the cesium-137 isotope
- unavailability of SRR and subcontractor Safety Basis Engineering personnel to support development of the TCCR Documented Safety Analysis due to emergent technical issues within the Liquid Waste Program

DOE considers these events to constitute a minor modification to the FFA.

RELATED COMMITMENTS OR SCHEDULES THAT WILL BE IMPACTED BY THE GRANTING OF THE EXTENSION: The proposed extension will not impact subsequent completion of bulk waste removal efforts milestones or operational closure milestones as specified in Appendix L and adopted in FFA Appendices D and E.

DOE welcomes your agencies’ feedback and is offering to coordinate a meeting for discussion of this request. The effort and time that the SCDHEC and the EPA have given is greatly appreciated. Questions from you or your staff may be directed to me at (803) 952-8365, Ms. Jolene Seitz at (803) 952-6451, or Mr. Jeffrey Bentley at (803) 208-7513.

Sincerely,



Brian T. Hennessey
SRS Remedial Project Manager
Infrastructure and Area Completion Project

WDPD-18-34

Enclosures:

- 1) Tank Closure Cesium Removal
(TCCR) Overview and Status
(SRR-CWDA-2018-00031, Rev. 1)
- 2) Tank 10H – Justification for Extension
Request

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cc w/encl:

R. Pope, EPA-Atlanta
H. H. Cathcart, SCDHEC - Columbia
G. N. O'Quinn, SCDHEC —Aiken Environmental Affairs Office
B. S. Mullinax, SCDHEC-Columbia

cc w/o encl:

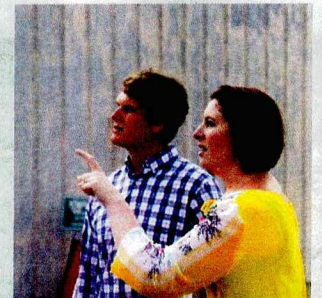
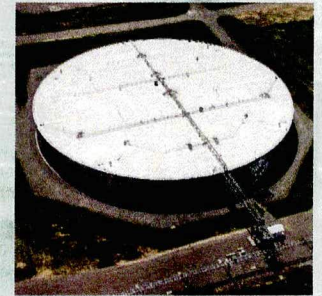
M. D. Wilson, SCDHEC-Columbia
J. P. deBessonnet, SCDHEC-Columbia
G. K. Taylor, SCDHEC-Columbia
D. Scaturro, SCDHEC-Columbia

June 20, 2018

TANK CLOSURE CESIUM REMOVAL (TCCR) OVERVIEW AND STATUS

Larry Romanowski / Pen Mayson
/ Mark Keefer

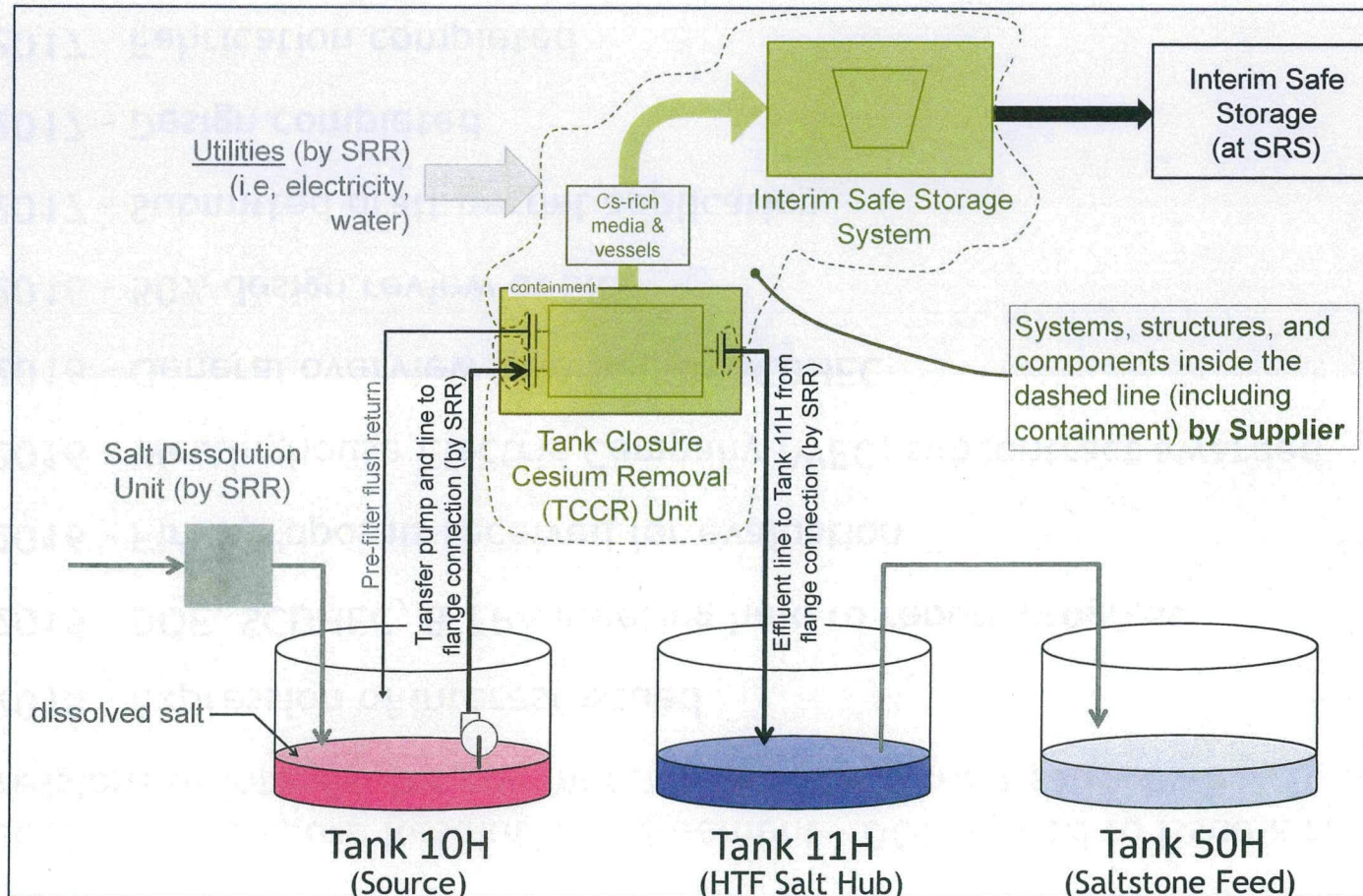
SRR-CWDA-2018-00031, Rev. 1



- **Tank Closure Cesium Removal (TCCR) was identified as a potential new and innovative salt waste treatment technology in April 2015. TCCR technology was selected because:**
 - Commercial application of the technology in cesium removal, and successes, indicated the process may be mature enough to be applied as a demonstration on SRS high level waste tank salt waste
 - It was a modular at-tank treatment process that would operate virtually independent from other Liquid Waste System processes
 - The salt waste removed would be treated and readied for disposition at the Saltstone Disposal Facility
 - If successful, it would provide opportunity to supplement the cleanup capability of existing salt processing facilities

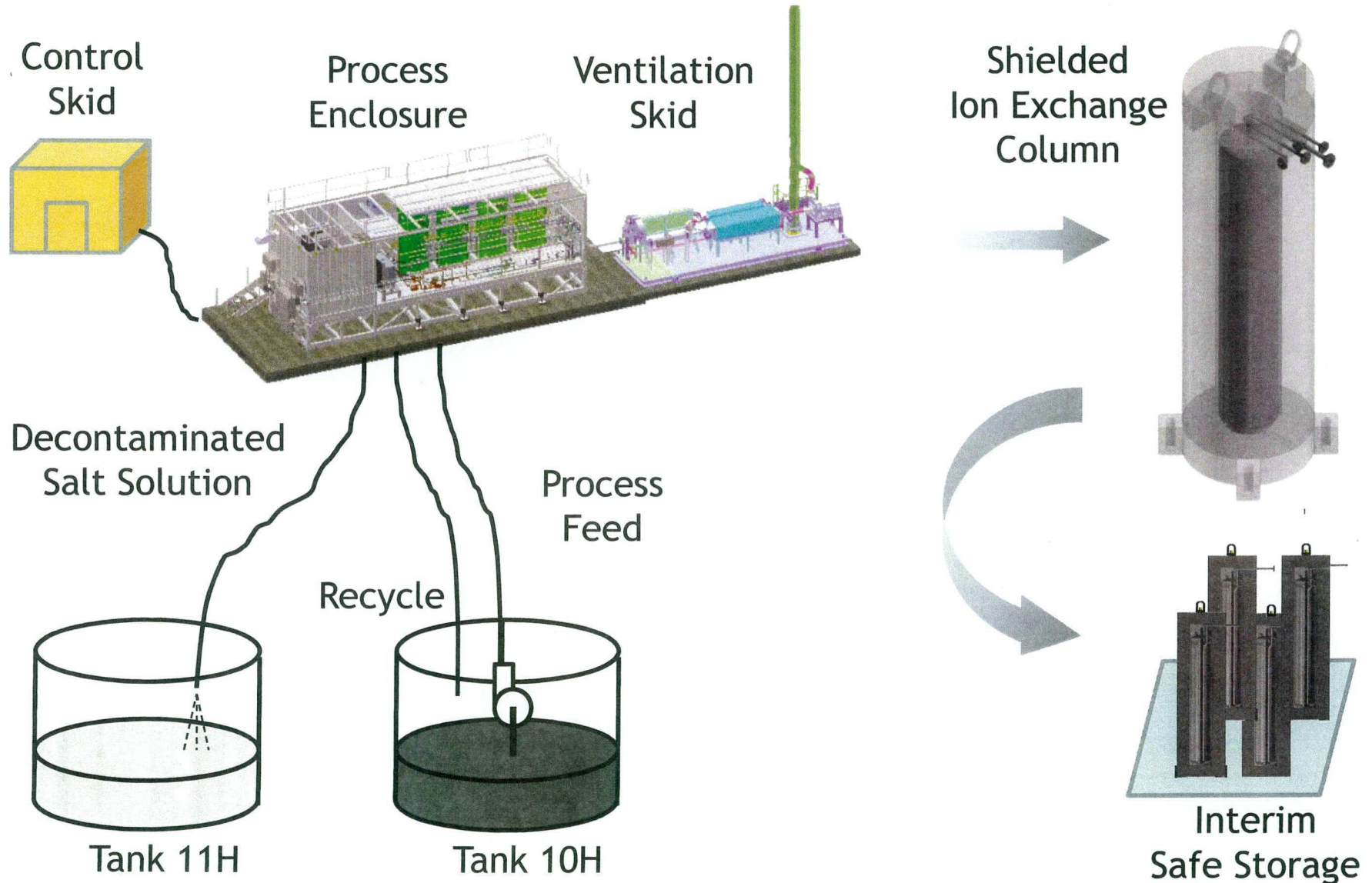
- 04/2015 - FFA Dispute Resolution Agreement - DOE agreed to issue a request for Expressions of Interest for commercial sources to treat salt waste
- 06/2015 - Expression of Interest issued
- 10/2015 - DOE, SCDHEC, & EPA meeting held to report progress
- 01/2016 - Final proposals received for evaluation
- 07/2016 - Westinghouse Electric Company (WEC) subcontract awarded
- 11/2016 - General overview briefing for SCDHEC
- 11/2016 - 50% design review at SRS
- 02/2017 - Submitted draft permit application
- 08/2017 - Design completed
- 09/2017 - Fabrication completed
- 10/2017 - Construction Permit approved
- 10/2017 - Facility Acceptance Testing initiated
- 04/2018 - TCCR equipment delivered

Conceptual Process Diagram



TCCR Concept

TCCR Process Overview



TCCR Site Plan in HTF



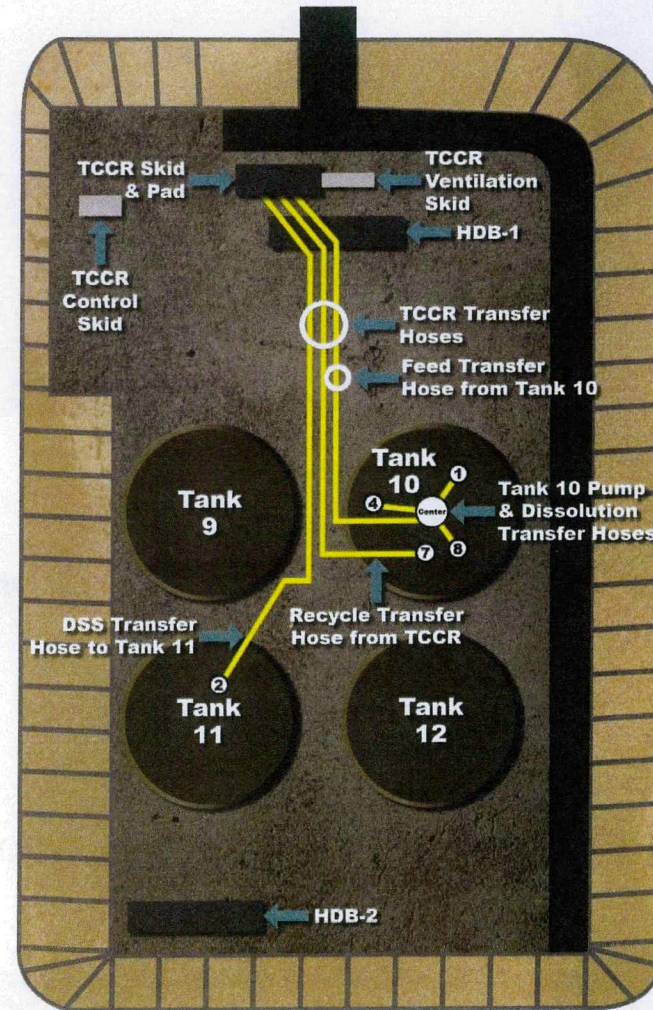
Control Skid



Process Enclosure

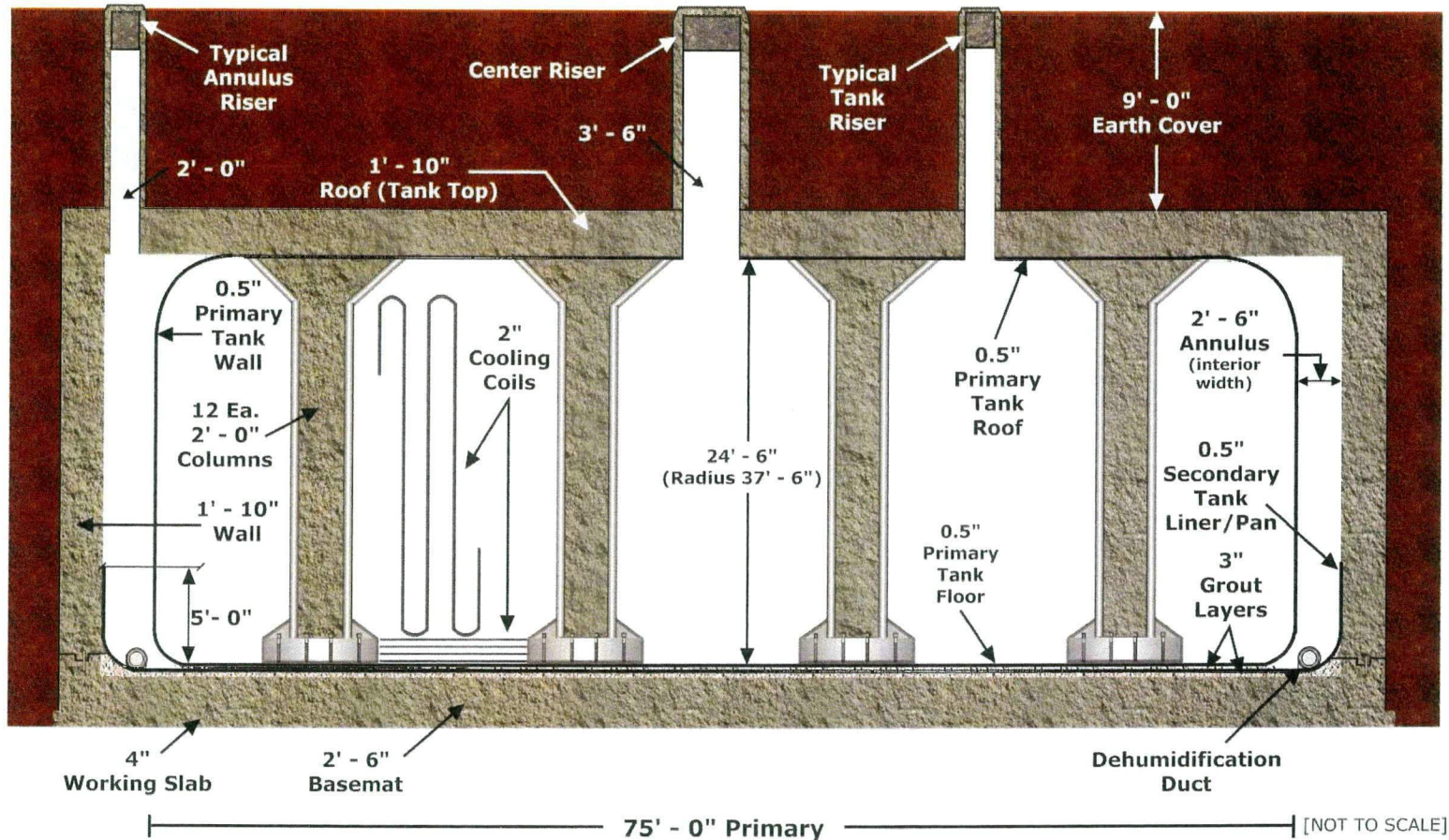


Ventilation Skid



Tank 10H Overview

Typical Type I Tank Design

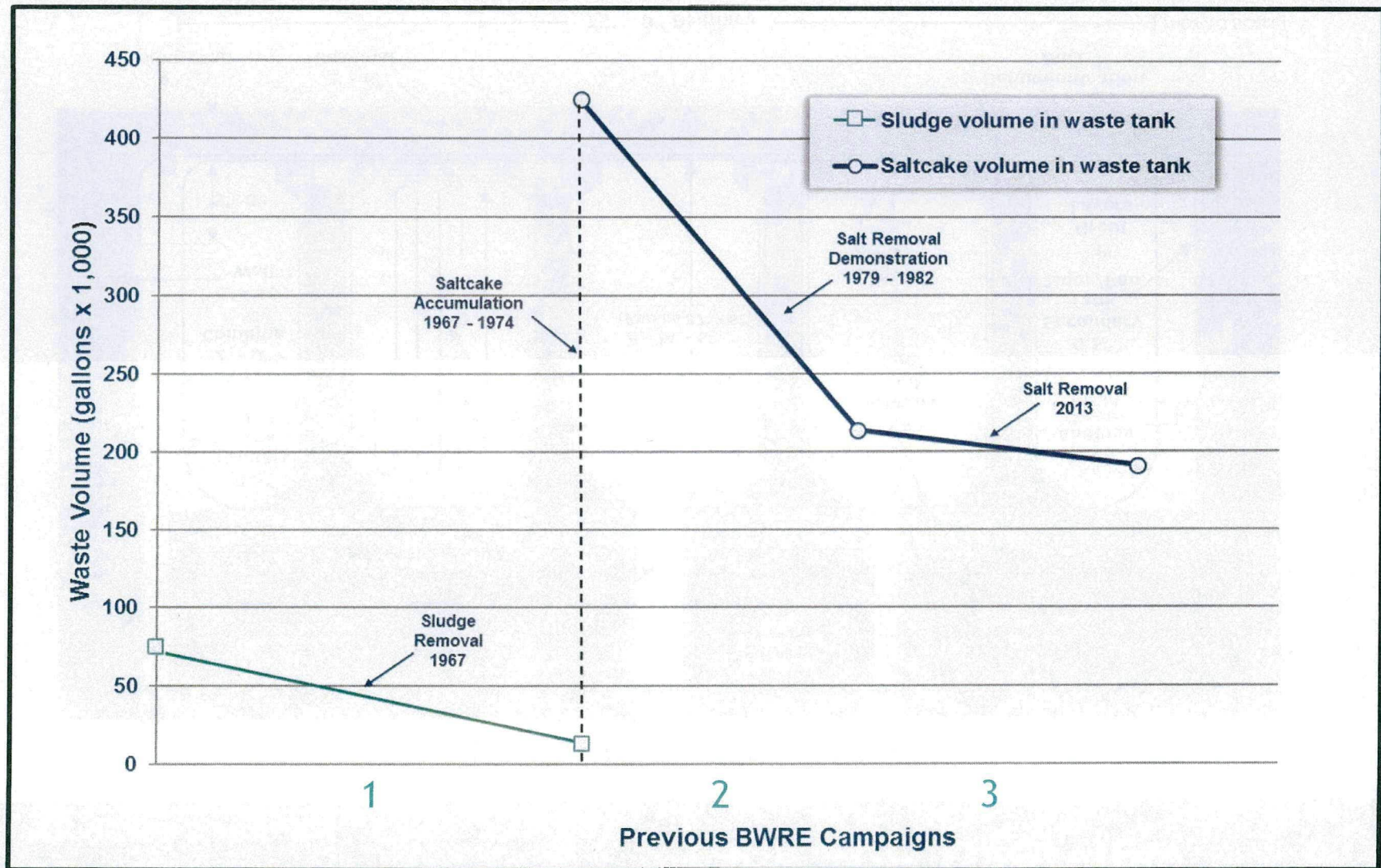


Nominal Working Capacity: 750,000 gallons

Current Salt Level: ~72 inches

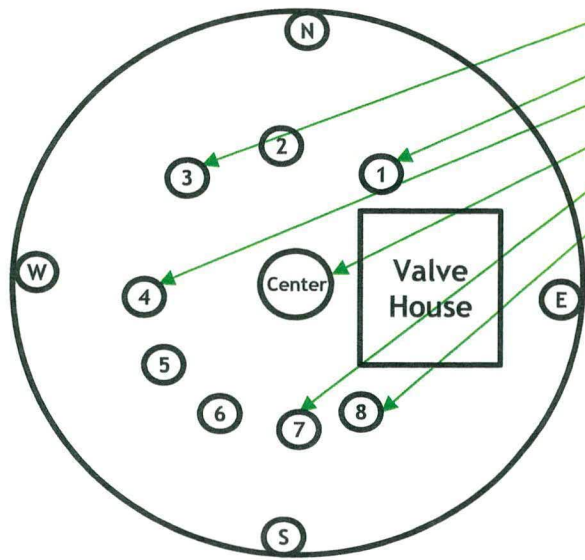
Current Contents: ~191,000 gallons saltcake, ~3,000 gallons sludge

Previous Tank 10H Waste Removal Campaigns



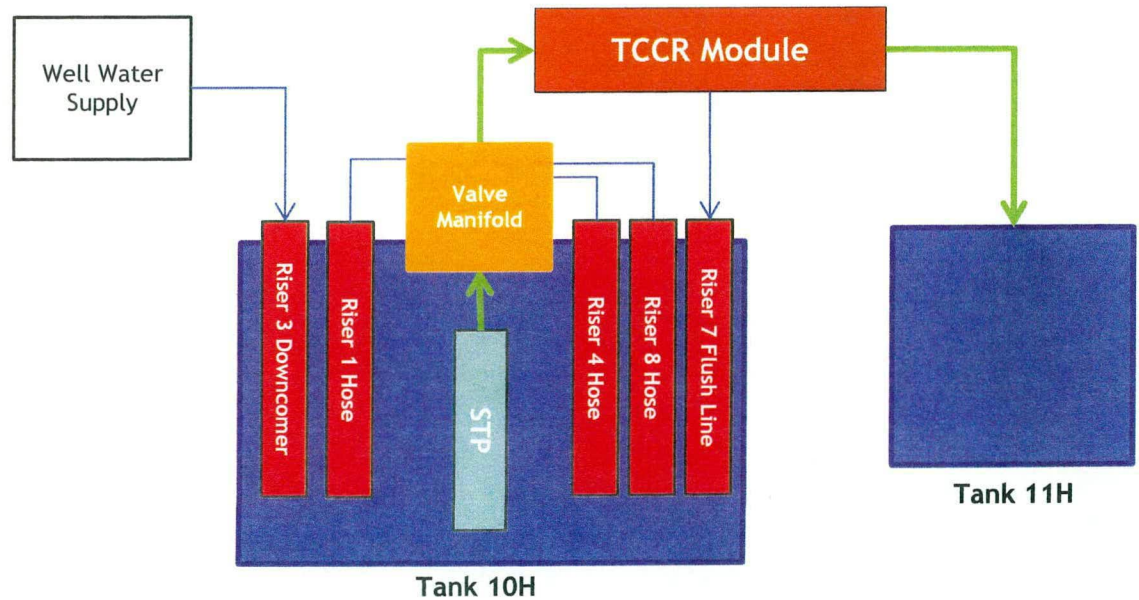
Tank 10H Equipment Overview

Tank 10H Riser Layout



- Riser 3: Well Water Downcomer
- Riser 1 : Recirculation Hose in Spray Chamber
- Riser 4 : Recirculation Hose in Spray Chamber
- Center Riser : Valve Manifold and Submersible Transfer Pump (STP)
- Riser 7: TCCR Flush Line
- Riser 8 : Recirculation Hose in Spray Chamber

Process Diagram



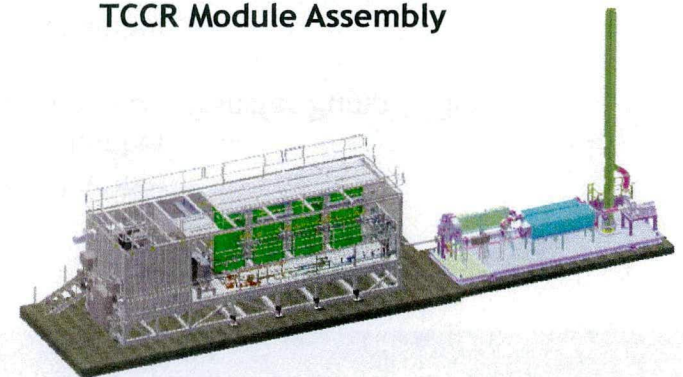
Westinghouse (WEC)/Columbia Energy:

- ✓ Fixed price subcontract awarded 07/16
- ✓ Completed design, fabrication and assembly
- ✓ Completed early shipment of the Control skid on 2/6/18
- ✓ Resolved the pre-filter issue and completed Factory Acceptance Testing (FAT) on 2/22/18
- ✓ Completed and approved all engineering and quality documents, including the FAT Summary Report, on 3/23/18
- ✓ 9 trailers of TCCR equipment were delivered from 4/2/18 - 4/6/18
- ✓ Completed receipt inspection and site acceptance



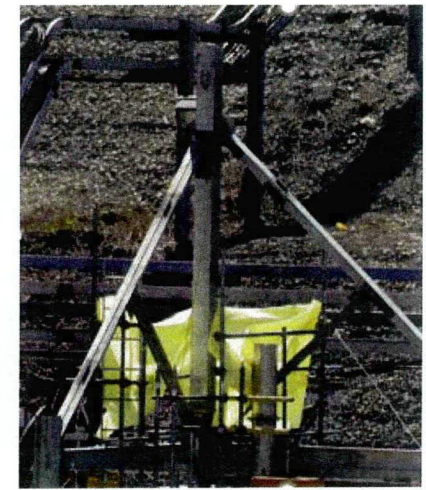
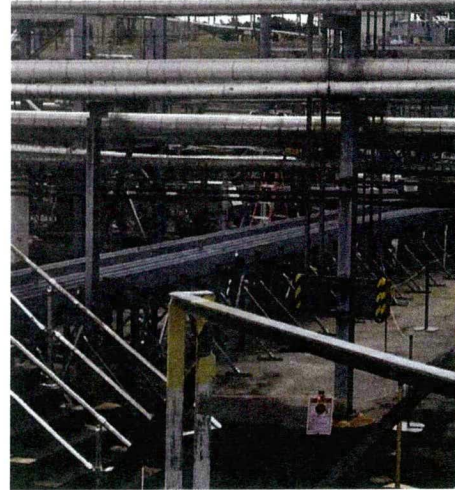
Shielded Ion Exchange Column (IXC)

TCCR Module Assembly



- **Field Activities:**

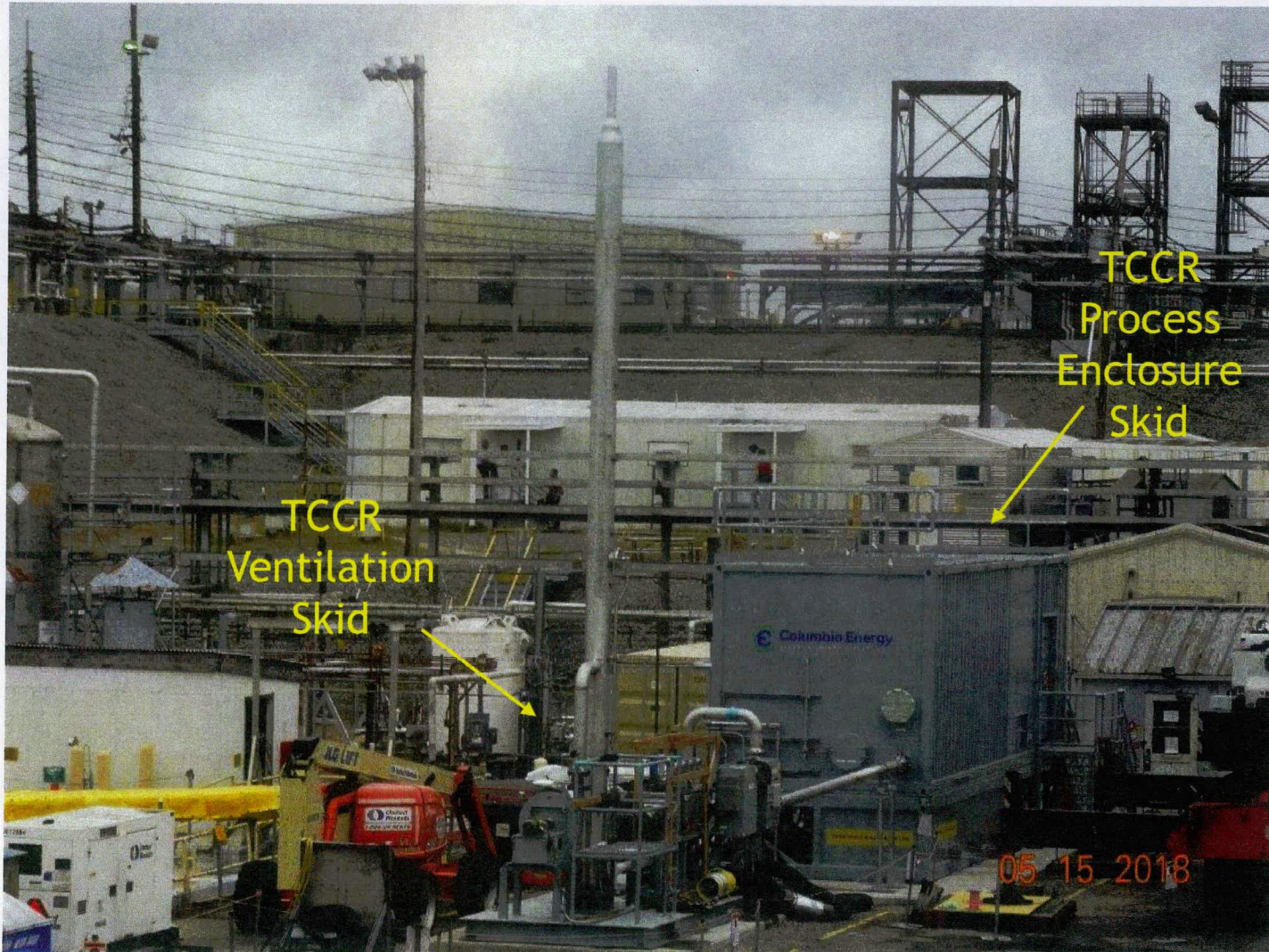
- ✓ Foundations pads are installed
- ✓ All equipment D&R complete and old Tank 10H Submersible Transfer Pump (STP) removed
- ✓ New shielded plugs installed
- ✓ New Tank 10H STP installation complete
- ✓ Tank 10H ventilation stack extension is complete
- ✓ All supports for transfer lines installed
- ✓ All hose-in-hose transfer lines installed
- ✓ TCCR equipment assembled
- Tank 11H stack extension is working
- Electrical and control utility services working



Tank 10H Transfer line Supports Tank 11H Stack Extension

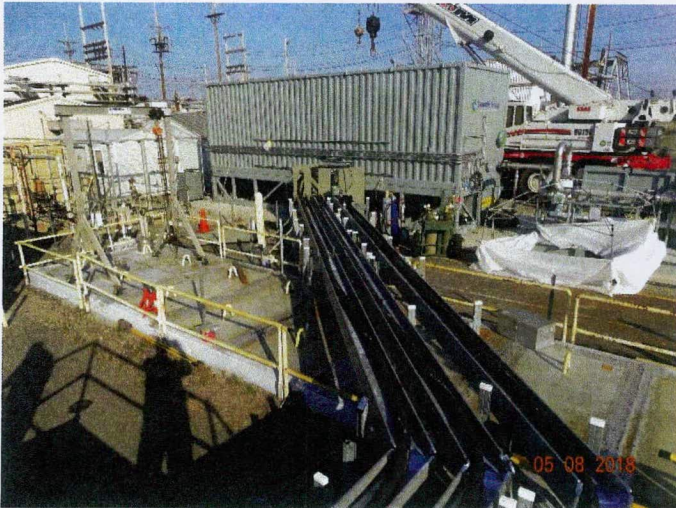


Transfer Line Supports at H-Tank Farm Diversion Box, HDB-1





TCCR Transfer Hose Installation



Transfer Lines
from TCCR to
Tanks 10H
and 11H

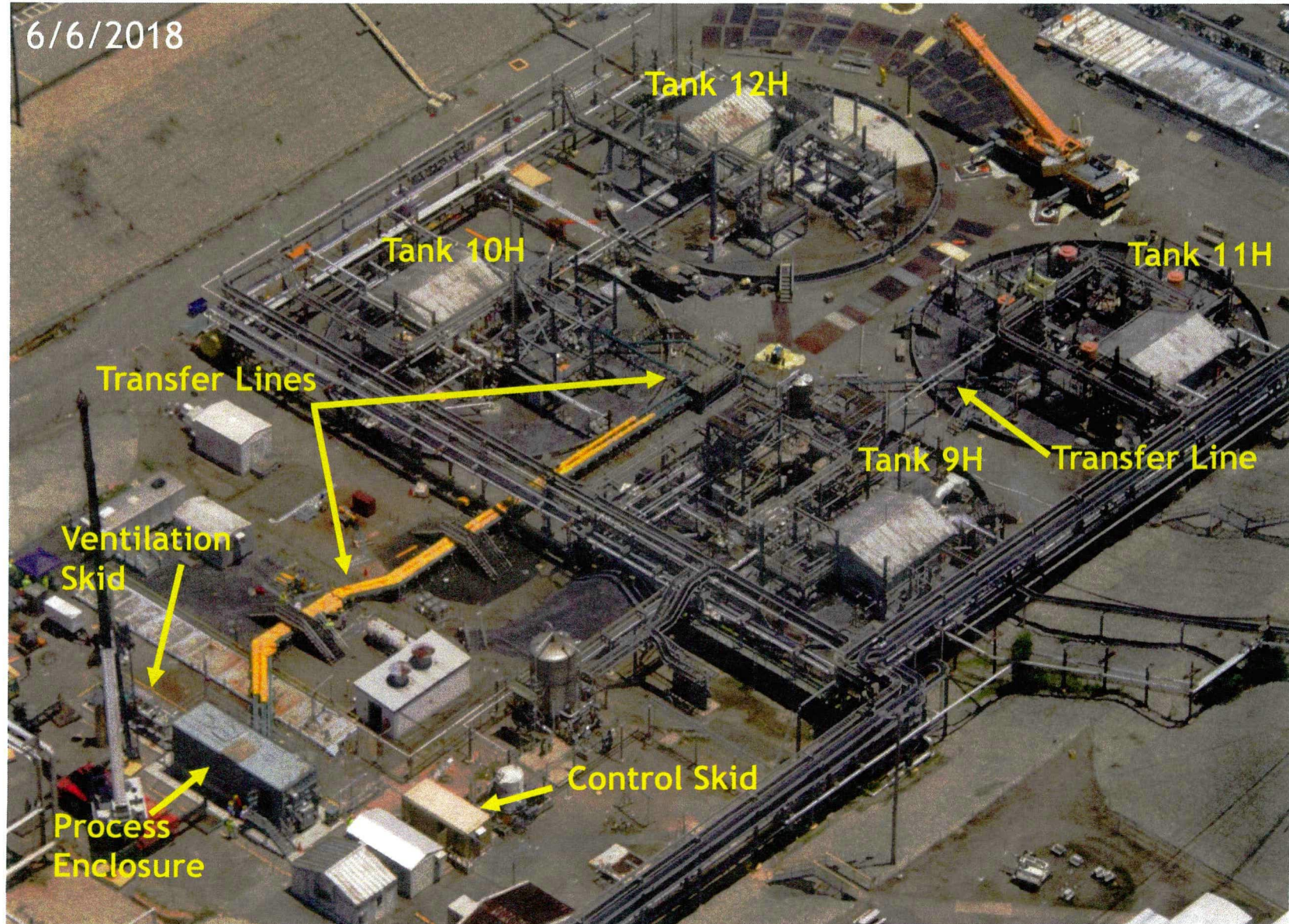


Transfer Lines
from TCCR on
Tank 10H

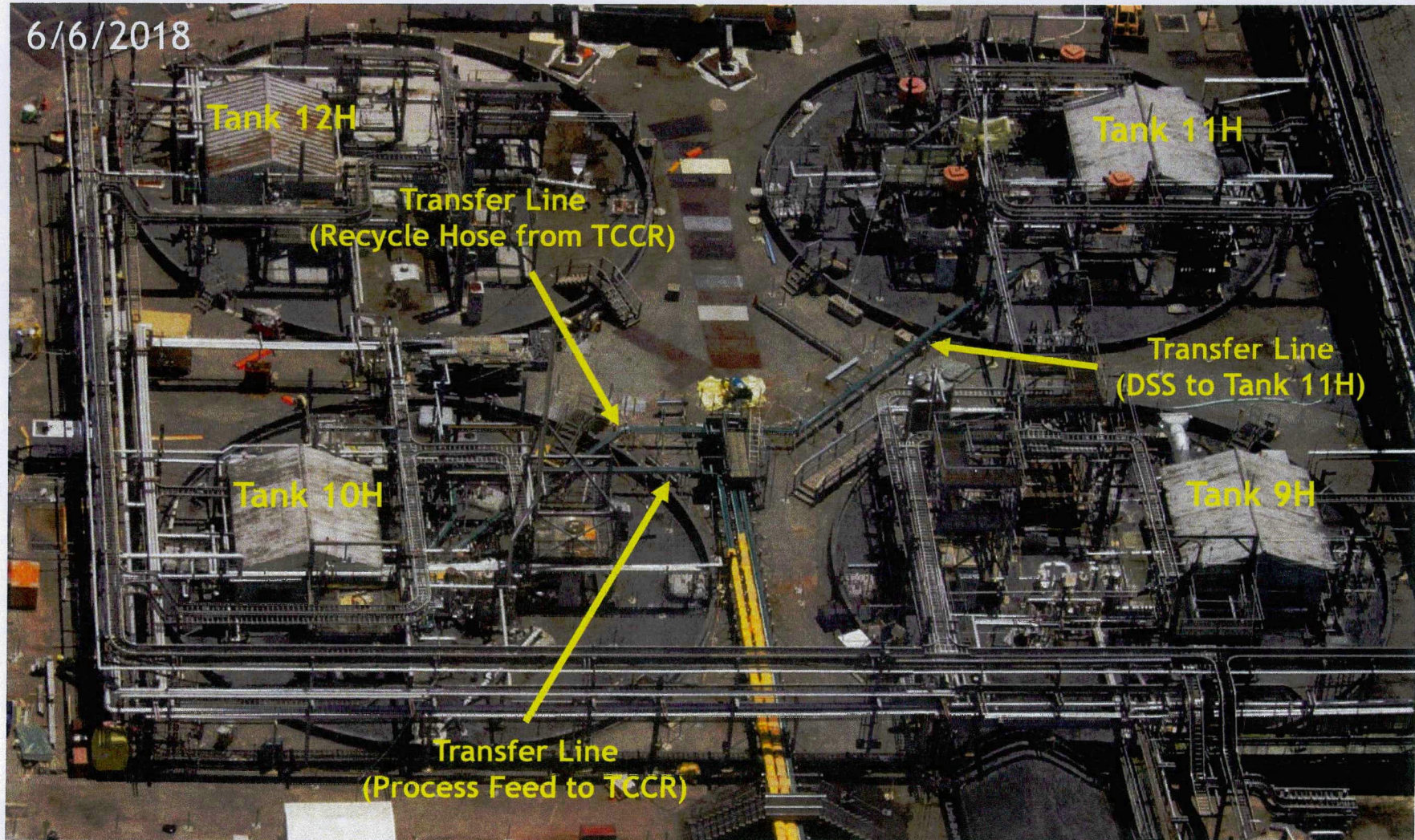


TCCR Process Area View

6/6/2018



TCCR Process Area View

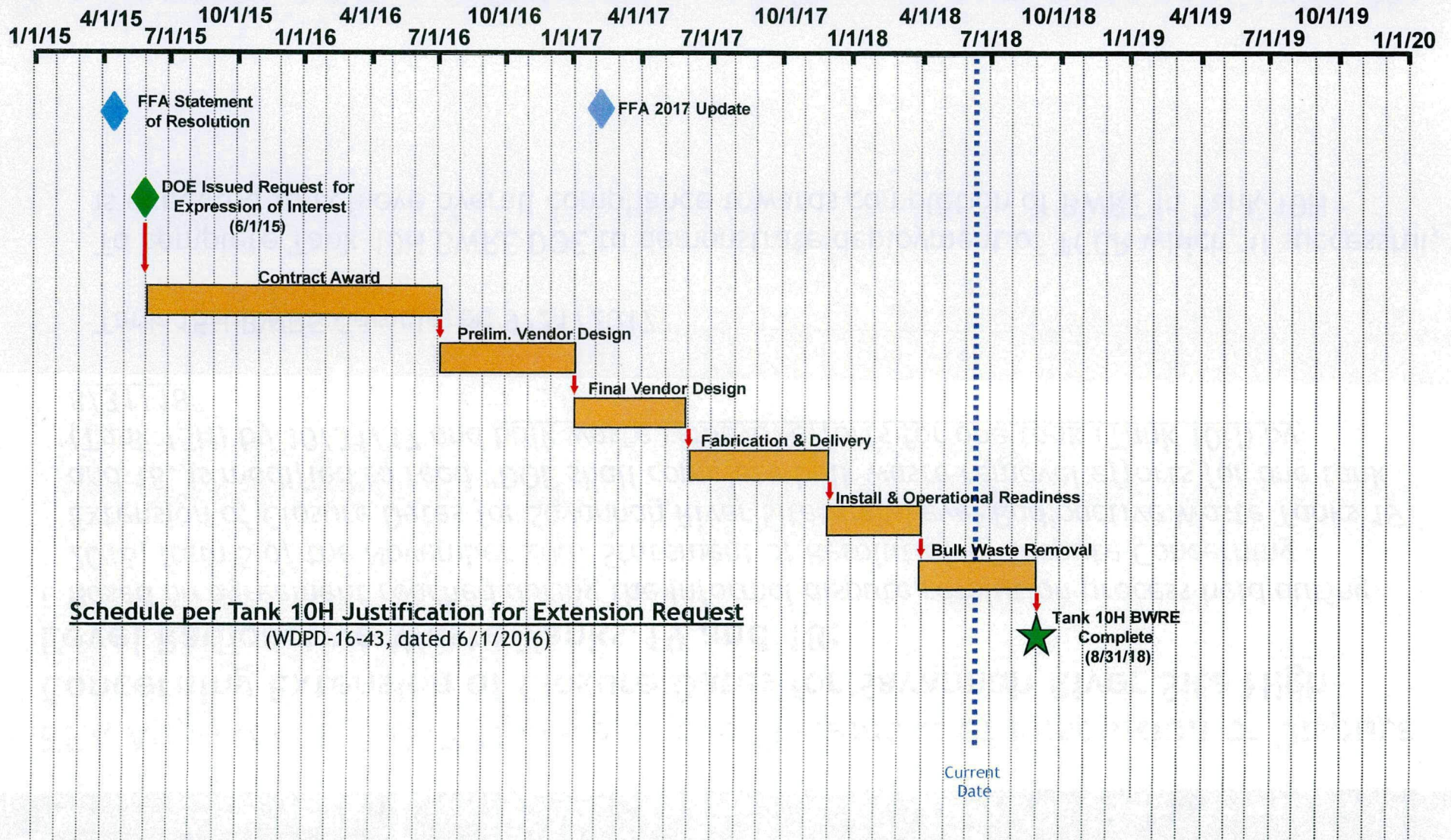


- **Complete Documented Safety Analysis (DSA) updates**
 - Physical changes to resin columns to support water jacket is complete
 - DSA submittal/acceptance/implementation
 - Real waste testing
- **Complete onsite testing:**
 - TCCR system operations
 - Transfer line blanks installed to isolate Tank 10H and Tank 11H
 - Operate TCCR system utilizing water
 - Programmable Logic Controller
 - Operators will be trained during testing
- **Complete procedures and training development**
 - Development of procedures and training materials is in-progress
- **Perform Facility Safety Assessment and Readiness Assessment**
 - Perform final tie-ins between TCCR Equipment Enclosure and Tanks 10H and 11H
- **Restart salt BWR activities (water addition) for saltcake dissolution and subsequent TCCR operations**

- **FFA Appendix L, Statement of Dispute Resolution, Item 3, signed on April 27, 2015:**
 - *DOE shall pursue commercial source for treatment of salt waste in an effort to accelerate and expedite tank closure through the issuance of a request for expressions of interest no later than July 31, 2015. DOE will report progress on the efforts to obtain commercial sources for treatment of salt waste in a meeting on October 15, 2015. DOE will provide continual updates on the process during on-going Liquid Waste Program quarterly meetings.*
 - Expression of Interest issued on June 1, 2015.
 - October 15, 2015 meeting DOE briefed SCDHEC and EPA on plans to pursue TCCR technology deployment
 - Progress and plans shared during subsequent Liquid Waste Program quarterly meetings

- **FFA Appendix L, 2017 Update to the Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18:**
 - *Based on agreement reached during the informal dispute resolution process held during 2016, Item 5 of the November 2007 Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18, is modified to read “DOE shall complete bulk waste removal efforts for one tank (Tank 15H) by 10/31/17 and bulk waste removal efforts for one tank (Tank 10H) by 8/31/18”*
 - Tank 15H BWRE Completed 9/21/2017
 - To complete Tank 10H BWRE DOE to demonstrate deployment of TCCR which, if successful, is expected to achieve overall compliance towards completion of BWRE in Tank 10H

Original BWRE Schedule



■ Hydrogen Generation Rate PISA:

- On February 28, 2017, a Potential Inadequacy of the Safety Analysis (PISA) was declared for DWPF, Saltstone, and F and H Tank Farms. The PISA identified potentially inadequate recognition of the effect of organics on hydrogen generation (thermal degradation and radiolysis).
 - No impact to TCCR design or operations currently anticipated
 - Impacted the availability of SRR Safety Basis Engineering resources to support TCCR DSA development

■ WEC Bankruptcy

- On March 29, 2017, the TCCR vendor, Westinghouse Electric Company (WEC), filed for Chapter 11 bankruptcy protection.
 - No impacts to date
 - DOE and SRR have worked closely with WEC and have required WEC to provide additional financial reporting. WEC has complied with all reporting requirements.
 - Shipping and receipt of the equipment to SRS is complete, however, continued commitments of the vendor (e.g., technical support) could be impacted by this condition.

■ TCCR Documented Safety Analysis Development

- On-going evaluation and development of the safety basis strategy for TCCR identified:
 - Individual feed batches of Tank 10H dissolved salt solution will require more extensive sampling, analysis and verification testing than originally planned to ensure TCCR operations remain within the required safety margins.
 - Ion exchange columns as originally designed limited heat dissipation within the columns
- Impacts
 - TCCR Operations start date delayed beyond the original date of May 2018
 - TCCR Operations duration (i.e., salt waste treatment and bulk salt waste removal) significantly longer than the original plan of approximately 5 months
 - Batch Qualification Testing is required for each dissolution campaign prior to processing through the TCCR Unit
 - Physical modification to ion exchange columns necessary to provide a “water jacket” to support dissipation of the heat generated by radiological decay of Cs-137 captured within the column. - completed 5/2018

▪ Filter Issues

- During the Factory Acceptance Testing (FAT) WEC encountered plugging issues with the TCCR pre-filters. The FAT testing was suspended and an evaluation was performed to determine the cause.
 - WEC determined that the filters were fouled from excessive fines carried over from the surrogate ion exchange resin
 - Issue was compounded by the closed loop nature of the test configuration causing the filters to plug with off-specification fines.
 - The corrective actions included a pre operational flush of the surrogate resin and simulated waste steam to remove the fines and better control the surrogate waste particle size.
 - Only one set of filters were fabricated for the test, the filters had to be shipped to an outside vendor for cleaning before the FAT test could resume.
- Impacts
 - Delivery date of TCCR equipment delayed beyond the original date of November 2018, impacting the start date of the TCCR demonstration
 - The pre-filter issue evaluation and corrective actions were completed and the pre-filters were successfully tested by the vendor at their facility and delivered to SRS.
 - Real waste testing performed at SRNL (risk mitigation)

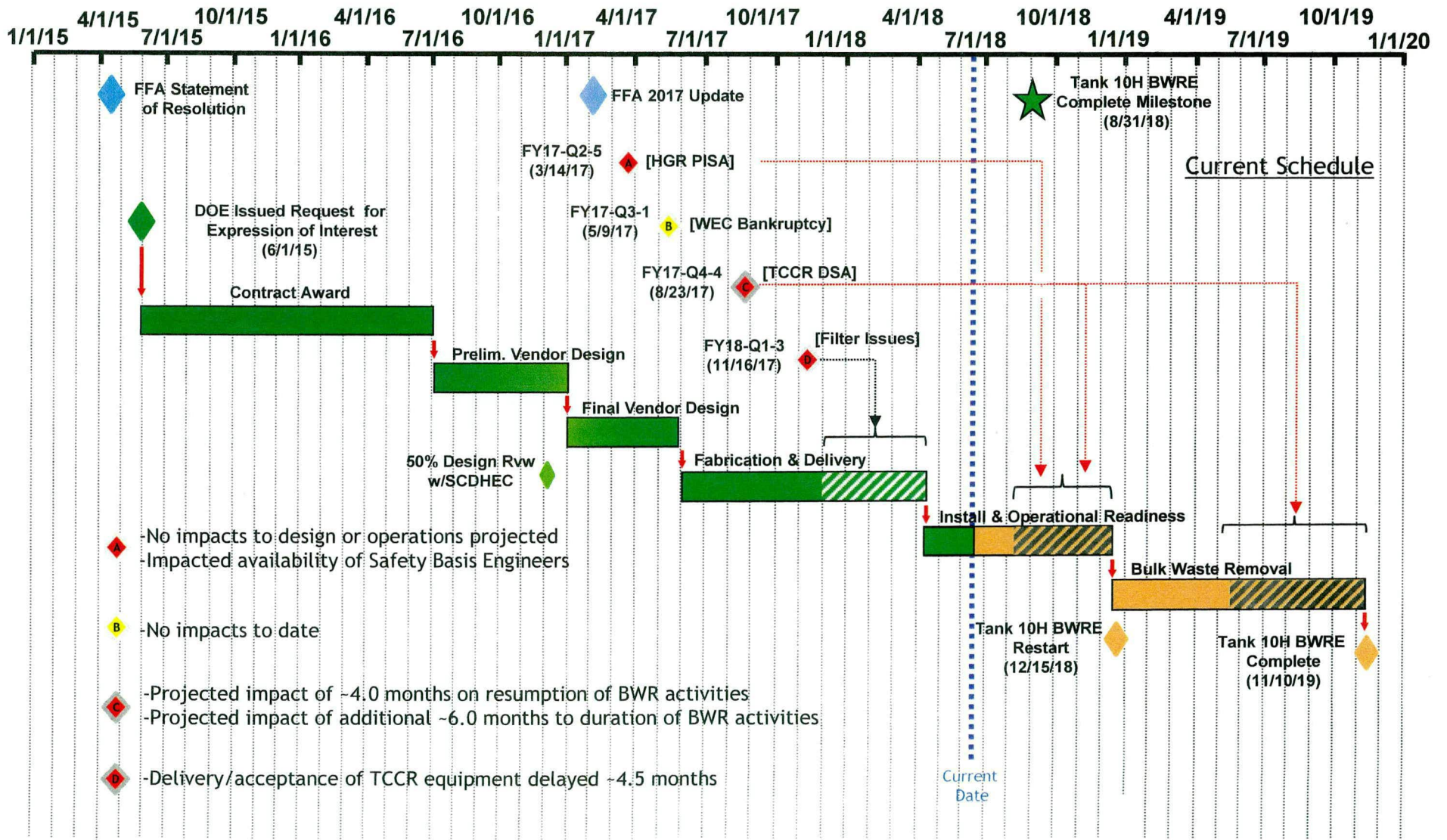
- A Hydrogen Generation Rate PISA:**
- No impacts to design or operations currently anticipated
 - Impacted availability of Safety Basis Engineers

- B WEC Bankruptcy:**
- No impacts to date

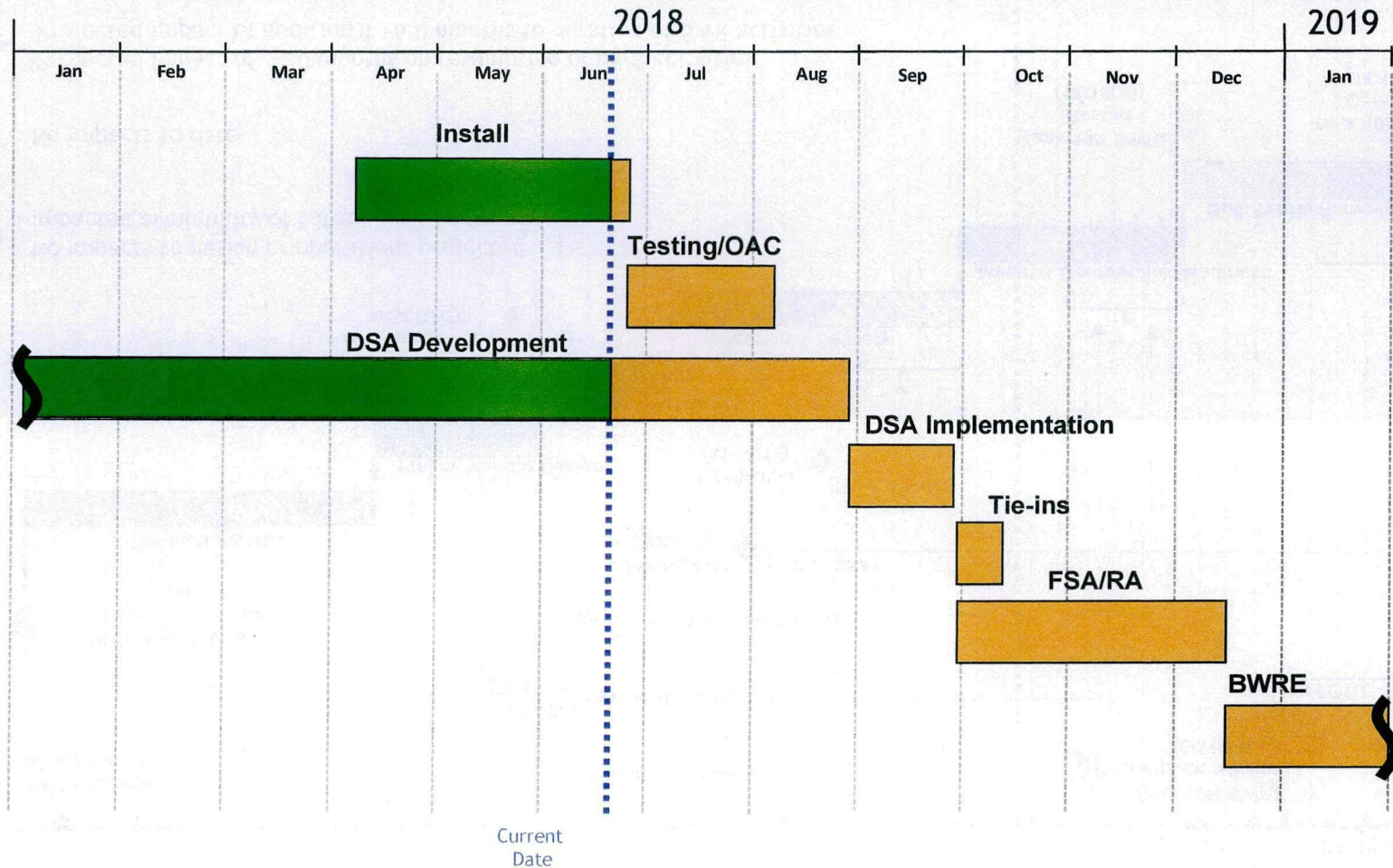
- C TCCR Documented Safety Analysis Development:**
- Projected impact on resumption of BWR activities
 - Projected impact to duration of BWR activities

- D Filter Issues:**
- Impacted delivery/acceptance of TCCR equipment

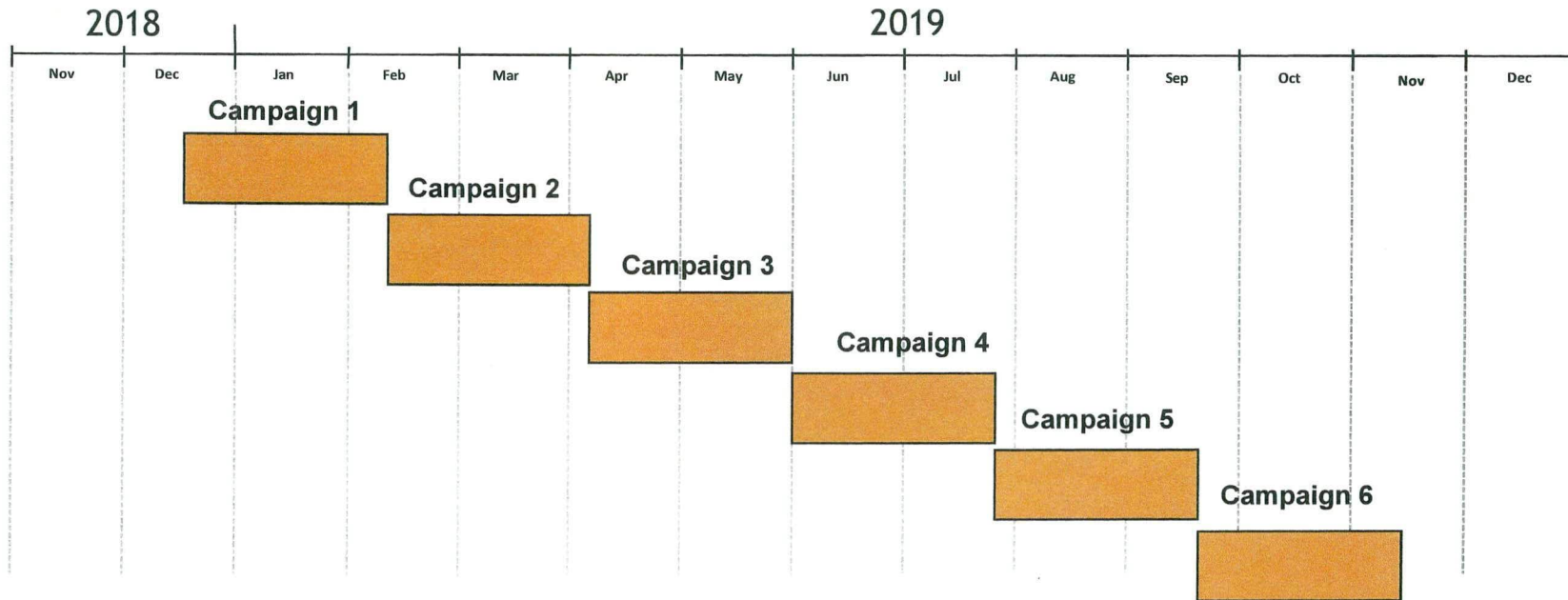
Current BWRE Schedule



Install & Operational Readiness

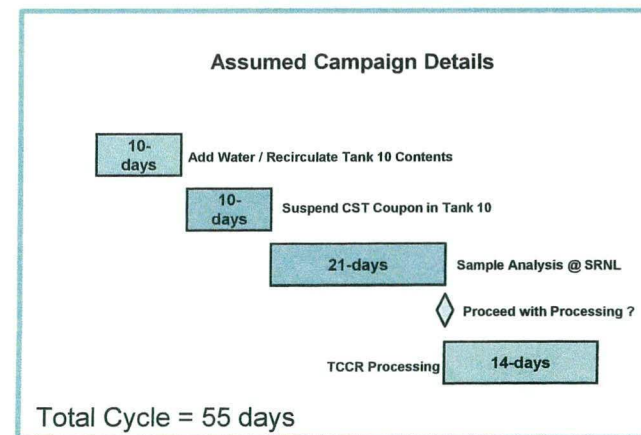


Waste Removal Campaigns



Schedule Notes for Each Campaign:

- Specific gravity of salt solution will be monitored during recirculation to ensure minimum target value is achieved. Duration of recirculation period may vary between campaigns. Later campaigns may require longer recirculation times.
- Tank conditions will be monitored during suspension of CST coupon in Tank 10H to verify tank temperature remains within assumed range.
- After suspension in Tank 10H, CST sample will be transported to SRNL for analysis.
- Results of sample analysis will be compared against DSA assumptions prior to initiating TCCR operations. Schedule shown assumes analysis within required limits and no additional adjustments necessary.
- TCCR processing assumes 5 gpm nominal processing rate.



- **Federal Facility Agreement Requirements**
 - Continued usage of Tank 11H requested by DOE on 11/6/2017
 - Continued usage of Tank 11H approved by SCDHEC and EPA on 11/8/2017
- **SCDHEC TCCR Construction Permit No. 20150-IW**
 - Construction Permit approved by SCDHEC on 10/31/2017
 - SRS site personnel met with SCDHEC personnel in Columbia, SC to discuss permit 9/2017 and 10/2017
 - Request Approval to Place into Operation after construction complete
- **SCDHEC Saltstone Disposal Facility Industrial Solid Waste Landfill Permit Facility ID# 025500-1603**
 - TCCR Decontaminated Salt Solution approved as a new waste stream per General Condition B.9, on 11/28/2017

- Installation of TCCR equipment complete pending final utility tie-ins
- Preparation for TCCR equipment testing in-progress
- Installation of Tank 10H dissolution equipment complete
- Permit and Tank 11H re-use approved
- Anticipated restart of BWRE activities (i.e., water addition to Tank 10H) is December 2018 based on current execution schedule
- Anticipated start of TCCR operations is late January 2019 based on current execution schedule
- Anticipated completion of Tank 10H BWRE is November 2019 based on current execution schedule

Enclosure 2

Tank 10H – Justification for Extension Request

Facts:

- Type I High Level Waste (HLW) storage tank
- Tank is submerged within the water table
- Commissioned for use in December 1955
- Received high-heat waste from H Canyon operations from 1955 to 1959
- Leakage into the annulus was first detected in 1959; approximately 2 to 3 inches of salt waste in the annulus; 19% of wall has been inspected
- Initial bulk sludge waste retrieval completed in 1967; removed ~63,000 gallons using sluicers
- Served as evaporator concentrate receipt tank from 1967 to 1974
- Initial bulk salt waste retrieval performed 1979 to 1982; removed ~ 211,000 gallons
- Resumed bulk salt waste retrieval in 2013, removed ~48,000 gallons
- Contents as of June 2018
 - o ~191,000 gallons of saltcake
 - o Sludge heel remaining from 1967

Summary of Operational History and Waste Removal

Tank 10 was constructed in 1953. Tank 10 received the waste generated from the early H-Canyon chemical separations PUREX process from 1955 through 1959, and stored the liquid waste through 1967 while various corrosion tests were performed in the tank. Bulk sludge solids removal was performed in 1967 to prepare Tank 10 to become an evaporator concentrate receipt tank. Five sluicers were used to slurry the sludge solids and a single ~232,000 gallons sludge slurry transfer utilizing multiple transfer pumps was made resulting in ~63,000 gallons of sludge being transferred. Four sludge sounding measurements were taken in 1967 and indicated that less than one inch of sludge solids is estimated to remain in the tank.

Tank 10 served as an evaporator receipt tank for the 242-H Evaporator System (typically referred to as the 1H Evaporator System) from 1967 to 1974. A saltcake removal demonstration using a density gradient methodology was performed in Tank 10 from 1979 to 1982. Liquid from Tank 23 was transferred into Tank 10 while a low flow transfer of dissolved salt solution was transferred from Tank 10 to Tank 29 using a jet mined into the saltcake. At that time, it was estimated that 211,000 gallons of saltcake were removed. At the conclusion of the bulk salt waste removal campaign, ~214,000 gallons of saltcake remained in Tank 10. Between 1982 and 1989, ~300,000 gallons of supernate was transferred into Tank 10. It then remained inactive until 2013.

In May 2013, the second bulk salt waste removal campaign was initiated in Tank 10 using a Semi-Continuous Dissolution methodology. Well water was added to Tank 10 through three low-volume mixer jets. A submersible transfer pump successfully transferred ~96,000 gallons of dissolved salt solution from Tank 10 to Tank 11. This dissolved salt solution was then transferred into Tank 21 for incorporation into Salt Batch 7. This waste retrieval campaign removed an estimated 48,000 gallons of saltcake.

Enclosure 2

Tank 10H – Justification for Extension Request

New Technology Demonstration to Support Waste Retrieval

In accordance with the Federal Facility Agreement (FFA) Appendix L, *Statement of Resolution of Dispute Concerning Extension of Federal Facility Agreement (FFA) Closure Date*, item 3, signed on April 27, 2015:

“DOE shall pursue commercial source for treatment of salt waste in an effort to accelerate and expedite tank closure through the issuance of a request for expressions of interest no later than July 31, 2015. DOE will report progress on the efforts to obtain commercial sources for treatment of salt waste in a meeting on October 15, 2015. DOE will provide continual updates on the process during on-going Liquid Waste Program quarterly meetings.”

An expression of interest was issued by DOE on June 1, 2015. As originally reported to South Carolina Department of Health and Environmental Control (SCDHEC) and U.S. Environmental Protection Agency (EPA) on October 15, 2015, the planned duration for obtaining the technology, deployment, and completion of the Bulk Waste Removal (BWR) phase of Tank 10 using the new technology was anticipated to be approximately 24 months after award of the contract. Beyond the commitment to issue the request for an expression of interest, U. S. Department of Energy (DOE) continued to pursue Tank Closure Cesium Removal (TCCR) technology, using a commercial supplier, on Tank 10 as a demonstration of the technology and determination of its capabilities in meeting the accelerated salt waste processing goals. On July 7, 2016, Westinghouse Electric Company (WEC) was awarded a subcontract to design and build the TCCR system. Progress and plans have continued to be shared with SCDHEC and EPA during the Liquid Waste Program quarterly meetings.

In accordance with the FFA Appendix L *2017 Update to the Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18* (signed 11/19/07):

“Based on agreement reached during the informal dispute resolution process held during 2016, Item 5 of the November 2007 Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18, is modified to read “DOE shall complete bulk waste removal efforts for one tank (Tank 15H) by 10/31/17 and bulk waste removal efforts for one tank (Tank 10H) by 8/31/18”

Bulk Waste Removal Efforts (BWRE) for Tank 15 were completed on September 21, 2017. The extension for Tank 10 was agreed upon to allow DOE to demonstrate deployment of a new technology, TCCR, for treating dissolved salt solution based on the schedule and best available information at that time. TCCR is not a waste removal technology; waste removal from Tank 10 is being performed using a continuous dissolution methodology. Waste removal will occur through the addition of well water to Tank 10 to dissolve the saltcake, recirculation of the resulting salt solution until adequate dissolution has occurred and then subsequent transfer of the dissolved

Enclosure 2

Tank 10H – Justification for Extension Request

salt solution from Tank 10 to Tank 11. During the transfer from Tank 10 to Tank 11, the dissolved salt solution will be processed through the TCCR unit for treatment. In the process of performing waste removal from Tank 10, the feasibility of the TCCR technology will be demonstrated and the completion of BWRE in Tank 10 is expected.

As discussed during the FFA informal resolution process held during 2016, the Tank 10 extension date of August 31, 2018 was based on the estimated duration to complete the “at-tank” cesium removal demonstration for salt waste and was based on the latest and best available technical information. Completion of the TCCR demonstration at Tank 10 was projected to take approximately 24 months after award of the contract, which as previously noted, occurred on July 6, 2016. As provided in the justification supporting that request for extension, the projected schedule for completion of the TCCR demonstration was the following:

- Completion of contract award: Anticipated by July 2016
- Completion of preliminary vendor design of TCCR: December 2016
- Completion of final vendor design of TCCR: May 2017
- Completion of fabrication and delivery of TCCR: November 2017
- Completion of installation and operational readiness of TCCR: March 2018
- Completion of BWR for Tank 10; four to five months duration; completion: August 2018

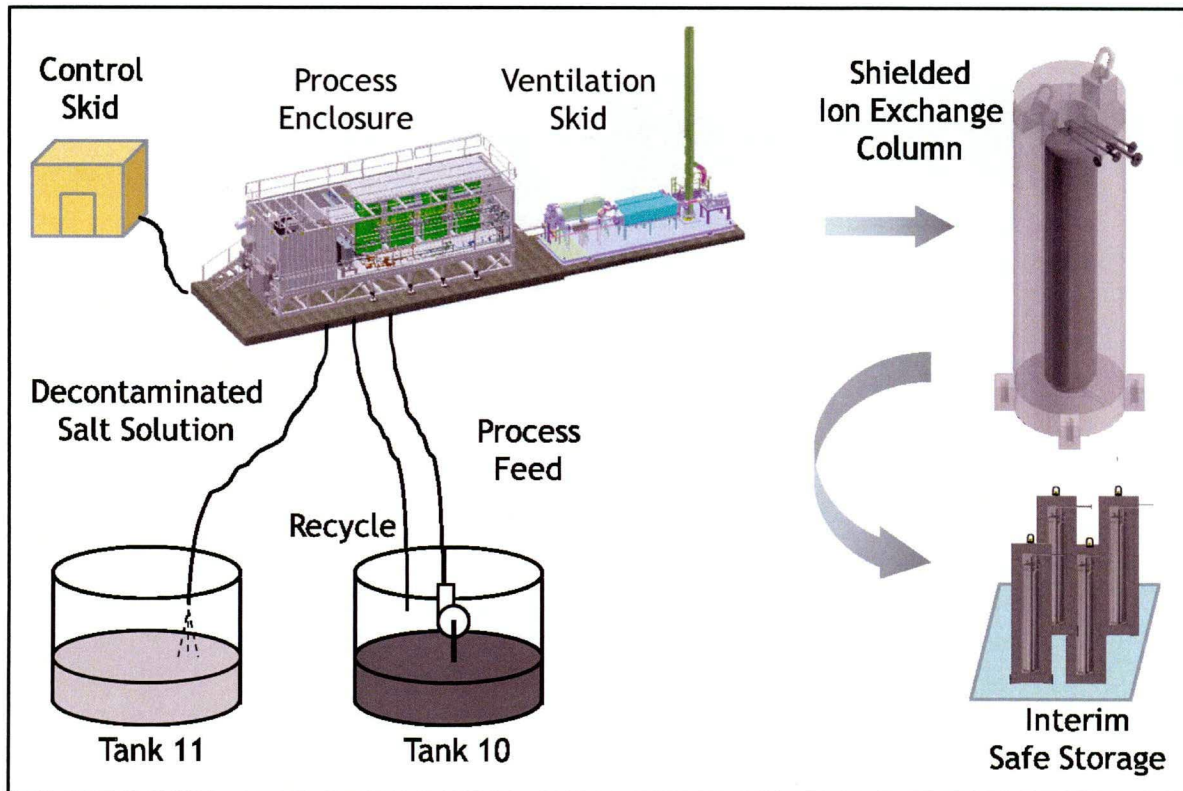
Throughout the informal resolution process held during 2016 and continuing since the FFA Appendix L *2017 Update to the Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18 (signed 11/19/07)*, DOE has continued to diligently pursue the TCCR technology. DOE has continued to provide progress updates with SCDHEC and EPA during the Liquid Waste Program quarterly meetings. In addition, SCDHEC personnel participated in the 50% design review of the TCCR process equipment in November 2016. Involvement with SCDHEC has also been ongoing regarding permitting beginning in February 2017 when Savannah River Site (SRS) site personnel provided a draft construction permit application for the TCCR process to SCDHEC for review.

To date, WEC has completed design and fabrication of the TCCR System. Facility Acceptance Testing requirements were met at WEC’s Richland, Washington facility and all TCCR equipment has been delivered and installed at SRS. A schematic of the TCCR process is provided in Figure 1.

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Figure 1: TCCR Process

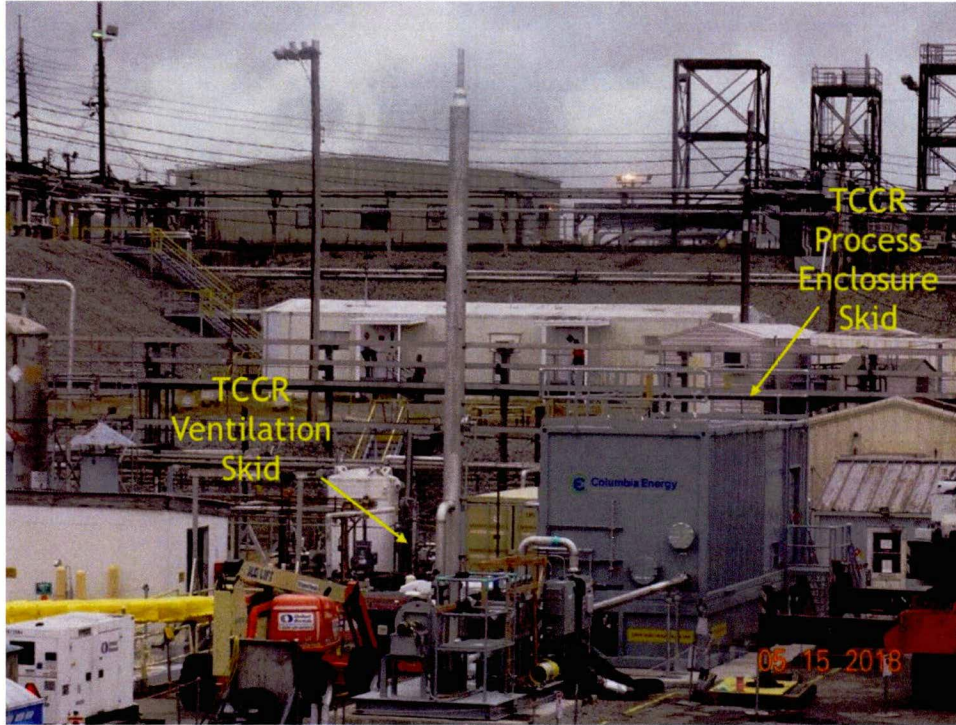


All electrical and control utility services to, and between, the TCCR equipment skids have been completed. In addition to installation of the TCCR equipment skids, all the required modifications to Tank 10 to support salt dissolution and subsequent treatment of the dissolved salt solution through the TCCR process have been completed. With the exception of finishing up work on the stack extension on Tank 11, all modifications to Tank 11 necessary to support receipt of the decontaminated salt solution from TCCR have been completed. Photographs of the actual installation are provided in Figure 2.

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Figure 2: TCCR Equipment Skids



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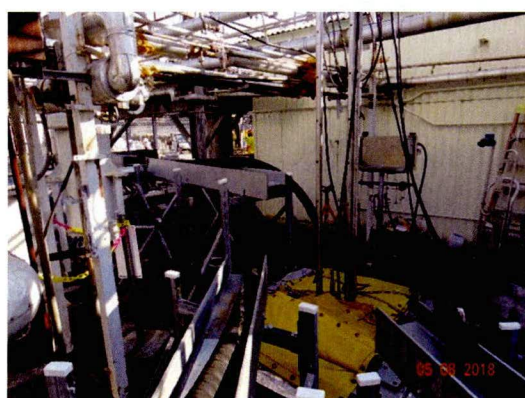
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Above grade hose-in-hose (HIH) transfer lines connecting the TCCR process to both Tank 10 and Tank 11 have been installed with only the installation of a short section of lead shielding and final tie-ins remaining to be completed. Figure 3 shows the installed transfer lines.

Figure 3: Transfer Lines



**Transfer Lines
from TCCR to
the tank top**



**Transfer Lines
from TCCR on
Tank 10**



In addition to equipment design and installation, SRS site personnel met with SCDHEC personnel beginning in February 2017 both at SRS and in Columbia, South Carolina regarding permit impacts of the TCCR process. In October 2017 SCDHEC approved the Construction Permit for TCCR. In addition, the TCCR decontaminated salt solution has been approved as a new Saltstone Disposal Facility (SDF) waste stream by SCDHEC as required by the SDF Industrial Solid Waste Landfill Permit.

Since BWRE were previously declared complete for Tank 11, as required by the FFA, in November 2017 DOE requested and both SCDHEC and EPA approved the continued usage of Tank 11 to support Tank 10 BWRE and the TCCR demonstration.

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Onsite testing of the installed TCCR process equipment has begun. The activities remaining to be completed prior to the restart of BWRE activities, (i.e., addition of dissolution water to Tank 10) are the following:

- Complete development and implementation of required updates to the Documented Safety Analysis and Technical Safety requirements (DSA/TSR);
- Complete onsite testing;
- Complete procedures and training development; and
- Perform Facility Safety Assessment (FSA) and Readiness Assessment (RA).

New Technical Information or Technological Barriers

As discussed, at the time the FFA Appendix L *2017 Update to the Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18 (signed 11/19/07)* was approved DOE anticipated a 24-month schedule, subsequent to awarding a subcontract for design and fabrication of the TCCR equipment, to complete the TCCR demonstration. During the actual development of the TCCR process, DOE has encountered several challenges which have impacted the TCCR demonstration schedule and therefore the Tank 10 BWRE schedule.

As discussed during the informal resolution process held during 2016, the selected technology had been deployed elsewhere, but its use was under very different physical, chemical, and radiological conditions. Direct comparison of use of the technology in this application to those used at Fukushima, Japan, other commercial nuclear applications, or waste water treatment systems is not appropriate, nor technically sound and safe. SRR, on DOE's behalf, conducted a competitive procurement process and received four viable proposals for review from commercial vendors that included scope, cost, and schedule estimates. Each proposal had similar forecasted schedules and did not offer any potential acceleration, supporting that the schedule assumed by DOE as the basis for the extension request was reasonable and effectively validated by third party industry experts. The technology has not been deployed previously within the DOE complex and subjected to the substantial mandatory safety requirements that must be adhered to when handling high-activity nuclear waste. It has not been used for this particular type of waste form: namely, the technology has been used primarily for the removal of cesium from contaminated water streams and not on the scale being proposed for testing by DOE on actual high activity tank waste. Tests with tank wastes, to the knowledge of the DOE, was limited to bench scale laboratory testing, and while highly encouraging in the results, is not comparable to actual full-scale tests. The waste form to be utilized in the demonstration is dissolved saltcake solutions which adds extensive complexities to the process to address the dissolved salts, attendant metal solids, and the additional complexities associated with compliance with the nuclear safety requirements and controls to assure the material can be processed safely **outside the containment provided by the underground high-level waste storage tank system**. DOE has been aggressively progressing deployment of the technology for demonstration, while assuring the safety and efficacy of the demonstration. DOE will not deploy the technology until applicable DOE, federal, and state requirements are met.

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Tank 10H – Justification for Extension Request

During the Liquid Waste Program quarterly meetings, DOE has kept SCDHEC and EPA informed of the following technical challenges which have been encountered and have resulted in impacts to the TCCR schedule:

1. TCCR Filter Issues

In late September 2017, during Factory Acceptance Testing at the WEC facility in Richland, Washington the TCCR pre-filters became plugged. The Factory Acceptance Testing was placed on hold and an evaluation was performed to determine the cause. Following several months of investigation, the vendor determined that the filters were plugged from excessive fines carryover from the surrogate IX resin used in the testing, compounded by the closed loop nature of the test configuration causing the filters to plug with off-specification fines. The corrective actions included a pre-operational flush of the surrogate resin and simulated waste stream to remove the fines and better control the surrogate waste particle size. Since only one set of filters were fabricated for the test, the filters had to be shipped to an outside vendor for cleaning before the Factory Acceptance Testing test could resume.

The pre-filter issue evaluation and corrective actions have been completed and the pre-filters have been successfully tested using simulated waste by the vendor at their facility. Prior to discovery of this issue, delivery of the unit was scheduled to occur in November 2017 as originally anticipated. The equipment was received at SRS in early April 2018, resulting in a 4.5-month impact to the anticipated start of Tank 10 BWR activities.

2. Tank Closure Cesium Removal DSA/TSR Development

On-going evaluation and development of the safety basis strategy for TCCR identified that, as a result of new information related to chemistry impacts on heat generation rates within the ion exchange columns, prior to feeding the TCCR Unit individual feed batches of Tank 10 dissolved salt solution will require more extensive sampling, analysis and verification testing than originally planned. The sampling/analysis is required to ensure TCCR operations remain within the required safety margins, especially as it relates to uniform loading of the ion exchange resin. In addition, physical modifications to the resin columns were required to provide a “water jacket” within the columns to support dissipation of the heat generated from radiological decay of cesium-137 captured within the columns. The physical modifications have been completed.

Due to the accelerated schedule of this project, development of the safety basis strategy has been occurring simultaneously with system design. It was understood that performing these tasks in parallel came with some project risk, however, the only way to potentially meet the desired 24-month schedule for deployment of TCCR was to accept the risk and proceed in parallel. Impacts to the project schedule have been realized as a result of this risk. The hazards assessment and safety basis strategy development has proven more complicated than originally anticipated and recent analysis of the current contents of Tank 10 determined the tank chemistry was inconsistent with previous analyses which has

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reduced the margin within Specific Administrative Control (SAC) calculations for the safety basis strategy. As a result of this new information, additional real waste testing at Savannah River National Laboratory (SRNL) was required to determine resin loading and subsequent heat generation rates given the physical, chemical and radiological make-up of actual Tank 10 dissolved salt solution. This testing was performed to provide additional technical information required to determine the safety envelope for TCCR operations. The complexity of the safety basis development, necessary real waste testing, and development of a methodology for the batch equilibrium testing, constitute new technical information and technological barriers which along with resource impacts from the PISA associated with hydrogen generation (see Item 3 below), are anticipated to result in an impact of at least four months to the restart of BWRE activities in Tank 10.

To ensure TCCR operations remain within the required safety margins, batch equilibrium contact testing will be required for the TCCR feed stream for each of the dissolution batches. The addition of the batch equilibrium testing will result in an at least a six-month extension to the duration of the overall TCCR demonstration. The original planned duration assumed six campaigns of salt dissolution and subsequent treatment through TCCR would be required to remove the saltcake currently in Tank 10. Each campaign included 10 days for well water addition and recirculation to dissolve salt followed by 14 days of TCCR operations to treat the dissolved salt solution and transfer it to Tank 11. The six campaigns resulted in approximately five months to complete the demonstration. The batch equilibrium testing will require that at the completion of the 10-day recirculation period, a vial containing a sample of the ion exchange (IX) resin will be suspended in the dissolved salt solution for 10 days, retrieved, and transported to SRNL for analysis. The transporting and analysis is estimated to take three weeks. At the completion of the analysis the results will be evaluated and if acceptable, the estimated 14 days of TCCR operations will be initiated. Therefore, assuming the analyses are all acceptable to allow TCCR processing without any additional adjustment, each campaign will require an additional 31-days beyond the original planning basis resulting in an overall six-month extension of the TCCR demonstration. Therefore, the TCCR demonstration is anticipated to take at least eleven months versus the originally estimated five-month duration.

Provided no new issues are identified, completion of all required real waste testing and subsequent development of DSA/TSR requirements to support TCCR operations is anticipated to be completed by SRR and provided to DOE for final approval in July 2018 supporting an anticipated implementation of the DSA/TSR changes beginning in August.

3. *Potential Inadequacy of the Safety Analysis regarding Hydrogen Generation Rates*

On February 28, 2017, a Potential Inadequacy of the Safety Analysis (PISA) was declared for the Defense Waste Processing Facility (DWPF), Saltstone, and F/H Tank Farms. The PISA identified potentially inadequate recognition of the effect of organics on hydrogen generation (thermal degradation and radiolysis) and resulted in unanticipated impacts to operations in all three facilities.

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Development of the safety basis changes required to support the future Alternate Reductant (glycolic acid) flowsheet at the DWPF unexpectedly identified potentially inadequate recognition of the effect of organics on hydrogen generation (thermal degradation and radiolysis) within all the Liquid Waste facilities. Identification of the new information led to the declaration of PISAs for DWPF, Saltstone, and the Tank Farms. Since the information was applicable to the waste itself, and not solely the DWPF flowsheet, evaluation of the Safety Basis Documentation for DWPF, Saltstone and Tank Farms was required. Therefore, operations at DWPF, Saltstone, Actinide Removal Process / Modular Caustic Side Solvent Extraction Unit (ARP/MCU) and both F- and H- Tank Farms were impacted.

As part of the Evaluation of the Safety Situation (ESS) for each of the facilities, operational restrictions were put in place until further evaluations could be performed. In the DWPF ESS, transfers from Tank 49 to Building 512-S (ARP filter building), Strip Effluent from MCU to DWPF, and sludge batch feed from Tank 40 to DWPF were all restricted. Because of these restrictions operation of ARP/MCU was not possible. As part of the Tank Farm ESS, operational restrictions were put in place that restricted transfers from Tank 49 to Bldg. 241-96H (ARP MST Strike Tanks) and do not allow any waste tanks to enter Acidic Chemical Cleaning Mode or Closure Mode. Additionally, restrictions were imposed on high temperature waste tanks, evaporator operations, and addition of organic material. At Saltstone, restrictions included limiting the fill height in the Saltstone Disposal Units. For each of the facilities, the restrictions were required to stay in-place until that facility's PISA was closed and applicable DSA/TSR changes were implemented.

The facility restrictions resulting from the various ESS's noted above prevented the operation of DWPF and the treatment of salt waste in ARP/MCU until certain restrictions within the Tank Farm and DWPF could be lifted. Site management placed a high priority on returning DWPF and ARP/MCU to operations to allow vitrification of waste at DWPF and salt processing through ARP/MCU to resume as soon as possible. Deployment of the unique and limited safety basis engineering resources (i.e., staff) to support the resumption of DWPF and ARP/MCU operations impacted the availability of qualified engineers to support development of the TCCR DSA/TSR requirements (see Item 2 above) while the safety basis work in DWPF and ARP/MCU were being addressed.

In addition to the challenges noted above which have impacted the TCCR schedule, on March 29, 2017, the TCCR vendor, WEC, filed for Chapter 11 bankruptcy protection. The ability of the vendor to meet financial, technical, and schedule commitments could potentially be impacted by the bankruptcy filing. To date, DOE, SRR and WEC have worked diligently to prevent this issue from impacting the TCCR schedule. To mitigate impacts DOE and Savannah River Remediation (SRR) have worked closely with WEC and have required WEC to provide additional financial reporting because of the condition. WEC has complied with all reporting requirements. Shipping of the equipment to SRS was completed in April 2018, however, continued commitments (e.g., technical support) could potentially be impacted.

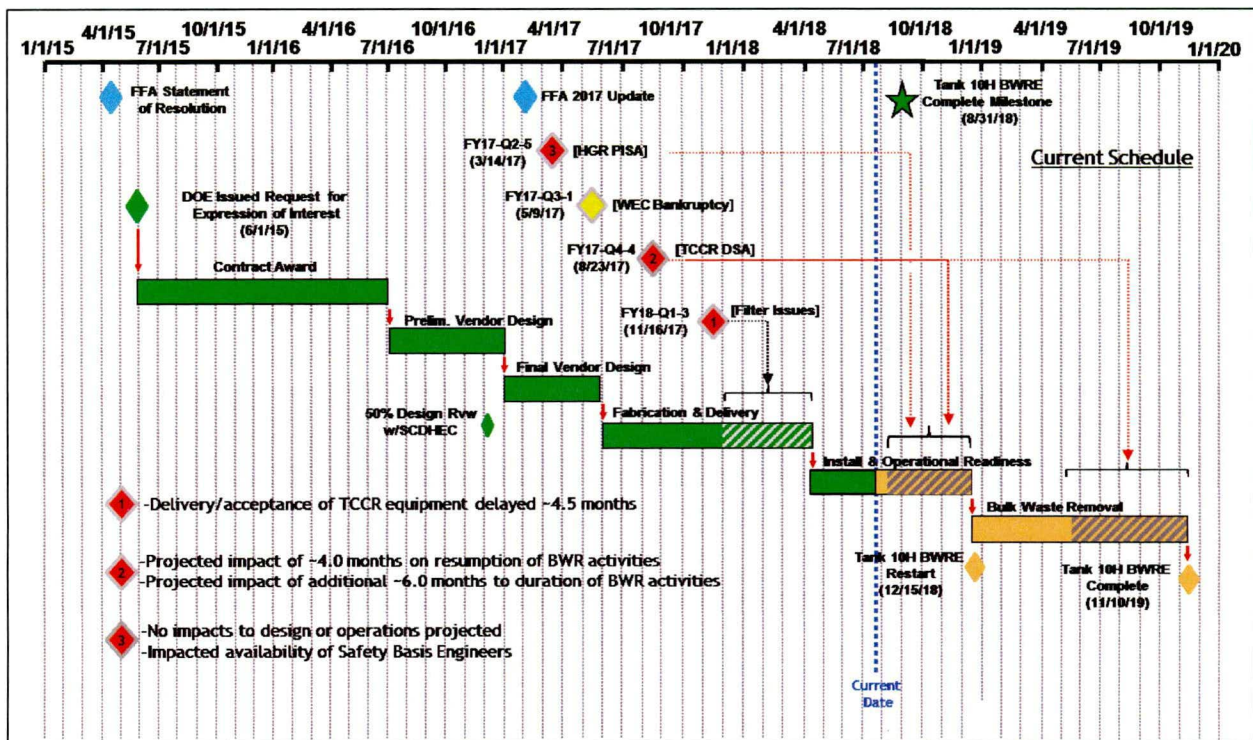
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It is noteworthy to mention that DOE and the U. S. Department of Justice requested that SRR file a motion with the New York bankruptcy court to ensure that the bankruptcy reorganization did not adversely affect the TCCR project. This request resulted from legal research performed by SRR Office of General Counsel. Specifically, supreme court and other federal cases demonstrated that the public’s interest could be used as a basis to prevent the TCCR project from being abandoned by the company requesting reorganization under Chapter 11 bankruptcy rules. As a result of the motion filed by SRR, the plan for reorganization was modified to require a special hearing with the bankruptcy judge prior to any adverse action being taken. Out of 600 pages of projects that were considered under the Chapter 11 process, SRR’s motion was the only protected measure taken by the Bankruptcy Court.

The overall impact of the challenges noted above is represented in Figure 4.

Figure 4: Current Schedule



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Waste Retrieval Path Forward

The following activities remain to complete BWRE for Tank 10;

- Complete onsite testing and training for salt dissolution and TCCR operations;
- Complete development and implementation of required DSA/TSR updates;
- Perform Facility Safety Assessment (FSA) and Readiness Assessment (RA);
- Restart BWR activities in Tank 10 December 2018; and
- Completion of Tank 10 BWR in November 2019.

Justification for Extension of FFA Commitment

Since the FFA Appendix L, *Statement of Resolution of Dispute Concerning Extension of Federal Facility Agreement (FFA) Closure Date*, was signed on April 27, 2015, DOE has been diligently pursuing development of what is now the TCCR treatment process for deployment at SRS to perform a demonstration of the technical and economic feasibility of the technology to treat SRS Tank Farm waste. In the FFA Appendix L *2017 Update to the Statement of Resolution of Dispute Concerning Extension of Closure Dates for Savannah River Site High-Level Radioactive Waste Tanks 19 and 18 (signed 11/19/07)*, the three agencies agreed to extend the milestone for completion of BWRE for Tank 10 to 8/31/2018 to allow the dissolved salt solution resulting from BWRE activities in Tank 10 to serve as the feed source for the TCCR operational demonstration.

The extension of the Tank 10 milestone to 8/31/2018 was based on DOE's projected execution schedule given the best available technical information at the time. In summary, the following technical challenges have occurred:

- WEC encountered technical issues (i.e., filter plugging) during the Factory Acceptance Testing which impacted delivery of the TCCR equipment to SRS. The technical issues encountered during Factory Acceptance Testing have been overcome and all the equipment has been received and installed at SRS.
- DSA/TSR requirements to support TCCR operations proved to be more complex than originally planned. Development of the safety basis requirements, as a result of new technical information related to chemistry impacts on heat generation rates within the ion exchange columns, was substantially under-estimated. More extensive sampling, analysis and verification testing during operations than originally anticipated will be required. Significantly more time than originally anticipated was needed to ensure TCCR operations remain within the required safety margins. At this time, additional real waste testing has been completed, the methodology for batch equilibrium testing has been developed, and the required DSA/TSR documentation is in final stages of development.
- During development of the DSA/TSR requirements to support TCCR operations, the availability of qualified safety basis engineers was impacted as priority was placed on the resumption of DWPF and ARP/MCU operations which had been suspended as a result of the hydrogen generation rate PISA declared in the Liquid Waste facilities.

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DOE provided SDCHEC and EPA a tour of the TCCR equipment and presented the status at a meeting on June 20, 2018 held at SRS. During the meeting, DOE informed SCDHEC and EPA of impacts to the original 24-month schedule used to establish the original 8/31/2018 milestone date and provided the current schedule. DOE is committed to continued pursuit of the technology and is now preparing to enter the final phases of operational readiness in preparation for restarting Tank 10 salt dissolution and subsequent operation of the TCCR equipment. As reported, BWRE is expected to restart in December 2018 and completion of the TCCR demonstration is expected in November 2019. The status of the original high-level schedule activities is as follows:

- Completion of contract award: (Complete)
- Completion of preliminary vendor design of TCCR: (Complete)
- Completion of final vendor design of TCCR: (Complete)
- Completion of fabrication and delivery of TCCR: (Complete)
- Completion of installation and operational readiness of TCCR: December 2018
- Completion of BWR for Tank 10; eleven-month duration; completion: November 2019

DOE is seeking an extension relative to Tank 10 from 8/31/2018 to 11/30/2019 for completion of BWRE. In summary, DOE is planning to continue with the current plans to demonstrate deployment of TCCR utilizing the dissolved salt solution resulting from BWRE activities in Tank 10. Incorporation of this technology as a methodology for salt waste treatment, if successful, is expected to achieve overall compliance toward completion of BWRE in Tank 10. An engineering evaluation will be completed on the demonstration parameters of TCCR and the feasibility of TCCR expanded use for applications to other older style SRS salt tanks.

The Department will continue to provide a routine status to SCDHEC and EPA of the Tank 10 BWR activities and TCCR demonstration through the FFA Liquid Waste Program quarterly meeting process, and will further notify the agencies between these routine updates if any unexpected conditions were to arise.