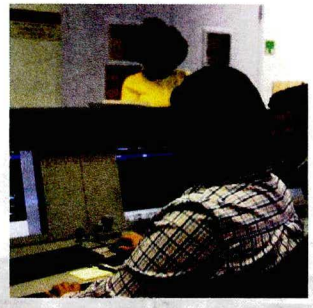
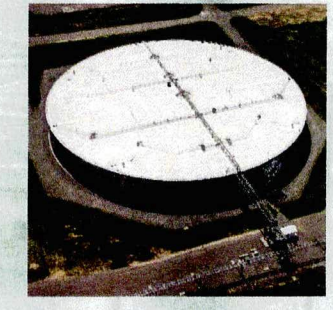
Savannah River Remediation
AECOM | BECHTEL | CH2M | BWXT

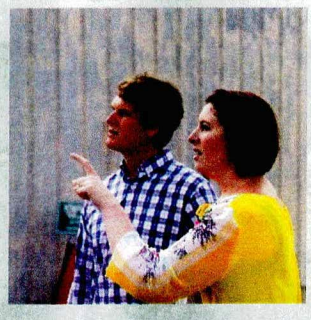
Enclosure 1

June 20, 2018

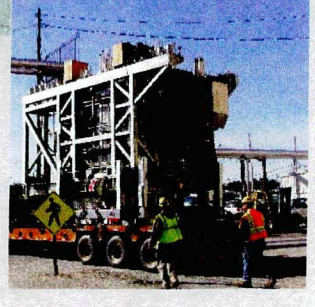




TANK CLOSURE CESIUM REMOVAL (TCCR) OVERVIEW AND STATUS



Larry Romanowski / Pen Mayson / Mark Keefer



SRR-CWDA-2018-00031, Rev. 1

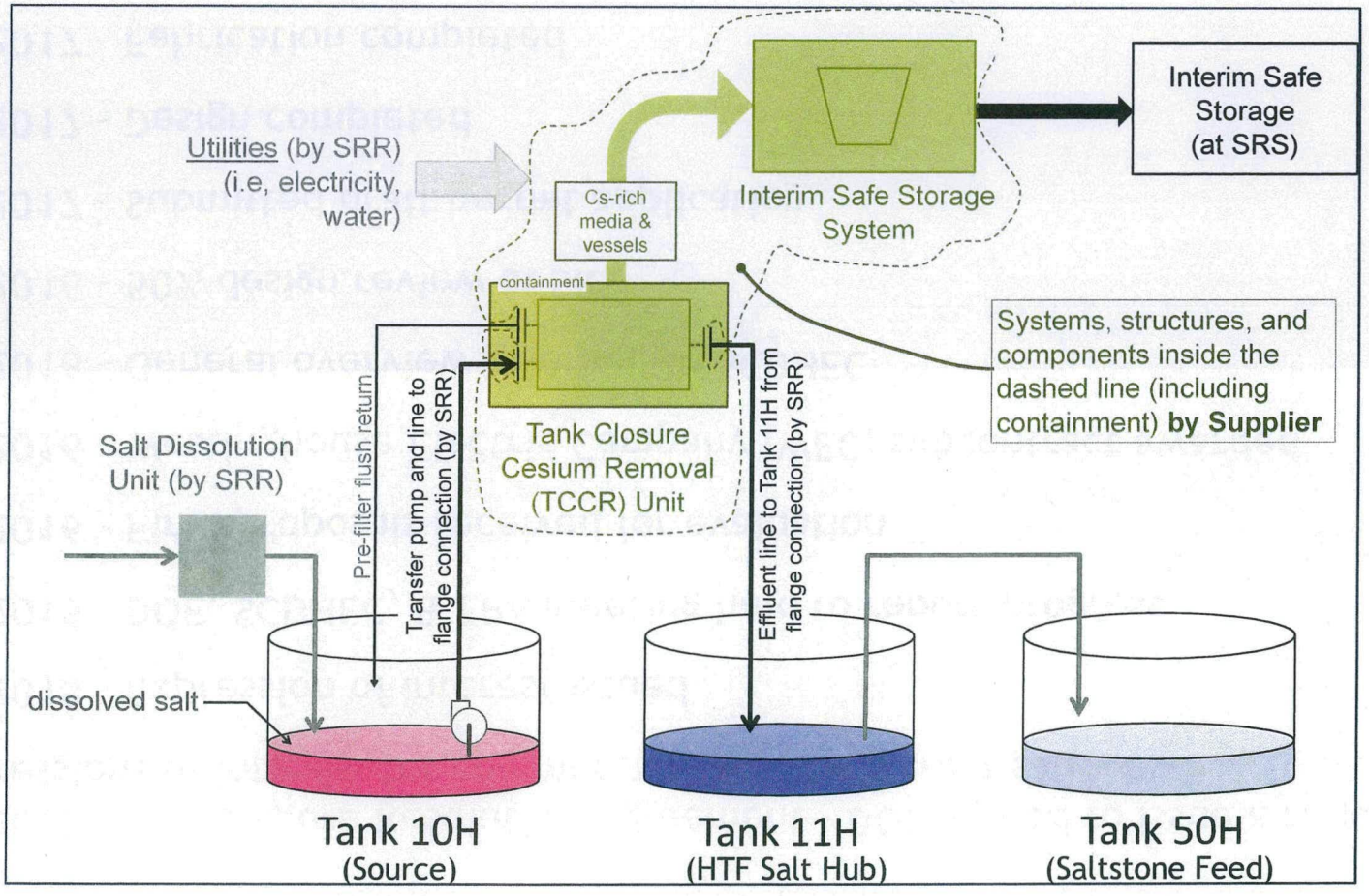
Tank Closure Cesium Removal

- **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

Project Timeline

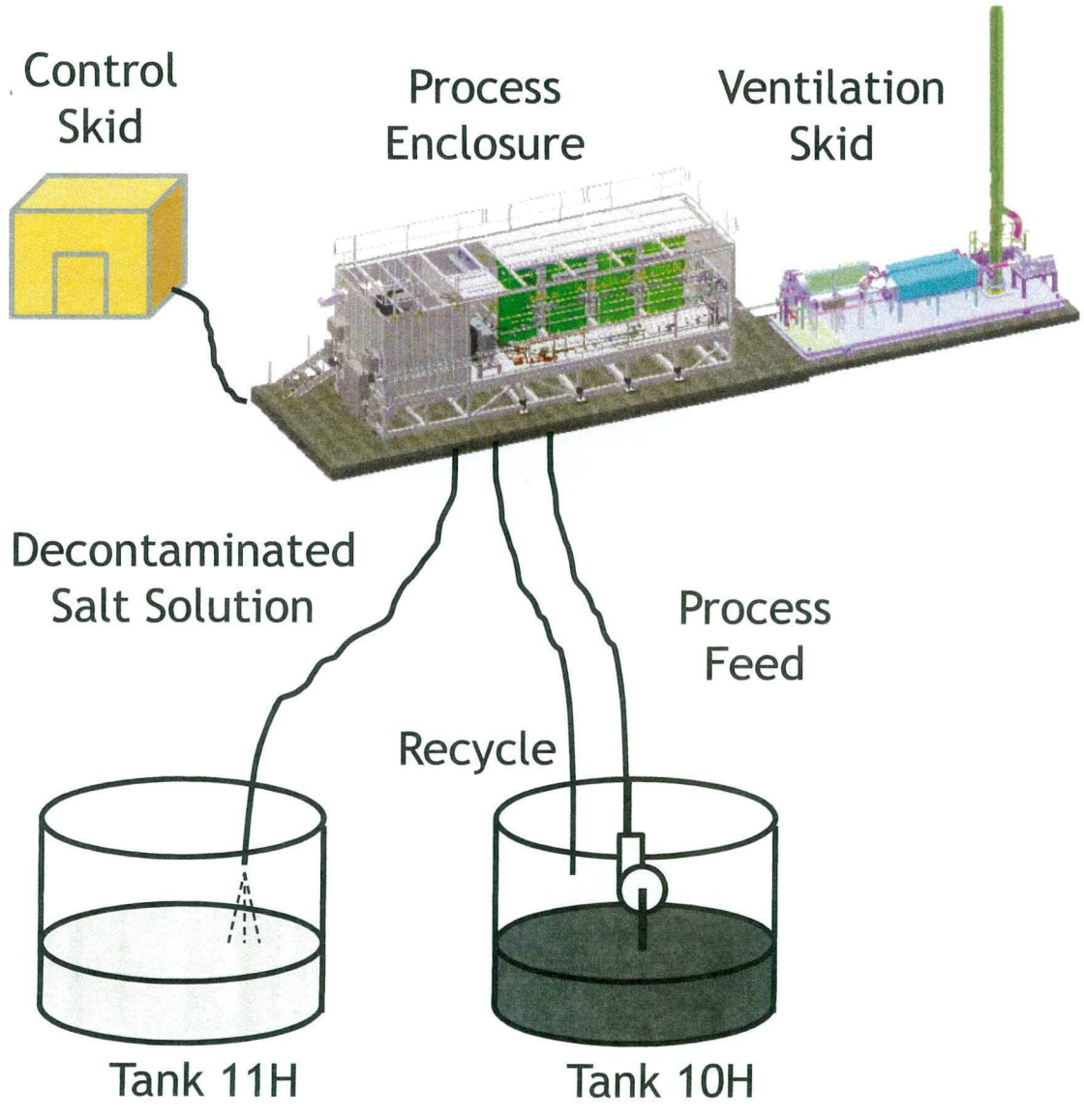
- 04/2015 - FFA Dispute Resolution Agreement - DOE agreed to issue a request for Expressions of Interest for commercial sources to treat salt waste
- 06/2015 - Expression of Interest issued
- 10/2015 - DOE, SCDHEC, & EPA meeting held to report progress
- 01/2016 - Final proposals received for evaluation
- 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

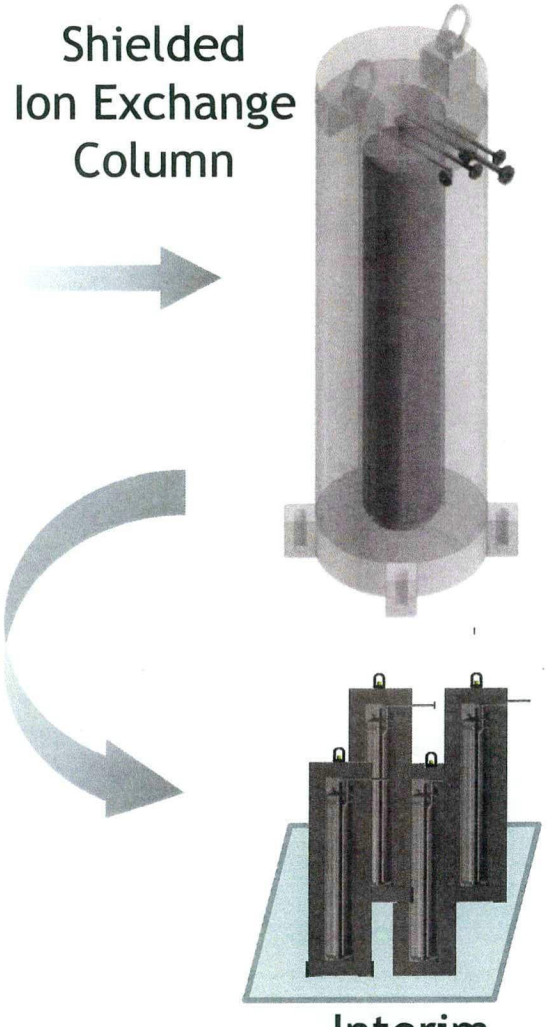
Conceptual Process Diagram



TCCR Concept

TCCR Process Overview

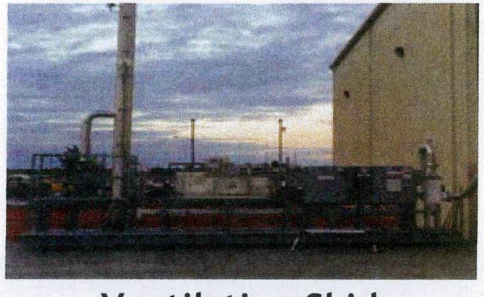




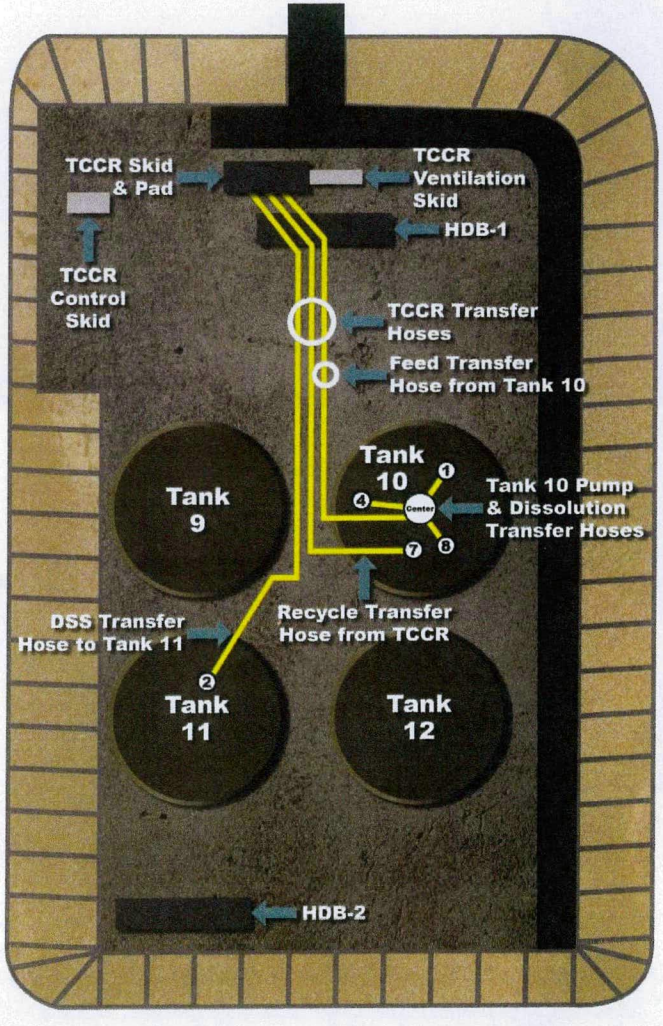
TCCR Site Plan in HTF

Control Skid

Process Enclosure

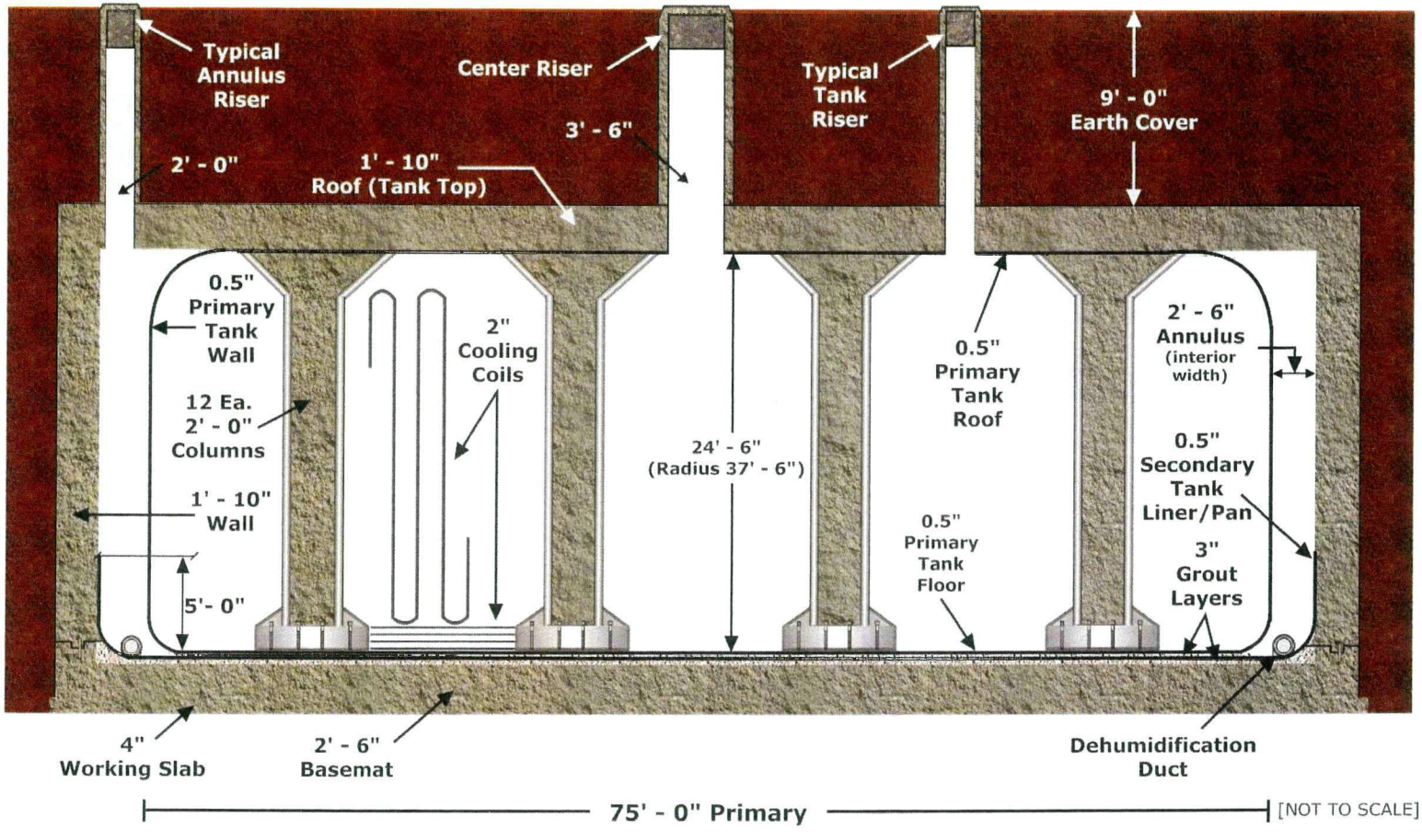


Ventilation Skid



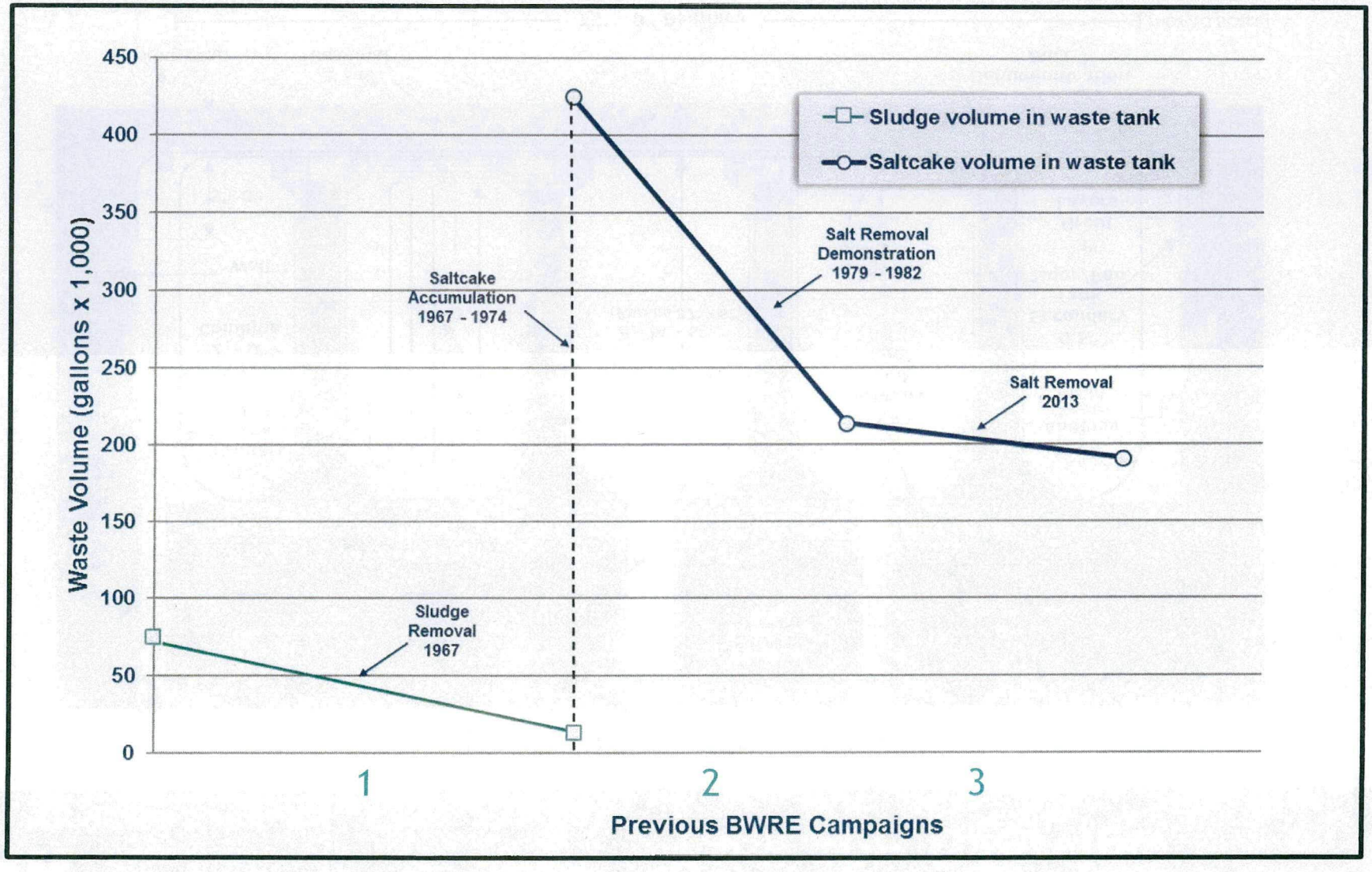
Tank 10H Overview

Typical Type I Tank Design



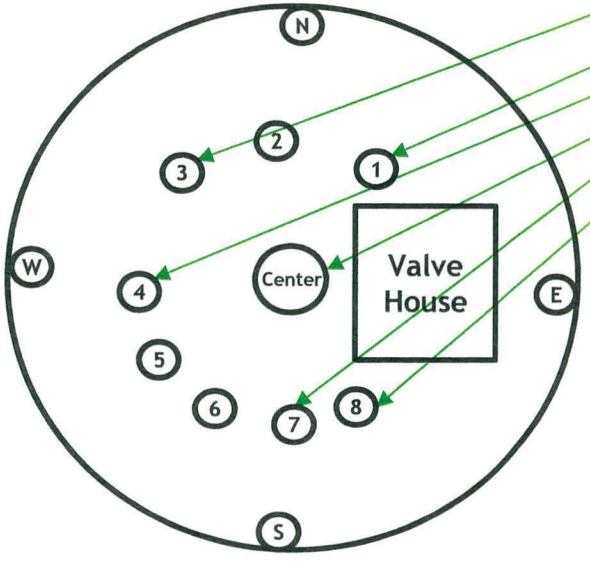
Nominal Working Capacity: 750,000 gallons
Current Salt Level: ~72 inches
Current Contents: ~191,000 gallons saltcake, ~3,000 gallons sludge

Previous Tank 10H Waste Removal Campaigns



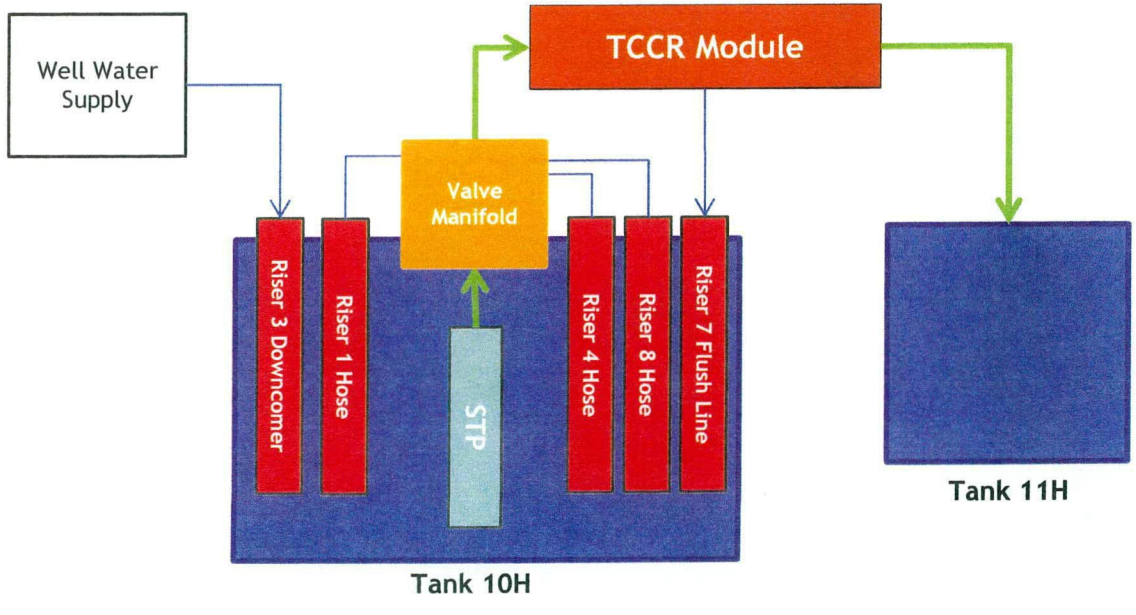
Tank 10H Equipment Overview

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

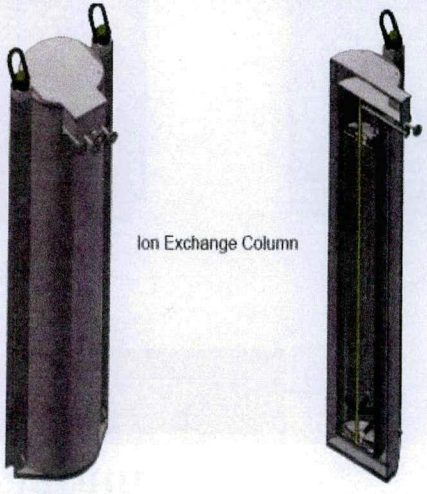
Process Diagram



TCCR Equipment Status

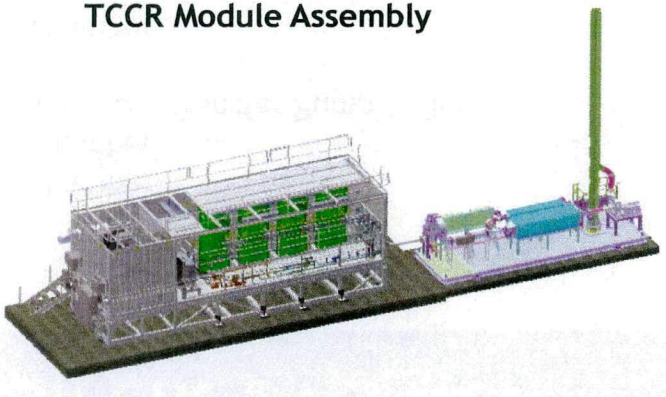
Westinghouse (WEC)/Columbia Energy:

- ✓ 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



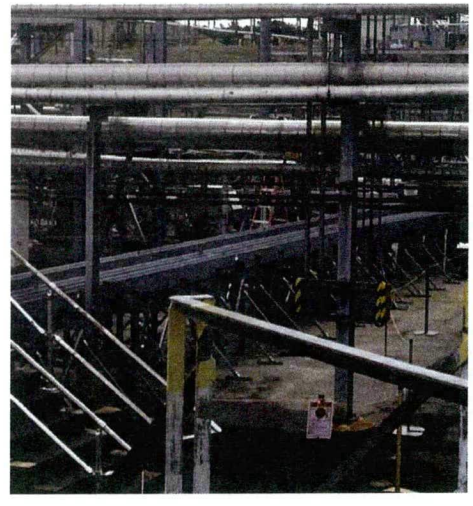
Shielded Ion Exchange Column (IXC)

TCCR Module Assembly

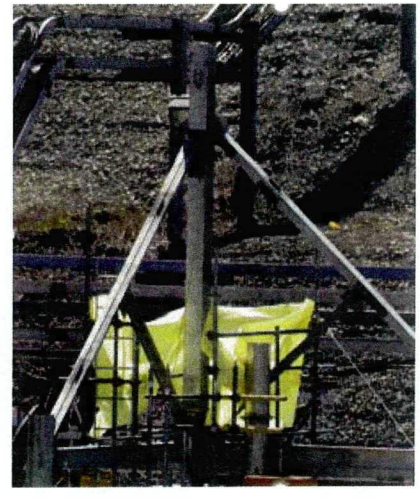


Balance of Plant Equipment Status

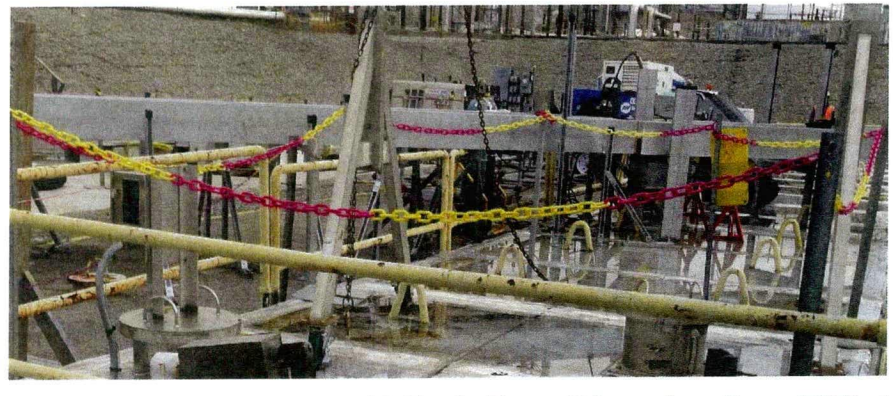
- Field Activities:
  - ✓ Foundations pads are installed
  - ✓ All equipment D&R complete and old Tank 10H Submersible Transfer Pump (STP) removed
  - ✓ New shielded plugs installed
  - ✓ New Tank 10H STP installation complete
  - ✓ Tank 10H ventilation stack extension is complete
  - ✓ All supports 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

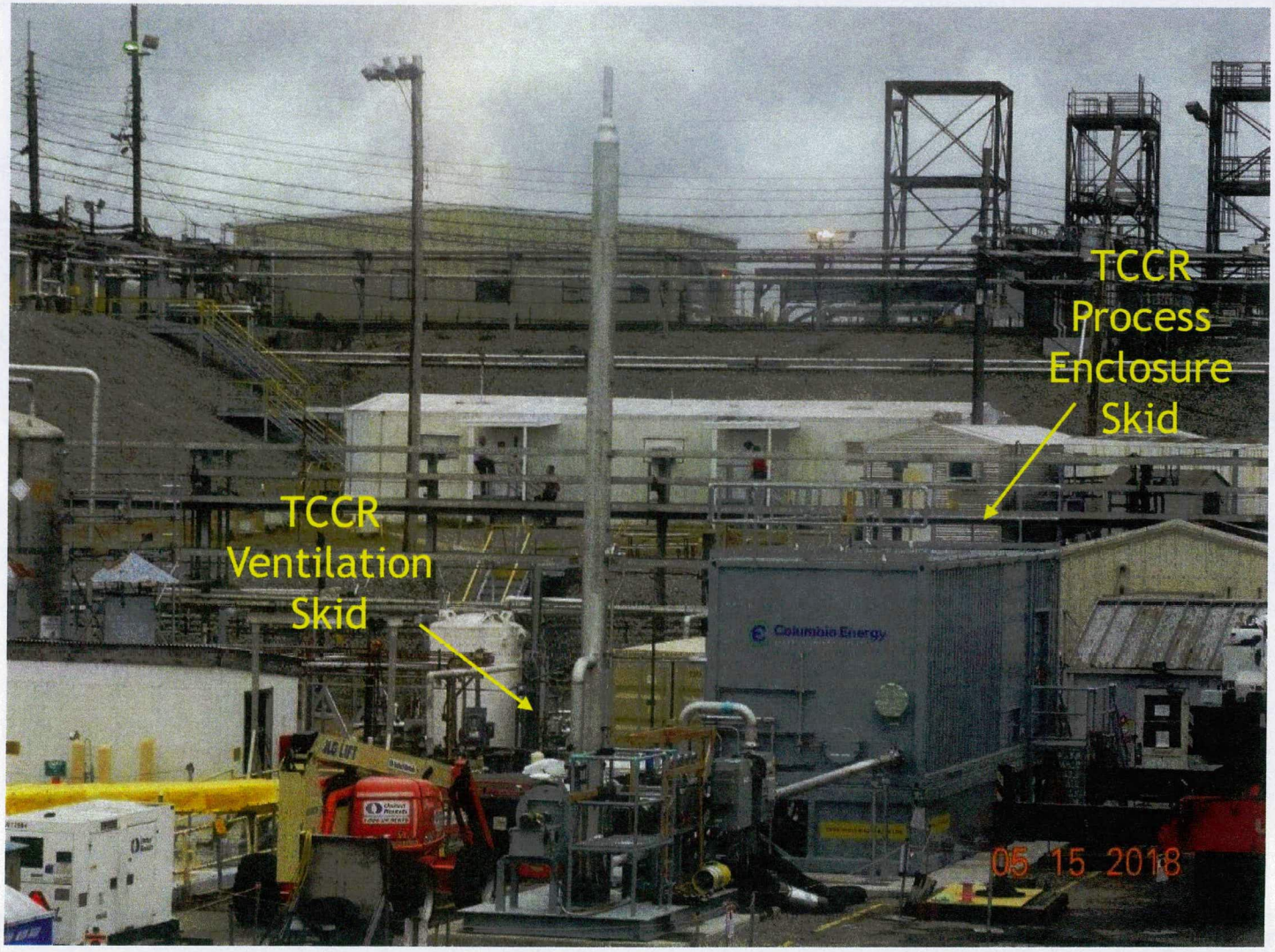


Tank 11H Stack Extension



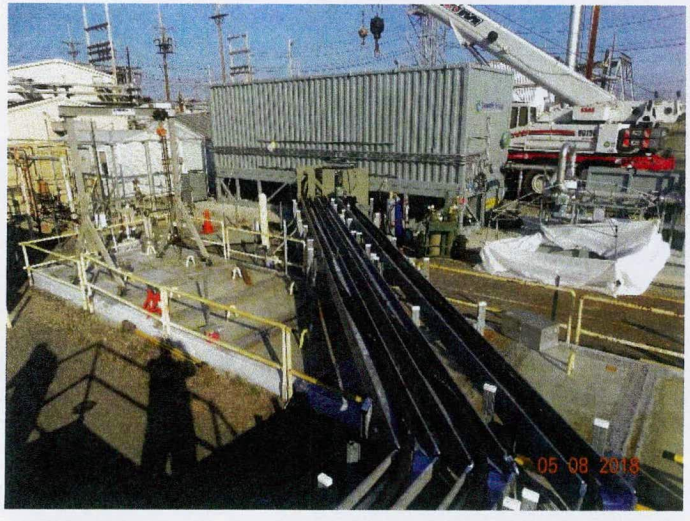
Transfer Line Supports at H-Tank Farm Diversion Box, HDB-1

TCCR Equipment Skids



TCCR Equipment Skids

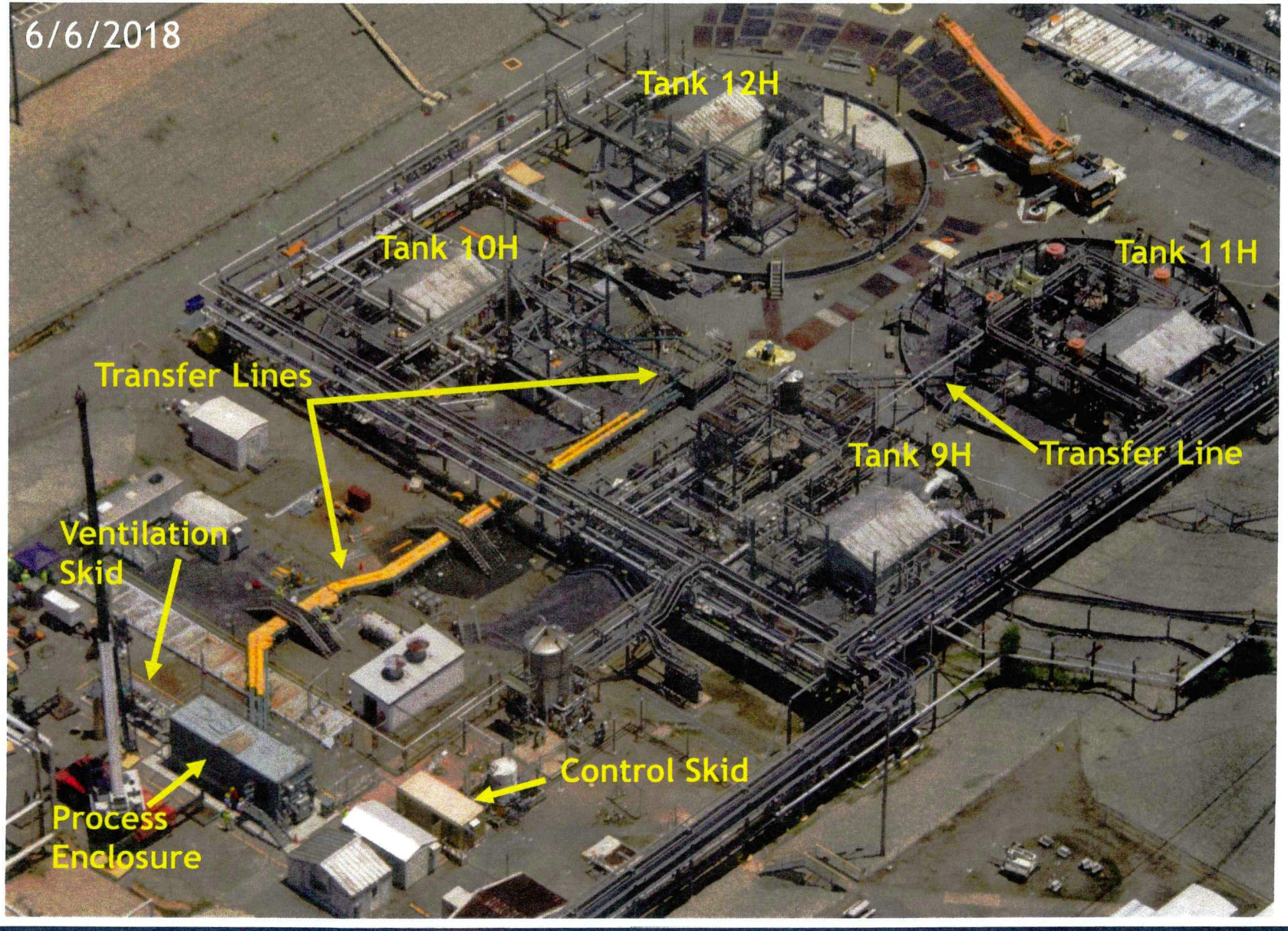
TCCR Transfer Hose Installation



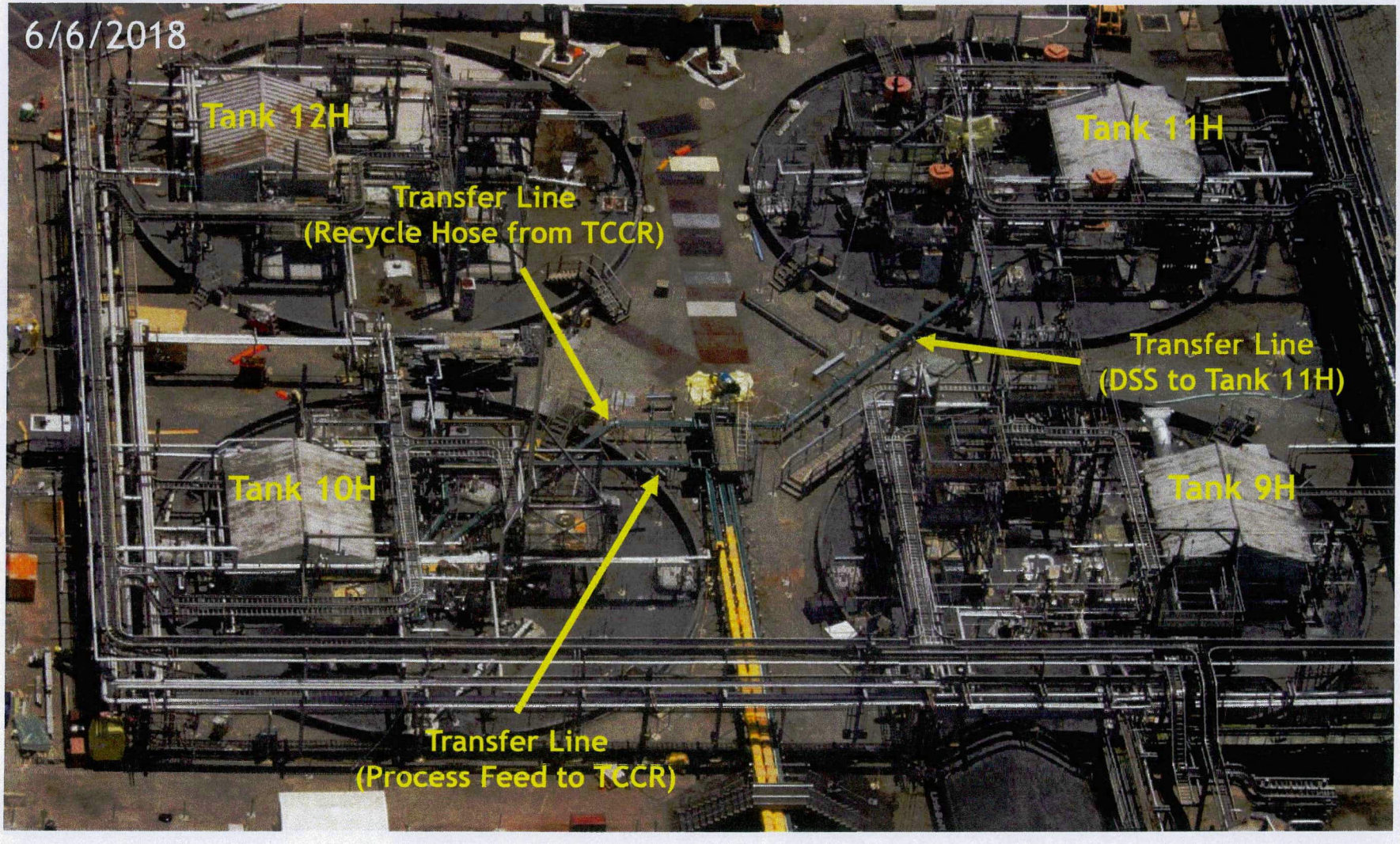
Transfer Lines from TCCR to Tanks 10H and 11H

Transfer Lines from TCCR on Tank 10H

TCCR Process Area View



TCCR Process Area View



Next Steps

- **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**

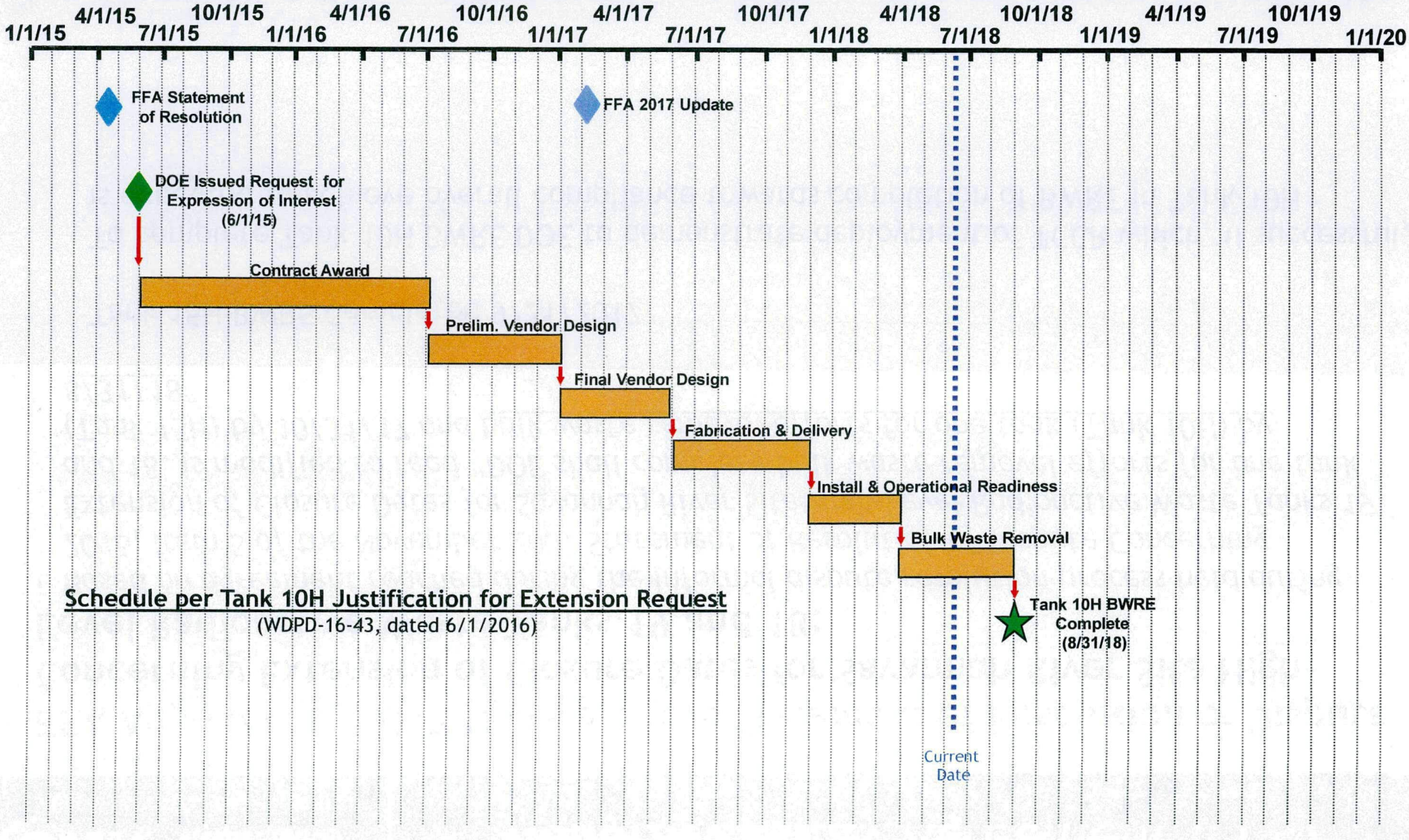
Federal Facility Agreement (FFA)

- **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

Federal Facility Agreement (FFA)

- **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



Schedule per Tank 10H Justification for Extension Request
(WDPD-16-43, dated 6/1/2016)

Challenges

- **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.

Challenges

- **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

Challenges

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)

Challenges Summary

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

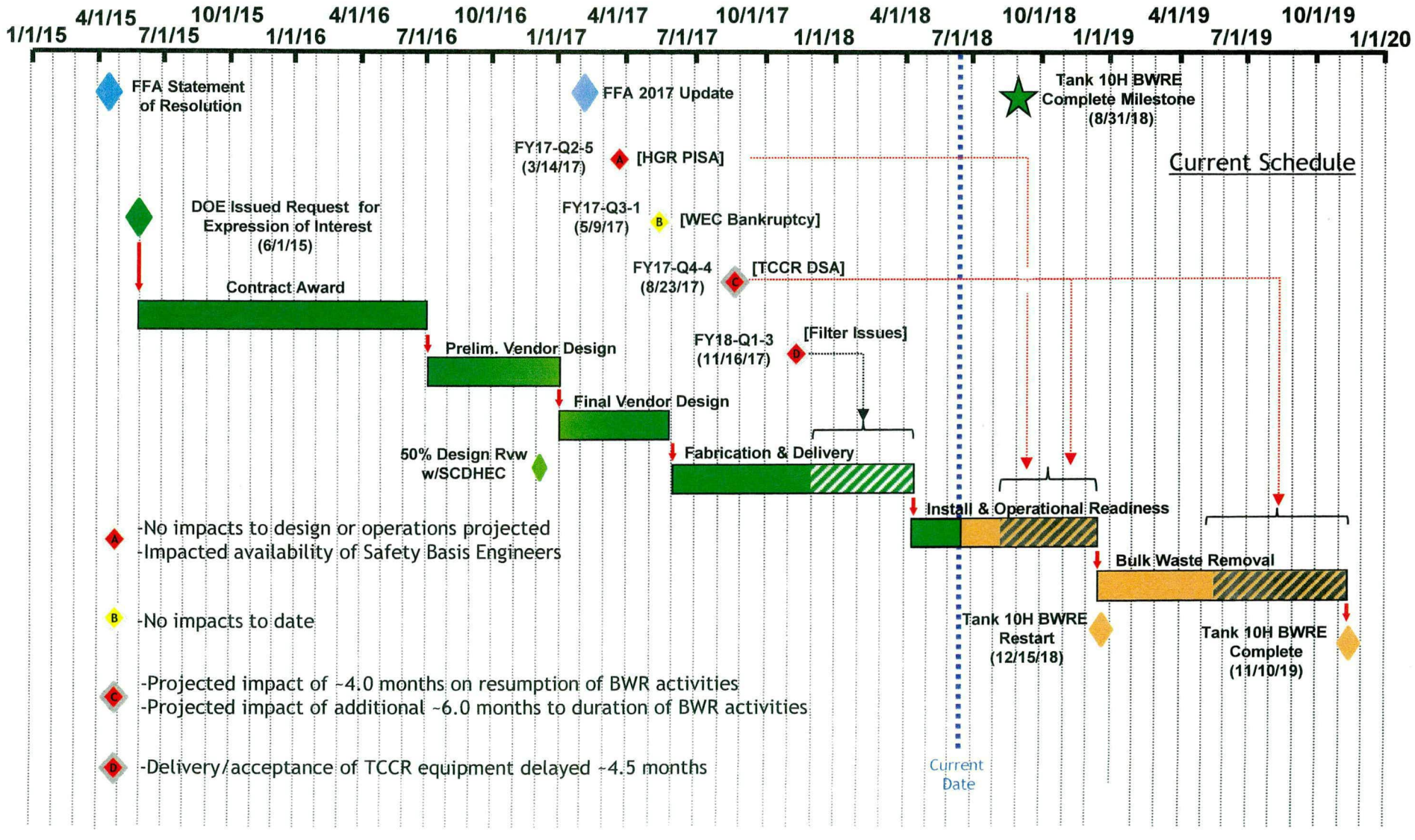
C TCCR Documented Safety Analysis Development:

- Projected impact on resumption of BWR activities
- Projected impact to duration of BWR activities

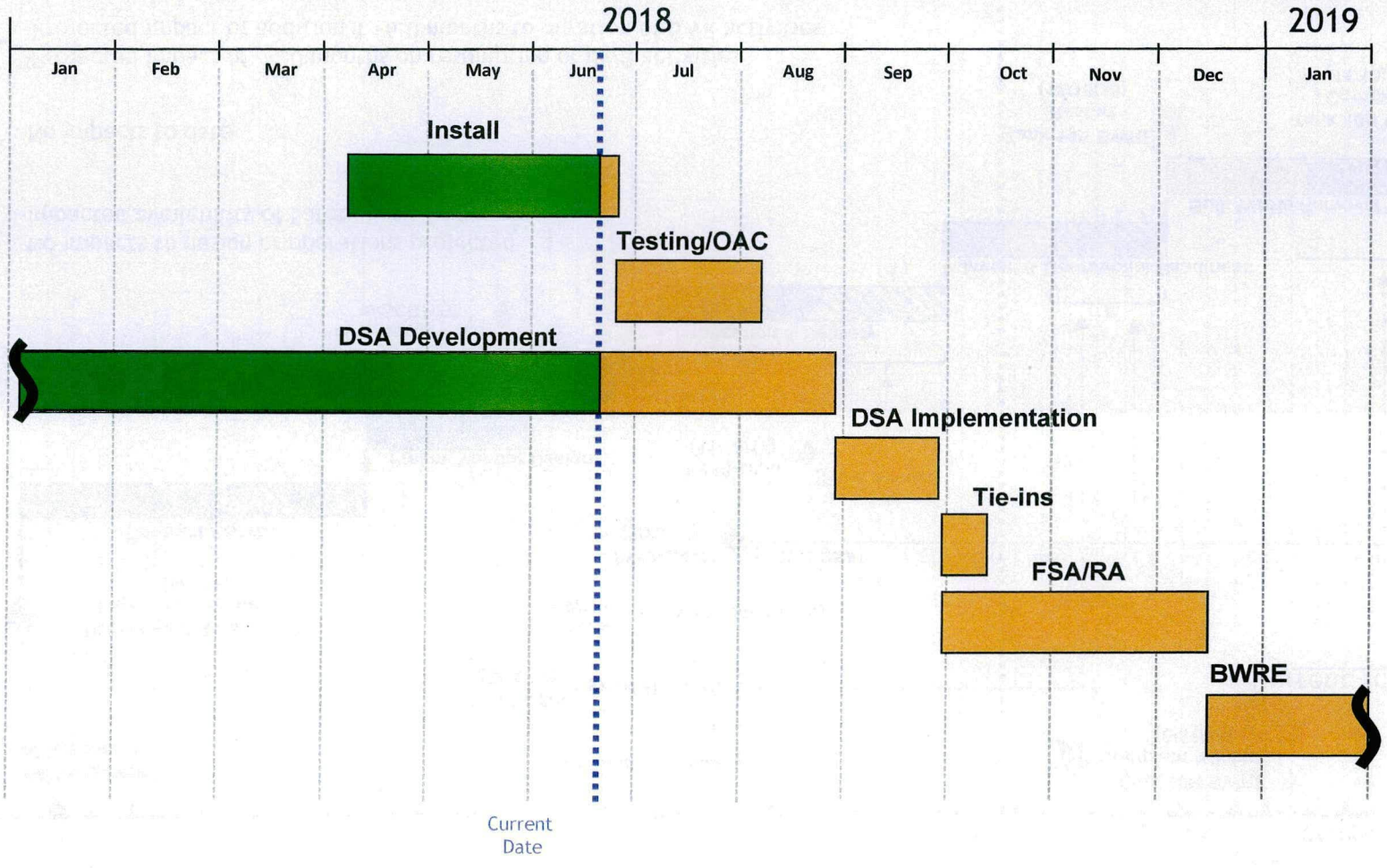
D Filter Issues:

- Impacted delivery/acceptance of TCCR equipment

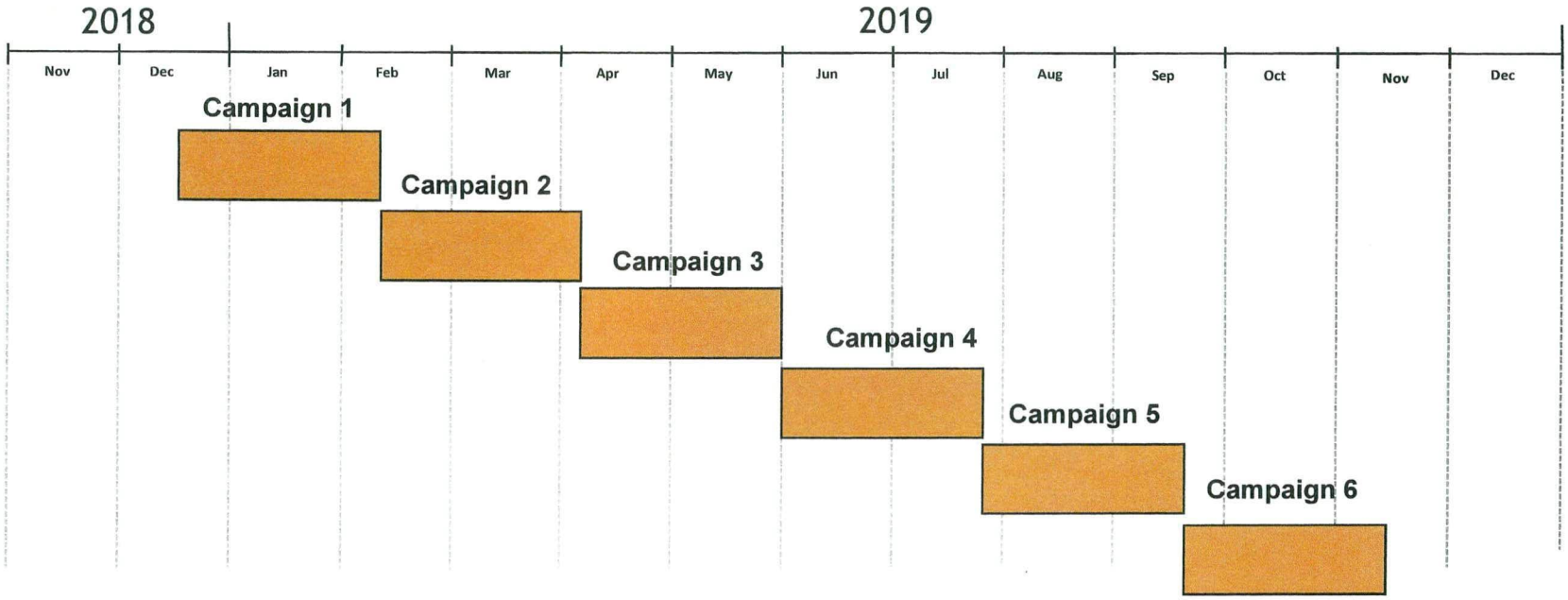
Current BWRE Schedule



Install & Operational Readiness

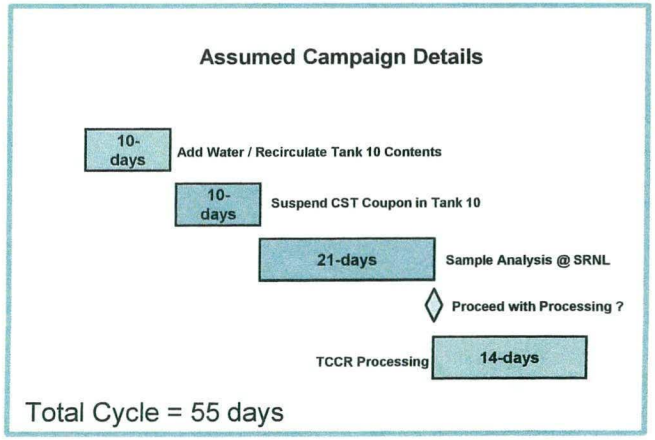


Waste Removal Campaigns



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.



FFA and Permits

- **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

Summary

- 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