



OFFICE OF  
**RIVER PROTECTION**  
United States Department of Energy

# Tank Side Cesium Removal (TSCR) Demonstration Project

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- ❑ **External Independent Review Team recommends two-phased pretreatment strategy**
  - Tank Side Cesium Removal (TSCR) system as a “first feed” solution
  - Optimized LAWPS for long-term LAW Vitrification feed
  
- ❑ **Subsequent ORP direction to suspend LAWPS facility design; perform future alternative analysis to determine long-term feed solution**
  
- ❑ **ORP issued RFP for Technology Demonstration of TSCR capability**
  - Provide system to meet LAW Vitrification waste acceptance criteria
  - Enable LAW Vitrification to complete hot commissioning by 12/21
  - Enable initial LAW Vitrification operations until LAWPS becomes operational
  - Use relevant information from Savannah River’s tank closure cesium removal (TCCR) demonstration
  - Leverage experience from commercial nuclear waste cleanup projects





- ❑ **TSCR scope is included under the LAWPS capital line item, DOE O 413.3B project**
  
- ❑ **LAWPS Sub-Project One includes:**
  - TSCR Demonstration Scope
  - Tank Farm Upgrades to support TSCR Installation/Operations
  - IX Column Interim Storage Pad
  - Transfer Lines from AP-Farm to WTP Interface Location
  
- ❑ **LAWPS Sub-Project Two will address Long-Term Cesium Removal Capability**
  
- ❑ **Plan for DOE O 413.3B Critical Decisions (CDs)**
  - CD-3A Approved in June 2018 to Authorize TSCR Design/Fabrication
  - CD-3B Planned for TF Upgrades/Transfer Lines Long Lead Procurements/Site Prep
  - CD-2/3 for Combined LAWPS Sub-Project One Scope will Authorize Construction
  - CD-4 for Start of TSCR Operations/Transfer to WTP





- ❑ **Design/build/factory acceptance test TSCR system**
  - Provide materials and consumables (e.g. media, vessels, containment systems, process support enclosures, and equipment) to support initial IX column loading (170,000 gallon campaign)
  - Provide method to prepare spent IX columns for interim storage
  - Provide technical support for hazard analysis, safety analysis, installation, startup testing, operator training, and procedure development
  - Provide design of equipment foundation pads
  
- ❑ **Nuclear Safety**
  - TSCR is a major modification to the tank farms (DOE-STD-1189 applicable)
  - Required documentation includes Safety Design Strategy, PDSA, and amendment to the tank farms DSA





Tank side cesium removal system will remove suspended solids and cesium from double-shell tank liquids to provide LAW feed to the Waste Treatment and Immobilization Plant.

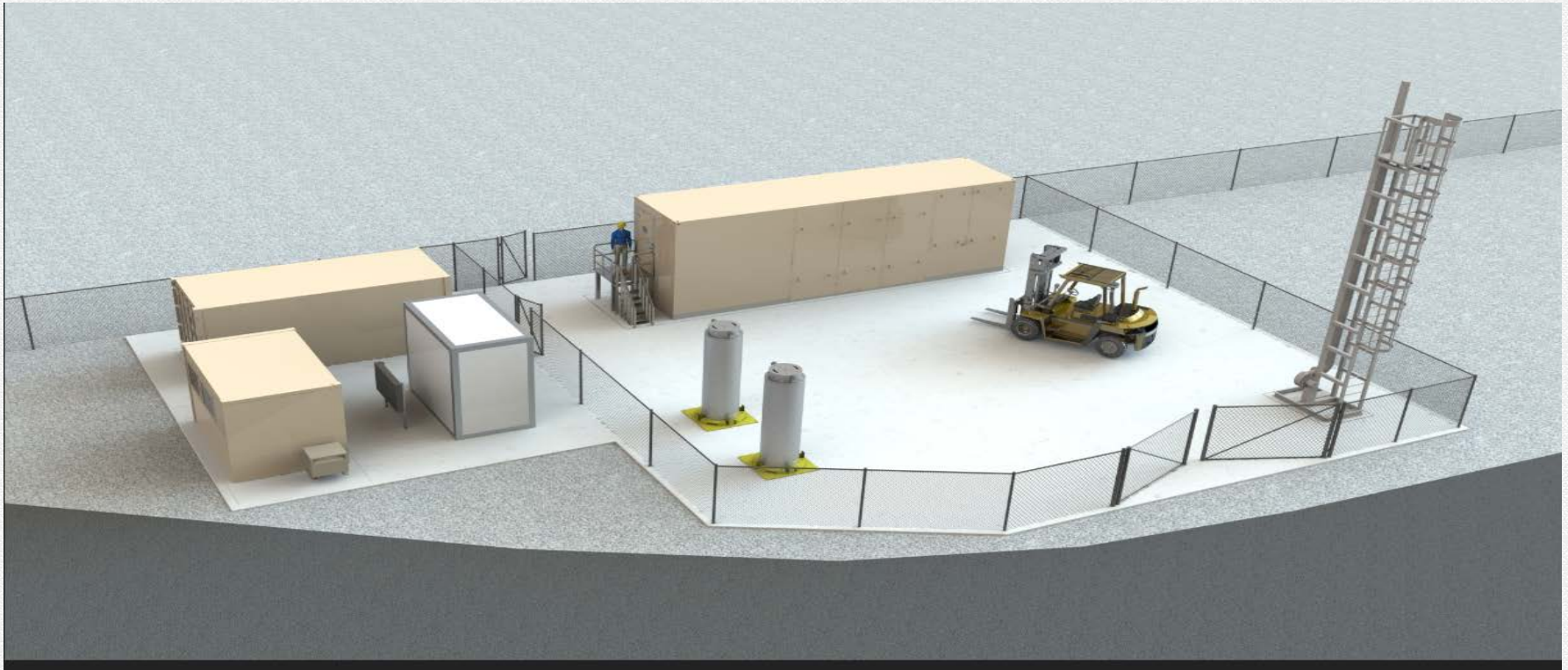
The initial phase is a “proof of concept” demonstration that has a target of loading the first set of columns with approximately 100,000 curies (Ci) of cesium.

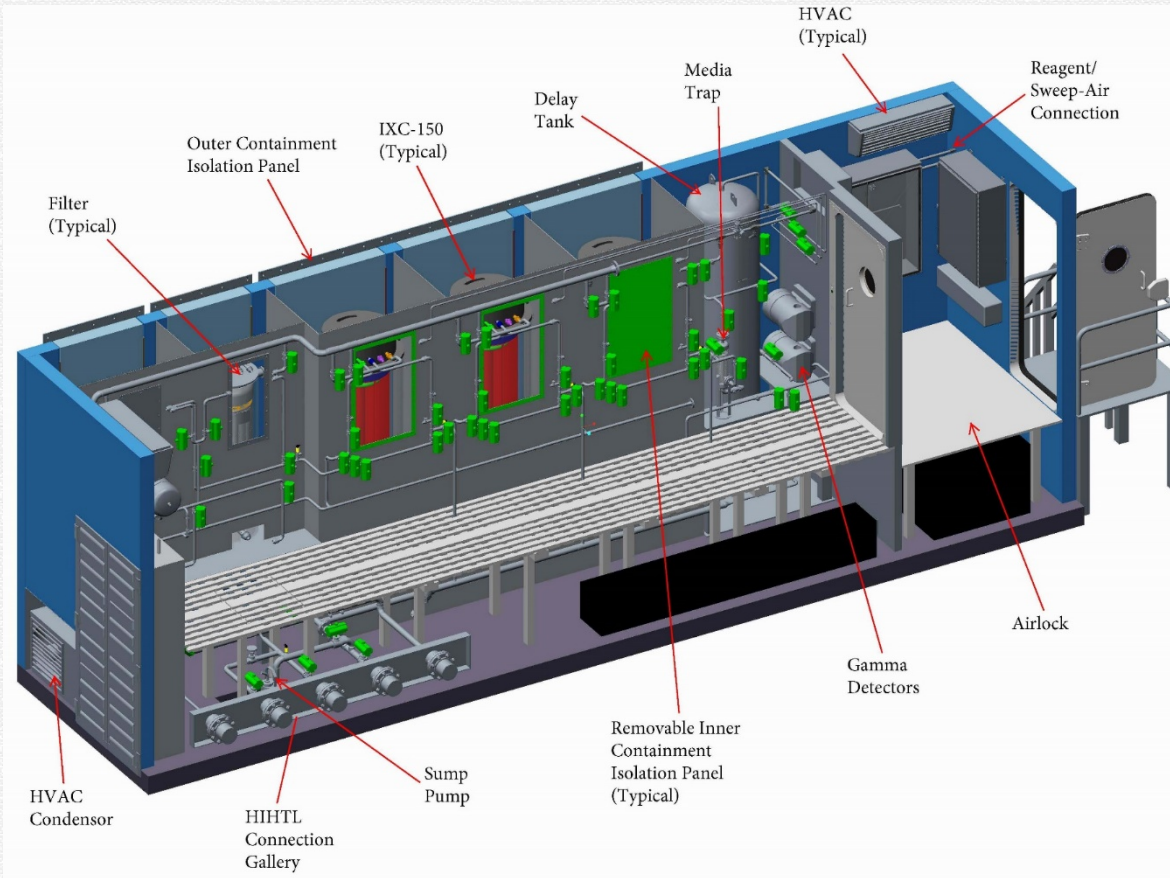
- Evaluate the selected IX resin removal efficiency performance
- Achieve a decontamination factor (DF) of greater than 1000
- First campaign will produce about 170K gallons of feed

The second phase is targeted for treating up to an additional 5 million gallons of waste designed to validate overall operability of the system including reliability and unit efficiencies.

- Increased column loading maintaining >1000 DF
- Increased Total Operating Efficiency
- Proving CST kinetics
- Proving filter operation and cleaning (simulant vs. real waste)
- Proving the ability for continued operations using replaceable columns
- Demonstrating column transportability, and
- Utilizing process knowledge to sustain operations







## Key Metrics:

- 5-gpm
- 5.6M Na+ Waste
- 160 ppm UDS
- 20 to 35 °C
- 0.163 Ci/L <sup>137</sup>Cs (process)
- 0.30 Ci/L <sup>137</sup>Cs (safety)

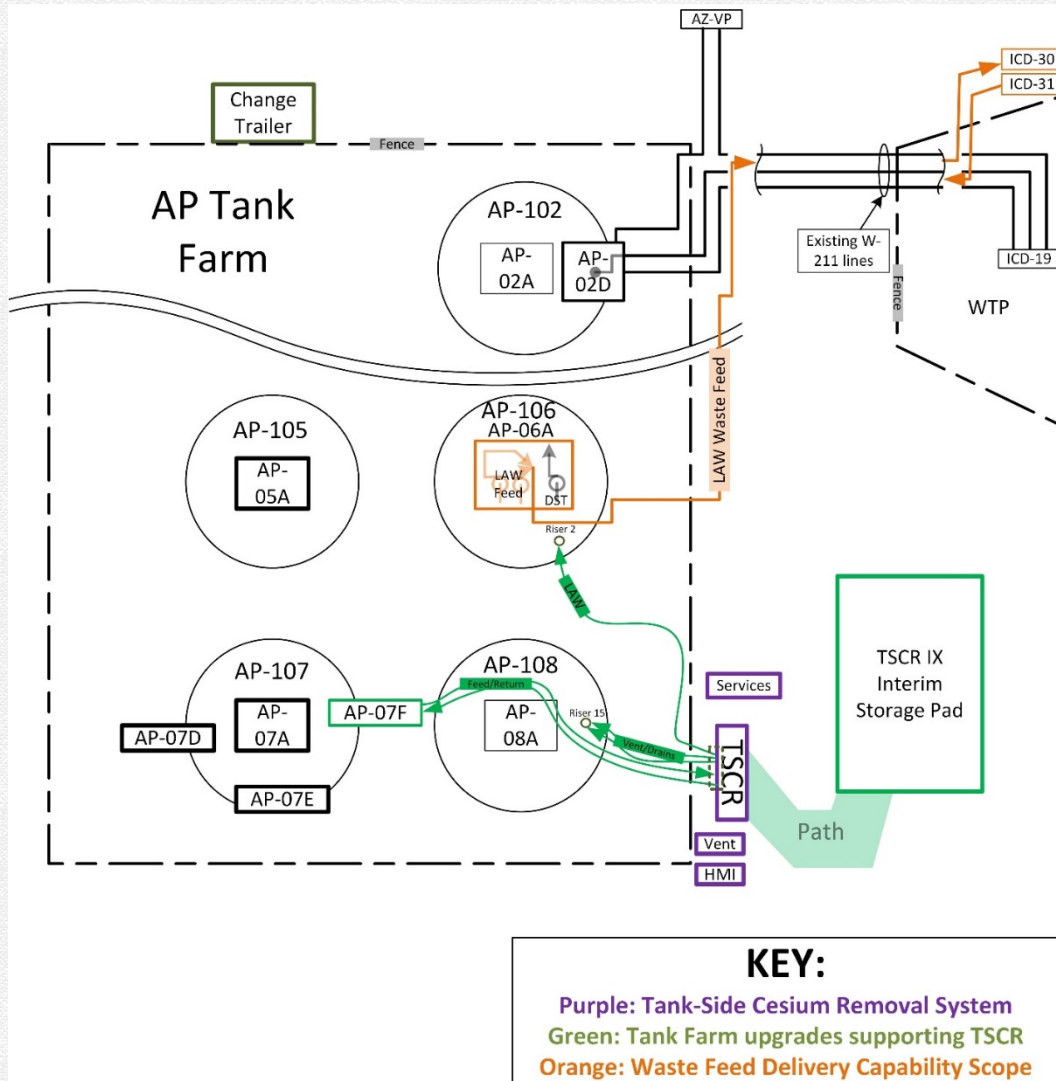
## Performance

- <sup>137</sup>Cs DF of ≈ 1000
- H<sub>2</sub> < 25% LFL
- No boiling at Atm
- Phase 1 – 170,000 gal
- Sys Availability > 70%





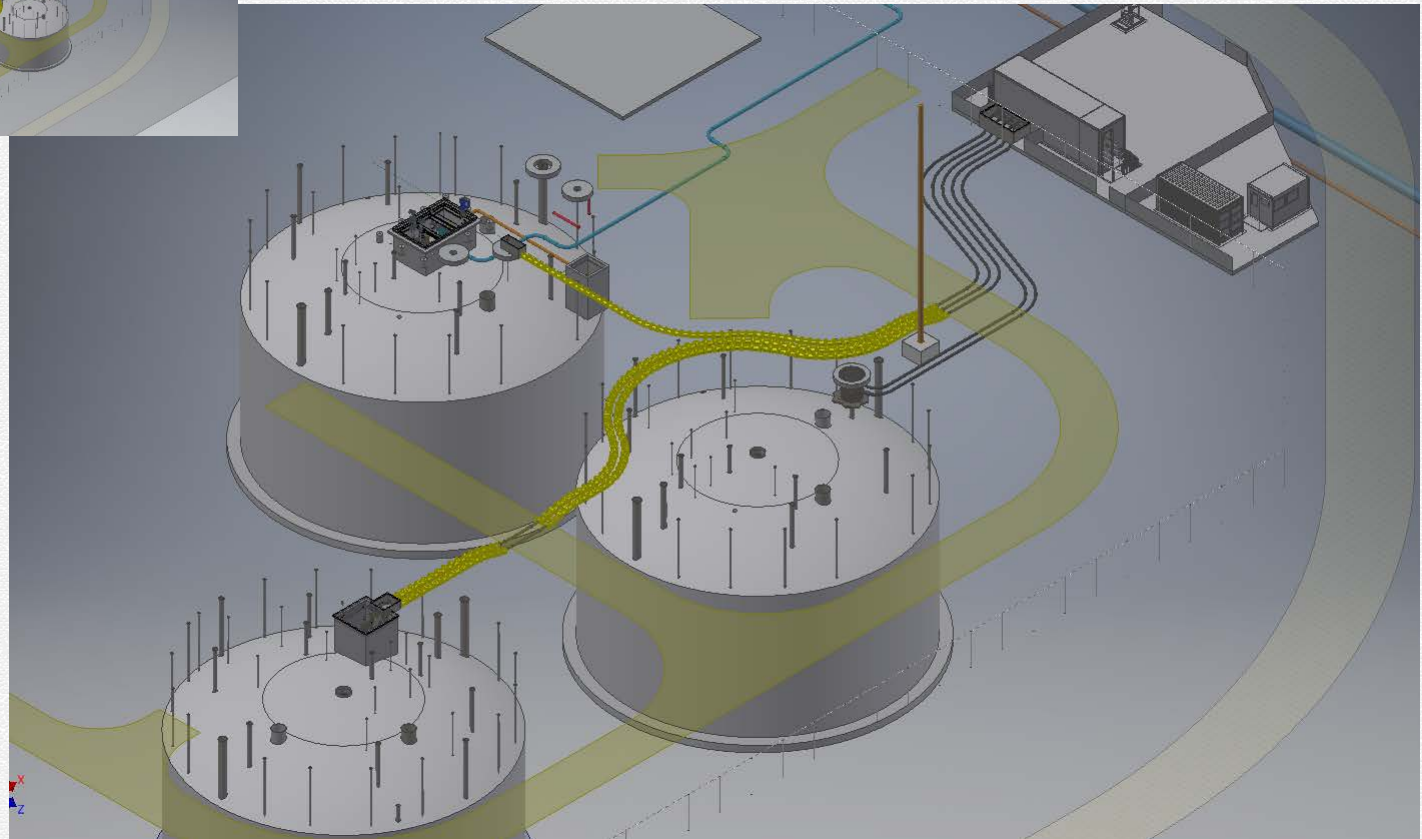
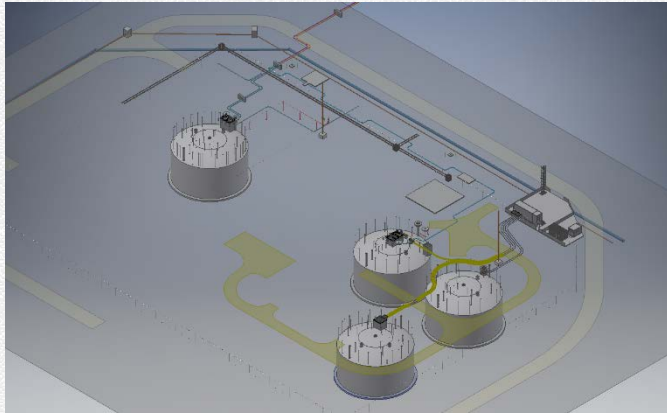
# AP Farm Integration



- Design, fabrication and field work for waste transfer from tanks to TSCR (transfer line, shielding, pump, jumpers, valves, and cover plate)
- Design, fabrication and field work for waste return, TSCR IXC vent, plant wash, and treated waste from TSCR to tanks (transfer line, shielding, adapter/drop leg)
- Fieldwork and construction of TSCR concrete pad
- Design, fabrication, and fieldwork for waste transfer system from WTP feed tank to the W-211 transfer lines









- **WRPS/ORP agree TSCR is a Major Modification to the DSA, primarily due to the Ion Exchange and Filtration processes that are not currently included in the Tank Farms DSA**
  - Four of the six checklist questions were answered “ YES “ supporting a Major Modification to the DSA.
  
- **Tailored approach to DOE-STD-1189 will exclude the Conceptual Safety Design Report (CSDR) and the Preliminary Safety Design Report (PSDR), but will include**
  - Safety Design Strategy
  - Hazards Analysis
  - Accident Analysis calculations
  - Preliminary Documented Safety Analysis
  - Tank Farms Documented Safety Analysis Addendum





## Path forward for Nuclear Safety strategy:

- TSCR and accompanying storage pad is a major modification to the Tank Farms DSA
  - ORP to seek approval to use DOE-STD-3009-94 CN3 for this major mod (**completed**)
  - Issue initial SDS (**completed**)
  - Perform hazards and accident analysis (**completed**)
  - Issue updated SDS at 60% design to support early procurement and construction activities (**completed**)
  - Prepare PDSA consistent with a Tank Farms DSA amendment (**completed**)
  - ORP review and approval of PDSA (**completed**) – **3 COAs**
  - WRPS completes TSR changes and submits DSA amendment
  - ORP review and approves of DSA amendment





### The TSCR system will share many functional characteristics of the TCCR system deployed at SRS

- An Enclosure to provide secondary containment
- IX Columns to remove radioactive Cs-137
- Pre-IX filtration to remove undissolved solids
- Post-IX filtration to remove IX media fines
- Hydrogen retention mitigation
- Enclosure ventilation skid
- Designed and fabricated under an NQA-1 QA program
- Utilize Hose-in-Hose Transfer Lines to connect to DSTs
- Waste feed rate  $\geq 5$  gpm
- Local control trailer with HMI control system





## Characteristics that distinguish the TSCR unit from TCCR

TSCR	TCCR
Up to 5 year design life (~2.9M Curies/5M gallons)	One Time Use (100K Curies/625K gallons)
Provide mobile skids for Utilities (Water, Caustic, Air, Nitrogen purge)	Utilities are available near TCCR foundation pad
Real waste testing for batch contact equilibrium, CST media kinetics, and gas generation testing for Hanford waste feed ranges	Real waste and simulant batch contact equilibrium testing for tank 10H waste range
RD&D RCRA permit required (substantial effort needed to meet requirements of the state of Washington)	Permitted under site industrial wastewater permit
Multiple DST waste sources	Single waste stream from tank 10H





## Differences Between TSCR and TCCR

TSCR	TCCR
Supernatant only feed	In-Process salt dissolution feed
Avg. Cs-137 concentration – 0.49 Ci/gal (3x TCCR)	Avg. Cs-137 concentration – 0.16 Ci/gal
Pre-filter designed to protect IX column	Pre-filter designed to filter to 10µm absolute
During operation, back pressure in system to retain H <sub>2</sub> in solution	During operation, active IX Column “burping” process to remove retention of H <sub>2</sub>
Environmental conditions for design specify -25°F to 115°F requiring freeze protection	Environmental conditions for design specify 15°F to 110°F
Processing operations for TSCR do not exist in any Hanford DSA	Processing operations for TCCR contained within Savannah River Tank Farms DSA

