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Revision 10

Technology and Innovation Roadmap

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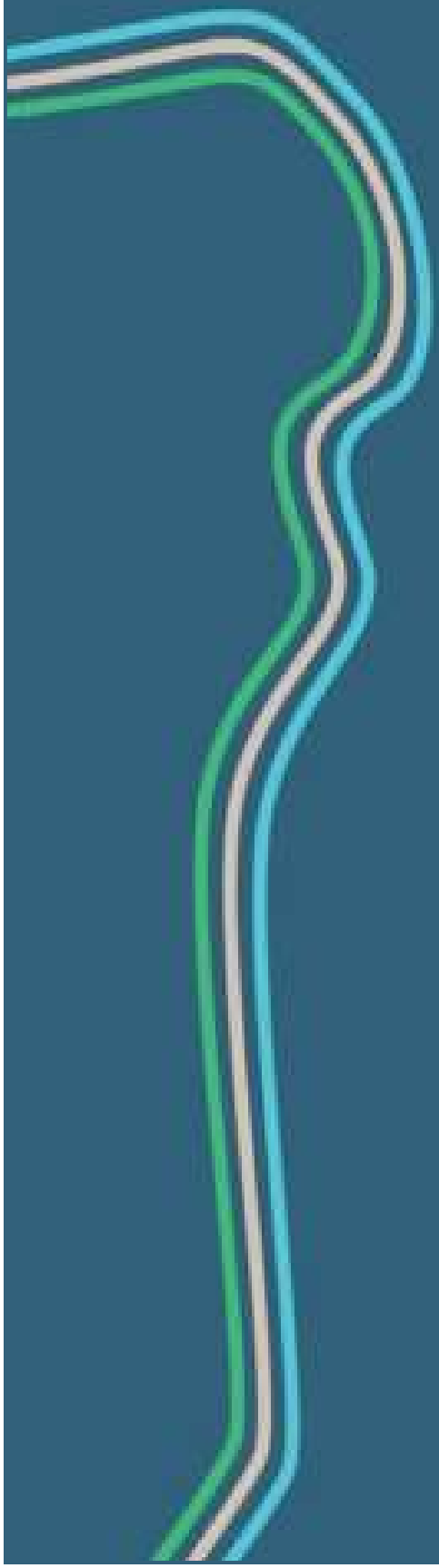

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Executive Summary

This Technology and Innovation Roadmap outlines the Hanford Tank Waste Operations & Closure, LLC (H2C) strategic approach for advancing the Hanford Tank Waste Treatment Mission (HTWTM) through technology development. Our focus is on addressing technology needs that address risks, enhance efficiency, ensure worker safety, and uphold environmental standards.

This Roadmap identifies key technology initiatives essential for the successful completion of the Hanford Site tank waste cleanup. Updated annually, it incorporates insights from the U.S. Department of Energy (DOE), the Integrated Tank Disposition Contractor (ITDC) H2C, recognized national lab experts, and fieldwork specialists.

The Roadmap includes approximately 100 technology elements, each detailed in Technology Element Description Summaries (TEDS) and summarized in catalog sheets. These elements are crucial for aligning technology development activities with mission objectives across the HTWTM.

With the initiation of the Direct-Feed Low-Activity Waste (DFLAW) program and the operation of the Tank-Side Cesium Removal (TSCR) system, our focus now shifts to the support of scaled up production in East Area; applying similar and exploring new treatment alternatives to West Area Tank Waste; and advancing retrieval, delivery and treatment technologies for waste managed as high-level waste (HLW) across the Hanford tank farms. This transition is reflected in the technology and maturation (TM&E) charts, which highlight the evolving technology priorities.

This document serves as a guide for navigating the challenges and opportunities in technology development at the Hanford Site.

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BBI	Best-Basis Inventory
CAM	Continuous Air Monitor
CD	Critical Decision
CFD	Computational Fluid Dynamics
CH	Contact-Handled
COC	Compound Of Concern
COPC	Chemical Of Potential Concern
CPCco	Central Plateau Cleanup Company
CTF	Cold Test Facility
CTO	Chief Technology Office
DFAS	Data Fusion and Advisory System
DFHLW	Direct-Feed High-Level Waste
DFLAW	Direct-Feed Low-Activity Waste
DOE	U.S. Department of Energy
DOT	Department of Transportation
DST	Double-Shell Tank
DTW	Dispose Tank Waste
Ecology	Washington State Department of Ecology
EM	U.S. Department of Energy, Office of Environmental Management
EMF	Effluent Management Facility
EROMS	Enterprise Risk and Opportunity Management System
ETF	Effluent Treatment Facility
FFRDC	Federally Funded Research Development Contractor
FLTF	Field Lysimeter Test Facility
FY	Fiscal Year
GC	Grand Challenge
H2C	Hanford Tank Waste Operations and Closure
HFO	Hanford Field Office
HLW	High-Level Waste
HTWTM	Hanford Tank Waste Treatment Mission
IDF	Integrated Disposal Facility
IHLW	Immobilized High-Level Waste
ILAW	Immobilized Low-Activity Waste
ITDC	Integrated Tank Disposition Contract
IX	Ion Exchange
LAW	Low-Activity Waste
LERF	Liquid Effluent Retention Facility
LSW	Liquid Secondary Waste
MTW	Manage Tank Waste
MW	Manage Waste
ORSS	Off-Riser Sampler System
PA	Performance Assessment
PTW	Process Tank Waste
RCRA	Resource Conservation and Recovery Act of 1976
Roadmap	Technology and Innovation Roadmap
RTW	Retrieve Tank Waste

List of Terms

SST	Single-Shell Tank
SSW	Solid Secondary Waste
T&O	Threat and Opportunity
TBD	To Be Determined
TBI	Test Bed Initiative
TEDS	Technology Element Description Summary
TM&E	Technology Maturation and Execution
TPP	Technology Program Portal
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989)
TRU	Transuranic
TSCR	Tank-Side Cesium Removal
TSR	Technical Safety Requirement
TWCS	Tank Waste Characterization and Staging
TWINS	Tank Waste Information Network System
UT	Ultrasonic Testing
WAC	Waste Acceptance Criteria
WFD	Waste Feed Delivery
WIPP	Waste Isolation Pilot Plant
WMA	Waste Management Area
WTP	Waste Treatment and Immobilization Plant

1.0 INTRODUCTION

The initial Technology and Innovation Roadmap (Roadmap) was released in 2010 by the Tank Operations Contractor in response to the 2009 National Academy of Sciences report and aligned with the desires and goals of the Department of Energy (DOE) Environmental Management (EM) at that time. The Roadmap has been updated and improved annually with each revision.

This edition of the Roadmap is focused on highlighting the technology needs of the Hanford mission for the next five fiscal years, as well as longer term future preliminary planning. All of the identified potential and previously decided upon technology development needs are described in electronic Technology Element Description Summary (TEDS) details and are concisely summarized in one or two pages, known as "Catalog Sheets." See Section 4.0 for more details on TEDS and Catalog Sheets.

The Integrated Tank Disposition Contractor (ITDC) Technology and Innovation Roadmap (Roadmap) represents a comprehensive compendium of Technology Development activities identified to efficiently execute the Hanford Tank Waste Treatment Mission (HTWTM). There are approximately 100 technology needs highlighted herein. The technologies are summarized by functional area in Table 1-1. The five functional areas are Manage Tank Waste (MTW), Retrieve Tank Waste (RTW), Process Tank Waste (PTW), Dispose Tank Waste (DTW), and Manage Waste (MW). More information on the Functional Areas can be found in Section 4.1.

Table 1-1. Technologies by Functional Area

Functional Area	Near-Term	Future Projects	Total
MTW	23	26	49
RTW	9	16	25
PTW	3	14	17
DTW	7	1	8
MW	2	2	4
Total	44	59	103

The change in the number of technology elements from those reported in the previous Roadmap revision is due to a combination of the retirement of TEDS as well as the drafting of new TEDS. Retirements are driven by development work completion and are discussed in APPENDIX B. New TEDS creation is driven by mission risks as identified in the Enterprise Risk Opportunity Management System (EROMS) and described in Section 4.1.

This document is compiled based on input from the DOE Hanford Field Office (HFO), Hanford Tank Waste Operations & Closure, LLC (H2C) management, national lab scientists, and knowledgeable fieldwork specialists. These specialists include facility managers, operations leads, cognizant engineers, design authorities, as well as other knowledgeable Hanford workers. All the known and possible technology needs are identified by the appropriate specialists and summarized via individual TEDS details. Section 4.1 describes how technology elements are aligned with mission initiatives.

2.0 ROADMAP TECHNOLOGY DEVELOPMENT SUMMARY

Near-term Technology Needs are identified by H2C as necessary to begin, continue, or deploy in the next five years for the most efficient use of time and greatest return on investment. Near-term technology needs that have specific identified funding are shown in Table 2-1.

Table 2-1. Near-Term Technology Needs Identified for work in Fiscal Year 2025 and Fiscal Year 2026

TEDS ID	Title
MTW-10	Improved Inspection Methods for DST Primary Tank Walls
MTW-11	DST Primary Tank Bottom Volumetric Inspection
MTW-24	Vapor Monitoring, Characterizing & Remediation
MTW-41	Analytical Method Development for Chemicals of Concern
MTW-70	Resolving Criticality Safety Concerns with Plutonium-Bismuth Particles
MTW-72	Continuous Air Monitor Remote Observation
MTW-76	Online Monitoring
MTW-79	Reduce Entries into Tank Farms while Collecting Vapor Related Data
MTW-83	Secondary Liner Bottom Damage Mitigation Technologies
MTW-84	Pipeline Forensic Inspection Technology
MTW-87	Real-Time Localized Corrosion Monitoring Probe
MTW-89	Remote Concrete Surface Cleaning Apparatus
MTW-92	Tank Refurbishment
MTW-94	Internal Data Access and Visualization (IDAV)
MTW-95	Predicting Tank Farm Vapor Conditions
MTW-96	Enhance Worker Capabilities
MTW-97	Continued Need for Improving Tools for Tank Farm Projects
MTW-98	Long-Reach Robotic Tool for Waste Storage Tank Pits
MTW-101	Large Data Management
MTW-113	Improve Waste Level Measurement
MTW-114	Underground Crossing List
MTW-115	Locating Underground Cathodic Protection Equipment
RTW-01	Retrieval and Closure Solid Waste Sampling Tools
RTW-02	Residual Volume Management System (RVMS)
RTW-04	Near Tank Soil Sampling
RTW-07	Post Waste Retrieval Updates to WMA CPA and Long-Term Maintenance
RTW-08	Dry Waste Retrieval System (A, SX, & U SSTs)
RTW-25	Void Filling to Prevent Collapse
RTW-34	Remove Residual Solids in Non-Leaking Tanks
RTW-44	Quantification of Solids in DSTs
RTW-61	Quantify Uncertainty Associated with the Best Basis Inventory Estimates
PTW-23	Methods for Mitigating DFLAW Flowsheet Gaps
PTW-38	Radioactive Waste Test Platform
PTW-62	Online strontium detection for process systems
DTW-02	Low Temperature Waste Form Process
DTW-03	Immobilized LAW Glass Testing for IDF PA Support
DTW-06	Advance Liquid Waste Transportation Capability
DTW-07	Solidification and Stabilization of Solid Secondary Waste
DTW-08	IDF Long-term Waste Form Durability Study (Lysimeter Data)

DTW-13	Long Term Durability of Cementitious Waste Forms
DTW-15	Natural Attenuation of CoCs in the IDF
MW-02	Ammonia Vapor Mitigation
MW-10	Remotely Operated or Automated ETF Internal Tank Cleaning Device

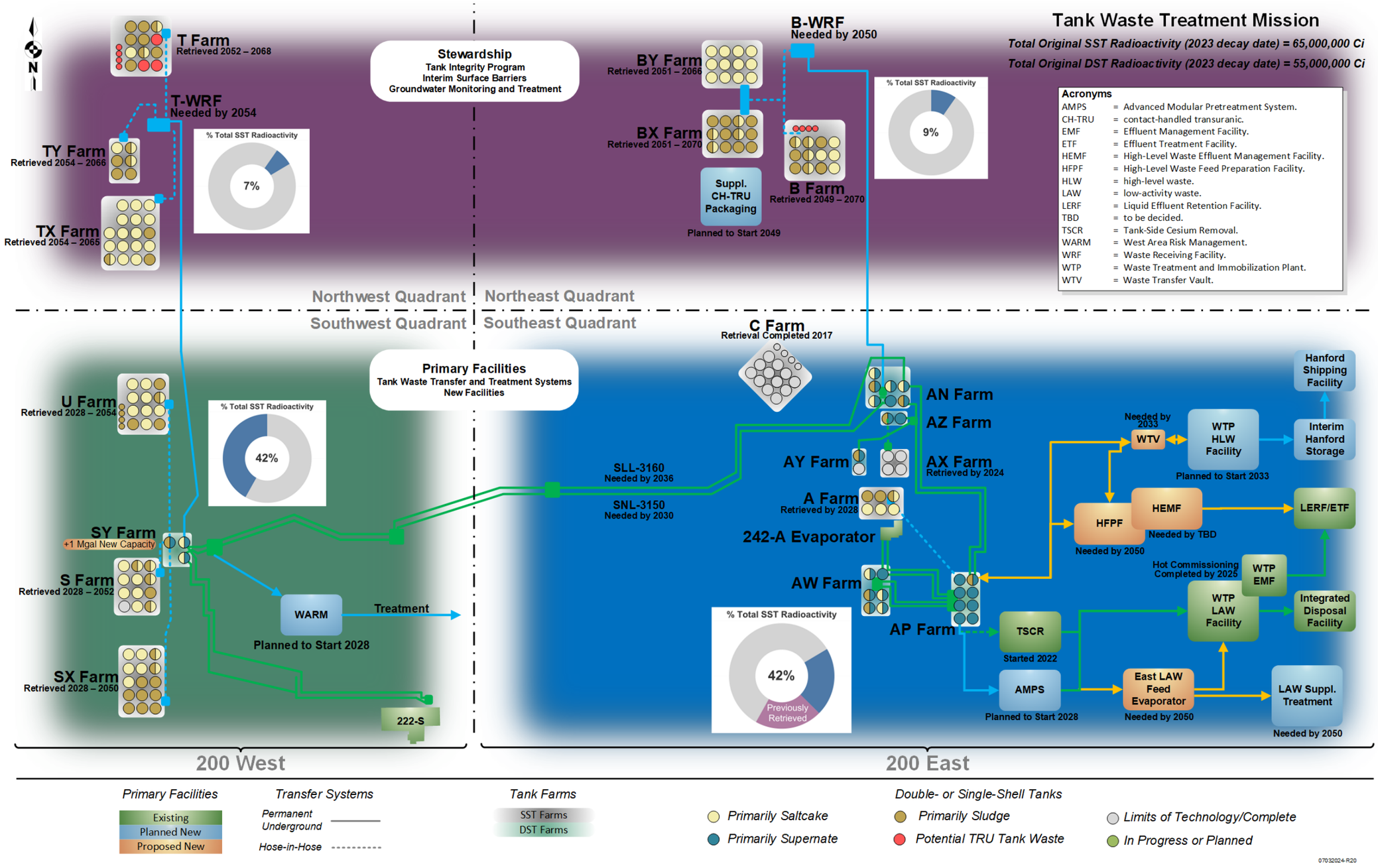
The Future Technology Needs are those needs that have been identified as beneficial areas of focus but are not part of the current five-year vision for technology development and do not have plans for specifically allocated funding. As time goes on and technology needs are fulfilled, retired, or become immediately necessary, needs may move between the Future and Near-term categories. Future Technology Needs are listed in Section 7.0.

3.0 MISSION INTEGRATION

This document maps technology needs that support accomplishment of HFO's HTWTM. As the Hanford mission has moved forward, the technology needs have changed. Initially the needs focused on worker safety associated with tank farm vapors, which led to the implementation of several solutions. The primary focus then shifted to technology supporting Direct Feed Low Activity Waste (DFLAW). Now as the treatment of waste managed as high-level waste (HLW) becomes the next focus in waste treatment a new emphasis for HTWTM technology needs and a new view of the tank farms has become necessary. To help facilitate maintaining a high-level overarching vision for the tank farms as a whole, the farms have been broken into sections based on geographical location. The focus at this time is on the southern half of the farms where the Advanced Modular Pretreatment System (AMPS) and the West Area Risk Management (WARM) capital projects will be located. Figure 3-1 shows the Tank Waste Treatment Mission chart with the Southwest region highlighted in green, the Southeast region highlighted in blue, and the Northern region highlighted in purple.

Technology Maturation and Execution (TM&E) charts have been generated for both long- and short-term needs. Long term technology needs have been categorized with the Tank Waste Treatment Mission regions in mind on the End-State TM&E chart. While shorter term needs are categorized topically, and color coded to reflect the geographical region on the Near-Term TM&E chart.

Figure 3-1. Regional Waste Treatment Chart



3.1 End-State Technology Maturation and Execution Chart

The End-State TM&E chart, Figure 3-2, is a 20 year look at technology development plans that are in work and needed, sorted by Tank Farms regional area. Each region has both unique challenges as well as mission wide challenges. Mission milestones and retrievals activities are listed at the top of the chart to show development activity alignment.

3.1.1 Southwest Quadrant (Tank Farms S, SX, SY, and U)

S, SX, and U farms retrievals are planned to move through SY farm. All liquid materials from SY farm are planned to be processed through WARM. Key technology needs are due to space limitations in SY farm and potential structural issues in SX farm.

3.1.2 Southeast Quadrant (Tank Farms C and A-complex)

At this time, all waste feed is assumed to process through the A complex. Key technology needs include mixing, qualification and transport of materials, retrieval of A-104 and A-105 Tanks, and if pursued, expanding the direct-feed high level waste (DFHLW) Waste Acceptance Criteria (WAC).

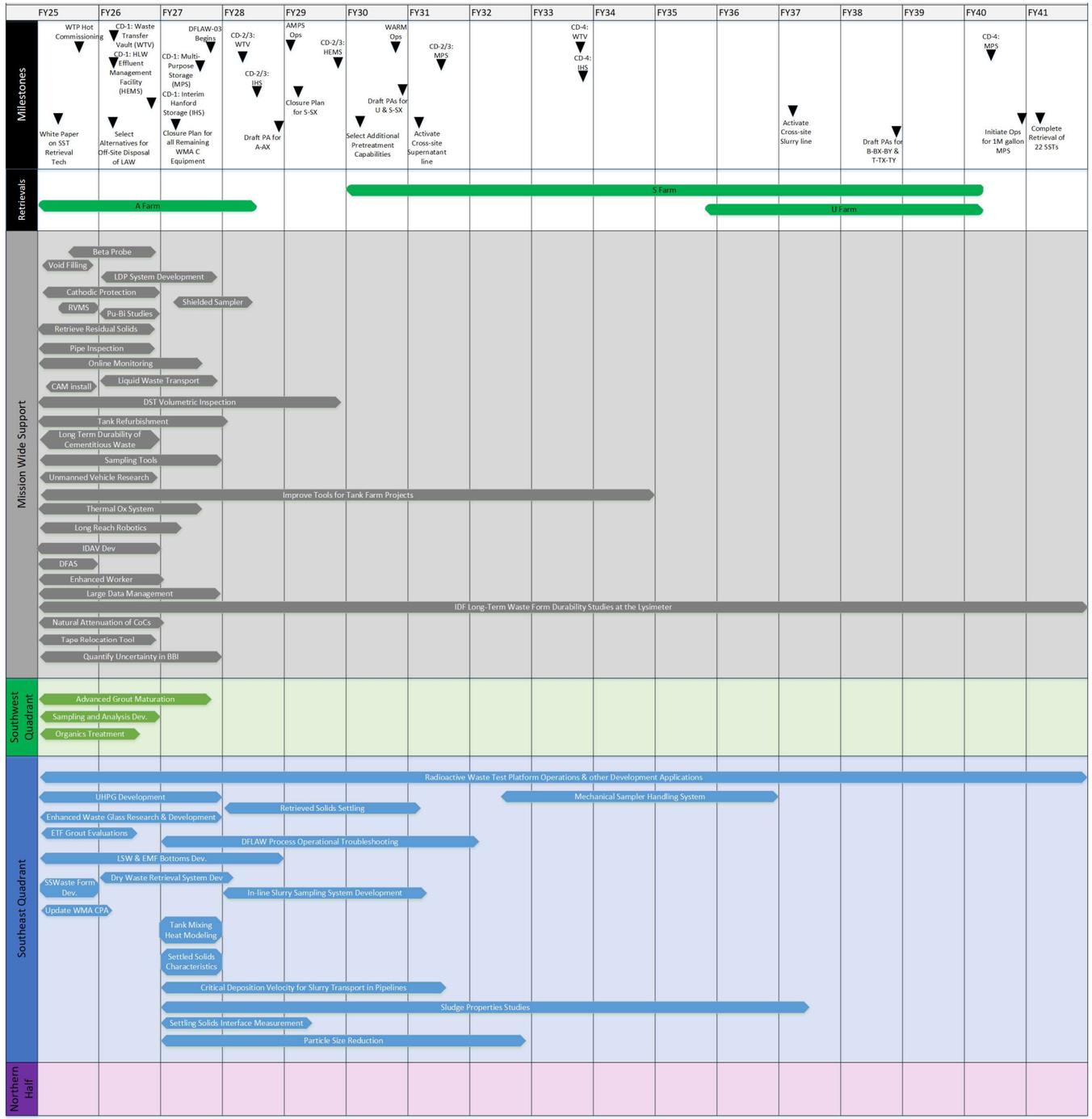
3.1.3 Northern Half (T and B Tank Farm complexes)

The northern half of the tank farms is largely characterized by long-term stewardship of the single-shell tank (SST) farms in that region. Remaining key technology needs include better in-tank monitoring technologies to determine remaining liquid and potential leaks, and waste form development for alternate disposition of waste.

3.1.4 Mission Support

There are a large number of technology needs that cross the regional divisions of the Tank Farms. Key technology needs include worker health and protection, infrastructure health and protection, and multi-use tools.

Figure 3-2. End-State Technology Maturation and Execution



3.2 Near-Term Technology Development

The Near-Term TM&E chart provides a more focused look at the next five years. This focused look at the near-term mission is intended to provide clarifying information to aid in the planning of projects. The Near-Term chart depicts the technology needs in nine major mission programs divided into two areas:

1. Feed Operations Support
    a. Immobilized Low Activity Waste (ILAW) Glass
    b. Tank-Side Cesium Removal & Low-Activity Waste Pretreatment Systems
    c. Cementitious Waste Forms
    d. Alternate Low Activity Waste (LAW) Treatment
    e. High Level Waste Pretreatment and Immobilization
2. Mission Support
    a. Alternate Retrieval Technology
    b. Tank Integrity Technology
    c. Sampling & Monitoring Technology
    d. Worker Protection

Major mission programs were identified from existing TEDS sheets, other Hanford Site contracts and the *River Protection Project System Plan*, ORP-11242. Development activities were mapped to the major mission programs and the corresponding TEDS are identified.

The technology elements documented in this Roadmap should inform planning decisions. As potential funding becomes available, the elements representing potential technology ideas that can reduce risk, improve operational flexibility, increase processing rates, decrease costs, and/or increase safety should be considered.

3.2.1 Feed Operations Support

The near-term mission for the HFO is to treat tank waste using the LAW Vitrification Facility, which is part of the Waste Treatment and Immobilization Plant (WTP). The DOE has opted to use and prioritize the Direct Feed LAW approach to start treating tank waste. This approach uses the Tank-Side Cesium Removal (TSCR) facility to remove cesium-137 from supernatant and then feed this stream to the LAW Vitrification facility. This approach requires technologies that develop glass formulations, support TSCR, enable cementitious waste forms for secondary waste, and enable Alternative LAW solidification in cementitious waste forms. In addition, HFO and the ITDC have begun considering the needs to address waste being managed as HLW, which requires planning and development of the vitrification and disposal technologies.

3.2.1.1 Immobilized Low-Activity Waste Glass

Immobilized LAW (ILAW) glass testing generates the required data for maintenance of the Integrated Disposal Facility (IDF) Performance Assessment (PA) and future revisions to the IDF PA to include Enhanced Waste Glass (EWG) compositions.

3.2.1.2 Tank-Side Cesium Removal & Low-Activity Waste Pretreatment Systems

The TSCR system is a technology that is utilized as a first feed solution supporting the production of ILAW. TSCR is a modular system that removes cesium (Cs) from tank waste supernatant prior to feeding it from Tank Farms directly to the WTP LAW Facility. The TSCR system has been deployed as a two-phased demonstration project. The first phase will monitor system performance and demonstrate the ability to safely operate and maintain the TSCR system in support of feed production for WTP hot commissioning and early operations.

The second phase will demonstrate the ability to treat tank waste reliably and efficiently for an extended operating period.

3.2.1.3 Cementitious Waste Forms

Advanced grout technology development spans three key areas,

1. Improving contaminant retention and waste form stability for immobilized secondary waste.
2. Development and implementation of waste formulations to treat unique process streams such as the high ammonia bearing Effluent Treatment Facility (ETF) effluent brine.
3. Formulation development to enhance the retention of key Compounds of Concern (CoCs) such as Iodine-129 and Technetium-99 to enable the opportunity to break the internal vitrification facility recycle by directly solidifying the bottoms from the Effluent Management Facility (EMF) evaporator.

In addition, this mission area addresses the cross-cutting technology maturation needs associated with the long-term stability and durability of cementitious waste forms.

3.2.1.4 Alternate Low Activity Waste Treatment

Technology maturation efforts to enable solidifying some low activity waste into a cementitious waste form include, quantifying and resolving issues associated with the possible presence of LDR organics regulated by Resource Conservation and Recovery Act of 1976 (RCRA), developing tailored waste formulations to enhance the ability of solid matrices to grab hold of and retain the problematic constituents, iodine-129, technitium-99, and nitrate, and evaluating modifications to the waste packages to enhance retention of hazardous and radioactive constituents. Offsite disposal requirements are included in this mission area to address opportunities for enhancing the waste treatment mission.

3.2.1.5 High Level Waste Feed Blending, Pretreatment, and Immobilization

High Level Waste Pretreatment and Immobilization addresses the technologies needed to develop any waste preparation necessary for the Hanford waste that is being managed as HLW. As DFLAW operations are set to begin, H2C is beginning to consider pretreatment and immobilization issues for this sub-set of the waste. Many decisions are yet to be made in this area of treatment and disposal, therefore both potential and necessary technology development activities have been identified. TEDS for both potential and necessary technology needs are present on the Near-Term TM&E chart and preliminary technology development activities have started. As the mission progresses, more technology development needs are expected to be identified and added to this mission area.

3.2.2 Mission Support

Other mission needs fall under Mission Support which works toward the mission end-state. This includes identifying and developing technologies to address alternate retrieval methods, tank integrity verification and improvement, waste sampling and monitoring methods, as well as overall worker protection.

3.2.2.1 Alternate Retrieval Technology

Alternate retrieval addresses the technologies needed to identify, develop, and allow successful deployment of new or enhanced retrieval technologies for solids removal from waste Tanks at the Hanford Site Tank Farms. The goal of this program is to develop and improve the technology necessary to support retrieval of the remaining tank waste solids in a safe and efficient manner. Tank retrieval activities are governed by the System Plan, ORP-11242 and by RPP-PLAN-40145, *Single-Shell Tank Waste Retrieval Plan*.

3.2.2.2 Tank Integrity Technology

The primary objectives of the Tank Integrity programs are to monitor the condition of the tanks and related infrastructure over time, evaluate any unanticipated changes in condition and rectify them where feasible. Discoveries of tank bottom corrosion in the primary tank of double-shell tank (DST) AY-102, material loss from the foundation side of the secondary liner of several DSTs, and liquid-to-air interface corrosion in Tank AY-101 have served to spur additional action to prolong the life of the DSTs and mitigate damage mechanisms as they are discovered. Awareness of these challenges early on is a critical component of the integrity program mission.

3.2.2.3 Sampling & Monitoring Technology

The primary driver for all sampling technologies is successful support of the HTWTM. To help prevent the risk of mission delays, all future project and mission elements need to be assessed as soon as possible for any potential waste sampling technology gaps. Identifying gaps in advance will allow ample time to develop the needed technologies to meet mission goals.

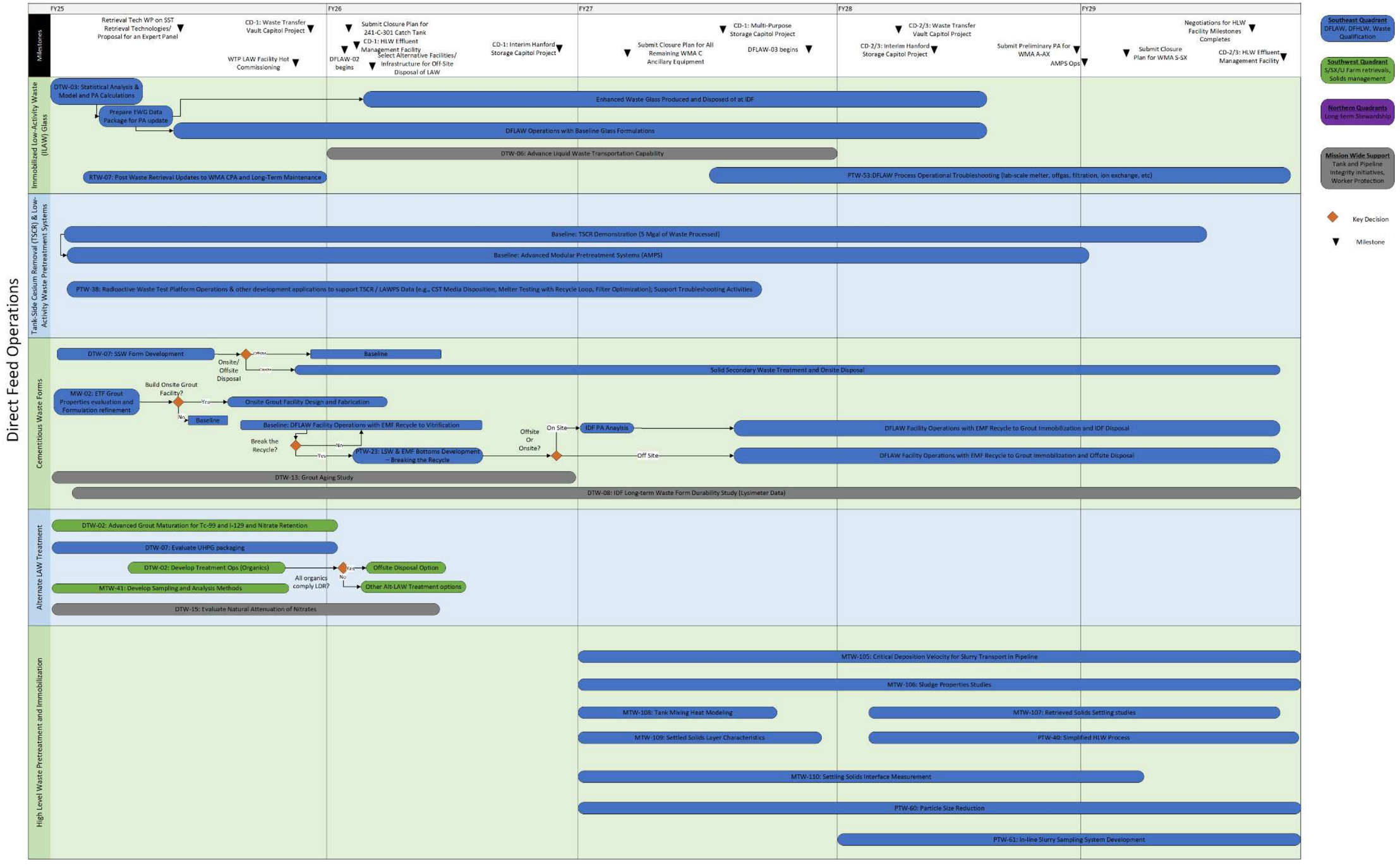
3.2.2.4 Worker Protection

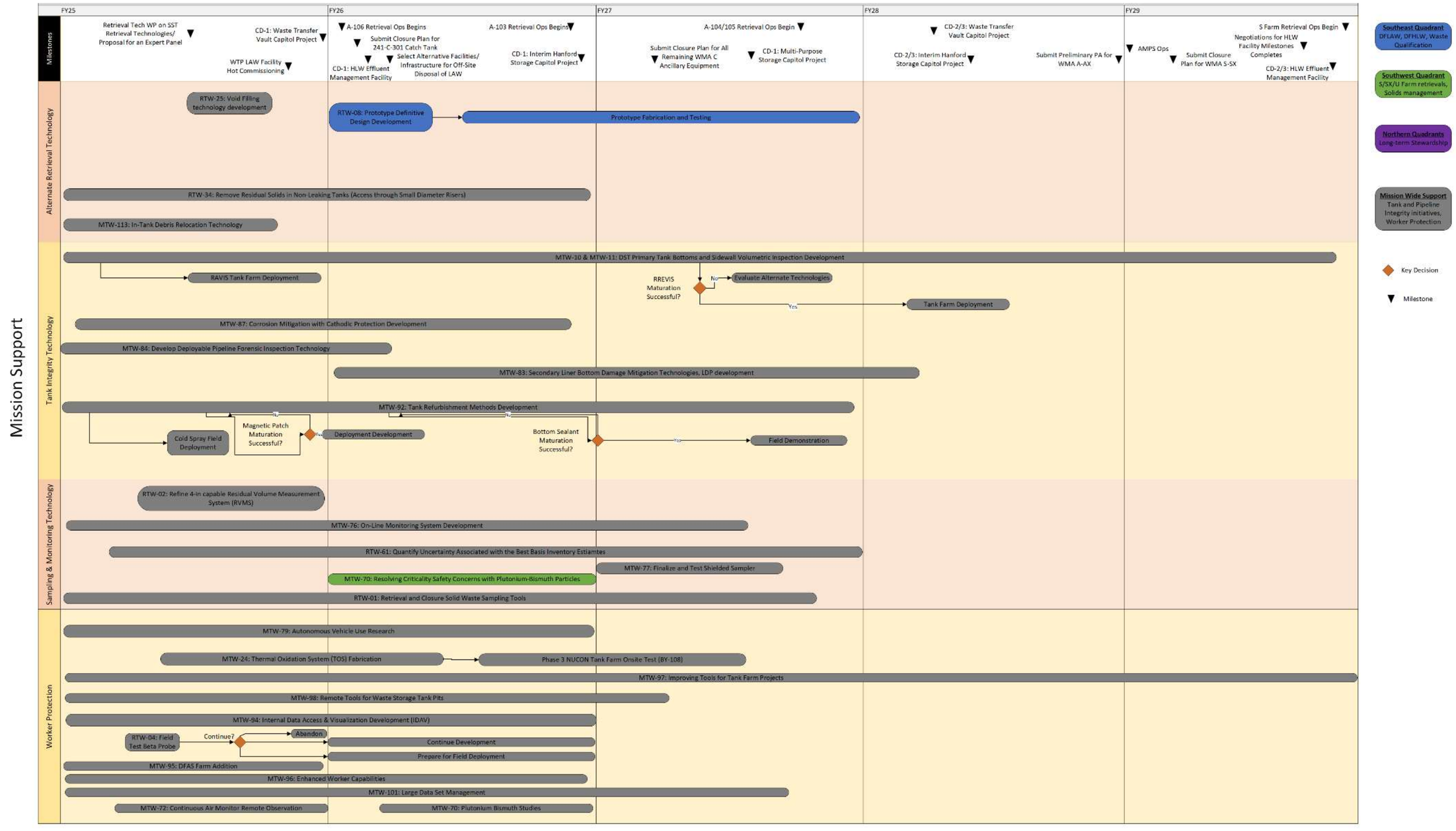
The purpose of worker protection mission area is to identify, develop, and deploy new or enhanced worker protection program technologies for protection of Hanford Site Tank Farm Workers and associated Hanford workers from potential hazards. The focus of this technology area is to determine, with the Hanford work force, what the potential hazards to workers are, the extent of the hazards and what technologies can be developed and deployed to mitigate these hazards to acceptable and/or required safe conditions.

3.3 Near-Term Technology Maturation and Execution Chart

The Near-Term TM&E chart, Error! Reference source not found., is used to highlight and identify the projects that are both in progress and those that are needed in the near future. This chart includes the on-going activities from the fiscal year of this revision of the Roadmap's publication with recommendations/expectations for the following four fiscal years including the related TEDS identification number. More information on each of the identified TEDS can be found in the corresponding Catalog Sheets Section 5.0.

Figure 3-3. Near-Term Technology Maturation and Execution Chart

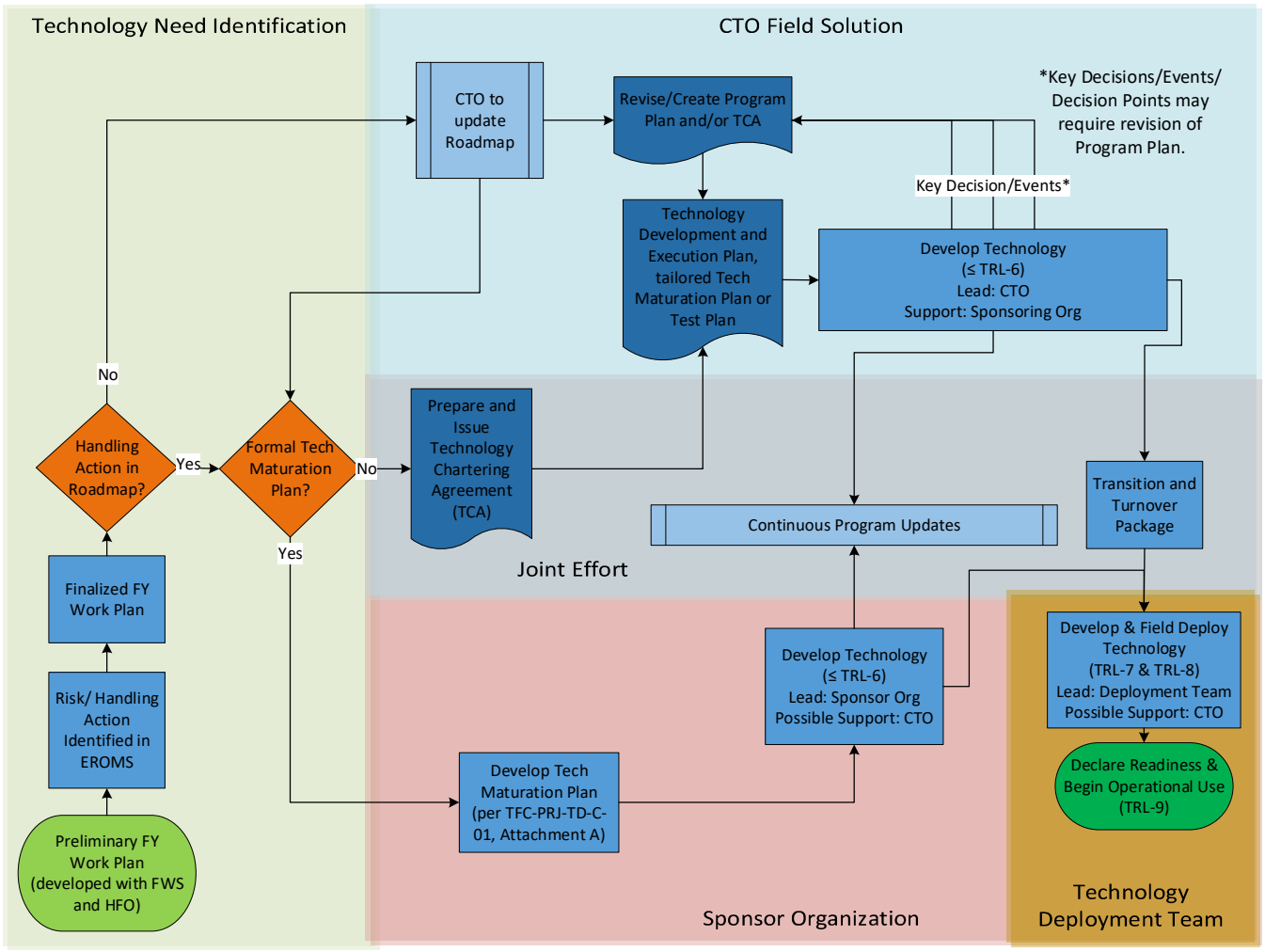



Mission Support
FY25
FY26
FY27
FY28
FY29
Milestones
Retrieval Tech WP on SST Retrieval Technologies/ Proposal for an Expert Panel
CD-1: Waste Transfer Vault Capitol Project
WTP LAW Facility Hot Commissioning
A-106 Retrieval Ops Begins
Submit Closure Plan for 241-C-301 Catch Tank
CD-1: HLW Effluent Management Facility
Select Alternative Facilities/ Infrastructure for Off-Site Disposal of LAW
A-103 Retrieval Ops Begins
CD-1: Interim Hanford Storage Capitol Project
A-104/105 Retrieval Ops Begin
Submit Closure Plan for All Remaining WMA C Ancillary Equipment
CD-1: Multi-Purpose Storage Capitol Project
CD-2/3: Waste Transfer Vault Capitol Project
CD-2/3: Interim Hanford Storage Capitol Project
Submit Preliminary PA for WMA A-AX
AMPS Ops
Submit Closure Plan for WMA S-SX
Negotiations for HLW Facility Milestones Completes
S Farm Retrieval Ops Begin
CD-2/3: HLW Effluent Management Facility
Alternate Retrieval Technology
RTW-25: Void Filling technology development
RTW-08: Prototype Definitive Design Development
Prototype Fabrication and Testing
RTW-34: Remove Residual Solids in Non-Leaking Tanks (Access through Small Diameter Risers)
MTW-113: In-Tank Debris Relocation Technology
Tank Integrity Technology
MTW-10 & MTW-11: DST Primary Tank Bottoms and Sidewall Volumetric Inspection Development
RAVIS Tank Farm Deployment
RREVIS Maturation Successful?
No
Evaluate Alternate Technologies
Yes
Tank Farm Deployment
MTW-87: Corrosion Mitigation with Cathodic Protection Development
MTW-84: Develop Deployable Pipeline Forensic Inspection Technology
MTW-83: Secondary Liner Bottom Damage Mitigation Technologies, LDP development
MTW-92: Tank Refurbishment Methods Development
No
Magnetic Patch Maturation Successful?
Yes
Cold Spray Field Deployment
Deployment Development
No
Bottom Sealant Maturation Successful?
Yes
Field Demonstration
Sampling & Monitoring Technology
RTW-02: Refine 4-in capable Residual Volume Measurement System (RVMS)
MTW-76: On-Line Monitoring System Development
RTW-61: Quantify Uncertainty Associated with the Best Basis Inventory Estiamtes
MTW-77: Finalize and Test Shielded Sampler
MTW-70: Resolving Criticality Safety Concerns with Plutonium-Bismuth Particles
RTW-01: Retrieval and Closure Solid Waste Sampling Tools
Worker Protection
MTW-79: Autonomous Vehicle Use Research
MTW-24: Thermal Oxidation System (TOS) Fabrication
Phase 3 NUCON Tank Farm Onsite Test (BY-108)
MTW-97: Improving Tools for Tank Farm Projects
MTW-98: Remote Tools for Waste Storage Tank Pits
MTW-94: Internal Data Access & Visualization Development (IDAV)
RTW-04: Field Test Beta Probe
Continue?
Abandon
Continue Development
Prepare for Field Deployment
MTW-95: DFAS Farm Addition
MTW-96: Enhanced Worker Capabilities
MTW-101: Large Data Set Management
MTW-72: Continuous Air Monitor Remote Observation
MTW-70: Plutonium Bismuth Studies
Southeast Quadrant
DFLAW, DFHLW, Waste Qualification
Southwest Quadrant
S/SX/U Farm retrievals, Solids management
Northern Quadrants
Long-term Stewardship
Mission Wide Support
Tank and Pipeline Integrity initiatives, Worker Protection
Key Decision
Milestone

3.4 Transition to Operations

Transitioning equipment, systems, and facilities from start-up and commissioning to field operations may require the deployment of different technologies. Additional technology development and/or studies may be required to support commissioning and field operations. For this reason, the Chief Technology Office (CTO) will work closely with the sponsoring organization to ensure continuity between technology development and deployment. See the figure below.

Figure 3-4. Technology Development Flow Chart

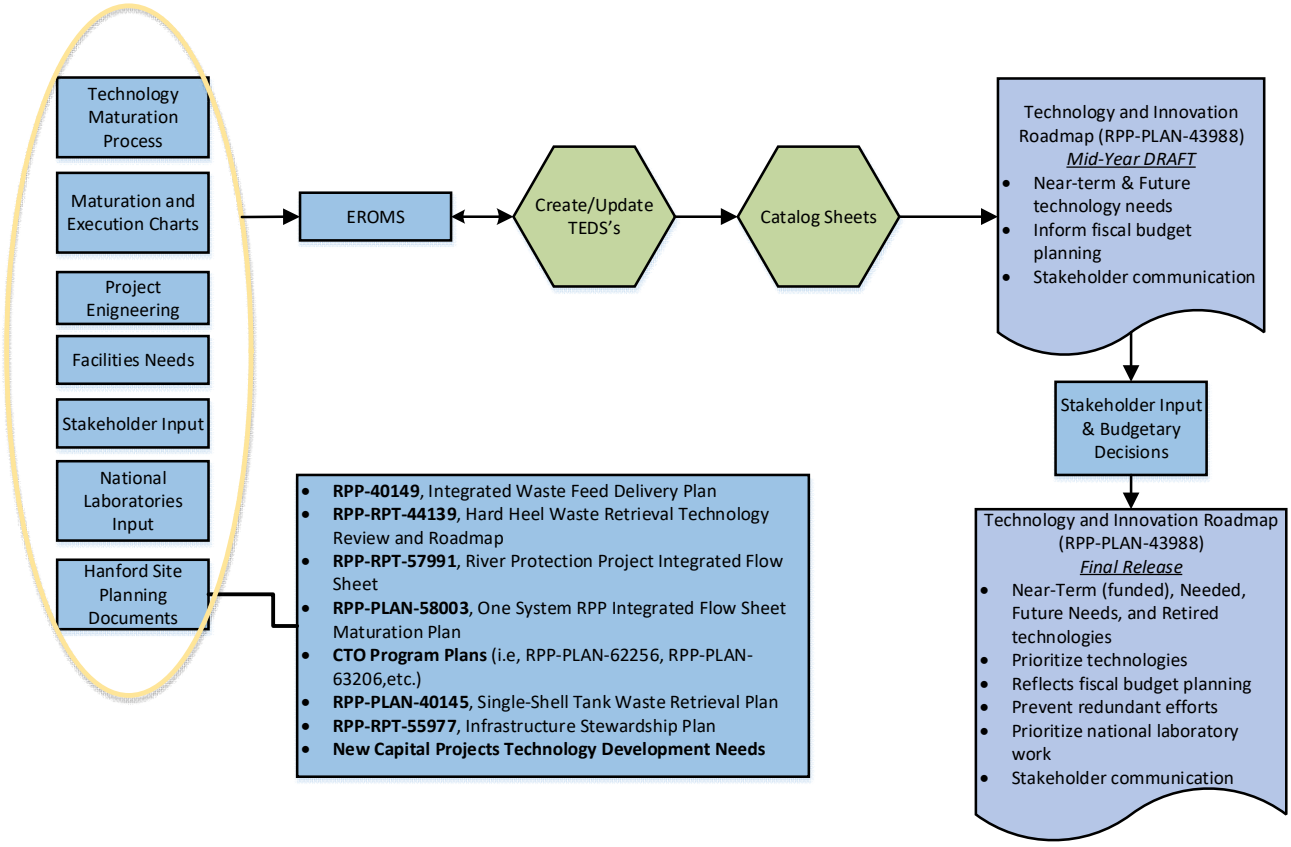


4.0 PROCESS SUMMARY

The technology maturation process as defined in TFC-PLN-90, *Technology Maturation Management Plan*, defines technology elements that are incorporated into electronic TEDS sheets as necessary. Figure 4-1 highlights some of the planning documents that are reviewed. An electronic TEDS sheet is generated for all technology needs.

This Roadmap is updated annually to incorporate changing technology needs. Figure 4-1 illustrates this process, which initiates with the entry of specific technology needs into EROMS.

Figure 4-1. Technology Roadmap Development Process



This process is used to ensure that the planning and strategic initiatives agree. These sources include: (1) previous year's Roadmap; (2) technologies derived through technology maturation; (3) TM&E charts; (4) stakeholder input; (5) facility needs; (6) EROMS; (7) Grand Challenges (GC); and (8) programmatic planning documents. Most of the inputs are Hanford-centered, except for the GC obtained solicitations from industry, academia, and the DOE-wide complex. The GC program was discontinued, and no new GCs have been produced since 2018.

All technology elements are mapped to programmatic and project threats and opportunities via EROMS. EROMS is the web-based application that H2C uses to identify and manage risks in the form of threats and opportunities (T&Os). The principal reasons for employing EROMS is to identify and manage those T&Os that may have significant impact on achieving goals and objectives of the entire H2C enterprise, and to provide a

basis for prioritizing and allocating limited resources required to implement recommended handling strategies.

T&Os are addressed at multiple levels, from functional organizations through Projects and Programs, and up to the Business, or top level. All of these T&Os are subject to potential interfaces with entities external to H2C, such as other Hanford site contractors, the DOE, or other stakeholders. It is important to note that T&Os are normally managed at the lowest possible level, and only those that have higher level impacts or that require resources beyond those available to the current organizational level would get elevated to the next level in the hierarchy. In addition, only those T&Os with significant potential impact to the overall organization would be elevated to the enterprise level where they would be managed as directed by the Senior Management Team.

4.1 Compiling Technology Element Description Summaries (TEDS)

All of the known technology needs are identified by appropriate fieldwork specialists, project managers, or cognizant engineers via individual TEDS. TEDS are housed in a database application for ease of management. The database application includes pertinent high-level information as well as attachments such as any of the previously used TEDS sheets in Word document format, and/or reference materials and measurable organizational value (MOV) evaluations.

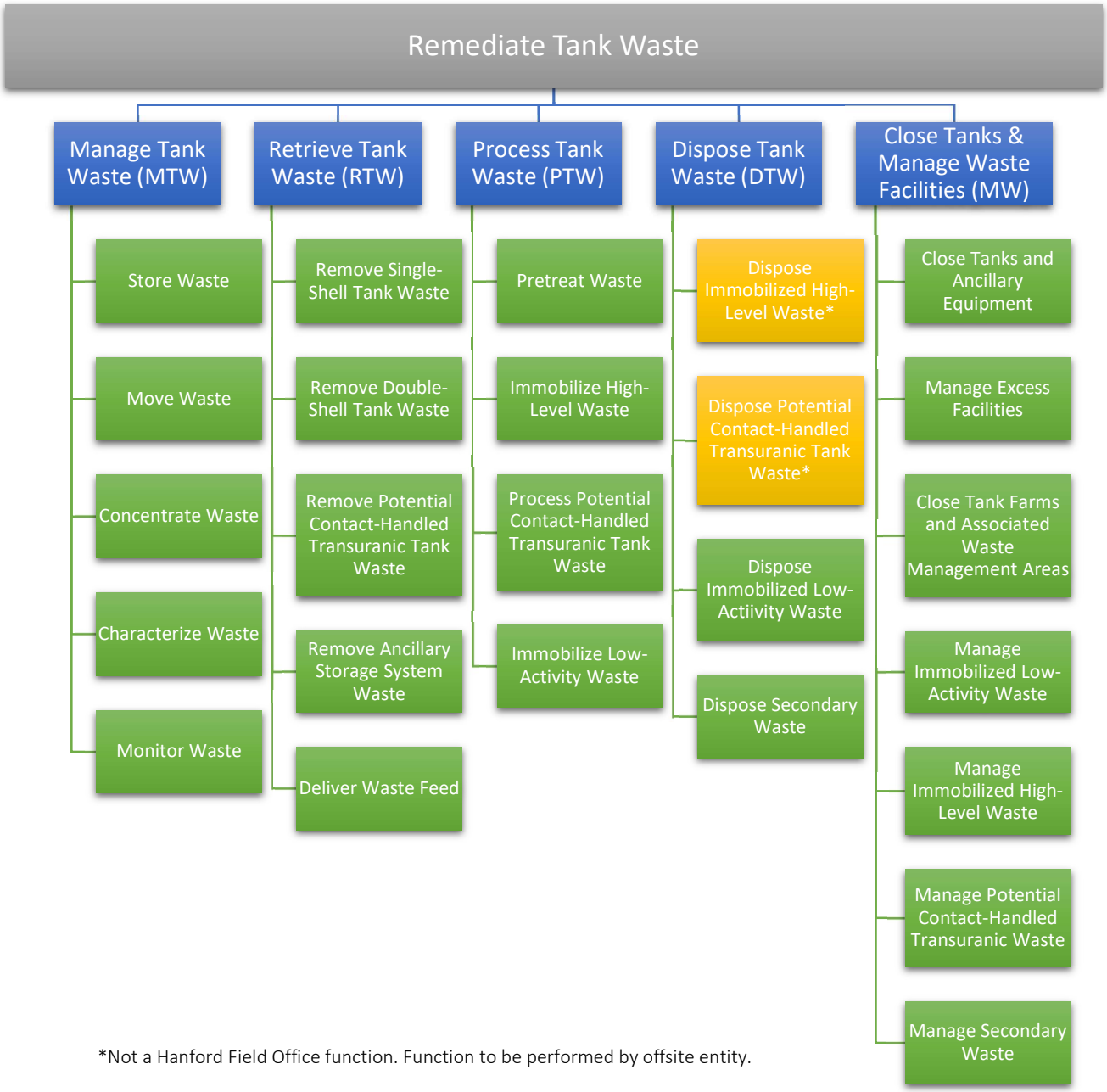
The TEDSs are standardized work sheets that enable direct comparison of provided input. All instances of TEDS include the following information:

- Baseline Status
- ROM funding
- Technology Summary
- Functional Area
- Cost and Schedule
- Points of Contact
- Technology Need
- Technology Solution
- Technology Maturation Level
- National Laboratory Involvement
- Grand Challenge Relationship
- Technology Impact and Threat Identification

To kick-off the original request for technology need information and ensure that the technology needs and gaps were comprehensively captured, the Tank Operating Contractor's Chief Technology Office assembled a team with extensive experience in Hanford Site Tank Farms that spanned all mission functional areas.[1] This team included DOE and Tank Operating Contractor personnel, including managers and technical leads and individuals with field experience. Although WTP technology development is identified in the functional framework, this roadmap currently does not include WTP technology development activities. The five mission functional areas are depicted in Figure 4-2. Having experienced Hanford Site members for all five functional areas served as a way to ensure all of the mission requirements had coverage in the Roadmap.

[1] The RPP mission functional areas are in alignment with the DE-AC27-08RV14800 Tank Operations Contract work breakdown structure and are discussed further in RPP-51303, *River Protection Project Functions and Requirements*, and RPP-RPT-56516, *One System River Protection Project Mission Analysis Report*.

Figure 4-2. Functional Area Summary



*Not a Hanford Field Office function. Function to be performed by offsite entity.

Technology development is primarily driven by the need to mitigate threats and realize opportunities; therefore, the risk registries are a significant input into the technology needs. The threats and opportunities are identified, managed, and assessed via EROMS which is also known as the Risk Registry. A key feature of the Risk Registry is handling actions. Handling actions propose what is or could be done about threats or opportunities to influence the impacts to the work scope. A section of the TEDS detail requests threat and opportunity input. Additionally, through the ongoing partnership with the Risk Analysis group, TEDS activities are being included in EROMS as both opportunities being managed by the CTO and as handling actions directly to the threats being addressed, further establishing the connection between identified risks and technology development.

Previously, the Grand Challenge (GC) Workshop brought together members of DOE, National Laboratories,

academia, contractors, and outside industries to propose technology development activities that would benefit the Hanford site. GCs have not been solicited since 2018, however many are still relevant. All GC ideas that were related to technology development have been incorporated into TEDS and tracked electronically.

4.2 Catalog Sheets

The catalog sheets for projects that are planned for Fiscal Year (FY) 25 and FY26 make up Section 5.0 of this Roadmap. Information provided by the TEDS is used in the automatic generation of catalog sheets through the TEDS database application. The catalog sheets are concise summaries of technology developments highlighting each technology need. They are shared with other DOE sites, national laboratories, academic institutions, and vendors as appropriate.

TEDS that are designated Near-Term and planned for FY25 and/or FY26 are described on two-page catalog sheets; identifying needs, solutions, threats, opportunities, activity duration, estimated funding, and the knowledgeable point of contact. TEDS that are identified but not planned for the next two fiscal years are described on single page catalog sheets. These catalog sheets contain high level rough-order-of-magnitude cost and duration information. The basis of estimate provided for out-years is the best estimate for the work scope. The best estimate values may not reflect baseline funding, in which case the duration of performance could change.

Increasingly included in the two-page Catalog sheets is a Measurable Organizational Value (MOV) statement. An MOV statement illustrates the potential benefits gained by completing a project. It communicates value and is used as a tool to compare, assess, and rank projects. The CTO primarily uses MOV statements to express project value.

4.3 Technology Roadmap Document

After catalog sheets are finalized, the Roadmap document is compiled and released for use within the DOE complex and for public information. The Roadmap is a living document that is updated annually to accommodate changing needs of the HTWTM. As such, it is a key resource for preparing program plans, transition plans, and out-year Roadmaps.

The extensive input to the Roadmap results in a multi-faceted output. The Roadmap is intended to be used as a planning tool for making informed budgetary decisions and to track the progress of ongoing technology development efforts, including completed tasks or abandoned efforts which are identified as “retired”. Ideally, the Roadmap will identify redundant efforts and gaps in technology development to optimize the approach taken to bring key technologies onto the Hanford Site. APPENDIX B includes retired TEDS with their reasons for retirement.

4.4 DOE Nuclear Complex National Laboratories

In addition to review of this document and its inputs, H2C holds regular events and initiates activities to encourage collaboration and input from the DOE national laboratories (NLs).

4.4.1 Technology Development Integrated Coordination Meetings

The Technology Development Integrated Coordination (TDIC) meeting is an annual meeting series organized and hosted by H2C. The meeting series kicks off with an all-day in-person conference featuring presentations from a variety of H2C engineering groups outlining mission strategies and challenges. Following the in-person kick-off, meetings are held weekly for 8-10 weeks with focused discussions on each of the topics introduced at the initial meeting. The intent of this meeting series is to promote an open forum discussion of

technology needs and opportunities with SMEs from around the complex. In FY24, the meeting series ran from July 11th to September 19th and covered a wide variety of topics from robotic solutions to improved chemical processes. A summary document of the meeting series was prepared and distributed (WRPS-71647), which includes the agenda, the presentations, and notes on the resulting discussions.

4.4.2 National Laboratory Meetings

Regular national laboratory meetings are held to continue the overall collaborative efforts of H2C and the labs. Each meeting includes the EVMS report for all of the lab related contracts, updates on recent and upcoming events and short verbal updates from HFO, H2C, and each of the participating labs and academic institutions.

4.4.3 Technology Development Projects

Many of the technology development efforts undertaken by H2C are in partnership with the NLs. NL involvement in these projects is invaluable and has resulted in great strides in applied and basic research. As a significant resource for technology development, NL involvement, either current or expected, is determined on every TEDS and indicated on each catalog sheet.

Additionally, the DOE complex of NLs have undertaken a number of technology development efforts to further the HTWTM. See Section 6.0 for a list of projects funded directly by the DOE.

5.0 NEAR-TERM TECHNOLOGY DESCRIPTIONS

This section presents catalog sheets for technologies that are planned for FY25 and FY26. These catalog sheets are two pages and are organized by the five basic functional areas:

- Manage Tank Waste (MTW)
- Retrieve Tank Waste (RTW)
- Process Tank Waste (PTW)
- Dispose Tank Waste (DTW)
- Manage Waste (MW)

Technology needs that are identified but not planned for FY25 and FY26 are listed in Section 7.0. These catalog sheets are one page and can be found in APPENDIX A.

5.1 Manage Tank Waste

The MTW functional area includes technologies to ensure that the radioactive waste liquids, salts, and sludges are maintained in a safe, regulatory-compliant manner. This includes safeguarding the overall integrity of the tanks and tank infrastructure and safely managing the waste contents. Tank farms management involves monitoring the tank contents and surrounding soil, upgrading aging infrastructure and equipment as required, providing contingency storage in the event of a tank failure, and providing means to extend the service life of existing tanks and ancillary equipment.

The Tank Farms infrastructure must also be upgraded to support the evolving mission. H2C is in the process of upgrading utilities, transfer lines, and support facilities to deliver LAW feed directly to the WTP LAW Vitrification Facility. Actions are being taken to support an effort that promotes modernizing and automating Tank Farms equipment and infrastructure to further protect Tank Farms workers from potential exposure to tank vapors and transition the equipment to Operations. Continued analytical support services from the 222-S Laboratory and operational support services from the 242-A Evaporator are required to achieve continued safe operations of the Tank Farms.

This functional area includes the following focus areas:

1. Tank Farm Operations – Improve technology related to everyday operations.
2. Vapor Programs – Modernize and automate infrastructure to further protect workers from potential exposure to vapors and general worker protection.
3. Infrastructure Integrity and Upgrades – Improve inspection techniques and upgrade utilities, transfer lines, and support facilities to deliver feed to the WTP.
4. 242-A Evaporator – Upgrade the facility as necessary to support the mission and increase DST space.
5. Sampling and Transport – Confirm tank waste is within chemistry control and prepare to feed to the WTP.

This section includes the catalog sheets for near-term projects that fall under the MTW functional area.

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Advancement of the DST nondestructive examination program through development of a more versatile and capable inspection technology. Faster and more comprehensive inspection of the DST primary tank wall, including welds and heat affected zones, could be realized.

Improved Inspection Methods for DST Primary Tank Walls

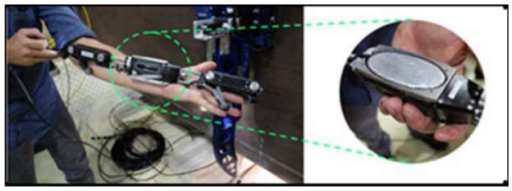
TEDS ID: MTW-10 **Timetable: > 5 Years**

TECHNOLOGY NEED

An addition to the DST nondestructive examination program through development of a more versatile and capable inspection technology is needed. Limited corrosion data for welds and heat-affected zones was identified as a contributing deficiency. Advancement of the double-shell tank (DST) nondestructive examination program through development of a more versatile and capable inspection technology has been identified as a means to correct the deficiency. In doing so, faster and more comprehensive inspection of the DST primary tank wall, including welds and heat-affected zones, could be realized.

TECHNOLOGY SOLUTION

Numerous technologies may be available for this need including flash thermography (FT), guided ultrasonic (UT) waves, electromagnetic acoustic transducers (EMAT) and magnetostrictive. The candidate being initially targeted is a guided wave UT system that is a variation of technology that is being developed, along with robotics, for primary tank bottom inspection. The system would be initially limited to be a detection system. Once a flaw is generally detected, normal beam UT can be used to determine approximate dimensions.
In addition to the H2C development efforts, PNNL was funded in FY24 to begin work on three sidewall inspection technologies; Guidedwave phased array UT, EMAT, and magnetic flux leakage (MFL).



Guidedwave Phased Array sensor currently in development for under-tank inspection

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

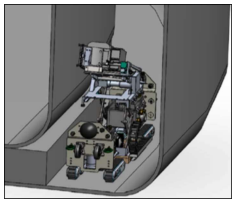
H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-10 Continued

ADDITIONAL TECHNICAL INFORMATION

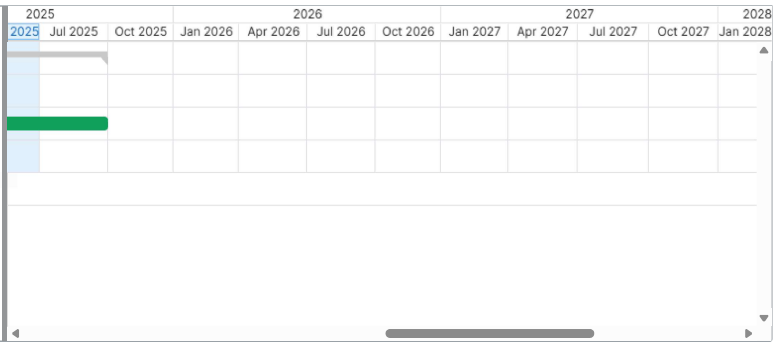
Tank sidewall inspection technologies would not only reduce risk to the Hanford infrastructure and maximize service life of the DSTs but it would also be appropriate to extend to other DOE sites with tank inspection programs.



Rendering of the Remote Robotic EMAT Volumetric Inspection System currently in development

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Improved Inspection Methods for DST Primary Tank Walls	1/31/24	9/30/25
FY24 GWPA Sidewall Performance Verification Testing	1/31/24	9/30/24
FY25 GWPA Robotic Integration	9/30/24	9/30/25
Magnetostrictive Demonstration	3/2/25	4/30/25



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Implement advanced ultrasonic testing (UT) techniques at the tank bottom to obtain quantitative data to validate the structural integrity in the bottom region of double-shell tanks (DSTs).

DST Primary Tank Bottom Volumetric Inspection

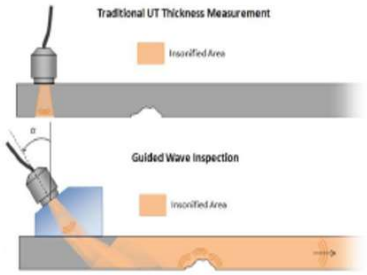
TEDS ID: MTW-11 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

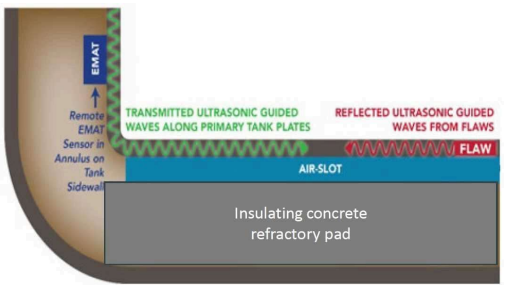
Currently, no technology is employed to quantitatively interrogate the integrity of the primary tank floor plates of the DSTs, which are physically inaccessible from the exterior of the tank and represent 90% of the tank floor. Development and deployment of such a technology would provide data to validate tank integrity through inspection of a suspect region where degradation understanding is limited.

TECHNOLOGY SOLUTION

The volumetric Ultrasonic Technology (UT) being proposed for this application falls under two categories: piezoelectric UT (shear wave, guided wave, and phased array) and electromagnetic acoustic transducers (EMAT) UT. Both methods propagate waves through the material being inspected giving data on the state of the plate as a whole rather than a single data point. The piezoelectric transducers are generally smaller and function at high frequencies. The challenge is that they require a couplant, which is often difficult for remote applications. EMAT requires no couplant because sound is generated in the part that is inspected and does not require a completely clean test surface. The challenge for EMAT is large size transducers and necessary additional signal processing.



Piezoelectric Ultrasonic Guidedwave



EMAT Wave Propagation

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

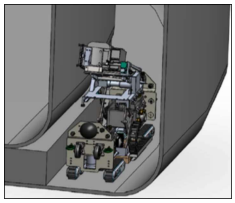
H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

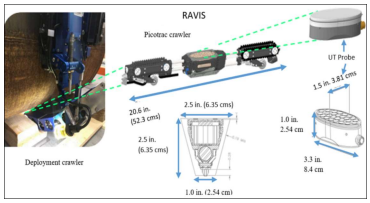
TEDS ID: MTW-11 Continued

ADDITIONAL TECHNICAL INFORMATION

Access to primary tank bottoms is extremely limited. Remote volumetric inspection devices, such as the EMAT, can take measurements from the annulus space by applying the EMAT to the lower portion of the primary tank wall and sending waves through the material to the bottom plates of the tank. Limitations to this inspection method are the size and location of risers as well as the impeding structures, such as pipes, in the annulus space. Inspection devices that cannot send waves through the curved knuckle of the primary tank, such as guidedwave phased array (GWPA) sensors, must couple directly to the primary tank bottom from the air-slots in the concrete refractory pad, on which the tank sits.



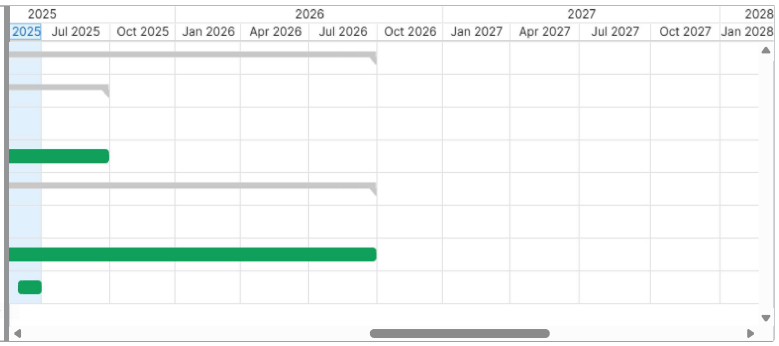
Remote Robotic EMAT Volumetric Inspection System (RREVIS)



Air-Slot Crawler of the Robotic Air-slot Volumetric Inspection System (RAVIS)

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
DST Primary Tank Bottom Volumetric Inspection	9/30/21	9/30/26
RREVIS Improvements	2/29/24	9/30/25
System Redesign and Fabrication	2/29/24	2/13/25
Performance Verification	2/16/25	9/30/25
RAVIS Data Analysis	9/30/21	9/30/26
PNNL Development Reports	10/1/23	2/28/24
PNNL Data Interpretation Optimization	9/30/21	9/30/26
GWPA Sensor Field Deployment	6/1/25	6/30/25



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

MEASURABLE ORGANIZATIONAL VALUE

Implementing the Remote Robotic EMAT Volumetric Inspection System (RREVIS) and the Robotic Air-slot Volumetric Inspection System (RAVIS) has the potential to provide the confidence in the material integrity of the existing DSTs needed to prevent the construction of an additional tank farm estimated at approximately $902.95 million and/or the knowledge of a material integrity issue prior to a potential release to the environment at a currently unknown cost.

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

NEAR TERM

This technology area supports the development of tank farm vapor monitoring, detection, and remediation system technologies (equipment and software).

Vapor Monitoring, Characterization & Remediation

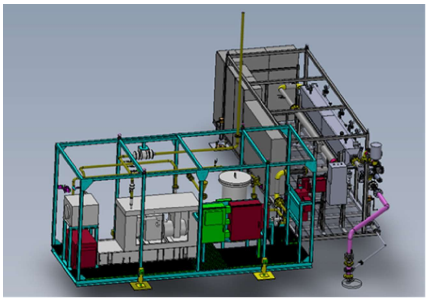
TEDS ID: MTW-24 **Timetable: > 5 Years**

TECHNOLOGY NEED

During work activities, it is desirable to quantify all known vapor sources (tank and fugitive emissions sources) and evaluate/investigate observed vapor situations, associated conditions, and provide a basis for resolution. The data/information gathered by various equipment in conjunction with dispersion modeling results supports three functional needs, namely: (1) a performance-based gas detection system designed to reduce risk by notifying/warning operations staff and workers during a potentially hazardous release event, (2) predictive tools for trending data analysis with dispersion modeling and forecasting events to assist work planning activities, and (3) characterization tools to describe tank farm vapor conditions. In addition, there is a need to mitigate vapors via destruction and filtration.

TECHNOLOGY SOLUTION

Technology development to support implementation of the recommended tank farm VMDS equipment/software is ongoing. Much of the down selected VMDS technologies, such as improved chemical and direct reading sensors (Ventis Pro5 and Radius BZ1) and ultraviolet differential optical adsorption spectroscopy (UV-DOA) stack monitors have been developed and deployed and are being continuously improved. The technology selected for vapor abatement, the NUCON Thermal Oxidation System, is being developed for demonstration on tank BY-108.



NUCON Thermal Oxidation Skid

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

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TEDS ID: MTW-24 Continued

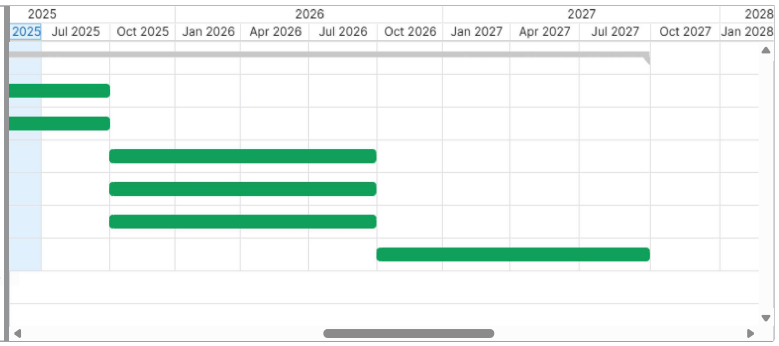
ADDITIONAL TECHNICAL INFORMATION

Radius BZ-1 Area Monitor

Ventis Pro 5 Personal Ammonia Monitor

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Vapor Monitoring, Characterization & Remediation	9/30/24	9/30/27
Control system software development, testing, & documentation	9/30/24	9/30/25
Procedure materials and initiate fabrication of TOS system, RPMS a..	9/30/24	9/30/25
Complete fabrication and factory acceptance testing of TOS, RPMS	9/30/25	9/30/26
Procure construction materials and perform construction	9/30/25	9/30/26
Complete test planning documentation for system testing at compl..	9/30/25	9/30/26
Complete testing, off-line analysis, data analysis and reporting	9/30/26	9/30/27



THREATS AND OPPORTUNITIES

WARR24-0032-T: Tank vapors

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Analytical methods need to be developed, standard reference materials are needed and new instrumentation is needed to facilitate addition of COCs to the list of calibrated compounds.

Analytical Method Development for Chemicals of Concern

TEDS ID: MTW-41 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Develop methods and/or improved detection limits to support tank characterization and flowsheet planning. The list of chemicals of concern (COC) contains many chemicals for which there are no qualified (calibrated) analytical detection procedures. Developing new analytical methods is very time consuming and must consider many factors including the health and safety of analytical laboratory workers who will be routinely implementing the procedures.

TECHNOLOGY SOLUTION

In FY22 WRPS identified a new method for organic analysis using extractive coatings on "stir bars" and carbon fiber strips. In this method, the solid extractants are contacted with a small volume of waste and allowed to equilibrate over a few hours. The twister bar and/or carbon fiber strip are removed and placed in a thermal desorption unit which volatilizes the organics and injects the concentrated sample into a gas chromatograph for analysis. Development work at the 222-S Laboratory starting in FY22 and continuing into FY25 has already demonstrated the method can detect many of the 132 target compounds at or below regulatory limits. In FY24 222-S Laboratory submitted a request to the Washington State Department of Ecology for full accreditation of the method for 32 constituents which can be analyzed and meet all applicable quality control criteria. Once accredited (anticipated to occur in FY25) for the initial 32 constituents, the process for accreditation of additional constituents within the target list of 132 will be streamlined.

WRPS, SRNL, and the 222-S laboratory are also collaborating to implement a method to differentiate between pertechnetate and non-pertechnetate forms ofTc-99 in Hanford tank waste. The method was originally developed and tested at the DOE's Savanna River Site, but has not been proven with Hanford wastes. Initial testing was completed in FY23 which demonstrated that speciation was possible but more development is needed.

Stirbar Extraction

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-41 Continued

ADDITIONAL TECHNICAL INFORMATION

Additional analytical method development funding would be directed toward the following:

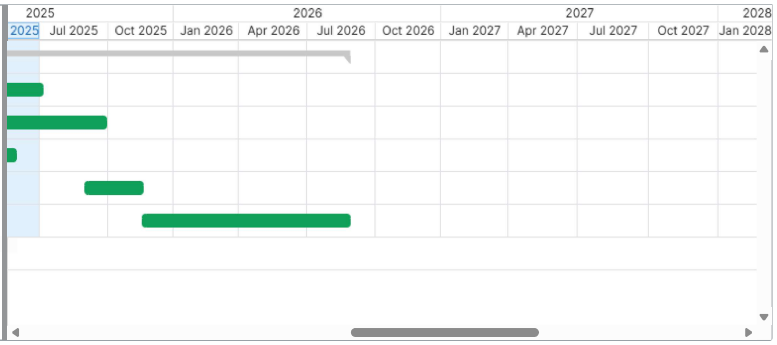
- Staff to identify alternative sources of standard reference materials
- The purchase of new sampling or trapping media
- Staff time to develop new analytical methods
- The coordination of supportive National Laboratory efforts
- The purchase, setup, and calibration of additional instrumentation

Carbon Mesh (top) and Stirbar (bottom) Coated with Organic Extractant and Placed Within a Thermal Desorption Tube

Thermal Desorption and Analysis on an Agilent 7890B Gas Chromatograph and Agilent 5977B Mass Spectrometer

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Analytical Method Development for Chemicals of Concern	11/12/24	8/27/26
PBC Analysis	11/12/24	7/7/25
Nitrosoamine Analysis	1/8/25	9/30/25
SVOA Analysis	2/2/25	5/29/25
Reporting	9/1/25	11/17/25
State Accredidation	11/16/25	8/27/26



THREATS AND OPPORTUNITIES

WARR24-0036-T: Unexpected field conditions

LYSM-0012-T: Unexpected Field Conditions (Included)

MEASURABLE ORGANIZATIONAL VALUE

Detecting additional chemicals of concern will allow for the use of grout solidification, rather than vitrification. The total savings from constructing and using a grout facility rather than a vitrification facility are estimated to be about $31 billion (un-escalated) and $95 billion (escalated). Using a grout facility in lieu of a vitrification facility would also save about 11 years time treating all tank waste and about 13 years time completing all SST retrievals.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Resolving Criticality Safety Concerns with Plutonium-Bismuth Particles

TEDS ID: MTW-70 **Timetable: ≤ 5 Years**

NEAR TERM

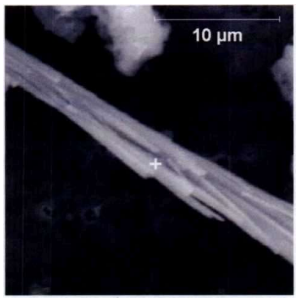
Plutonium-Bismuth particles in the waste samples create criticality safety concerns with potential for unsafe fissile accumulations during tank retrievals. To support required criticality safety evaluation, the Pu-Bi particles need laboratory studies to determine their processing origins or the mechanisms by which they formed.

TECHNOLOGY NEED

Plutonium-Bismuth (Pu-Bi) particles are found in some waste samples and create safety concerns because of potential that such large, dense plutonium particles might segregate during waste retrievals and accumulate to cause a nuclear criticality accident. Laboratory work is needed to find the processing origin or an in-tank formation mechanism for Pu-Bi particles. Identifying the origin of the Pu-Bi particles will provide the basis for required criticality evaluation determining that tank retrieval operations will be safe. Special concerns arise with the potential that the Pu-Bi bearing waste in tank SY-102 might need to be retrieved under emergency conditions if that tank starts leaking. Retrieval options are limited because it is one of only three DSTs in the 200 West Area. The proposed laboratory work is needed to establish the origin or formation mechanism of the Pu-Bi particulate as a necessary input to a safety evaluation allowing retrieval of the SY-102 DST.

TECHNOLOGY SOLUTION

The criticality safety concerns with Pu-Bi particles and especially their origin were identified a decade ago, but a recent postulate is that these particles may have been formed by galvanic deposition of soluble bismuth onto plutonium particles while in the waste tanks. The criticality concerns would be alleviated if laboratory studies can confirm the postulated galvanic deposition mechanism for the Pu-Bi formation. Proposed laboratory studies are detailed in RPT-RPP-63693 and might first profile the Bi deposition within available Pu-Bi particles. This profiling requires measuring Bi concentrations on tiny nanometer scales. Results showing Bi presence only near the particle surfaces would support the galvanic deposition postulate. Depending on initial results further studies are proposed such as to synthesize the Pu-Bi particles in the laboratory to confirm the formation mechanism.



Micrograph of a Pu-Bi Particle.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

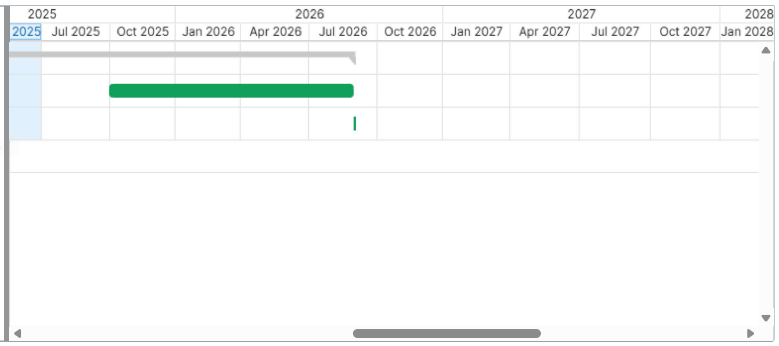
CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-70 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Resolving Criticality Safety Concerns with Plutonium-Bismuth Par...	9/30/25	9/1/26
Initial Laboratory Studies	9/30/25	8/31/26
Evaluate Need for Additional Studies	8/31/26	9/1/26



THREATS AND OPPORTUNITIES

DAO24-0021-T: Waste Characterization Change

DSTI24-0001-T: DST Tank Failure

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Provide CAM technology to minimize the need for operations and maintenance personnel to service the equipment during daily rounds.

Continuous Air Monitor Remote Observation

TEDS ID: MTW-72 **Timetable: > 5 Years**

TECHNOLOGY NEED

Continuous air monitors (CAMs) are inspected during daily surveillance rounds and weekly/biweekly maintenance rounds. This potentially exposes numerous operations, maintenance, and safety personnel to radiation and industrial (self-contained breathing apparatus) hazards. Finding a solution to reduce or eliminate the need for daily surveillance rounds and limiting the number of farm entries for maintenance would reduce potential worker exposure and improve exposures to as low as reasonably achievable. In addition, the method to analyze, determine, and report on emissions monitoring is time-intensive; having an automated system to analyze emissions would improve worker efficiency.

TECHNOLOGY SOLUTION

Work has begun to test an alternate CAM to resolve on going exhauster reliability issues in both SSTs and DSTs.

Desired improvements for the system are:
- Remote indication of CAM operability.
- Reduce the need for surveillance and service.
- Allow more frequent verifications that emissions are within regulatory limits.

Advetage Solutions RPC-1000 Versatile Radiation Processing Controller (RPC)

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

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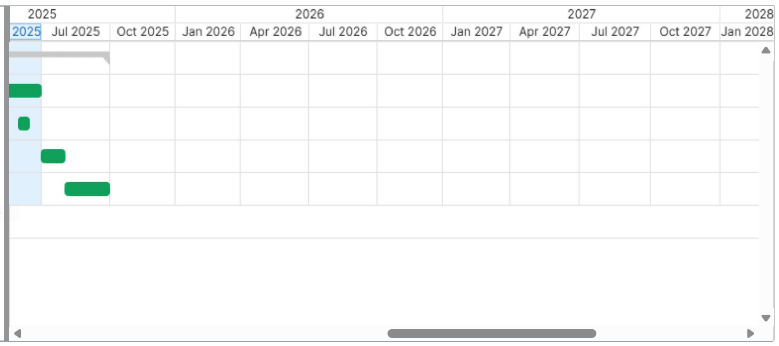
TEDS ID: MTW-72 Continued

ADDITIONAL TECHNICAL INFORMATION

WRPS Engineering is working on the documents to allow the field installation of the new CAM's for testing. With the environmental group's approval, target dates for logic changes and procedure updates will be established. These dates will drive installation and testing in the field with the goal of field testing in July of 2025 and published results by October. Once the results have been reviewed and the system performs as expected, documentation for replacing the existing CAM's across the complex will start.

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Continuous Air Monitor Remote Observation	1/5/25	9/30/25
CAM Procedure Updates	1/5/25	6/30/25
CAM Field Installation	6/1/25	6/12/25
CAM Field Testing	6/30/25	7/31/25
CAM Field Test Analysis and Reporting	7/31/25	9/30/25



THREATS AND OPPORTUNITIES

WARR24-0032-T: Tank vapors

MEASURABLE ORGANIZATIONAL VALUE

TBD

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NEAR TERM

Using the Raman Spectroscopy, Laser-induced breakdown spectroscopy, multi-isotope process (MIP) method to develop a real-time, online monitoring system of tank waste.

Online Monitoring

TEDS ID: MTW-76 **Timetable: ≤ 5 Years**

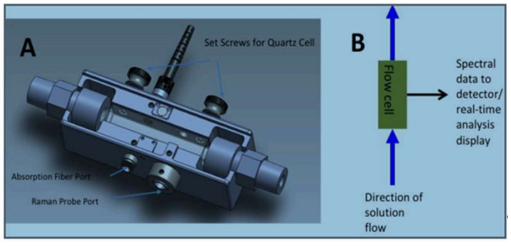
TECHNOLOGY NEED

Process control for direct-feed low-activity waste (DFLAW) operation relies on process sample collection and analysis for composition information. The process cycle times for many vessels in the Low-Activity Waste Vitrification Facility and Effluent Management Facility is very short, requiring an increased number of samples to support operations. Additionally, the sampling and analysis duration coupled with the increased number of samples will challenge operations. This burden on the laboratories and impact on the process cycle time has the potential to impact operational throughput.

TECHNOLOGY SOLUTION

Applying a combination of automated material balances with selected real-time in-line monitoring with laser-induced breakdown spectroscopy (LIBS) or Raman probes, will reduce the number of samples required and avoid process delays due to time-consuming sample analysis. Proven analytical modeling techniques can be adopted for use with the unique Hanford Site tank treatment matrices and analytes and for application to radioactive operations. The goal of the technology development is to limit sampling and analysis to periodic verification and confirmatory sample collection and time-consuming conventional analysis while maintaining compositional uncertainties within acceptable levels. Any implementation of real-time process control instrumentation requires an understanding of uncertainties and their impact on modeling (e.g., glass models).

PNNL has DOE-EM funding to pursue the development of a deployment method for several waste characterization sensors at Hanford. Additionally, a multi-lab effort to develop new and innovative sensors for the Hanford site is being funded by DOE-EM and lead by LANL.



a) drawing of cell holder b) schematic of how flow cell can be integrated

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-76 Continued

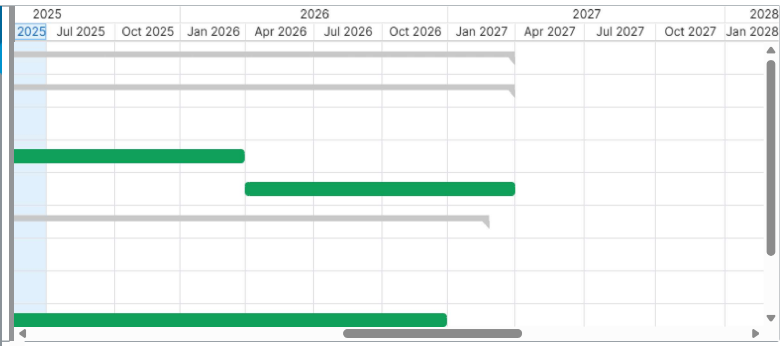
ADDITIONAL TECHNICAL INFORMATION

The Raman method and system will be made of commercially available hardware and chemo-metric analysis software developed at Pacific Northwest National Laboratory. Testing has been carried out on tank waste simulants and real waste samples from the Radioactive Waste Test Platform.

LIBS probe

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Online Monitoring	3/31/24	3/31/27
PNNL: Comprehensive On-line Monitoring	3/31/24	3/31/27
Identify, procure, and perform off-line testing of sensors	3/31/24	3/31/25
Engineer and Prepare Sensors for Integration in Skid Platform	3/31/25	3/31/26
Integrate Sensors onto Skid Platform and Perform Testing	3/31/26	3/31/27
LANL: Real-Time In-Line Monitroing for Hanford Tank Waste Tre...	4/14/24	2/25/27
CRESP/Georgia Tech: Sensor Fusion in Slurry	4/30/24	4/30/25
SRNL/FIU: Simulant development and Test ReactIR probe	4/30/24	4/30/25
Develop Enhaned LIBS Techniques	4/14/24	12/31/26
Accoustic Characterization of Slurries	4/30/24	2/25/27
Flow Loop Testing	8/19/24	6/30/26



THREATS AND OPPORTUNITIES

DAO24-0019-O: Live Process Monitoring to Reduce Sample Analysis Needs
EAO24-0012-T: Enrafs, High Level Probes, or Other Monitoring Equipment Become Inoperable or Obsolete
EAO24-0047-O: Reduce Field Surveillances with Automation
WAO24-0008-T: Enrafs, High Level Probes, or Other Monitoring Equipment Become Inoperable or Obsolete

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Reduce Data Collection Entries into Tank Farms

TEDS ID: MTW-79 **Timetable: ≤ 5 Years**

This technology seeks to reduce worker exposure to radiation by providing a virtual alternative to farm entries. Workers can use this tool to remotely enter a tank farm, equipped with the necessary sensors to perform data collecting, sampling, monitoring, and visual inspection of equipment.

Potential solutions include commercial-off-the-shelf wheeled and quadruped platforms, each with strengths and opportunities. Current efforts focus on demonstrating and testing these technologies on simulated farm environments and incorporating the operators' feedback on their operability, performance, and safety.

TECHNOLOGY NEED

Multiple tank farm routine and emergent operations require field crews to physically enter the farms to perform direct physical data collection and monitoring activities. These daily entries include operator rounds, vapor tracking in worker breathing zones, engineering walkdowns and radiation control monitoring. Each of these activities involve exposure to radiation, adding to the worker's dosage.

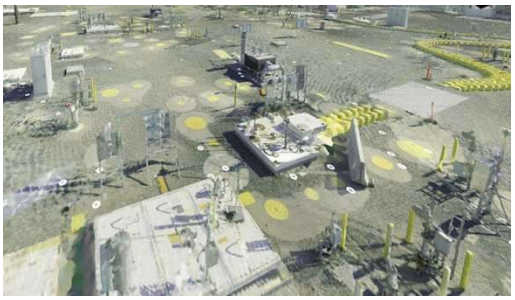
Complying with the ALARA principle drives the need for incorporating technologies that minimize this potential worker exposure by reducing the number of entries into the farms. A solution to this need would require a sensor-equipped, remote, mobile platform which operators can use as tool to perform tasks from outside the farm perimeter.

To be the most effective and flexible, this tool should leverage the worker's expertise by being driven remotely by operators, or autonomously as required. This would provide the option to perform a farm-entry task virtually rather than physically. The application of this technology would save an estimated 50mRem per month.

TECHNOLOGY SOLUTION

The solution being explored is based on adapting commercial-off-the-shelf mobile platforms to tank farm needs. Partners in industry and academia have made their robotic units available for testing and demonstration of their navigability, control, obstacle avoidance and safety features, as well as task-specific data collection, visual inspection, and monitoring capabilities. The main unit being researched is the Boston Dynamics Spot Quadruped, as it is able to step over obstacles, unlike traditional wheeled platforms. Other relevant advantages of a quadruped include its natural ability to change viewing angles by tilting its body and the onboard camera, and the incorporation of a mounted manipulator.

Planned testing and demonstration efforts deploy an operator-controlled farm monitoring tool, assisted in its navigation by the Spot's GPS waypoint capabilities. The intent is not to perform a fully automated routine, but rather to have a hybrid or semi-autonomous control. Spot would then traverse a simulated farm around its pits, barriers, and other above-grade equipment until the target is reached, at which point, and operator can confirm visual inspection or reading of equipment.



Example of tank farm environments and obstacles to be navigated by remote platforms

Husky Autonomous Instrumented Vehicle by Clearpath

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

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TEDS ID: MTW-79 Continued

ADDITIONAL TECHNICAL INFORMATION

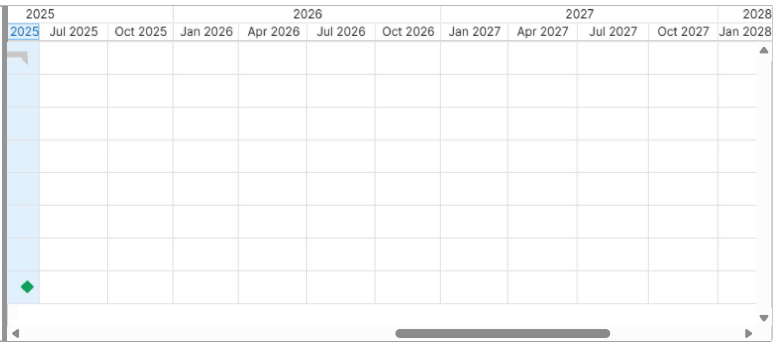
The commercial-off-the-shelf tools identified have the flexibility to be applied in a variety of applications and deployed through multiple control methods. Adapting these to the tank farms requires identifying specific needs for operation and control that will be required at deployment. Currently identified requirements include waypoint-based or and remote-controlled navigation, wired communication, manipulation envelope to move a sensor from the ground to human breathing zone height, outdoor- and weatherproofing, smart recharging at low battery, and collision avoidance among others.

Example Quadruped Robot with Instrument Pack

Example Quadruped Robot with a sensor mounted on a manipulator arm

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Reduce Data Collection Entries into Tank Farms	12/8/24	6/16/25
Spot Tank Farm Remote Entry Demo	12/8/24	1/14/25
Develop Tank Farm entry demonstration Requirements	12/8/24	12/19/24
Conduct Tank Farm Entry demo at vendor facility	1/14/25	1/14/25
Spot Instrumentation Demo	2/16/25	5/14/25
Gather Relevant Instrumentation for Spot Demo	2/16/25	3/13/25
Conduct Spot Instrumentation Demo at CTF	5/13/25	5/14/25
FIU Summer Internship Deployment	6/15/25	6/16/25



THREATS AND OPPORTUNITIES

WARR24-0032-T: Tank vapors

MEASURABLE ORGANIZATIONAL VALUE

Implementing an remote monitoring Robotic Platform will save $141,400 annually, per farm. The platform will pay for itself in 2.4 years or 376 events.

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US DEPT OF ENERGY

NEAR TERM

Methods to alter environmental conditions beneath the secondary liner are required. Technology to dry out the under tank environment or otherwise make the environment protective of the carbon steel secondary liner bottom should be developed to ensure long-term availability of the DSTs.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Secondary Liner Bottom Damage Mitigation Technologies

TEDS ID: MTW-83 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

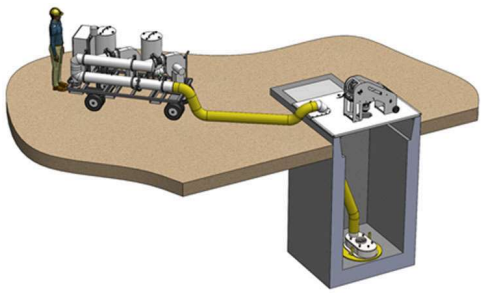
Devices or systems to install on existing double-shell tank (DST) systems to cease moisture accumulation in the tertiary leak detection system and foundation space beneath the secondary liner. This technology needs to dry out the foundation space and/or otherwise prevent continued exposure of the secondary liner to corrosive conditions.

TECHNOLOGY SOLUTION

After the initial design of a special tool to isolate the leak detection pit (LDP) and modeling and evaluation for possible structural concerns, implementing a positive pressure test would encompass the following:
- Conduct a visual inspection of the tertiary leak detection system (via the Inuktun Versatrax marsupial crawler system)
- Install a positive pressure nitrogen purge system on the LDP capable of maintaining the tank tertiary atmosphere (i.e., the space between the secondary liner and the concrete foundation/shell) at a slight positive pressure relative to ambient.
- Monitor changes in water intrusion (via a camera on the LDP drain line and/or LDP liquid level).
- Monitor conditions in the LDP (i.e., verify slight positive pressure when the fan is on and slight negative when the fan is off, humidity, temperature).

Additional technology to investigate is Electro Osmotic Pulse.

Details can be found in RPP-PLAN-60778, *Double-Shell Tank Tertiary Leak Detection System Investigation and Mitigation Plan*.



Pit Pressurization and Monitoring System

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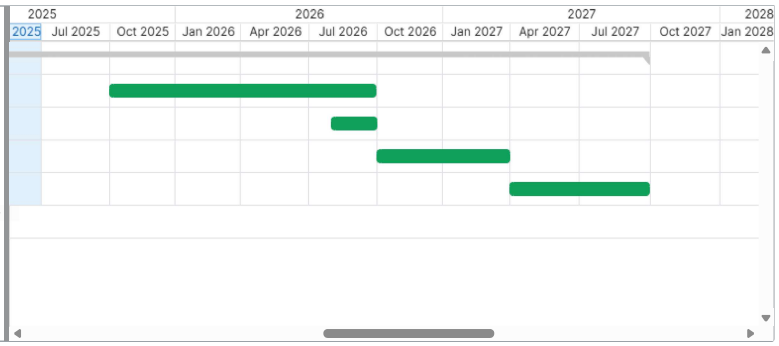
TEDS ID: MTW-83 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Secondary Liner Bottom Damage Mitigation Technologies	9/30/25	9/30/27
Develop LDP system	9/30/25	9/30/26
Conduct a visual inspection of the tertiary leak detection system	8/2/26	9/30/26
Install in SY Farm	9/30/26	3/31/27
Monitor system results	3/31/27	9/30/27



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Tank Failure

MEASURABLE ORGANIZATIONAL VALUE

TBD

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US DEPT OF ENERGY

NEAR TERM

The Hanford Fitness for Service program has no readily deployable solution to inspect and identify pipeline failure mechanism locations in pipe lines under 3". A tool to travel through a pipeline and provide a condition assessment in 2" pipelines is needed to expand current understanding of pipeline failure phenomenon.

Pipeline Forensic Inspection Technology

TEDS ID: MTW-84 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Visual and volumetric inspection capability delivered remotely through 2in. SCH 40 waste transfer lines in the tank farms is needed.

TECHNOLOGY SOLUTION

The proposed technology solution will enter a waste transfer line via a nozzle penetration of a pit. The device would be either self-propelled with a lightweight tether or driven from a push-pull system with a more rigid tether. The end of this inspection tool would be comprised of a visual inspection camera with pan/tilt functionality and lighting adjustment. Future iterations of the tool could include volumetric inspection sensors such as an eddy current probe or guided wave ultrasonic transducers.
Development of a tool for a 3" transferline was completed in FY23.

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Versatrax 100 for Inspection of Small Pipe and Ducts

Self-Propelled Pipe Crawler with Camera Attachment

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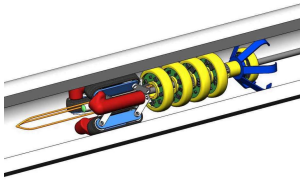
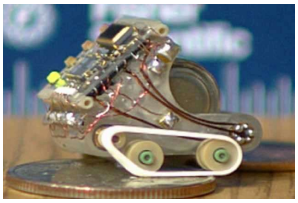
TEDS ID: MTW-84 Continued

ADDITIONAL TECHNICAL INFORMATION

In FY23, Sandia National Laboratories (SNL) was awarded DOE-HQ funding for their Self-Propelled Interior Inspection of Networks of Small Pipes (SPIINe) project. SNL's proposal is "to develop and demonstrate a novel capability to access and couple sensors to small-diameter enclosed spaces (e.g. 2" and 3" pipes), in order to enable visible and volumetric (e.g. guided wave) inspections."
Quote and photos from Sandia National Laboratories DOE-HQ proposal; *Self-Propelled Interior Inspection of Networks of Small Pipes (SPIINe)* May 2023 Principal Investigator: Stephen Buerger.



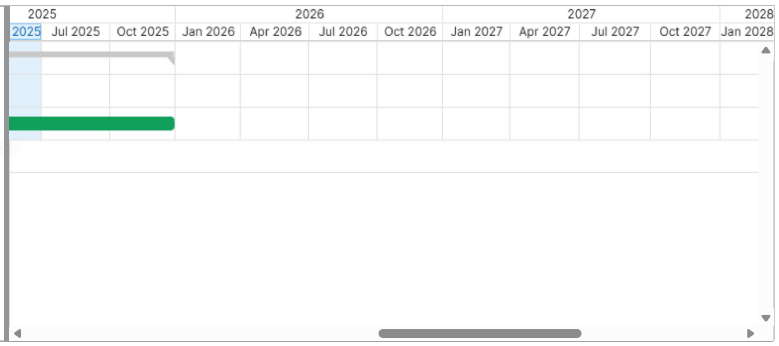
Concept Sketch of modular, low-profile, robotics-enabled inspection system



Fully integrated micro tracked robot

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Pipeline Forensic Inspection Technology	12/31/23	12/31/25
Robotics development for traversing 2" pipelines	12/31/23	12/31/24
Improve Robotics and Sensor Integration	12/31/24	12/31/25



THREATS AND OPPORTUNITIES

TLI24-0001-T: Waste Transfer Line Failure While Operating

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

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NEAR TERM

Deployment of corrosion monitoring and mitigating technologies would provide real time data to ensure localized corrosion is minimized in the DSTs and at ETF. Investigations into Cathodic Protection for the DSTs including tank modeling and testing are being conducted by DNV in Ohio.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Real-Time Localized Corrosion Monitoring and Mitigation

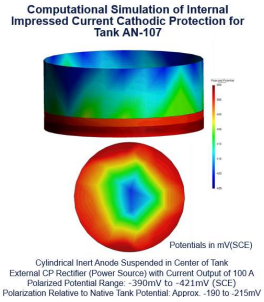
TEDS ID: MTW-87 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Currently, no technology is employed to perform real time monitoring or mitigating of tank waste localized corrosion (i.e., pitting) in the DSTs or at Effluent Treatment Facility (ETF). Development and deployment of such technology would provide valuable information on localized corrosion in the DSTs and the ETF. An added benefit of deploying real time corrosion monitoring in DSTs would be the ability to monitor changes in corrosion rates due to various tank operations such as waste transfers and chemistry additions to meet the new corrosion control limits. Such a technology could identify potential corrosion at the ETF during processing and allow for operational changes or the implementation of a mitigation technology. Investigation of both monitoring and mitigating technologies are recommended by the Tank Integrity Expert Panel – Corrosion Subgroup.

TECHNOLOGY SOLUTION

As a mitigating technology, cathodic protection methods and their impacts are currently being tested at DNV. Cathodic protection is a commonly used method to protect infrastructure from corroding. The application to Hanford tanks is additionally complicated due to the unique chemical characteristics of each tank.



Computational Simulation of Internal Impressed Current Cathodic Protection for Tank AN-107

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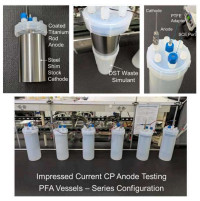
TEDS ID: MTW-87 Continued

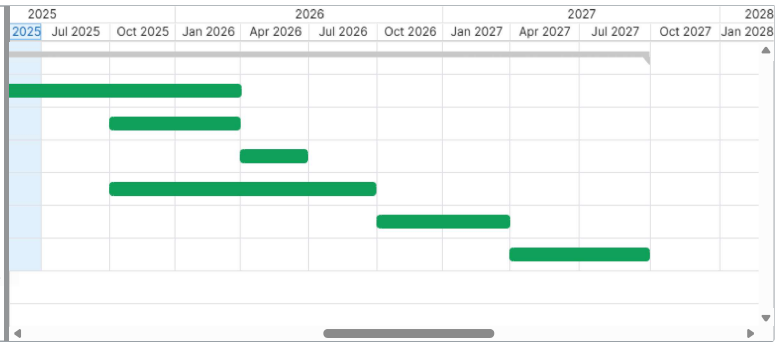
ADDITIONAL TECHNICAL INFORMATION



Current Anode Test Setup at DNV

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Real-Time Localized Corrosion Monitoring and Mitigation	4/30/25	9/30/27
Testing on Engineering Scale Mock-Up	4/30/25	4/1/26
Evaluate Other Anodes	9/30/25	3/31/26
Test alternate Anodes	3/31/26	6/30/26
System Conceptual Design	9/30/25	9/30/26
Prototype Fabrication	9/30/26	3/31/27
Testing	3/31/27	9/30/27



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

MEASURABLE ORGANIZATIONAL VALUE

The ability to monitor corrosion in real time, would provide information that could allow for early mitigative actions and prevent the necessity of building a new tank farm, estimated at approximately $902.95 million, or a release to the environment at a currently unknown cost.

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

NEAR TERM

CTO has identified Laser Ablation Technology (LAT) as a solution for this technical need. LAT provides multiple advantages over conventional forms of metal cleaning (sandblasting, needle guns, chemical treatment, or other abrasives) and significantly reduces waste as there are little to no contaminated materials generated.

Remote Concrete Surface Cleaning Apparatus

TEDS ID: MTW-89 **Timetable: > 5 Years**

TECHNOLOGY NEED

Waste transfer pits and ceiling cover blocks are required by WAC-173-303 to be painted with a special protective coating (SPC). Pit surfaces must often be cleaned, prepped, repaired, re-coated with the SPC before being inspected by means of high-quality digital photographs. The first stage of this process, cleaning and surface prepping, would traditionally require entering the pits and using mechanical systems i.e., grinders, sand blasters, or similar tools. These physical entries into the pits produce high dosage to workers, introducing the need for a remote alternative to cleaning concrete pit wall and cover surfaces.

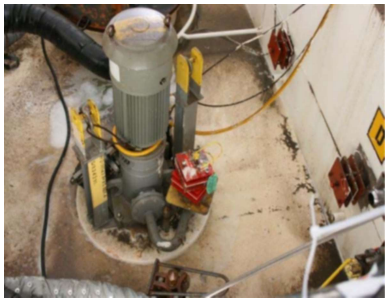
A technology is needed to allow for cleaning these concrete walls without entering the pits. Due to the remote aspect of this need, the applied technology is suited for tooling that does not require high forces for application. Additionally, a technology is preferred that can perform cleaning without damaging the underlying infrastructure and equipment and without generating additional waste.

TECHNOLOGY SOLUTION

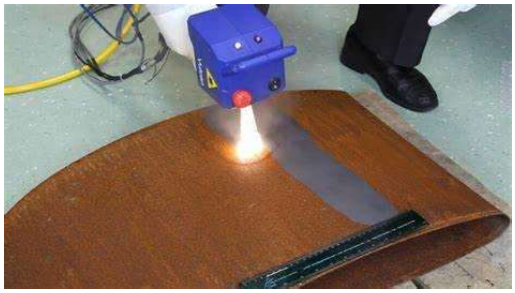
CTO has identified Laser Ablation Technology (LAT) as a solution for this technical need. LAT provides multiple advantages over conventional forms of surface cleaning (sandblasting, needle guns, chemical treatment, or other abrasives) and significantly reduces waste as there are little to no contaminated materials generated.

Although LAT has been used on contaminated and coated concrete in many industries, specific studies have not been conducted for ablating the specific coating/substrate interfaces common to Hanford Pits. Tahe LAT project's current efforts focus on acquiring and testing a system that is calibrated to these specifications. An award has been placed for the testing and refinement of Laser Ablation parameters for these representative combinations, which include epoxies on concrete, mineral deposits on stainless steel, and salt precipitates on carbon steel.

Future phases of the Laser Ablation project will focus on adapting and deploying a Laser Ablation tool for Hanford use. This development may include a system capable of performing this work remotely. A possibility to be explored is mounting a LAT tool as an end effector for a robotic arm, leveraging other pit repair work efforts that use these collaborative robotic platforms.



Typical Transfer Pit Configuration showing areas that require cleaning



Example cleaning application using Laser Ablation

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

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TEDS ID: MTW-89 Continued

ADDITIONAL TECHNICAL INFORMATION

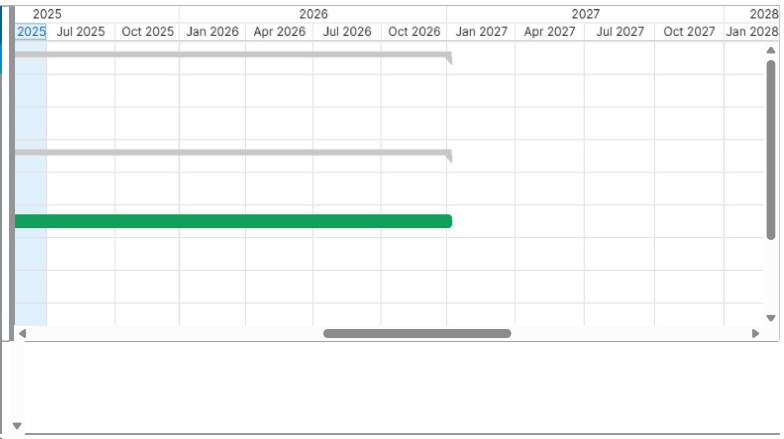
H2C has partnered with Hanford's 222-S lab to develop artificially coated coupons with a layer of simulated tank waste. These test samples will allow WRPS and future LAT vendors to physically test their equipment in a realistic target and to calibrate the lasers parameters to the appropriate abrasion threshold. Current test coupons include eleven A515 GR60 carbon steel plates (3 in. by 3 in., 1/4 in. thick) and a pipe assembly consisting of a schedule 40, 1 in. diameter steel pipe with elbows on either side. The salt simulant is based on Tank 241-SY-101's (SY-101) composition as reported from 2018's TBI Grab Sampling. More coupons will be generated in FY25 to test LAT on concrete for pit surface cleaning applications.

Coupons covered with salt waste simulant for Laser Ablation Testing

Pipe covered with salt waste simulant for Laser Ablation Testing

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Remote Concrete Surface Cleaning Apparatus	1/8/24	1/7/27
Laser Ablation Vendor Demonstration	1/8/24	1/10/24
Develop Test Coupons	7/24/24	12/5/24
Laser Ablation Contract Award	4/28/24	1/7/27
Obtain Laser Ablation Technology EOIs	4/28/24	5/16/24
Develop Procurement Documentation	10/6/24	1/7/27
Submit Laser Ablation Technology RFP	3/2/25	3/13/25
Receive Proposals	4/6/25	4/7/25
Complete Evaluations	5/11/25	5/15/25
Award Subcontract / Amendment	5/21/25	5/22/25
Develop Testing Procedure for Laser Ablation Technology	5/25/25	6/26/25
Develop Testing Plan for Laser Ablation Technology	6/29/25	7/3/25



DAOR24-0016-T: Pit Corrosion

DSTI24-0001-T: DST Failure

TLI24-0001-T: Waste Transfer Line Failure While Operating

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

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NEAR TERM

Double-shell tank (DST) refurbishment technologies are vital in case the tank liner experiences extreme wall thinning. Several refurbishment technologies have been screened through an evaluation process as presented in RPP-RPT-62020. These technologies are modifications of existing proven commercial systems. Their development would support the Hanford mission and could help avoid new tank construction.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

Tank Refurbishment

TEDS ID: MTW-92 **Timetable: ≤ 5 Years**

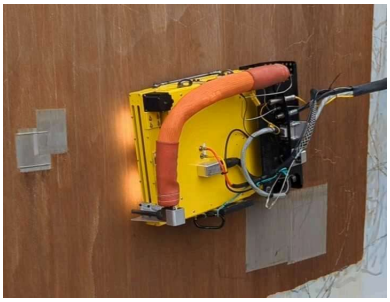
TECHNOLOGY NEED

Hanford's double-shell tanks (DSTs) have a mission-essential role associated with the Waste Treatment and Immobilization Plant. Since the current waste treatment mission extends beyond the design life of the existing double-shell tanks, refurbishment technologies are being pursued in case the tank liner experiences extreme wall thinning.

TECHNOLOGY SOLUTION

Based on the assessment provided in RPP-RPT-62020, a three-pronged technology development approach was recommended to address a range of refurbishment needs. Bottom sealant application was identified as a promising, purpose-driven refurbishment technologies that could be used to build up the bottom thickness of a primary tank. A magnetic patch was identified as a short-term technology for expedited deployment to a location on the primary tank wall that is at risk of breach. And lastly, cold spray application was identified as a long-term, proactive endeavor that could build up the primary tank wall or annulus floor prior to realizing through-wall penetrations.

Cold Spray Floor-Crawler System



Cold Spray Wall-Crawler System

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TEDS ID: MTW-92 Continued

ADDITIONAL TECHNICAL INFORMATION

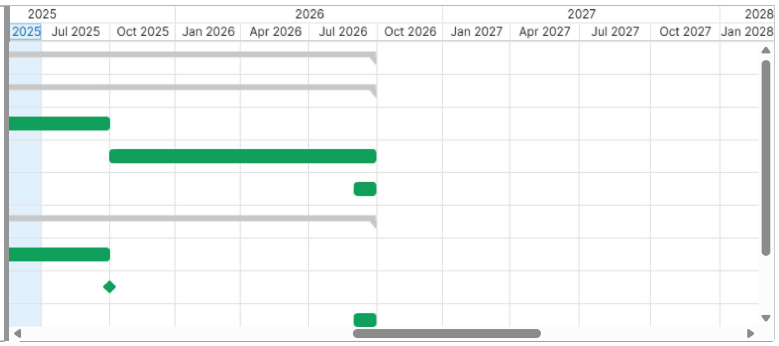
Technology development for all of the proposed technologies will include, as appropriate:
- Optimized deposition parameters (e.g., effects of substrate preparation)
- Mechanical, physical, and/or chemical property evaluation
- Technology delivery (e.g., robotic deployment, size restrictions, etc.)
- Allowance for non-destructive evaluation assessment of a solid phase refurbishment

Potential Bottom Sealant Materials

Potential Magnetic Patch Technologies

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Tank Refurbishment	9/30/24	9/30/26
Bottom Sealant	9/30/24	9/30/26
Material Investigation & Testing	9/30/24	9/30/25
Continue Material Investigation & Testing	9/30/25	9/30/26
Small Scale Demonstration	8/31/26	9/30/26
Magnetic Patch	9/30/24	9/30/26
Material Investigation & Testing	9/30/24	9/30/25
Develop Deployment Method	9/30/25	9/30/25
Large-Scale Demonstration	8/31/26	9/30/26
Cold Spray	9/30/24	9/30/25
In-Field Deployment	9/30/24	9/30/25



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

MEASURABLE ORGANIZATIONAL VALUE

Implementing the Cold Spray technology would save approximately $899.46 million by extending use of current DSTs and preventing the need to construct an additional tank farm.

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NEAR TERM

Internal Data Access & Visualization (IDAV)

TEDS ID: MTW-94 **Timetable: ≤ 5 Years**

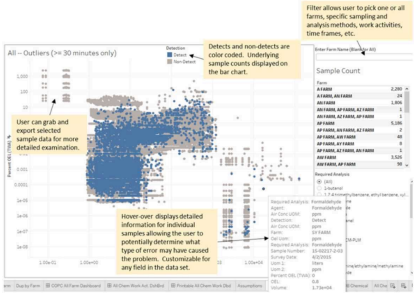
Web-based application that provides IH users with access to historical and current vapor sampling and monitoring data. The application would provide intuitive tools for data analysis, exposure assessments, supporting development of hazard controls. The application also provides tools for visualizing and analyzing data from personal ammonia monitors and Gastronics fixed instrument skids.

TECHNOLOGY NEED

Technology development and adaptation are needed to improve efficiencies of current processes, procedures and equipment to protect tank farm workers. Step-change improvements in worker efficiencies will be needed to achieve the increased pace of operation associated with full operations of the Waste Treatment and Immobilization Plant. An example of such technology is the industrial hygiene (IH) internal data analysis and visualization (IDAV) platform. Although deployment of the IDAV has greatly improved IH data collection and assessment it needs further optimization to provide the level of worker protection desired.

TECHNOLOGY SOLUTION

Future development needs for the IDAV platform include:
- Complete in-farm surveillance tools
- Complete asbestos tools
- Develop system for automation of information collection into IDAV (e.g., iNet)
- Maturation and development of new tools supporting industrial scientific equipment (Ventis - iNet Now, Radius)
- Develop method for exporting IDAV (Radius) data to IDMS
- Exposure assessment updates to include resolution of data duplicates and NULLs, data conditioning review, data sync enhancements, comparison function, sample data refinement
- Develop and maintain "watchdog" functions to alert developers and users to potential off-normal activity in the data
- Maintain data warehouse for data retention and archival for all datasets (data storage & archival, data access, etc.)
- Develop data collection & planning framework capability to extend auto login capability to other IH data collection efforts



Error Detection and Outlier Analysis (OEL Basis)

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

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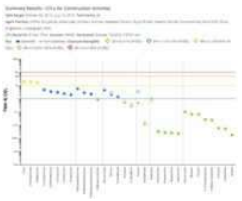
TEDS ID: MTW-94 Continued

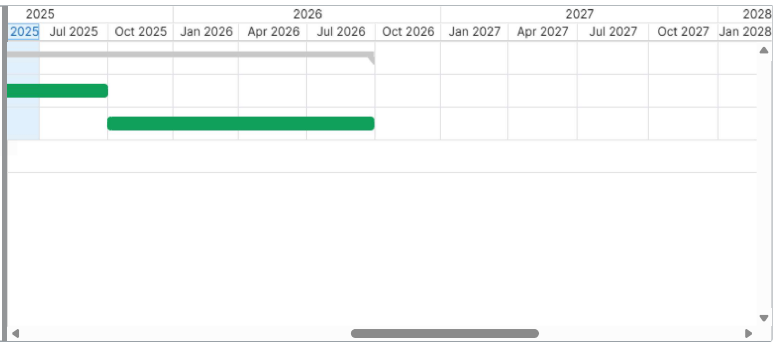
ADDITIONAL TECHNICAL INFORMATION



Upper Tol Limit Summary Results by Work Activity (Const in AX Farm)

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Internal Data Access & Visualization (IDAV)	9/30/24	9/30/26
IDAV and Tableau tools development and testing	9/30/24	9/30/25
IDAV and Tableau tools development and testing	9/30/25	9/30/26



THREATS AND OPPORTUNITIES

GMAIN24-0027-T: Conflicting Results for Asbestos Sampling (Main R)

WARR24-0032-T: Tank Vapors (Included)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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NEAR TERM

The DFAS compiles vast amounts of dynamic data and delivers it in an easily understandable dashboard monitor.

Predicting Tank Farm Vapor Conditions

TEDS ID: MTW-95 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Based upon the existing DFAS, develop an integration of real-time vapor and meteorological data to predict tank farm vapor conditions (i.e., plume location or transient vapor concentrations) in the tank farm work areas. The Data Fusion and Advisory System (DFAS) is 1 of the 15 technologies identified during the Chemical Vapors Solutions Team (CVST) evaluations. DFAS will use a chemical vapor release and response software system to gather and assimilate real-time data from detection/monitoring technologies (new and existing) to predict tank farm vapor-related conditions. A goal of this integrated system is to develop means to predict potential exposure scenarios and establish preemptive mitigating actions.

TECHNOLOGY SOLUTION

The DFAS will be able to correlate data from the multiple vapor sources and other vapor-related instruments, allowing users to study the factors present when the field conditions change in real-time. The system will allow Hanford tank farms central shift office staff and field workers to track and trend vapor source data and to potentially predict future vapor source concentrations and weather conditions in work spaces and locations based on historical and real-time field-based data. Dashboard graphics will provide at-a-glance data displays indicating current conditions and potential risks.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

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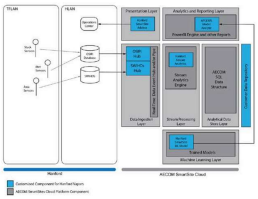
TEDS ID: MTW-95 Continued

ADDITIONAL TECHNICAL INFORMATION



SmartSite Solution Components

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Predicting Tank Farm Vapor Conditions	2/2/22	9/30/26
Transition to Hanford Azure	9/30/22	11/1/22
Upgrade for Security	1/31/25	4/30/25
Transition to HLAN	2/2/22	4/14/25
Add an Administration Page	2/2/22	2/2/22
Add Four additional Tank Farms	9/30/25	9/30/26
	2/2/22	2/2/22
	2/2/22	2/2/22
	2/2/22	2/2/22
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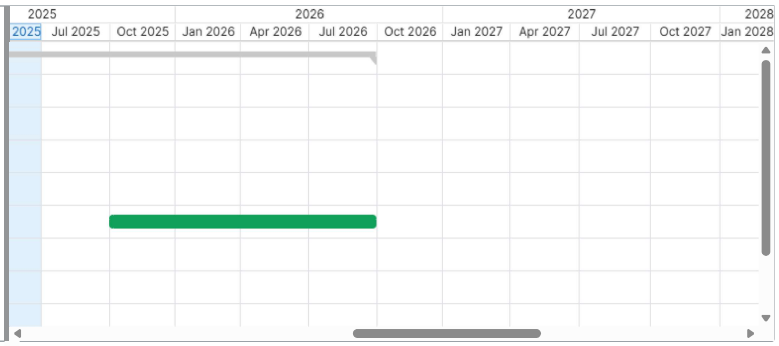
	2/2/22	2/2/22



THREATS AND OPPORTUNITIES

WARR24-0032-T: Tank Vapors (Included)

TBIE24-0017-T: Tank Vapors Controls Impact Project Execution (TOC)

MEASURABLE ORGANIZATIONAL VALUE

The data fusion & advisory system will save ~ $950,000 over 5 years, save ~7,100 hours per year of daily work planning, and help workers avoid 3 days of hazardous vapor exposure annually.

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NEAR TERM

Wearable Robotics (WRs) and Exo-suits (ESs) are commercially available devices that support and augment body movement by transferring loads from a weaker part the body to stronger part. WRs are typically battery powered and use artificial intelligence to adjust to body movement, whereas exo-suits are non-powered using cables and springs for load distribution.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Enhance Worker Capabilities

TEDS ID: MTW-96 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Technology is needed to enhance worker capabilities allowing safer and more efficient work. Currently, tank farm workers experience repetitive movements, such as going up and down stairs, and lifting heavy objects. Technology is needed to enable work to be less tiring, and dangerous. Most applicable; Tank farm workers, including firefighters, must regularly wear air bottles, such as self-contained breathing apparatus (SCBA) rack, or heavy packs. These heavy loads place a lot of strain on the body's spine, especially when crouching, kneeling, or carrying heavy loads. Transfer of heavy loads from the spine to the Exoskeleton could protect tank farm workers from the strain of added weight, such as SCBA systems.

TECHNOLOGY SOLUTION

Deploy technology designed to augment human strength and endurance by taking stress off the lower back and legs. Providing additional leg support for physically demanding tasks. The system provides support for the lower body, reducing the burden on a user's knees and leg muscles. Technology makes it easier to perform intensive activities, such as:

- Picking up heavy loads lifting with the knees (e.g Back X).
- Manual excavation lower back and knee strain (e.g. Herowear Apex).
- Prolonged crouch or lowered posture (e.g., Chair-less chair).

The Exoskeleton AI reads Exoskeleton sensors to determine how a user is moving. Actuators then apply torque to the user's knee joints to support their movements. This results in less muscle strain and more endurance.

Hero wear Apex demo at 2101 HV warehouse

Noonee Chair less Chair deployed during a 2022 sampling event

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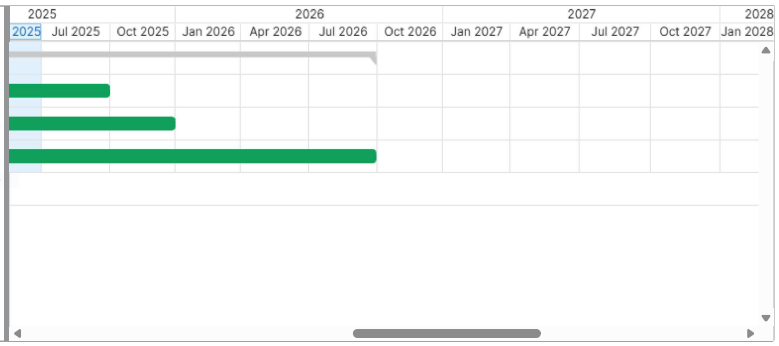
TEDS ID: MTW-96 Continued

ADDITIONAL TECHNICAL INFORMATION

Hero wear Apex use while shoveling

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Enhance Worker Capabilities	9/30/24	9/30/26
Shoulder exoskeleton Study for radiation monitoring	9/30/24	9/30/25
Biomechanical Analysis of Wearble devices for DOE tasks	9/30/24	12/31/25
Field testing of Weables at DOE sites	9/30/24	9/30/26



THREATS AND OPPORTUNITIES

WARR24-0045-T: PPE availability

MEASURABLE ORGANIZATIONAL VALUE

Studies (MacLean & Ferris, 2019) indicate an exo-suit reduces metabolic cost by an average of 4.2%. An NCO cost (burdened) is ~$96/hr. For simplicity, a linear cost savings directly correlated to metabolic cost reduction is assumed; i.e., $4/hr. Payback period is 19,550 hours or 9.4 years. The return on investment, assuming 10 year life of equipment, is 6.4%. This return will be measured using time spent in work-zone wearing SCBA and air consumption (baseline vs. augmented). Procurement costs are not applied to MOV calculations.

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NEAR TERM

Advanced robotic solutions needed to address high-risk repair and maintenance tasks in hazardous nuclear environments. Current manual operations expose workers to radiation and physical dangers.

Continued Need for Improving Tools for Tank Farm Projects

TEDS ID: MTW-97 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

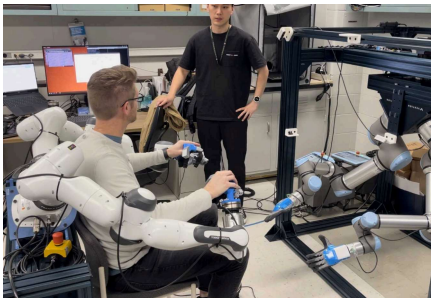
Traditional methods rely on direct human intervention in contaminated zones, leading to prolonged downtime and elevated risks. There is a need for a telerobotic system that replicates human dexterity remotely, minimizes errors during dynamic contact operations, and adapts to variable field conditions. The system must integrate force feedback, impedance control, and real-time adaptability to ensure operational stability

TECHNOLOGY SOLUTION

The Symmetric Bilateral Telerobotic Hand Tool, developed by Argonne National Laboratory uses identical robotic arms on both operator and remote ends, enabling intuitive mirroring of movements (Figures 1 and 2). Key features include:

- Dynamic Force-Reflection Control: Ensures stable tooling operations (e.g., grinding) by transmitting real-time force feedback to the operator.
- COTS Components: Reduces costs and allows customization for diverse applications.
- Open-System Architecture: Supports advanced functionalities like teleautonomy and virtual fixtures.
- Phased Deployment: Proof-of-concept testing (Phase 1) and full mock-up demonstration (Phase 2) ensure scalability.

Symmetric Bilateral Telerobotic System



Remote Robotics

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

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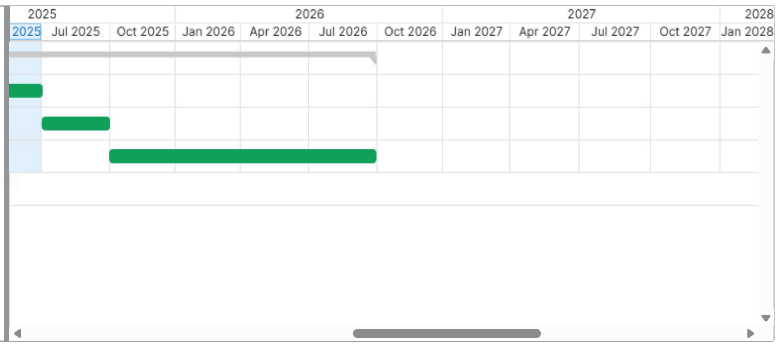
TEDS ID: MTW-97 Continued

ADDITIONAL TECHNICAL INFORMATION

Collaboration with academia and labs has accelerated prototyping. The system's open architecture allows integration of AI-driven teleautonomy, enabling semi-autonomous adjustments during tasks. Robust impedance control mitigates instability risks from uneven surfaces or tool resistance.

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Continued Need for Improving Tools for Tank Farm Projects	3/31/25	9/30/26
Issue EOI for Advanced Telerobotic System	3/31/25	7/1/25
Award Contract for Advanced Telerobotic System	7/1/25	9/30/25
Phase 1 System Design and Build	9/30/25	9/30/26



THREATS AND OPPORTUNITIES

WARR24-0036-T: Unexpected field conditions
LYSM-0012-T: Unexpected Field Conditions (Included)
TFP24-0002-T: As Found Field Conditions Differ from Expected (Excluded)

MEASURABLE ORGANIZATIONAL VALUE

- Reduced Worker Risk: Eliminates direct exposure to hazardous zones.
- Operational Efficiency: Enables continuous, precise repairs without downtime.

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NEAR TERM

Maintaining the operability and integrity of the tank farm pits currently involves inspections and repair work that require removing the pits' cover blocks, an operation that is costly and produces a significant exposure to dose for the workers. The technology alternative being explored is a custom robotic system consisting of a snake-like manipulator that can fit the current cover block openings. The Pit Inspection Radiation Scanning System (PIRSS), would produce a high-fidelity inspection record

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

Remote Tools for Waste Storage Tank Pits

TEDS ID: MTW-98 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

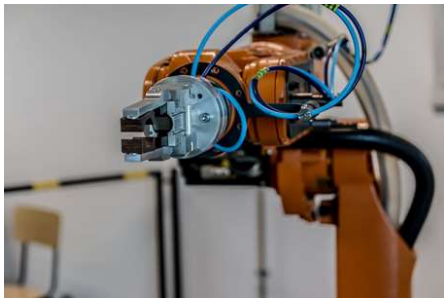
The Tank Farms Operations Contractor is required to perform work and inspections in the single shell and double shell tank pits. Most of these operations require the pits' concrete cover blocks to be removed. Besides adding a substantial operational cost ($350K are budgeted for the pit cover removal alone) these present a considerable exposure to dose for the workers. It is critical to research and deploy technologies that can reduce worker exposures to hazardous conditions, and confined space hazards.

Ideally, this technology would perform work without removing or altering the current cover blocks, thus an appropriate tool would make use of the existing access ports, which due to their limited size, rules out many off the shelf robotic manipulator solutions. A possible solution would consist of a custom robotic system that can be deployed through the pit cover access ports perform both functions in question: inspections and physical work.

TECHNOLOGY SOLUTION

The leading technology alternative to address this need is a custom, multiple degrees-of-freedom, robotic manipulator that can be inserted into pits without removing their cover blocks. CTO is procuring a bespoke system centered around a snake-arm type robot whose baseline function is delivers a comprehensive visual inspection of the pit, of its contents and of the pit lining, collection of samples for characterization of the pit, and radiation scanning.

This tool, given the name Pit Inspection Radiation Scanning System (PIRSS), would be deployed similarly to current pit cameras, while being significantly more advanced and capable. With tool and senso-head mounts, the PIRSS would produce 3D laser scans, 360^{o} visual captures and radiation scans. Besides the baseline design's inspection functions, the system is scoped to perform manual operations with 3D adaptive grippers, laser-cutters, and repair tools.



Robotic Arm

Robotic arm with tooling designed for pit work.

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TEDS ID: MTW-98 Continued

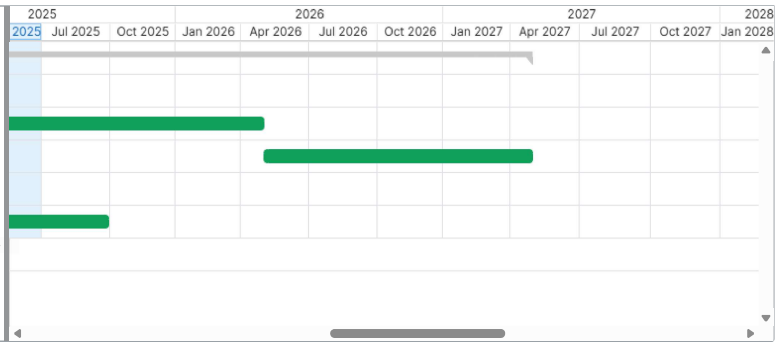
ADDITIONAL TECHNICAL INFORMATION

Image of a typical DST pit (with shield blocks removed)

Image of a typical SST pit (with shield blocks removed)

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Remote Tools for Waste Storage Tank Pits	4/30/24	4/29/27
INL Project Year 1: Select Design Path	4/30/24	4/30/25
INL Project Year 2: Prototyping and Design	4/30/25	4/30/26
INL Project Year 3: Full System Fabrication and Demonstration	4/30/26	4/29/27
H2C Commercial Sub-Contract Award	9/30/24	3/31/25
H2C Vendor Design Development	3/31/25	9/30/25



THREATS AND OPPORTUNITIES

242SS-0001-T: Resources Not Available when Required
APEU24-0001-T: Resources Not Available When Required
WARR24-0027-T: Resources not available (Excluded)
WARR24-0028-T: Resources not available (Included)
ANFWS-0801-T: Resources Not Available When Required
ETFG-0009-T: Resources Not Available (Included)

Developing the proposed tooling is estimated to save a minimum of $12.9M dollars and prevent a collective dose of up to 18.1-person Rem on AMPP pit inspections over 20 years.

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NEAR TERM

Artificial intelligence can improve operations around the site by automating tasks, analyzing data, and making decisions. AI can process large amounts of data, identify trends, and recognize and respond to issues, leading to increased efficiency. Its use can also help optimize energy usage and reduce downtime, improving safety and productivity.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Large Data Management

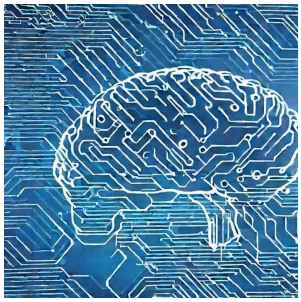
TEDS ID: MTW-101 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Large data management is needed for many tasks including improving the operation and maintenance of facilities by automating tasks, analyzing data, and making decisions. Large data management is needed to process and analyze large amounts of data quickly and accurately. This can help identify trends and patterns that may not be easily noticeable by human operators, allowing for proactive maintenance and improved efficiency.

TECHNOLOGY SOLUTION

One solution to improve the operation and maintenance of facilities is the implementation of artificial intelligence (AI). AI systems can be trained to analyze data and make decisions, allowing for proactive maintenance and improved efficiency. For example, AI can identify trends and patterns in data that may not be easily noticeable by human operators, leading to the timely resolution of potential issues. AI can also assist with tasks such as scheduling maintenance, identifying spare parts needed for repairs, and optimizing energy usage. HMIS is currently working on the improvement and expansion of their Hanford Artificial intelligence Liaison (HAL). HAL was deployed in a question and answer type configuration in March of 2024, and has a long list of business cases and additional projects that the development team is working on.



AI Generated Art

AI Generated art depicting an industrial facility

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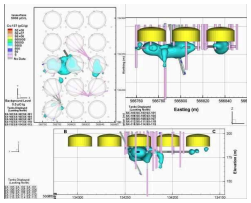
TEDS ID: MTW-101 Continued

ADDITIONAL TECHNICAL INFORMATION

There are many identified areas of need for an AI application. Business cases that are currently being worked on by HMIS include;

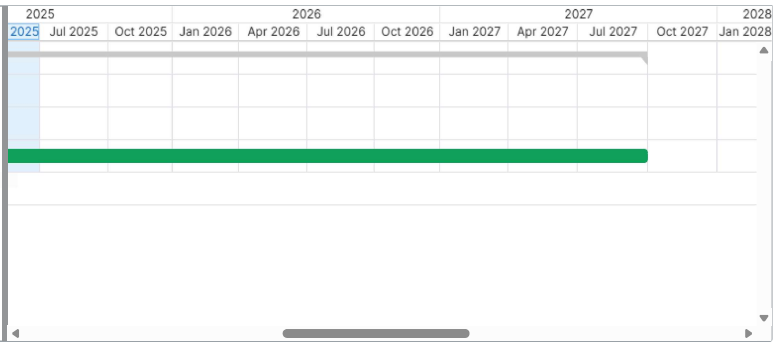
- Hanford Search
- Software Documentation
- Excel Data Interrogation
- Quick Coding Solutions
- Quick summaries of longer technical analyses
- Aggregating portions of large technical data sets based on specific criteria



Plan and Cross-Section View of Cesium-137 Contaminated Soil Above 5x10^3pCi/g

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Large Data Management	9/1/24	9/30/27
HAL Early Adopter Rollout	9/30/24	3/27/25
Full Hanford Site HAL Rollout	3/2/25	4/1/25
Customize Tool	9/1/24	9/30/27



THREATS AND OPPORTUNITIES

ARR-0028-T: Resources Not Available (Included)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Improve Waste Level Measurement

TEDS ID: MTW-113 **Timetable: ≤ 5 Years**

A metal tape relocation device is desired to remove abandoned metal tape from underneath ENRAF risers. This will allow for more effective use of the existing ENRAFs for Hanford tank waste level measurements. Additionally, radar technology has proven effective as a method for tank level measurement.

TECHNOLOGY NEED

Methods to improve waste level measurement is needed. Metal tape relocation from underneath ENRAF risers is required to allow for accurate Hanford tank waste level measurements when an ENRAF is used. Over the years abandoned metal tapes have accumulated under the risers that are typically used for waste level measurements causing obstructions to the ENRAF devices. A technology to relocate the abandoned tape within the tanks is needed.

TECHNOLOGY SOLUTION

A metal tape relocation device (MTRD) must meet the following requirements: Be deployable through risers that range from nominally 4 to 12 inches in inside diameter. Must clear a 12-inch diameter zone below the ENRAF riser occupied by the subject ENRAF system. Abandoned metal tapes can be partially embedded in a semi-solid waste layer, therefore the MTRD must be able to exert enough force to remove and relocate partially buried tapes from this waste.

Abandoned metal tape debris pile

ENRAF in the field

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-113 Continued

ADDITIONAL TECHNICAL INFORMATION

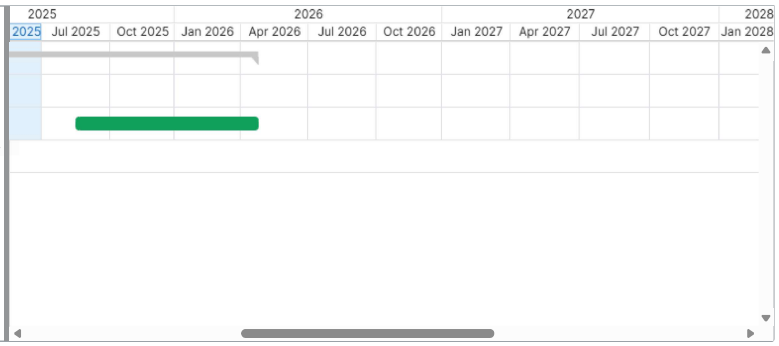
Current efforts include collaborating with WSU to build prototype devices. Images below show WSU prototypes. The image on the right is a tape removal device being tested at Hanford's Cold Test Facility. Additionally, a tank level radar device has proven effective. The WSU built device on the left was used during sampling operations at Tank AN-102 in Spring of 2024.

Radar Device Deployed in AN-102

Prototype Demonstration at Cold Test Facility

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Improve Waste Level Measurement	8/18/24	4/23/26
Initial Scoping and Design with WSU	8/18/24	4/24/25
Continued Scoping and Design with WSU	8/17/25	4/23/26



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Developing the capability to effectively visualize geographic information system data and underground infrastructure in a real-world context.

Underground Crossing List

TEDS ID: MTW-114 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

For decades, burying infrastructure has been used at the Hanford Tank farms as a method of shielding. As a result, there is a lot of infrastructure that is below the surface of the ground and therefore difficult to precisely identify in the field. A method is needed to aid in spatial understanding of sub-surface equipment for future construction projects.

TECHNOLOGY SOLUTION

Engineering is working to develop the capability to effectively visualize Geographic Information System (GIS) data and underground infrastructure in a real-world context by combining a 3D model of underground piping systems with an augmented reality interface from vGIS, inc. This immersive experience allows for better spatial understanding and more informed decision-making. Planners and engineers can overlay digital maps onto physical environments, providing a clear view of underground utilities, pipelines, and other critical infrastructure.

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

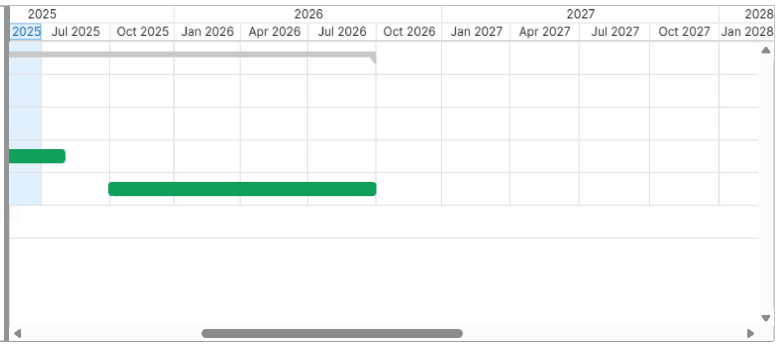
CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-114 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Underground Crossing List	2/2/25	9/30/26
Upgrade for Security	2/2/25	2/3/25
Transition to HLAN	2/2/25	4/30/25
Add an Administration Page	4/30/25	7/31/25
Add Four Additional Tank Farms	9/30/25	9/30/26



THREATS AND OPPORTUNITIES

ARR-0035-T: Unexpected Field Conditions (Excluded)
ARR-0036-T: Unexpected Field Conditions (Included)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Locating Underground Cathodic Protection Equipment

TEDS ID: MTW-115 **Timetable: ≤ 5 Years**

NEAR TERM

Cathodic Protection (CP) at Tank Farms relies on buried anodes to prevent corrosion of underground equipment, but their uncertain locations have hindered maintenance. The Chief Technology Office has identified Ground Penetrating Radar (GPR) as a viable technology to accurately locate these anodes and assess their condition. GPR operates by sending high-frequency radio waves into the ground and analyzing the reflected signals to create detailed subsurface maps. Plans are underway to integrate GPR with an unmanned ground vehicle (UGV) for autonomous mapping, with a demonstration set for 2025 in collaboration with Florida International University.

TECHNOLOGY NEED

Cathodic Protection (CP) is used at Tank Farms as a method of controlling corrosion of underground equipment. CP protects a metal surface by introducing a second metal as a sacrificial anode, making the target the cathode of an electrochemical cell. A number of anodes have been buried across tank farms to prevent the oxidation and loss of material in transfer lines and waste storage tanks. The integrity of this system depends on servicing the anodes and test stations; however, this has been limited by the uncertain location of these underground anodes.

CP design authorities at Tank Farms have identified the need for a technology able to precisely identify the location of underground anodes and produce a map that can be used for reference. As a further objective, this technology solution would seek to provide a qualitative reference regarding the structural condition of the underground equipment. Such a tool would be an advantage to the engineering groups that manage maintenance and integrity of the CP system, by both, confirming the layout and condition of the anode systems and their wiring. Currently a tool for detecting underground pipes and cables is used for this purpose, however, this tool must be deployed manually and is not intended or optimized for finding non-pipe and -cable structures.

TECHNOLOGY SOLUTION

The Chief Technology Office has identified ground penetrating radar (GPR) as a viable solution for the localization of buried systems and equipment at the tank farms.

GPR works by using a transmitting antenna to send high-frequency radio waves into the ground. As these waves propagate through the subsurface, they are reflected back when they encounter boundaries between materials with differing properties. A receiving antenna then captures these reflected signals, measuring the time it takes for them to return to the surface. The data from this process is used to create a detailed map of the subsurface, allowing for the precise identification and assessment of underground structures, such as anodes in Cathodic Protection systems.

The solution envisioned is to mount a GPR unit onto an unmanned ground vehicle (UGV). Such autonomous UGV could traverse a GPS grid and capture a corresponding depth map that would pinpoint underground equipment. In 2025, CTO will partner with Florida International University to demonstrate this integration of GPR on a UGV at the Tank Farms.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Submitted As Grand Challenge?

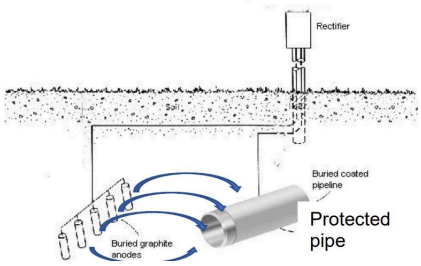


Diagram representing Active Cathodic Protection for Transfer line corrosion prevention.

Sample Buried anode

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: MTW-115 Continued

ADDITIONAL TECHNICAL INFORMATION

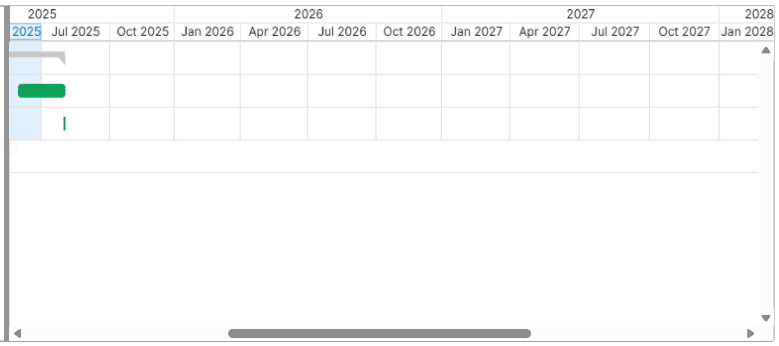
GPR systems can operate at various frequencies, with lower frequencies providing deeper penetration but less resolution, while higher frequencies offer more detailed imaging at shallower depths. The effectiveness of GPR is influenced by the electrical conductivity of the ground; dry, sandy soils provide better conditions for GPR imaging compared to wet, clay-rich environments. The data produced will require interpretation, for which sample data using known, buried anodes can be used as a basis. Advanced data processing techniques, such as signal filtering and 3D imaging, enhance the clarity and accuracy of the subsurface maps generated by GPR.

Ground Penetrating Radar unit mounted on a UGV

Radiodetection Device currently used to localize underground wiring

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Locating Underground Cathodic Protection Equipment	6/1/25	7/31/25
Florida International University (FIU) Summer Internship	6/1/25	7/31/25
FIU Ground Penetrating Radar Deployment Demo	7/30/25	7/31/25



THREATS AND OPPORTUNITIES

EAO24-0036-T: Unexpected Field Conditions Encountered (Excluded)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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5.2 Retrieve Tank Waste

The waste retrieval functional area is required to remove the waste to close the tanks per regulatory requirements. Retrieval efficiency is based on knowledge of the tank contents for the extraction of the waste with effective tools, the transfers downstream, and the mixing and blending for delivery of feed to the WTP that meets the requirements. Across all aspects of the waste retrieval process, there is a need-to-know overall waste composition, and chemical and physical characteristics. Remote in situ monitoring of these parameters would enhance and improve retrieval operations. The waste retrieval function can also include special processes such as those envisioned for contact-handled transuranic (CH-TRU) waste and mitigation or remediation of selected DSTs.

The various methods of waste retrieval are described in RPP-RPT-44139, *Nuclear Waste Tank Retrieval Technology Review and Roadmap* as well as RPP-PLAN-40145, *Single-Shell Tank Retrieval Plan*. Modified sluicing or salt cake dissolution is typically used to retrieve the majority of the waste volume from the SSTs; however, these methods are typically insufficient to reach the established residual waste volume goal of 360 ft^3 or less for 100-series SSTs, and 30 ft^3 or less for 200-series SSTs as mandated by the Tri-Party Agreement. This residual waste is typically characterized as a hard heel of insoluble material that requires more aggressive methods to mobilize and remove from the tank. The ITDC also uses mechanical and chemical technologies for hard heel removal subsequent to waste retrieval operations using modified sluicing.

Implementing these technologies can require tank modifications in the form of new or larger tank penetrations to accommodate waste retrieval equipment. The RTW functional area includes the following focus areas:

1. Retrievals – Characterization of the SST waste is a first step in successful mobilization and retrieval of the tank waste. Multiple techniques are required to mobilize and retrieve the waste to the level needed for ultimate closure of tanks.
2. DST Transfers – The DST waste transfer system is a critical, interdependent system within the HTWTM that relies on the ability to continually retrieve, treat, and transfer tank waste to the Tank Farm Pretreatment System, WTP, and various waste treatment facilities. The near-term DST waste transfer strategy focuses on startup, commissioning, and initial operation of pretreat systems, waste volume management, and modeling of waste blending and staging strategies.
3. Cross-Site Transfers – Important technology considerations for cross-site transfer lines are leak detection, line plugging detection and clearing capability, and critical velocity measurement.
4. DST Upgrades – A primary objective of DST upgrades is to ensure that the Hanford Site Tank Farms are able to provide optimized, continuous, and reliable feed to the WTP or any potential new treatment systems.
5. Feed Preparation – The primary goal of feed preparation is to ensure that qualified waste feed batches are readily available for WTP and secondary waste treatment system campaigns.
6. Tank Closure – Retrieval technologies that support the ultimate HTWTM goal of closing the waste tanks and associated waste management areas.

This section includes the catalog sheets for the near-term technologies that fall under the RTW functional area.

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Develop, design, build or modify solid waste sampling tools such as the existing ORSS, the extended finger trap and the rotating auger.

Retrieval and Closure Solid Waste Sampling Tools

TEDS ID: RTW-01 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

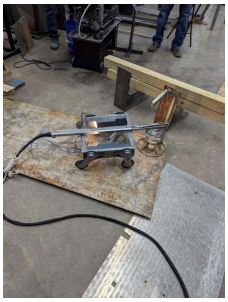
Improved tank waste sampling tools (e.g. off-riser) are necessary for:
- Collection of pre-retrieval samples used to identify/optimize retrieval methods.
- Collection of west area single shelled tank (SST) pre-retrieval samples to plan alternate treatment strategies.
- Collection of samples needed to support integrity assessments.
- Collection of samples needed for verification of tank closure standards.

Current sampling technologies do not fully address the challenges in collecting representative samples.

TECHNOLOGY SOLUTION

Technology development efforts could involve modification of the existing off-riser sampling system (ORSS, bottom right) to address inadequacies based on previous deployments. Additional efforts may include locating a replacement for the current ORSS as necessary. Additional efforts may involve modification of an existing design to collect solids known as the finger trap sampler. Modification includes lengthening the sample chamber and improving the deployment to include off-riser capability. Another option for hardened solids could include development of a rotating auger bit (shown bottom left). Both the core sampler and the prototype ORSS were developed and tested in 2024. Further development for both devices are planned for 2025.

Alternative core sampler concept development as a WSU Capstone Project



Prototype ORSS designed, built and tested in 2024

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: RTW-01 Continued

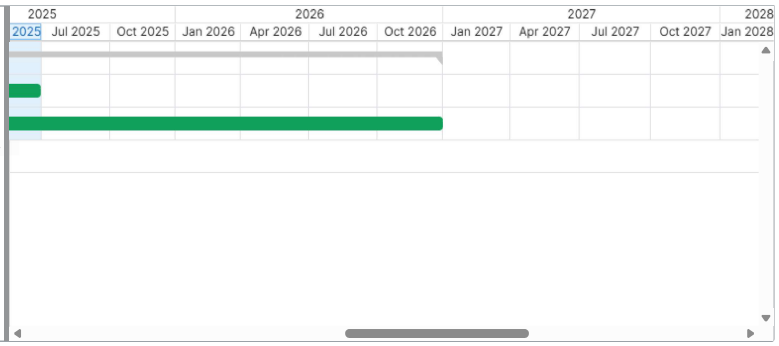
ADDITIONAL TECHNICAL INFORMATION

The auger sampling system will be deployable through any 4-in.-diameter or greater riser using a simple "top hat" and worktable setup. The heart of the sampling system is a motorized drill unit that has the function of a demolition rotary hammer and streamlined to fit inside of a 3.5-in.-diameter form factor. The drill utilizes a commercial off-the-shelf, 1.5-in. diameter, four-fluted masonry drill bit fitted to a sample collection vessel that will carry the sample from the waste interface up to a collection cup above the tank. The drill bit efficiently works through rock-hard media, but the tank bottom will not be damaged if the bit comes into contact with it. The application of a "push-mode" sampler would be to retrieve solid core samples.

Push Mode Core Sampling Device

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Retrieval and Closure Solid Waste Sampling Tools	1/1/24	12/31/26
Off Riser Sampler System Replacement-design/fab/testing	1/1/24	6/26/25
Alternative Core sampler-design/fab/testing	1/2/25	12/31/26



THREATS AND OPPORTUNITIES

SSTI24-0001-T: SST Failure

MEASURABLE ORGANIZATIONAL VALUE

The auger will save approximately $1.278 million, the new ORSS will save approximately $1.036 million, and the push mode sampler will save approximately $613 thousand. These new sampling methods will improve accessibility, save time, reduce worker exposure by reducing labor time, and improve sampling results.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

The previous RVMS that the Tank Operations Contractor used was limited by the size of the system (12-in. risers only). The current system was recently deployed for deployment in a 6-in. riser. Smaller technology with similar data resolution is needed to access the more available 4-in. risers.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

Residual Volume Measurement System (RVMS)

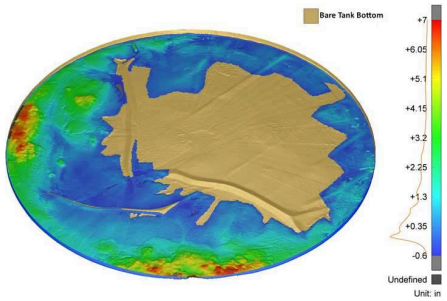
TEDS ID: RTW-02 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

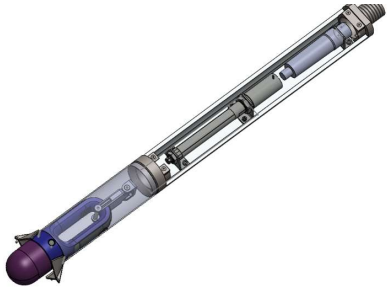
Accessibility to 12-in. and 6-in. risers is limited; therefore, a system easily deployable down 4-in. risers is needed as they are more accessible. The ability to deploy down 4-in. risers would provide flexibility in deployment locations ensuring ideal positioning for single or multiple location scans. This is essential when in-tank equipment would otherwise obstruct the scanner's view from a single riser. In addition, the existing RVMS, the sole tool used to determine residual waste volumes, was recently deployed to aide in tank dome condition inspections. This was a new use case not previously considered, further justifying the need.

TECHNOLOGY SOLUTION

A laser scanner small enough to fit down a 4-in. riser that performs similarly to the larger units currently in service.



Depth of the waste remaining in AX-102 after 2nd retrieval technology was used



Custom Laser Scanner

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: RTW-02 Continued

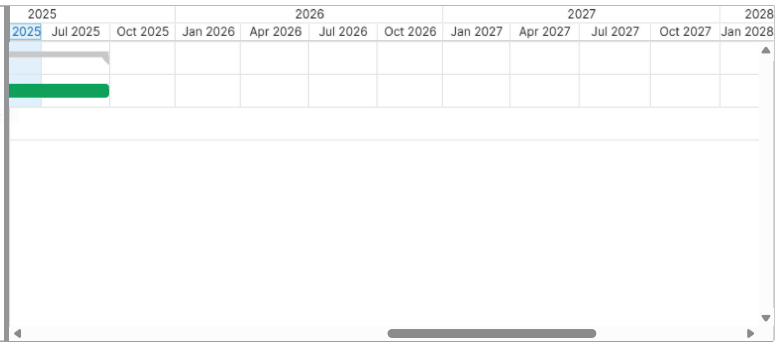
ADDITIONAL TECHNICAL INFORMATION

4-in Capable Laser Scanner

6-in Capable Laser Scanner

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Residual Volume Measurement System (RVMS)	1/2/25	9/30/25
Redesign and Test 4-inch capable technology	1/2/25	9/30/25



THREATS AND OPPORTUNITIES

SRTVS24-0306-T: Equipment in Risers is More Difficult to Remove Than Anticipated (Excluded)

MEASURABLE ORGANIZATIONAL VALUE

Using the proposed laser scanner, field hazard exposure per worker will decrease by .0111 REM saving $68, and direct costs will decrease by $15,300, resulting in a total savings of $15,368 per removal.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Characterization of contaminated soil is a step to the remediation and closure of tank farm waste management areas. A prototype beta detection probe designed for in-situ detection of beta-emitting soil contamination would be helpful.

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

Near Tank Soil Sampling

TEDS ID: RTW-04 **Timetable: > 5 Years**

TECHNOLOGY NEED

Appendix I of the Tri-Party Agreement requires characterization of contaminated soil as a step toward the remediation and closure of tank farm waste management areas. One of the most important risk contributors in soil is technetium-99, a beta emitter. Current methods for identifying technetium-99 contamination involve removing soil samples and performing laboratory analysis. In situ identification can reduce cost and time associated with soil characterization in all tank farms.

TECHNOLOGY SOLUTION

One option under consideration is a prototype that has been previously designed for deployment with a direct-push unit. A survey of other potential methods is planned. A down-selected technology can then be configured and deployed in coordination with the other soil characterizations.

Direct-Push Prototype Beta Detection Probe

H2C Hanford Tank Waste Operations & Closure

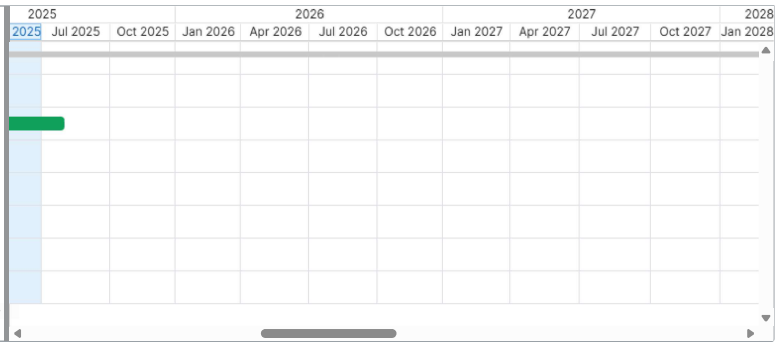
CHIEF TECHNOLOGY OFFICE

TEDS ID: RTW-04 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Near Tank Soil Sampling	2/2/25	9/30/30
Beta Probe Testing	2/2/25	2/13/25
Report Writing	2/16/25	7/30/25
Full Field Validation	10/1/28	9/30/30
Rebuild and Modify Equipment	10/1/28	5/30/29
Drill Bore Holes	3/1/29	5/30/29
Perform Testing	6/1/29	9/27/29
Reporting	10/1/29	9/30/30



THREATS AND OPPORTUNITIES

ARTVS24-0403-T: Old Spill Sites Exposed During Excavation While Installing New Equipment (TOC)
ARTVS24-0404-T: Old Spill Sites Exposed During Excavation While Installing New Equipment (Excluded)
SRTVS24-0303-T: Old Spill Sites Exposed During Equipment Removal (TOC)
SRTVS24-0304-T: Old Spill Sites Exposed During Equipment Removal (Excluded)
SRTVS24-0403-T: Old Spill Sites Exposed During Excavation While Installing New Equipment (TOC)
SRTVS24-0404-T: Old Spill Sites Exposed During Excavation While Installing New Equipment (Excluded)

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Identify areas where new information or technology maturation will provide the greatest future benefit (e.g., altered retrieval requirements, affected closure cap design). Information will be integrated into Rev. 1 of the WMA C PA and into the assessments being developed for other WMA closures.

Post Waste Retrieval Updates to WMA CPA and Long-Term Maintenance

TEDS ID: RTW-07 **Timetable: > 5 Years**

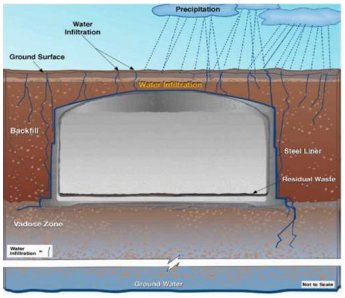
TECHNOLOGY NEED

This technology is needed to support future updates of the Waste Management Area C (WMA C) Performance Assessment (PA) (RPP-ENV-58782), A and AX, and development of other WMA PAs, selection of closure technologies and future retrieval planning.

TECHNOLOGY SOLUTION

A review is planned to support future updates of the WMA C PA, development of other WMA PAs, selection of closure technologies and future retrieval planning:

- Testing on residual waste samples from tanks to better define waste release characteristics (this task would not pay for sampling, just for the extra tests).
- Sampling and testing of concrete samples from tank walls of ancillary equipment, to learn more about tank concrete degradation. This task is in progress for single-shell tanks.
- Evaluation of grout development and testing to better define waste release characteristics for final closed tanks.



Long-Term PA Maintenance Parameters

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

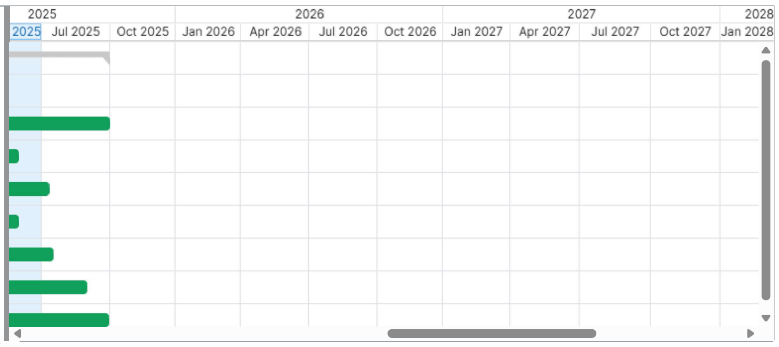
TEDS ID: RTW-07 Continued

ADDITIONAL TECHNICAL INFORMATION

Testing on residual waste samples from tanks is expected to start in the second half of FY25 and continue into FY26. PNNL and 222-S Lab will support the scope. Sampling and testing of concrete samples from tank walls of ancillary equipment is in progress for single-shell tanks. There is no expectation to perform additional testing in FY25 or FY26. PNNL is performing some analysis of a concrete sample from single-shell tank A-106 in FY25 (this effort started with other samples from A-106 in FY23). Evaluation of grout development and testing to better define waste release characteristics for final closed tanks has no expectation to perform additional testing with grout in FY25 or FY26. It may be later determined to be unnecessary.

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Post Waste Retrieval Updates to WMA CPA and Long-Term Mainte...	10/1/23	9/30/25
Prepare HFFACO IPA Analysis Vol 2 - Past Leaks Analysis	9/30/24	3/20/25
Prepare HFFACO IPA Analysis Vol 3 - Risk Assessment	10/1/24	9/30/25
Prepare HFFACO IPA Analysis Vol 4 - CA of Rad Impacts from Residu	10/1/23	5/29/25
WMA A-AX HFFACO IPA Analysis Vol 6	3/23/25	7/10/25
WMA A-AX HFFACO IPA Analysis Vol 5	12/22/24	5/29/25
WMA A-AX Waste Sample Analysis	12/1/24	7/16/25
WMA A-AX PA Maintenance Plan	12/22/24	8/28/25
WMA A-AX Waste Incidental to Reprocessing Evaluation	3/31/25	9/30/25



THREATS AND OPPORTUNITIES

CLOSE24-0001-T: Delays in SST Tank Farm Closure Criteria (Excluded)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

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NEAR TERM

A dry waste retrieval system is needed to facilitate the retrieval of hard packed wastes from assumed leaking SSTs to nearby DSTs.

Dry Waste Retrieval System (A, SX, & U SSTs)

TEDS ID: RTW-08 **Timetable: ≤ 5 Years**

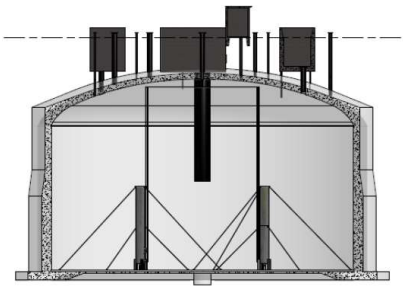
TECHNOLOGY NEED

To meet Hanford Federal Facility Agreement and Consent Order (HFFACO) requirements, a Dry Waste Retrieval System (DWRS) is needed to be designed and built to facilitate the retrieval and transfer of waste from assumed leaking SSTs to nearby DSTs where the DST provides an additional barrier to the environment for interim storage of waste. The DWRS is intended to remove waste from assumed leaking SSTs for transfer to a double shell tank (DST) using mechanical, or other, means with only minimal liquid (e.g., dust/contamination suppression, etc.) usage inside the SST structure. For assumed leaking A-Farm SSTs, the DST to receive the waste is AP-101. For assumed leaking U- and SX-Farm SSTs, the DST to receive the waste is SY-102.

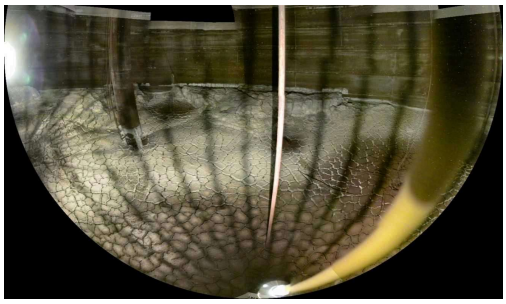
TECHNOLOGY SOLUTION

Design and fabrication of a dry waste retrieval system will remove hard-packed waste in tanks using minimal introduced liquids. The system will make use of in-tank and ex-tank components to mobilize, condition, and transfer waste and interface with existing retrieval system components and utilities. The system will leverage industry knowledge and experience allowing an integrated system to be designed, fabricated, and tested.

Functions and requirements are captured in various documents RPP-SPEC-65346, Rev. 0, Specification for the Dry Waste Retrieval System (A, SX, & U SSTs) and RPP-RPT-64764 Rev. 0 Conceptual Design Recommendation Report for the Dry Waste Retrieval System (A, SX, & U) SSTs.



Typical A-Farm Tank Cross-Section Model



A-104 Waste Topography

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

Yes

H2C Hanford Tank Waste Operations & Closure

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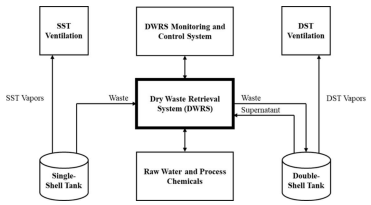
TEDS ID: RTW-08 Continued

ADDITIONAL TECHNICAL INFORMATION

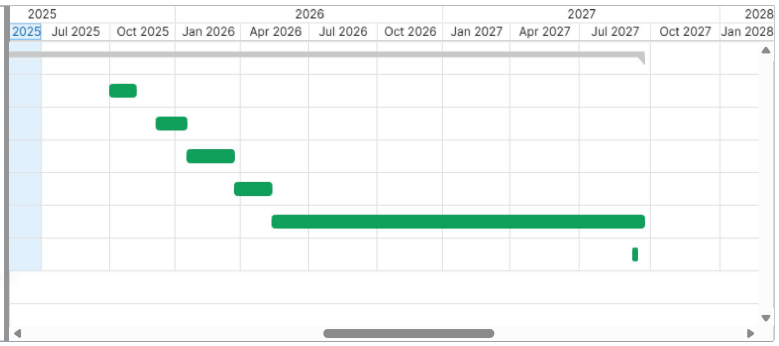
To date, the Tank Operations Contractor (TOC) has utilized modified sluicing, enhanced sluicing, extended reach sluicing system, salt cake dissolution, and the vacuum-mode mobile arm retrieval system. Each process requires addition of liquids to the tanks for heavy sludge and hard cake removal. The hard-packed waste can be granular like sand, hardened rock-like materials (chunks), or a mixture of the sandy material with clay and the hardened chunks. Additionally, several of these tanks have very high radioactive dose rates (~24,000 R/hr total beta, at the surface of the waste). The next series of tanks to be retrieved include those known to have leaked. Although the liquid portion (supernatant/slurry) is no longer present and leaving a heavy sludge, hard cake or salt cake to be retrieved, reintroduction of liquids into the tanks presents environmental issues.



Potential Dry Waste Retrieval/Transfer System

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Dry Waste Retrieval System (A, SX, & U SSTs)	9/30/25	9/23/27
Definitive/Deployable Prototype Design - 45% Design	9/30/25	11/4/25
Definitive/Deployable Prototype Design - 60%	12/3/25	1/19/26
Definitive/Deployable Prototype Design - 90%	1/19/26	3/24/26
Definitive/Deployable Prototype Design - 100%	3/24/26	5/12/26
DWRS II Prototype Design - Build, Test & Deliver	5/12/26	9/23/27
DWRS II Vendor FAT of Prototype	9/8/27	9/15/27



THREATS AND OPPORTUNITIES

RPP-0005-T: SST Retrieval Systems Performance Does Not Meet Requirements Due to Unexpected Conditions

MEASURABLE ORGANIZATIONAL VALUE

Ability to retrieve dry waste from known or suspected tanks of compromised integrity.

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NEAR TERM

This technology is being implemented now to develop formulations for highly-flowable grout for small and complex structures and bulk fill grout for large and less complex structures.

Void Filling to Prevent Collapse

TEDS ID: RTW-25 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

This technology is needed to support Waste Management Area (WMA) C closure required under Tri-Party Agreement (TPA) Milestone M-045-83. The information gathered from these activities is needed to complete closure of the C-200-series tanks and larger ancillary equipment voids from pipeline encasements, catch tanks, vault tanks, diversion boxes, as one of the first steps in application of the Incremental Closure Approach for WMA C and has applicability to other tank farm waste management areas.

TECHNOLOGY SOLUTION

Final development and testing of highly-flowable grout and bulk fill grout are designed to provide data needed to reach agreement among TPA stakeholders and WRPS for closure of the diversion boxes, 200-series tanks, and vault-tank structures within WMA C. The amount of testing required to achieve this purpose will be determined through meetings and discussions among the entities involved. The remaining work is to reach an agreement among TPA stakeholders and WRPS on the use of the formulated grout as an interim measure to stabilize the diversion boxes, 200-series tanks, and vault-tank structures within WMA C as a part of the incremental closure approach at WMA C. The goal is to use the same formulated grout as a demonstration project on how we should fill and stabilize one or more of the 100-series tanks prior to final closure of WMA C.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

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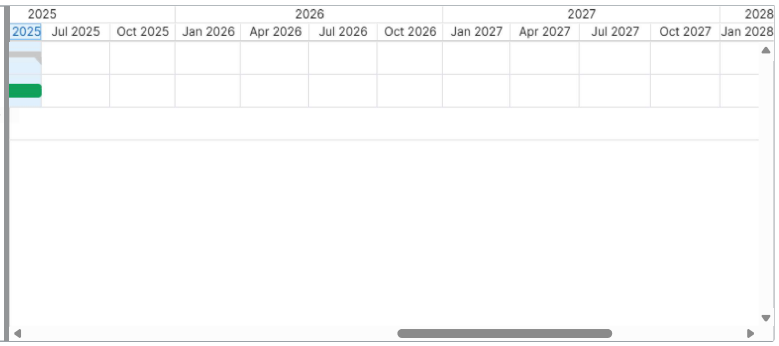
TEDS ID: RTW-25 Continued

ADDITIONAL TECHNICAL INFORMATION

The first object is to find a viable solution in the lab to meet ASTM C1611 Slump Flow and Visual Stability requirements for a new formulation that does not use fly ash. Preliminary work at WSU suggested blast furnace slag may be a viable bulk-fill replacement for fly ash. Additional work is needed.

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Void Filling to Prevent Collapse	2/28/25	6/30/25
Bulk Fill Grout Formulation Testing at WSU	2/28/25	6/30/25



THREATS AND OPPORTUNITIES

CLOSE24-0001-T: Delays in C Farm Closure Criteria

MEASURABLE ORGANIZATIONAL VALUE

TBD

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NEAR TERM

Technologies are needed to remove residual waste from non-leaking tanks. This could include new technologies or modifications to existing technologies.

Remove Residual Solids in Non-Leaking Tanks

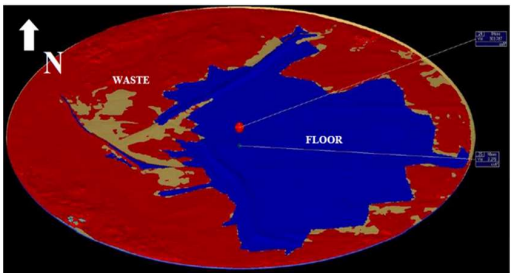
TEDS ID: RTW-34 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Modifications to existing technology or new technologies are needed to more effectively remove residual waste from non-leaking tanks. Closure standards require a minimum amount of remaining solids in the tank bottom. These solids accumulate in hard to reach areas of tank bottoms.

TECHNOLOGY SOLUTION

New technology will focus on retrieving the hard to reach residual waste that current sluicing methods struggle to retrieve. Smaller technology that can be installed down small diameter risers is desirable because these risers are more available. The development approach for this effort includes: preparation of a specification, down selection, awarding a contract, and fabrication and testing. The Figure below shows a representation of an tank floor by a laser scan.



Tank 241-AX-102 Waste Surface Laser Scan (Floor Visible Locations)

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Submitted As Grand Challenge?

No

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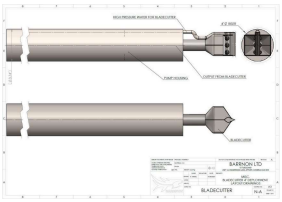
TEDS ID: RTW-34 Continued

ADDITIONAL TECHNICAL INFORMATION

The figures below show a concept pump being pursued.

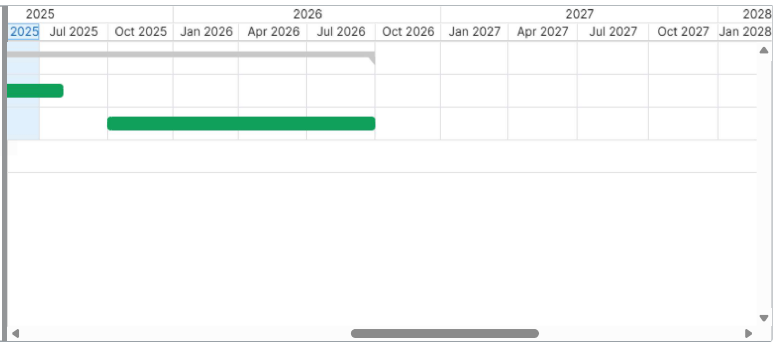
4 inch pump concept rendering



4 inch pump concept drawing

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Remove Residual Solids in Non-Leaking Tanks	7/4/24	9/30/26
Design/Fabricate/Test Small Riser Residual pump	7/4/24	7/31/25
Finalize Equipment Design	10/1/25	9/30/26



THREATS AND OPPORTUNITIES

ARTVS24-0504-T: Excessive equipment failures (other than pumps)
SSTI24-0001-T: SST Failure

MEASURABLE ORGANIZATIONAL VALUE

Successful implementation of the Simplified Sluicer would reduce cost and schedule risks associated with limited DOE funding and would reduce the over-all mission risk.

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NEAR TERM

A combination of sonar and ultrasonic sensors enables 3D profiles of settled solids and in situ measurements of the concentration of suspended solids to determine total volume of undissolved solids. Time-of-flight sonar will provide topography of the settled solids (i.e., bottom profile) based on integrating scans of 2D profiles.

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

Quantification of Solids in DSTs

TEDS ID: RTW-44 **Timetable: ≤ 5 Years**

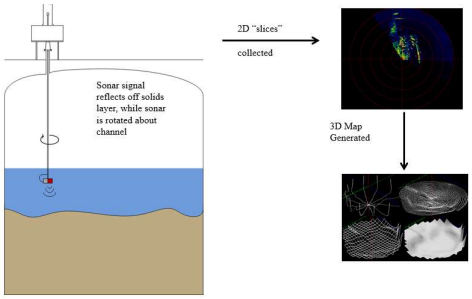
TECHNOLOGY NEED

Solids accumulation in the DSTs is sometimes difficult to characterize, there is photographic evidence of crust formation in many of the group A tanks. However, physical samples have not been collected due to a gaps in understanding the crust formation. 3D imaging under the surface of the waste would allow for a physical assessment (thickness and location within the tank) which would greatly help sampler development and deployment. Deploying a technology of this nature could reduce the uncertainties and therefore conservatism used by current methods that rely on localized (i.e., point) contact measurements of settled solids levels and sampling to measure suspended solids concentrations.

TECHNOLOGY SOLUTION

The suspended solids concentration changes waste characteristics (e.g., rheology, settling rate) and system performance (e.g., mixing, pipeline transfer). Solids concentration is an important parameter for estimating slurry rheology and pipeline critical velocity, performing hindered settling calculations, and developing waste acceptance criteria for direct-feed low-activity waste. Furthermore, more accurate undissolved solids accounting enables the tank farm contractor to reliably rebalance tank contents, maximizing the double-shell tank solids inventory and freeing up space. Knowing where the solids are predominantly located is also very important. This information will be critical for modeling chemical addition methods for out-of-specification wastes, and where chemicals should be added so they will not migrate to one side of the tank or the other. The instrumentation allows tracking of interface and suspended solids concentration concurrently as a function of time. Knowledge of time to settle to a desired level and concurrent supernatant concentration provides the ability to initiate transfers when target decant conditions are attained, expediting waste. Florida International University (FIU) has developed a prototype Solid Liquid Interface Monitoring System (SLIMS) that was previously tested in their lab. This is shown in the photograph below. In the summer of FY24 interns from Florida International University (FIU) attempted to further demonstrate the capabilities of a sonar probe that was previously purchased and performed development work on many years ago.

3D Profiling Sonar & Controller



Sonar Field Deplpyment Concept

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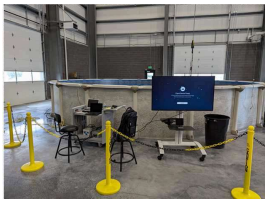
TEDS ID: RTW-44 Continued

ADDITIONAL TECHNICAL INFORMATION

The most recent efforts were performed at the Atkins Technology Center using a large above ground swimming pool as a water reservoir. To guide this effort a previously outdated specification was revised and reissued as RPP-SPEC-31604 Functional Requirements and Technical Design Criteria for the Solid Liquid Interface Monitoring System. Data was gathered with the sonar probe submerged in the pool, but it was determined the probe was likely to be to outdate to provide reliable useful. Further development of the overall system will require new equipment which FIU is considering for FY25.

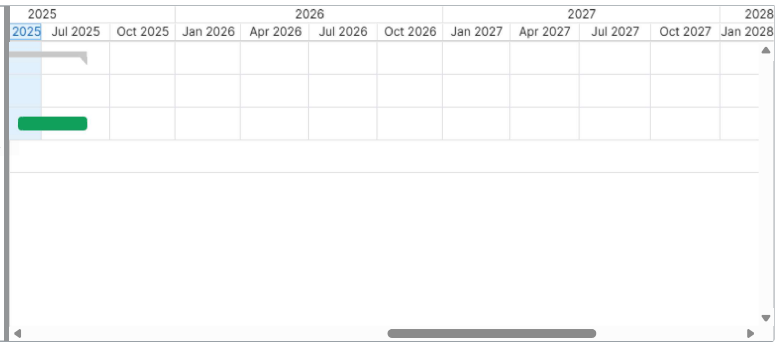


Sonar Test Pool Located at the Atkins Technology Center (ATC)

Adjustable boom for sonar probe deployment

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Quantification of Solids in DSTs	6/2/24	8/28/25
Sonar Technology Development at FIU, Phase I	6/2/24	9/2/24
Sonar Technology Development at FIU Phase II	6/1/25	8/28/25



THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

MEASURABLE ORGANIZATIONAL VALUE

TBD

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Quantify Uncertainty Associated with the Best Basis Inventory Estimates

TEDS ID: RTW-61 **Timetable: ≤ 5 Years**

NEAR TERM

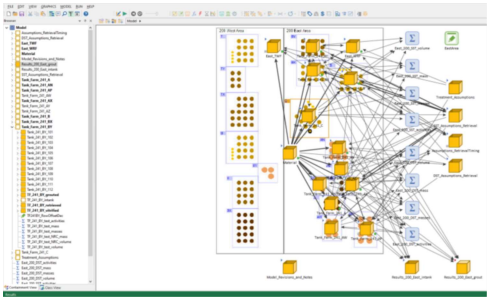
A stochastic flowsheet model is being developed using Goldsim software to estimate uncertainties of waste inventories in Hanford's 177 storge tanks. This approach helps estimate probability distributions for waste composition, impacting waste classification and compliance, with potential applications in sampling planning, DFLAW, DFHLW, and off-site waste management.

TECHNOLOGY NEED

Data provided in the Best Basis Inventory (BBI) are used in flowsheet development and analysis efforts. Properties estimated from BBI data include, but are not limited to, the chemical and radionuclide composition of retrieved waste, the physical properties of the waste, the types of solids in retrieved waste, and the composition of residual waste left in a tank after retrievals. It is important when using estimates made from BBI data to recognize that the properties reported in the BBI have associated uncertainty and these uncertainties propagate as the values are used in calculations.

TECHNOLOGY SOLUTION

One method of accounting for multiple uncertainties is through stochastic analysis where properties are described by a statistical distribution rather than a single value. Multiple realizations of a calculation can then be made by randomly sampling each of the distributions that represent the properties in question. The final result is itself a statistical distribution rather than a single value. This approach allows engineers and scientists using the results to consider how the probability range for a particular result impacts assumptions and decisions. A stochastic flowsheet model is being developed in Goldsim software to run Monte Carlo simulations to estimate the impacts of uncertainties through simulated retrieval, pretreatment, and treatment processes. The BBI records of waste inventory in the 177 Hanford storage tanks are transformed using Matlab to a format amenable for import into Goldsim. Data are organized by waste phase and type. The Relative Standard Deviation (RSD) available in BBI records for "sample-based" concentrations are combined with other qualitative "template-based" RSD estimates to build probability distributions for the Goldsim model input. The Goldsim model runs Monte Carlo simulations based on the BBI RSD values to estimate probability distributions for waste composition within the process streams associated with pretreatment and treatment to reveal how BBI uncertainty impacts properties such as waste classification and compliance with waste acceptance criteria.



Under-Development Goldsim Model

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

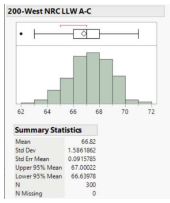
H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: RTW-61 Continued

ADDITIONAL TECHNICAL INFORMATION

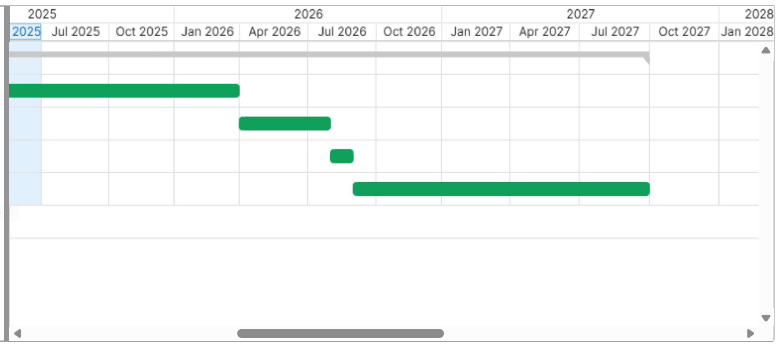
The estimated inventory uncertainties are presented by log-normal probability distributions that estimate confidence levels for planning of retrieval activities and post-processing. The open structure of the Goldsim model allows adding/interfacing with other models to propagate uncertainty estimating tank residuals, processing rates, volumes of immobilized waste forms and associated risk/dose estimates. Potential focus areas for immediate applications include sampling planning, DFLAW, DFHLW, and off-site management of waste/immobilized waste forms.



Output Example

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▼ Quantify Uncertainty Associated with the Best Basis Inventory Est...	12/31/24	9/30/27
Develop Uncertainty Model	12/31/24	3/31/26
Test Model	3/31/26	7/30/26
Go/No-Go Decision to Further Refine	8/2/26	8/31/26
Update MOdel and NQA-1 Certify	8/31/26	9/30/27



THREATS AND OPPORTUNITIES

DFLAW-1272-T: Qualification Batch Does Not Meet Waste Acceptance Criteria

MEASURABLE ORGANIZATIONAL VALUE

TBD

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5.3 Process Tank Waste

The processing functional area focuses on methods through which Hanford Site tank wastes are processed and safely immobilized into stable waste forms for disposal. The baseline method for Hanford Site waste immobilization is vitrification. As part of the WTP design basis, the retrieved waste will be separated into LAW and high-level waste (HLW) fractions. The HLW fraction of the waste will be vitrified into borosilicate glass at the WTP HLW Vitrification Facility and some of the LAW will be vitrified into borosilicate glass at the WTP LAW Vitrification Facility. The LAW Vitrification Facility alone was never intended to treat the entire inventory of Hanford Site LAW in the same period as the HLW can be treated. Alternate LAW Treatment was proposed to treat part of the LAW (ORP-11242). Technologies that have been considered for alternate treatment include joule-heated melter vitrification (similar to WTP), grout (Cast Stone), fluidized bed steam reforming, and bulk vitrification.

The ITDC is committed to providing support for startup of the LAW Vitrification Facility by designing and deploying the DFLAW pretreatment facilities that will enable early facility startup.

As the mission focus transitions from managing and retrieving Tank Farms to waste treatment operations, the need exists to understand the flowsheet interactions that may occur and to anticipate the implications this interconnectedness may cause, with respect to chemical interactions, process flows, unit operations, and effluent management. The HTWTM is examined holistically to develop integrated process flowsheets from the individual process flowsheets that comprise each aspect of the mission. The portions of RPP-RPT-57991, *One System River Protection Project Integrated Flowsheet*, that are of greatest importance for the scope of the Roadmap are those that directly impact the Tank Farms and future waste treatment activities.

The PTW functional area includes the following focus areas:

1. DFLAW Pretreatment Operations – Uses filtration to remove suspended solids containing alpha-emitting TRU nuclides and highly radioactive strontium-90, and ion exchange (IX) using crystalline silicotitanate (CST) resin to remove cesium-137 from supernatant tank waste.
2. Effluent Management Facility (EMF) – During DFLAW operations, evaporation of off gas condensate will be performed in the EMF. The volatile and corrosive halide and sulfate components are highly concentrated in this stream because they are volatile at melter operating temperatures.
3. WTP LAW – The LAW Vitrification Facility has been designed to vitrify LAW into borosilicate waste glass using a joule-heated, ceramic-lined melter system. That facility will generate a substantial volume (i.e., millions of gallons per year) of liquid secondary waste (LSW) from the off-gas treatment system.
4. WTP HLW – The HLW Vitrification Facility has been designed to vitrify waste being managed as HLW into borosilicate waste glass using a joule-heated, ceramic melter system.
5. Tank Waste Characterization and Staging – Provide a compatibility bridge between sludge wastes stored in the Tank Farms and the WTP receipt systems to ensure delivered waste is within the WTP waste acceptance criteria.
6. CH-TRU Tank Waste – Current assumptions are that 11 SSTs containing CH-TRU tank waste will be treated at a supplemental TRU treatment facility and then stored onsite at the Central Waste Complex until final disposition is determined.

This section includes the catalog sheets for the near-term technologies that fall under the PTW functional area.

H2C Hanford Tank Waste Operations & Closure

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NEAR TERM

Laboratory and engineering-scale testing will be conducted to assess alternative processing technologies for various EMF feed and effluent streams. This work will address gaps in the baseline DFLAW flowsheet on partitioning and treatment of key COCs, determine if the WTP liquid effluent sent to the LERF/ETF will meet ETF WAC for delisting organics, evaluate the opportunity to purge the EMF bottoms and redirect to an alternate disposal path, and address recycle risks.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

Mitigating Flowsheet Gaps for Secondary Liquid Effluent

TEDS ID: PTW-23 **Timetable: > 5 Years**

TECHNOLOGY NEED

Technology development and maturation activities are needed to address limitations in Waste Treatment and Immobilization Plant (WTP) operations caused by the Effluent Management Facility (EMF). This includes laboratory and pilot scale tests to:

- Address gaps in direct-feed low-activity waste (DFLAW) flowsheet on partitioning of key chemicals of concern (COCs) Tc-99, I-129, Hg, and organics within the melter and off-gas treatment system.
- Determine if the liquid effluent from the WTP sent to the Liquid Effluent Treatment Facility (LERF)/Effluent Treatment Facility (ETF) will meet ETF waste acceptance criteria (WAC).
- Identify and develop solutions for COCs that exceed the LERF/ETF WAC or other regulatory requirements.
- Demonstrate the efficacy of purging EMF bottoms to alternate disposal path to increase DFLAW throughput, reduce immobilized low-activity waste (ILAW) container count, and free space in double-shell tanks.
- Address risk associated with high sulfate and high halide concentration in EMF bottoms recycle, fluctuations in the waste feed composition, reduction in waste loading/increased ILAW glass container count.

TECHNOLOGY SOLUTION

Laboratory and engineering scale testing will be completed to address project uncertainties associated with the partitioning and speciation of organics, Tc-99, I-129, and Hg in within the WTP melter and off-gas system to identify possible risks to meeting the LERF/ETF regulatory requirements. Mitigation strategies will subsequently be developed and test for these risk areas.

Key activities to support this include:

- Develop and test iodine removal media and technologies capable of targeting the species of iodine observed in FY 2019 tests in the caustic scrubber liquids and EMF evaporator overheads.
- Evaluate extent of the natural potential for biological activity in the LERF basin to reduce the concentration of organics in WTP liquid effluent.
- Assess organic destruction technologies that can augment ETF operations and aid in meeting waste disposal requirements.
- Consolidate and analyze FY 2019 Hg speciation test results to determine if they indicate a deleterious impact on the ability of the LERF/ETF to accept WTP liquid effluent.
- Demonstrate at 1/10 scale the physical and Tc-99 release properties of optimized cementitious waste forms for simulated EMF bottoms and develop an IDF PA data package for evaluation of onsite disposal.

Packed columns to test removal of COCs from aqueous media

H2C Hanford Tank Waste Operations & Closure

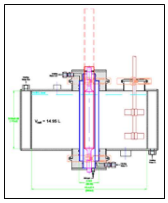
CHIEF TECHNOLOGY OFFICE

TEDS ID: PTW-23 Continued

ADDITIONAL TECHNICAL INFORMATION

Other activities associated with end-state completion of this project include:

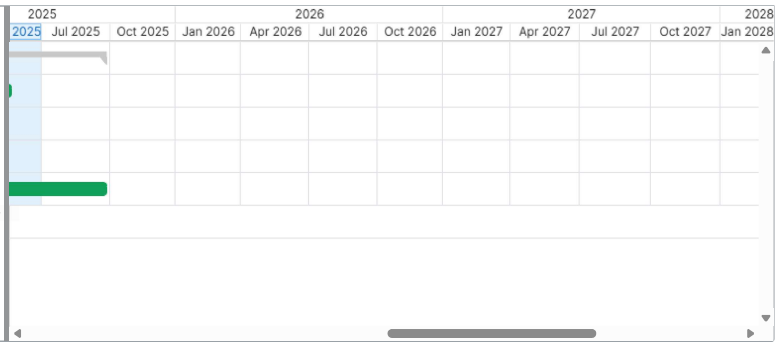
- Organics – Down select treatment method and complete engineering-scale demonstration using ETF simulant and lab-scale tests with real waste.
- Iodine – Complete media testing to determine process scale-up properties, down-select reactor and process design and conduct engineering-scale testing.
- EMF Purging - Select vendor for offsite treatment of EMF bottoms waste stream; determine solidified EMF bottoms disposal location requirements; and complete a large-scale demonstration for immobilization of the EMF bottoms waste stream.



Laboratory-scale V light reactor for organic destruction

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Mitigating Flowsheet Gaps for Secondary Liquid Effluent	10/24/24	9/25/25
Media Testing for Iodine Removal from WTP Secondary Off-Gas	12/15/24	5/20/25
Batch Contact Testing	10/24/24	2/11/25
Rotating Bed Reactor for Treatment of LDR Orgnaics in LAW	2/10/25	5/6/25
DM10 Melter Test with pH Control	12/3/24	9/25/25



THREATS AND OPPORTUNITIES

DAO24-0021-T: Waste Characterization Change
DFLAW-0232-T: WTP Radioactive Dangerous Liquid Effluent Composition LTA
DFLAW-0401-O: Alternative treat/dispose path for EMF evaporator concentrate
DFLAW23-0232-T: WTP radioactive dangerous liquid effluent composition LTA
DFLAW23-0401-O: Alternative treat/dispose path for EMF evaporator concentrate.

MEASURABLE ORGANIZATIONAL VALUE

~22% increase throughput; reduce container count (~8,300); increase available DST space.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Develop and operate test platform that will provide bench scale unit operations for DFLAW and treatment of waste managed as high level for feed to WTP. Capability for informing operations, troubleshooting, supporting waste feed qualification, informing new designs, evaluating specific process parameters, testing new unit operations, and closing flowsheet gaps.

Radioactive Waste Test Platform

TEDS ID: PTW-38 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Provide a test platform that supports unit operations trouble shooting, waste feed qualifications, flowsheet validation, TSCR operations, and provides AMPS/WARM design input. Support waste form development and confirm design inputs for EMF bottoms. Provide unit operations trouble shooting. Support for waste feed qualifications and flowsheet validation.

TECHNOLOGY SOLUTION

A test platform is needed to address flowsheet gaps, inform direct-feed LAW (DFLAW) operations and future direct-feed of waste managed as high-level waste. A scaled test platform will enable completion of the following tasks: waste feed preparation, solids analysis, filtration, ion exchange, waste solids handling with washing/leaching, solids waste form production and melter condensate recycle. The platform is intended to contribute to treatment of both LAW and waste managed as high-level waste. Additionally, the platform provides treated feed that can be utilized in waste form development.

Future applications include:
- Understand specific tank chemistry with individual unit operations
- Inform production operations
- Process troubleshooting and evaluation
- Tank batch qualifications for crystalline silicotitanate (CST) usage
- Waste managed as high-level, sludge and CST melts
- Waste managed as high-level, solids processing with washing and leaching
- Increase waste loadings for glass
- Opportunistic samples (after decontamination)
- Any new operation validation and design input
- Alternate waste form development and testing

Technology Maturation Level

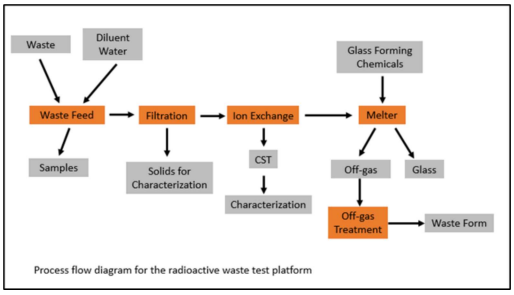
Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No



Process Flow Diagram for the Radioactive Waste Test Platform

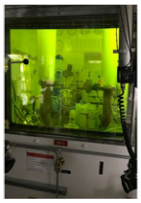
Hot Cell Filtration Unit

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: PTW-38 Continued

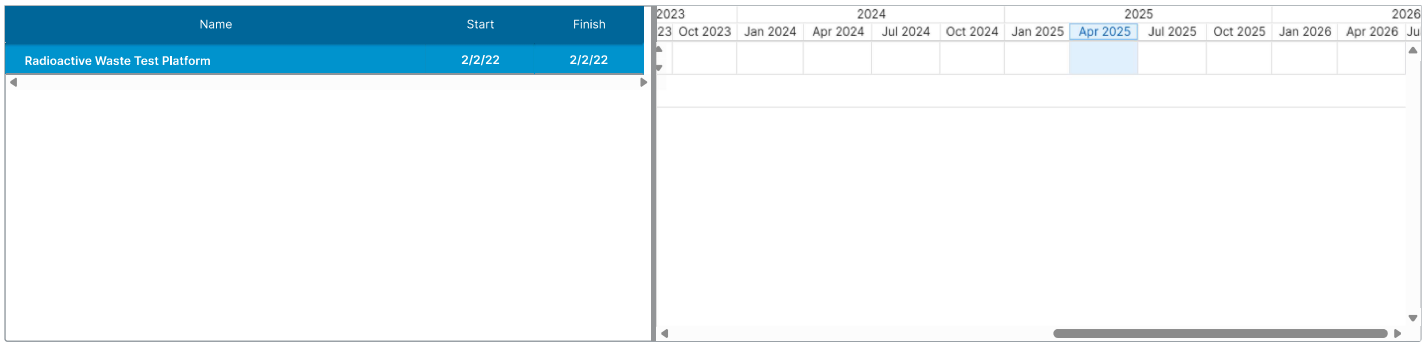
ADDITIONAL TECHNICAL INFORMATION



Hot Cell Ion Exchange Unit

Real Waste Scale Melter

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY



THREATS AND OPPORTUNITIES

DAO24-0021-T: Waste characterization change
DFLAW-0106-T: Staged treated LAW feed to WTP does not meet waste acceptance criteria for Cesium-137
DFLAW-1095-T: TSCR and WFD systems unable to meet WTP feed demand during operations
DFLAW-1148-T: TSCR solids filtrations throughput LTA
DFLAW23-0106-T: Staged Treated LAW Feed to WTP Does Not Meet Waste Acceptance Criteria for Cesium-137
DFLAW23-1095-T: TSCR and WFD Systems Unable to meet WTP Feed Demand during Operations

TBD

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

NEAR TERM

Online strontium detection for process systems

TEDS ID: PTW-62 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

The West Area Risk Management program will pretreat tank waste supernate in preparation for offsite disposal. The amount of strontium present in treated tank waste can limit disposal options and plays a key role in determining the Class of waste. Disposal of Class C waste is estimated to cost 5 times more than Class A waste making it advantageous to ensure as much of the treated waste can be disposed of as Class A. Although CST has been shown to remove Sr, complexants can be present in the waste feed and have been shown to prevent Sr uptake. An online detection method is needed to ensure Sr concentrations are below Class A limits for as much treated feed as practical.

TECHNOLOGY SOLUTION

The technology solution involves development of an online Sr monitoring capability for the process modules of the WARM system. This solution would utilize direct monitoring of the process line through secondary decay effects or use of a sampling (take and return) stream through a spectral analyzer. Having this capability would allow the waste processing to ensure the treated waste is kept below the Sr limits for Class A waste by informing the operation on when to segregate treated product.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

On-line process pipe monitors

On-line monitoring system for the detection of radioactivity through sampling

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: PTW-62 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Online strontium detection for process systems	12/30/24	12/31/24
Please Reach out to POC for Details.	12/30/24	12/31/24
	12/30/24	12/31/24
	12/30/24	12/31/24
	12/30/24	12/31/24
	12/30/24	12/31/24
	12/30/24	12/31/24
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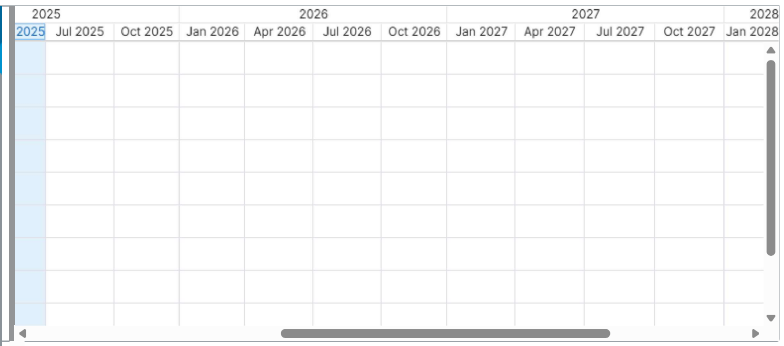
	12/30/24	12/31/24



THREATS AND OPPORTUNITIES

RPP-0081-T: Offsite Supplemental LAW (Grout) Throughput Rate Does Not Meet Plan

MEASURABLE ORGANIZATIONAL VALUE

This technology will ensure that as much as practical waste can be disposed of as Class A by ensuring strontium concentrations are below Class A limits. Class A waste is estimated to be 5 times less costly than disposal of Class C waste.

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5.4 Dispose Tank Waste

Disposal is the ultimate goal for Hanford Site tank waste. The method of treatment, final waste form characteristics, and type of waste form will determine how and where the waste can be disposed. LSW effluents will be treated at the ETF and disposed at a permitted land disposal site. ETF secondary solid waste (SSW) will be disposed of in the IDF. ILAW will be disposed of in the IDF, with some offsite options being explored. Immobilized HLW (IHLW) maybe interim-stored onsite and ultimately disposed of at an as-yet undetermined geologic repository, however final decisions have yet to be made. CH-TRU waste is planned to be disposed of at the Waste Isolation Pilot Plant (WIPP). There are other relatively benign wastes that may be treated offsite and disposed of at commercial waste disposal facilities.

The DTW functional area includes the following focus areas to assess potential methods of disposal for the waste:

1. IDF – The IDF is located on the Hanford Site in the 200 East Area and is the designated disposal location for ILAW. The facility consists of a single landfill with two expandable cells for extra capacity. The cells use a double lined system with leachate collection, detection, and removal capability.
2. IHLW Interim Storage – The path forward for possible IHLW interim storage would entail sequential construction of potentially several modular facilities. One or more facilities would be provided as necessary to furnish IHLW interim storage capacity.
3. WIPP – The WIPP is the nation's underground disposal facility for DOE TRU solid waste. Hanford Site ships legacy TRU waste to WIPP as part of the Central Plateau Cleanup Company program to disposition solid waste landfills.
4. Offsite Disposition – Offsite disposition refers to both offsite treatment and disposal of Hanford Tank liquid and/or related solid waste.
5. Offsite Transportation – Offsite transportation refers to future transportation systems needed for shipping Hanford waste to offsite treatment and/or disposal facilities. This effort supports offsite disposition by developing shipping transportation systems for material transport.

This section includes the catalog sheets for the near-term technologies that fall under the DTW functional area.

H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

NEAR TERM

Low Temperature Waste Form Process

TEDS ID: DTW-02 **Timetable: ≤ 5 Years**

Develop and qualify a low-temperature waste form for supplemental immobilization of Hanford LAW. A low temperature immobilization process for Hanford LAW would be significantly less complex to design, construct and operate than a high-temperature vitrification process. Estimates indicate capital costs will be approximately seven times lower and operating costs three times lower for a low temperature process. A further benefit could be realized if a single grout facility is used to immobilize both LAW and Secondary Wastes.

TECHNOLOGY NEED

The Waste Treatment and Immobilization Plant (WTP) Project is designing and building a vitrification facility for immobilizing Hanford Site low-activity waste (LAW) in a glass waste form. However, the LAW Vitrification Facility has limited capacity and projections show it will be able to treat about one-half of the total LAW within the mission duration time frame [bounded for high-level waste (HLW) treatment]. Additional LAW immobilization capacity is needed for timely completion of the waste treatment mission and to avoid protracted interruptions of the HLW Vitrification Facility operations. A low temperature alternative for LAW treatment (i.e., grout) could provide the needed capacity. However, formulation development and waste form performance data for grouted LAW are needed to inform potential grout facility construction and operations as well as allow for disposal of the waste form. Technology maturation activities are also needed to support future decisions on what process to use for alternative immobilization of Hanford LAW.

TECHNOLOGY SOLUTION

The development approach is patterned after the DOE/EM 413.1-4 technology maturation process and embodies a phased approach to mature the technology over multiple fiscal years. The logical progression of the technology development work includes formulation development, testing to support long-term performance projections for the performance assessment, engineering-scale integrated testing, and waste form qualification testing. Work is needed to integrate LDR treatment with low temperature solidification/stabilization. Finally, integration of a low temperature solidification process into the full WTP mission is also planned. This includes the development of sampling and analysis methods necessary to ensure RCRA LDR compliance in the final waste form.

Testing with Actual Waste

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: DTW-02 Continued

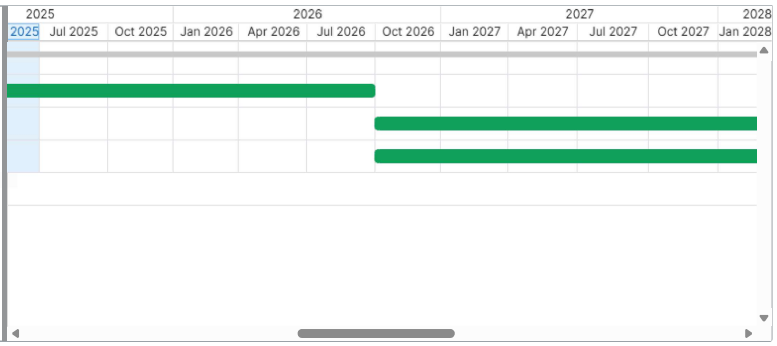
ADDITIONAL TECHNICAL INFORMATION

Technology maturation efforts in fiscal years 2021 through 2025 have focused on the objectives described above. For example:
1. Formulations for enhanced retention of key constituents of concern (Nitrate, I-129, Tc-99) have been developed. 2. The impacts of several LDR organic removal and destruction technologies (evaporation, chemical oxidation, vacuum thermal desorption) have been evaluated. 3. Retention factors for LDR inorganics have been measured for several waste formulations. 4. Analytical methods have been improved to lower detection limits for many of the LDR organics. 5. The mass balance of LDR species in simulated SY-101 tank waste through the full pretreatment and treatment process has been documented to support offsite treatment and disposal SY-101 pretreated waste.

Test Cylinders

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Low Temperature Waste Form Process	10/1/24	9/28/28
Capture & Hold Formulation Development	10/1/24	9/30/26
Engineering Scale Testing	10/1/26	9/28/28
Grout Performance Assessment Model Improvement	10/1/26	9/28/28



THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less than Adequate
DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

MEASURABLE ORGANIZATIONAL VALUE

The total savings from constructing and using a grout facility rather than a vitrification facility are estimated to be about $31 billion (un-escalated) and $95 billion (escalated). Using a grout facility in lieu of a vitrification facility would also save about 11 years' time treating all tank waste and about 13 years' time completing all SST retrievals.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Perform engineering and laboratory tests to characterize Immobilized Low Activity Waste (LAW) glass to support the Integrated Disposal Facility (IDF) Performance Assessment (PA) update and future maintenance.

Immobilized LAW Glass Testing for IDF PA Support

TEDS ID: DTW-03 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

The Waste Treatment and Immobilization Plant (WTP) Project designed and built a vitrification facility for immobilizing Hanford Site LAW in a glass waste form. Immobilized waste from the LAW vitrification facility, starting with direct-feed LAW processing, will be disposed of onsite in the Integrated Disposal Facility (IDF). Waste form performance data is needed to support the IDF Performance Assessment (PA) and PA maintenance to permit and operate the IDF. Work performed in FY 2017 through FY 2023 supported improvements in waste loading/processing and to prepare the data package used to update the IDF PA modeling platforms to include the glasses that reflect the enhanced waste loading. It is a requirement in DOE O 435.1 (and the accompanying manual) and the Hanford RCRA Permit that the Performance Assessment be maintained to evaluate changes that could affect the operating basis for the IDF. The near-term risk associated with not performing this work is the necessity to restrict WTP operations to lower waste loading baseline glasses rather than expanding operations to include enhanced waste glasses. Long-term risks include the potential for higher operating costs for LAW immobilization and IDF disposal caused by the need for lower throughput to maintain lower waste loading in the glass and the subsequent generation of a greater volume of waste for disposal.

TECHNOLOGY SOLUTION

The 2017 IDF PA evaluated baseline glasses. However, recent work has developed new LAW glasses that can achieve higher waste loadings. The intention is to integrate the new glass formulations into DFLAW operations immediately after DFLAW LAW system commissioning. To implement enhanced waste glass formulation, testing data on the short- and long-term dissolution rate of the new glasses is needed along with updates to the ILAW glass corrosion model to better reflect the expanded glass formulations. This information will be needed to support PA analysis of the fate of the enhanced glasses in the IDF and their potential impact on the environment. It is likely the PA analysis will be performed right before startup of DFLAW.

ILAW Glass Sample Formulation

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

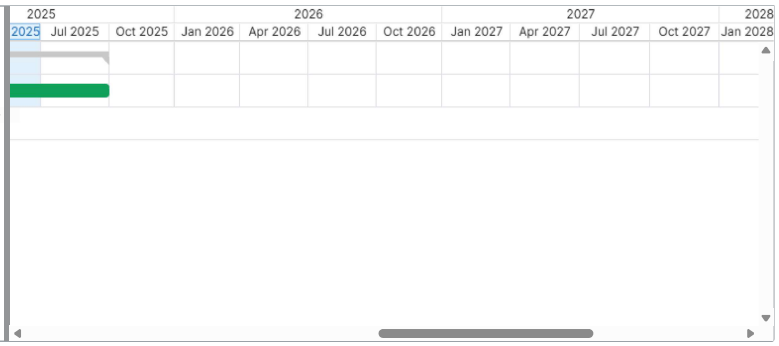
TEDS ID: DTW-03 Continued

ADDITIONAL TECHNICAL INFORMATION

Ground Glass Samples used in Dissolution Rate Tests

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Immobilized LAW Glass Testing for IDF PA Support	9/30/24	9/30/25
FY25 ILAW EWG Data Package Development	9/30/24	9/30/25



THREATS AND OPPORTUNITIES

DFLAW-0149-T: IDF Permits to Operate Including Disposal Authorization Statement (DAS) Delayed
DFLAW23-0149-T: IDF Permits to Operate including Disposal Authorization Statement (DAS) Delayed

MEASURABLE ORGANIZATIONAL VALUE

By developing and implementing Enhanced Waste Glass, the total mission canister count will be reduced by ~52,000. By using Enhanced Glass over Baseline Glass, ~$1.885 billion dollars are saved, excluding the DOE development costs.

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Advance the technology to ship large quantities of radioactive and mixed liquid waste offsite for treatment and/or disposal.

Advance Liquid Waste Transportation Capability

TEDS ID: DTW-06 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

The capacity to ship large quantities of mixed low level radioactive waste (MLLW) for offsite treatment and disposal is needed to support future Hanford operations identified in the 2025 Holistic Settlement Agreement. Specifically, Milestone M-045-135 requires the retrieval of 22 single-shell tanks (SSTs) by 12/31/2040. On possible disposition path is to retrieve, pretreat (by settling, decanting, filtration, and ion exchange to remove key radionuclides), and ship liquid waste to a commercial vendor for further treatment, including solidification/immobilization in a cementitious waste form, and out-of-state disposal. The quantity of waste is large, up to 95,000 gallons per week. Implementing offsite shipment at this scale requires a dedicated effort to understand the packaging and logistic requirements and to design and fabricate the needed containers. Fabrication and certification of these containers will likely not require technology maturation, however, the interface systems for the new containers may need development. Also, certification testing of the new containers for DOE use may require National Laboratory testing and/or data review and analysis.

TECHNOLOGY SOLUTION

Establish criteria to procure new shipping container to meet regulatory requirements for large-quantity shipment (no technology development). Procure new certified shipping container (no technology development except for potential National Laboratory involvement in the certification testing). Develop technology for interface/transportation of the new shipping container (technology development involved in this effort).

ISO Portable Tank Surrounded by Framework

Tank Trailer

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

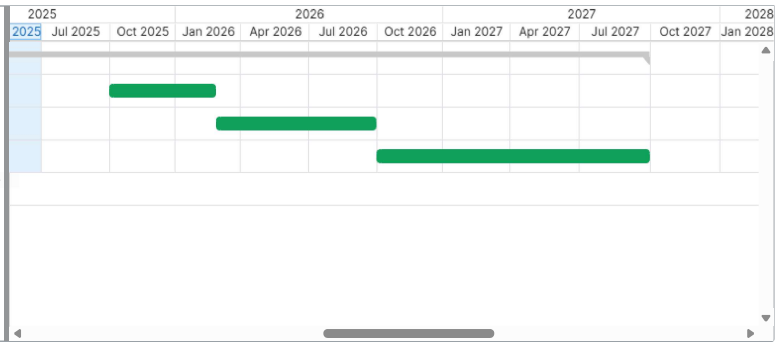
TEDS ID: DTW-06 Continued

ADDITIONAL TECHNICAL INFORMATION

Tanker Trailer

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Advance Liquid Waste Transportation Capability	9/30/25	9/30/27
Design	9/30/25	2/26/26
Fabrication	3/1/26	9/30/26
Test	9/30/26	9/30/27



THREATS AND OPPORTUNITIES

DFLAW-0300-T: LERF/ETF is not ready to receive liquid effluents when DFLAW is ready to generate effluents
DFLAW-0401-O: Alternative treat/dispose path for EMF evaporator concentrate
DFLAW23-0300-T: LERF/ETF is not ready to receive liquid effluents when DFLAW is ready to generate effluents
DFLAW23-0401-O: Alternative treat/dispose path for EMF evaporator concentrate.
DFLAW23-1407-T: Inability to accept return of EMF effluent
DFLAW23-1564-T: Offsite Treatment of ETF Brine/Distillate is LTA

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Solidification and Stabilization of Solid Secondary Waste

TEDS ID: DTW-07 **Timetable: ≤ 5 Years**

Development and maturation of a technology for the solidification and stabilization of solid secondary waste (SSW) by macro or micro-encapsulation in grout waste forms.

TECHNOLOGY NEED

During DFLAW operations, radioactive SSW will be generated at the waste processing facilities. Such wastes are expected to include used process equipment, contaminated tools and instruments, decontamination wastes, high-efficiency particulate air filters, carbon absorption beds, iodine sorbent beds, and spent ion exchange resins. SSW treatment processes and waste forms will be needed in time to support DFLAW operations. Accordingly, these waste forms have been included and analyzed as part of the 2017 IDF PA. In FY16, information available from published literature was reviewed, surveyed and compiled in a data package for the 2017 IDF PA. Development and testing activities to collect data on Hanford SSW was started in FY17. The baseline grout formulations identified provide adequate contaminant retention however, results in FY20 for ultra high performance grout (UHPG) indicate orders-of-magnitude improvement for contaminant retention over those baseline formulations. Additional data using specific SSW materials is needed to confirm these results and provide data for upcoming PA maintenance activities. These results will also provide insight on the ability of UHPG to be used as a diffusion barrier for other waste forms.

TECHNOLOGY SOLUTION

Work scope priorities are based on the results of the 2017 IDF PA analysis, which indicated that there are 3 major SSW that have significant inventories of contaminants of concern for the IDF. Those 3 major SSWs are HEPA filters, carbon bed adsorbers, and silver mordenite. Since then, a fourth SSW, A-532E resin, has been identified for iodine removal from ETF feed. This work will employ a variety of standard laboratory scale tests to measure physical and chemical properties of grout/waste form formulations. The findings will then be assessed with anticipated IDF disposal requirements to identify waste forms and processing methods for producing SSW disposal packages. These results will also provide insight on the ability of UHPG to be used as a diffusion barrier for other waste forms.

Technology Maturation Level

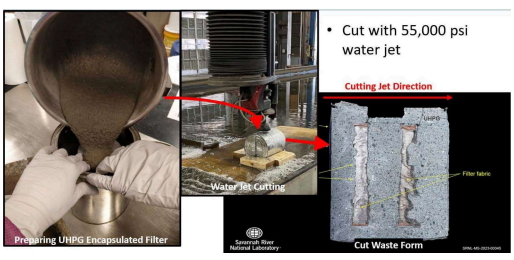
Laboratory Testing

National Laboratory Involvement?

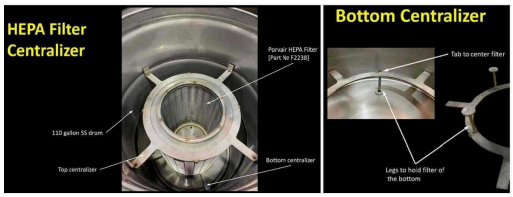
Yes

Submitted As Grand Challenge?

No



HEPA Filter Waste Form Fabrication and Cross Section Cuts for Characterization



Encapsulation Process of HEPA Filter

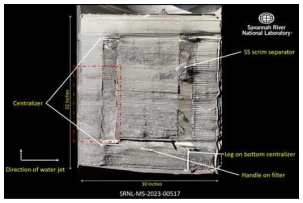
H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: DTW-07 Continued

ADDITIONAL TECHNICAL INFORMATION

HEPA filter encapsulation scope testing was conducted in FY23 and FY24 and demonstrated the ability to use UHPG as a direct substitute for baseline encapsulation grout for immobilization of spent HEPA filters at full scale. Some issues with material mixing, aggregate settling and material availability were noted which are being addressed in FY25. This work is to verify that SSW generated during DFLAW operations will meet DOE 435.1 requirements for disposal in the IDF. UHPG has the potential for reducing the impact to groundwater in the IDF PA. UHPG encapsulation for HEPA filters may preclude the time, cost, and risk associated with having to ship HEPA filters offsite for both treatment and disposal

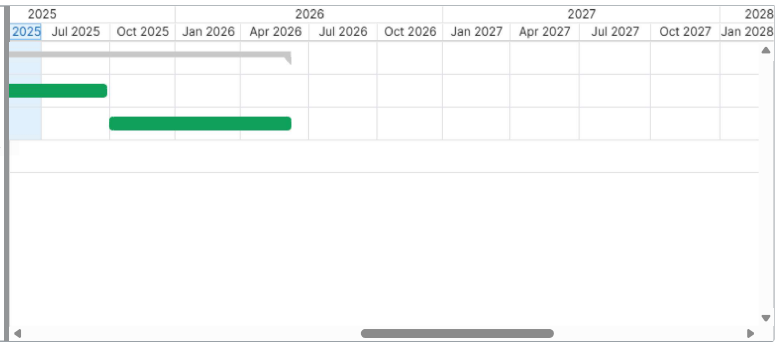


Encapsulated Full-Scale HEPA Filter

Section of Encapsulated HEPA

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Solidification and Stabilization of Solid Secondary Waste	1/30/25	6/8/26
Waste Form Development	1/30/25	9/25/25
Container development/testing	9/30/25	6/8/26



THREATS AND OPPORTUNITIES

DFLAW-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)
DFLAW23-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

IDF Long-Term Waste Form Durability Study (Lysimeter Data)

TEDS ID: DTW-08 **Timetable: ≤ 5 Years**

Validation of Performance Assessment (PA) (RPP-RPT-59958) models using field results from monitored and well understood/documented lysimeter tests are needed to improve stakeholder confidence in disposal facility and waste form performance. Increased understanding of model performance can allow modelers to better understand how well the model predicts Integrated Disposal Facility (IDF) conditions and could allow a reduction in conservatism in release estimates, resulting in better utilization of the IDF and lower IDF closure requirements and costs.

TECHNOLOGY NEED

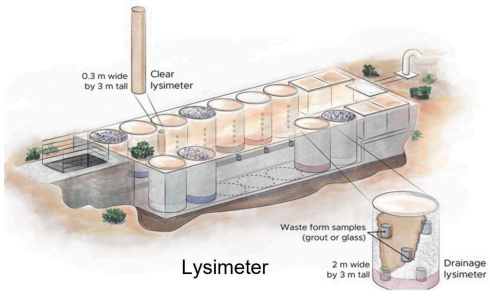
A long-term study of LAW waste form degradation using the Hanford Field Lysimeter Test Facility (FLTF or Lysimeter) will:

- Provide field experimental data on degradation of various waste forms identifying relevant secondary phases that are formed during waste form alteration in the lysimeter to improve long-term predictions of waste form performance.
- Be used to refine process model descriptions of contaminant (source term) release from the waste forms and determine potentially important impacts from co-disposal of the glass and cementitious waste forms.
- Reduce uncertainties about the representativeness of laboratory testing results for determining long-term waste form performance under field conditions.
- Improve confidence in the Integrated Disposal Facility (IDF) Performance Assessment (PA) by providing data to verify parameters and assumptions used in the PA modeling.
- Determine changes in the physical and chemical properties of the glass and cementitious waste forms during interaction with surrounding materials to improve long-term predictions of waste form performance.

TECHNOLOGY SOLUTION

Plan, implement, and maintain waste form degradation tests at the Lysimeter using the fourteen lysimeter cells to evaluate both glass and cementitious waste forms under different disposal configurations. Parameters evaluated in the various lysimeter cells are those that influence waste form durability and are key inputs to performance assessment models, including, the waste form type, surface to volume ratio, precipitation rate, and the impacts of co-disposal of glass and cementitious waste forms. Temporal data collected for the duration of 10+ year tests include the moisture profile and the chemical and radiological composition of the soil gas and pore water at various depths within the lysimeter cells. This information is compared to predicted results from waste form degradation fate-and-transport models and used to refine how waste form degradation in unsaturated flow is numerically described. On-going work includes:

- Loading the lysimeters and monitor parameters needed as input and to validate models.
- Systematically retrieving samples, analyze them, and compare results to models ran to simulate sample/lysimeter history; including analysis for secondary phases.
- Updated modeling results for expanded envelope of waste form properties.
- Improved lysimeter waste form modeling (3-D) and ongoing improvements to incorporate data results into the Risk Budget Tool.



Schematic of the FLTF

Aerial view of the FLTF

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

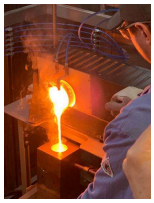
H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: DTW-08 Continued

ADDITIONAL TECHNICAL INFORMATION

Glass waste forms in the study are made of two formulations: LAWA44, a baseline waste glass formulation, or ORLEC28, an enhanced waste glass formulation. These glass waste forms are cylinders, 15 cm tall and 8 cm in diameter, and include Re and Mo as tracers. Grout waste forms included in the study are slightly larger cylinders, 19 cm tall and 10 or 15 cm in diameter. The formulations include LAW simulant immobilized as Cast Stone (LAW-CS), a possible alternative treatment for LAW; WTP off-gas condensate (liquid secondary waste) simulant immobilized as Cast Stone (LSW-CS), the perceived baseline for LSW; and WTP off-gas condensate simulant immobilized using a hydrated-line-based formulation (LSW-HL), shown as the best lab performance for Tc-99 retention in a cementitious matrix. Grout waste forms include Tc99 and I-127 as tracers.

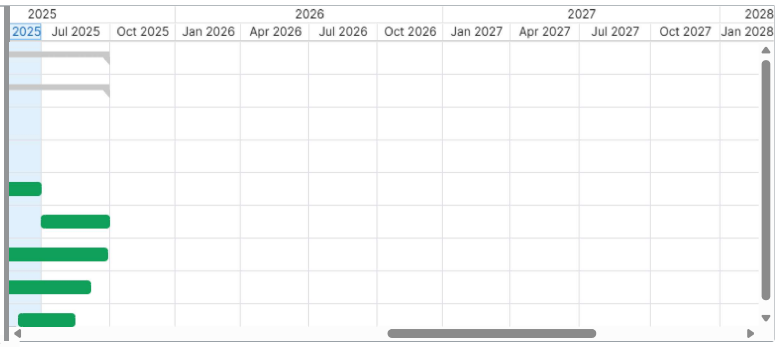


Molten Glass Test Waste Form being Poured

Grout Waste Form

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
IDF Long-Term Waste Form Durability Study (Lysimeter Data)	2/25/24	9/30/25
Facility Operations FY25	9/30/24	9/30/25
Water and Gas Sampling Q1	9/30/24	1/2/25
Water and Gas Sampling Q2	12/31/24	3/31/25
Water and Gas Sampling Q3	3/31/25	6/30/25
Water and Gas Sampling Q4	6/30/25	9/30/25
UHPG Tube Lysimeter Installation	3/31/25	9/29/25
Modeling Updates	2/25/24	9/4/25
Reporting	6/1/25	8/13/25



THREATS AND OPPORTUNITIES

DFLAW-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)
DFLAW23-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)

MEASURABLE ORGANIZATIONAL VALUE

Facilitates DFLAW operations by reducing uncertainty associated with the IDF PA fate-and-transport modeling predictions for grout waste forms, specifically. Provides long-term data on containment release, at actual IDF conditions, that can be used to validate the numerical models. Reduces conservatism used for the IDF PA analyses.

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H2C Hanford Tank Waste Operations & Closure

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NEAR TERM

Long-term durability of cementitious materials is uncertain and should be evaluated through examination of ancient manmade and natural materials and through experimental and theoretical assessment of plausible degradation mechanisms.

Long Term Durability of Cementitious Waste Forms

TEDS ID: DTW-13 **Timetable: > 5 Years**

TECHNOLOGY NEED

Long-term durability of cementitious waste forms is an uncertainty that affects the regulatory approval of these materials for disposal of low activity waste at locations where there is a pathway to groundwater. The lack of information on the long-term aging of these waste forms also increases the uncertainty with performance assessments for near-surface low level waste landfills. Current representations of cementitious waste in performance assessment models typically rely on short term measurements of contaminant release (order of weeks) in a saturated environment as the basis for estimating release over centuries. Changes in the waste form properties that affect contaminant release, such as chemical aging (e.g. oxidation and carbonation) or physical aging (e.g. cracking) are not directly accounted for in numerical models. A better framework is needed to model long-term grout aging in the semi-saturated conditions that are experienced by near surface buried waste.

TECHNOLOGY SOLUTION

Two lines of evaluation would be pursued in this work. The first would be to undertake an effort to collect and analyze information on natural and anthropogenic ancient cement materials to quantify the stability of the underlying crystalline structures and macro properties. The analysis would help confirm and possibly modify the results of the FY21 technical panel review of natural degradation mechanism. Second, laboratory and possibly field lysimeter testing along with theoretical mineral stability calculations would be completed to quantify the impacts of the key degradation mechanisms on the rate of contaminant release from various cementitious low level waste forms buried in an arid environment.

In FY21, WRPS hosted an expert panel that reviewed the state-of-understanding for degradation of cementitious materials in the environment and produced a report detailing the most relevant mechanisms that should be the focus of future studies (PNNL-32458). Work was initiated in FY24 and continues in FY25 to begin evaluating the most impactful processes identified in FY21. In addition, a multi-laboratory project was funded by DOE-EM headquarters to update how cementitious waste forms are represented in the Hanford Integrated Disposal Facility Performance Assessment. This latter work is assessing new conceptual models against experimental data.

Example of Ancient Concrete from the Roman Empire

Pozzolan (volcanic ash) deposits in Southern California

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

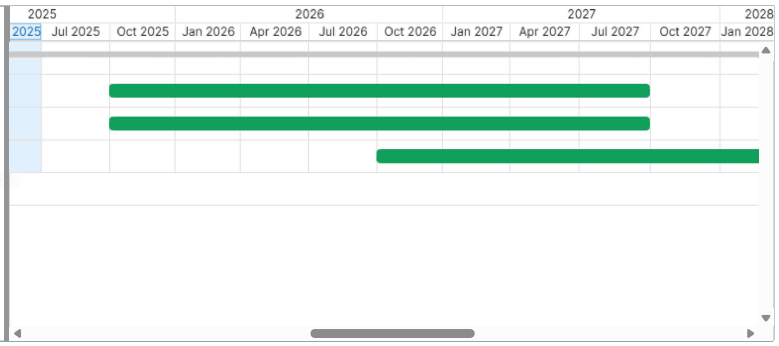
TEDS ID: DTW-13 Continued

ADDITIONAL TECHNICAL INFORMATION

Tasks in FY24 measured the dynamic reduction capacity changes in these waste forms through gas and liquid exposures. The reducing Cast Stone were used to solidify a simulated low-activity waste (LAW) stream. The waste forms were exposed to experimental test conditions that varied both in the type of gaseous or aqueous chemistry used and exposure time. The spatial change of accessible reduction capacity were monitored and compared across samples to serve as invaluable input for future PA model development. Reoxidation by gaseous oxygen was slower than by dissolved oxygen likely due to mass transfer limitations and the gas/liquid interface.

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
Long Term Durability of Cementitious Waste Forms	9/30/25	2/29/28
Waste Aging Studies	9/30/25	9/30/27
Waste Form Aging Model Development	9/30/25	9/30/27
Validation of Aging Model Using Lysimeter Data	9/30/26	2/29/28



THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

MEASURABLE ORGANIZATIONAL VALUE

TBD

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Work is needed to understand the natural biological and abiotic processes in the subsurface that affects the transport of constituents to the ground water.

Natural Attenuation of CoCs in the IDF

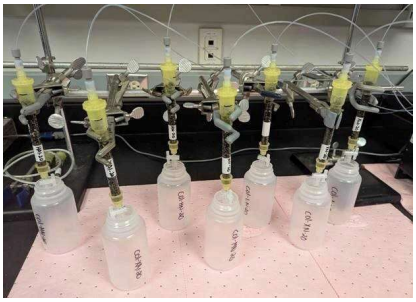
TEDS ID: DTW-15 **Timetable: > 5 Years**

TECHNOLOGY NEED

Natural biological and abiotic processes in the Hanford subsurface will affect the transport of constituents of concern (COCs) to the groundwater and vadose zone due to their release from grouted waste. Understanding these processes is an important component to predicting the future concentration at the regulatory point of compliance, located 100-m down gradient of the Integrated Disposal Facility (IDF). The department of energy has funded a substantial amount of work to quantify these processes to support site cleanup and restoration. Work is needed to harvest this information for the purpose of determining the fate of COCs at engineered disposal sites such as the IDF. Additionally, the IDF Performance Assessment (PA) computational tools need to be updated to include these reactive processes and evaluate the potential for natural attenuation at the IDF subsurface which may limit the release of COCs from the vadose zone.

TECHNOLOGY SOLUTION

Natural attenuation testing information generated for remediation and site closure is being evaluated for application to near surface soils in the IDF. Initial focus is on the fate of nitrate released from grout waste forms buried in the IDF. The information is supporting quantification of the biotic (microbial conversion to gaseous nitrogen or ammonium) and abiotic (mineral precipitation of insoluble nitrate compounds) processes. This information is being prepared in a manner that will facilitate it being evaluated in the IDF PA.



Columns loaded with IDF soil surrogate for testing of natural abiotic attenuation of nitrate from grout

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

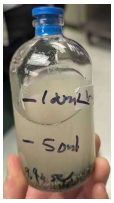
No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

TEDS ID: DTW-15 Continued

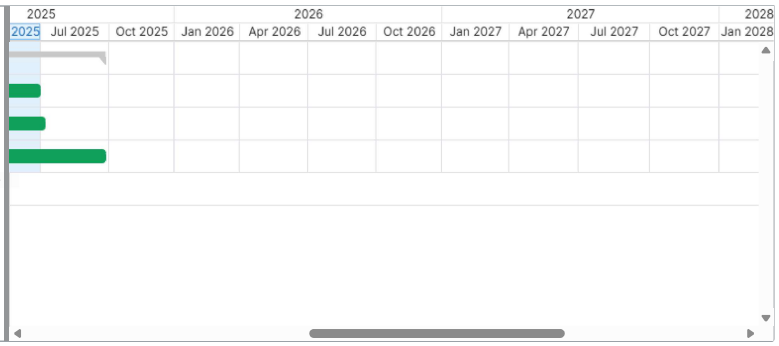
ADDITIONAL TECHNICAL INFORMATION



IDF soil surrogate in contact with growth media for use in future microbial natural biotic attenuation testing

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Natural Attenuation of CoCs in the IDF	2/3/25	9/25/25
Column Testing	2/3/25	6/30/25
Microbe Testing	2/9/25	7/8/25
Reporting	4/22/25	9/25/25



THREATS AND OPPORTUNITIES

DFLAW-0150-T: IDF Readiness Review Completion Delayed Impacting Ability To Commence Disposal of DFLAW Products/Wastes

MEASURABLE ORGANIZATIONAL VALUE

TBD

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5.5 Manage Waste

Hanford Site waste immobilization processes will generate secondary waste byproducts in addition to canistered waste forms. Safe, effective disposal paths must be provided for the secondary waste byproducts. The appropriate disposal path will be determined based on the nature of the waste type.

Secondary Solid Waste (SSW) may be disposed of using a variety of different methods, depending on the type, size, and level of contamination of the waste. SSWs are non-liquid waste debris and byproducts of Hanford Site operations. The different SSW types include miscellaneous failed equipment, filters, debris, spent IX media, LAW melters; LAW melter consumables (e.g., bubblers, thermocouples), and glass residues, among other things. Some SSW may be treated on or offsite and are planned to primarily be disposed of at the IDF.

The WTP HLW and LAW Facilities will convert radioactive wastes into glass. Vitrification is a high-temperature process. As a result of WTP vitrification, a portion of the volatile species in the waste will partition to the off-gas system and become part of the LSW streams. In the DFLAW configuration, LAW vitrification will generate off-gas condensates that will be concentrated by evaporation at the EMF. The concentrate will be recycled to incorporate additional volatiles in the glass. EMF condensate must be processed through the Hanford Site ETF.

Management of long-lived radionuclides such as technetium-99 and iodine-129 may be needed to facilitate LSW disposal. Approximately 26,000 Ci of Tc-99 and 30 Ci of I-129 are present in the soluble fraction of the waste that will be processed as LAW. These radionuclides are not currently planned to be removed from the aqueous waste during pretreatment. Significant percentages of these volatile components will be immobilized in the LAW glass with the remaining amounts captured in secondary wastes which may also be disposed of in the IDF. Due to their long half-lives and high mobility in the environment, Tc-99 and I-129 have the potential to be major dose contributors at the IDF based on the PA. Sufficient risk to satisfying the performance standards may warrant technology development for managing this risk. Options for offsite treatment and disposal of wastes are being evaluated.

The final disposition of spent LAW and HLW melters has not yet been determined (ORP-11242). The alternatives evaluated (DOE/EIS-0391, *Final Tank Closure and Waste Management Environmental Impact Statement for the Hanford Site, Richland, Washington*) assume that the spent HLW melters will be packaged in an overpack and stored at the interim Hanford storage area until they can be removed for disposition and final disposal. For planning purposes, the final disposition of the LAW melters is assumed to be at the IDF to maintain consistency with the current performance measurement baseline.

The MW functional area includes the following focus areas:

1. Liquid Effluent Retention Facility (LERF) / ETF – The low radioactivity LSW output stream will be transferred to the LERF for treatment at ETF. However, the ETF currently treats wastes from a number of sources on the Hanford Site. LSW feed streams will include the following:
    - Mixed Waste disposal trench leachates
    - IDF leachates
    - 242-A Evaporator condensates
    - Laboratory wastewaters and other miscellaneous minor aqueous streams
    - EMF overheads and other miscellaneous LSW
2. SSW – These wastes are non-liquid waste debris and byproducts of Hanford Site operations.

3. LSW – As a result of WTP vitrification, a portion of the volatile species in the waste will partition to the off-gas system and the concentrated condensate will become incorporated into the waste glass via recycle through the melters.
4. Management of Long-Lived radionuclides – This effort evaluates and guides the options for reducing the environmental impact of long-lived radionuclides such as Tc-99 and I-129 in secondary waste disposed of in the IDF.
5. Cesium Management – The treatment of LAW must provide for the removal of cesium.
6. Melter Disposal – It is assumed that spent HLW melters will be packaged in an overpack and stored at the interim Hanford storage area until they can be removed for disposition and final disposal. For planning purposes, the final disposition of the LAW melters is assumed to be at the IDF to maintain consistency with the current performance measurement baseline.

This section includes the catalog sheets for the near-term technologies that fall under the MW functional area.

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

NEAR TERM

Evaluate ETF brine waste form performance against IDF disposal requirements.

ETF Brine Solidification and Disposal

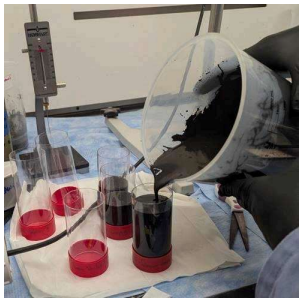
TEDS ID: MW-02 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

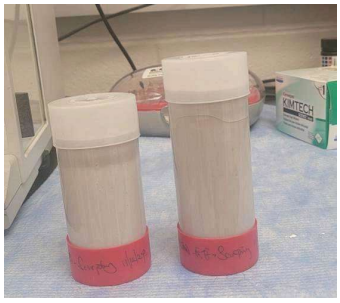
The current baseline treatment strategy for the Effluent Treatment Facility (ETF) brine stream after the Waste Treatment Plant (WTP) start-up is to ship the stream off-site to Perma-Fix Northwest (PFNW) for treatment and immobilization followed by disposing of the final stabilized waste form on-site at the Integrated Disposal Facility (IDF). The previous plan to construct an on-site Modular Grout Facility adjacent to the ETF is not anticipated to be implemented at the Hanford Site for at least 10 years. The immediate need is to gather data on the performance of the grout waste form to be generated at PFNW and evaluate its performance relative to the IDF Performance Assessment (PA) requirements for disposal at the IDF. The PA evaluation is used to give DOE a reasonable expectation that the low-level and mixed low-level waste being disposed of in the IDF will meet the radiological performance objectives established in DOE Order 435.1, ensuring that onsite disposal of radioactive waste will be protective of the public and environment now and in the future.

TECHNOLOGY SOLUTION

Testing of the PFNW grout waste form is being completed at the Pacific Northwest National Laboratory (PNNL). PNNL is utilizing the proprietary formulation and process provided by PFNW to prepare grout waste forms and measure its fresh and cured grout properties for use in performance assessment calculations. Results from these tests will be used to ensure the production of waste forms that are acceptable for disposal at the IDF in support of DFLAW operations.



Fresh Grout Poured Into Containers for Curing



Cured Grout to Undergo Disposal Property Testing

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

Yes

H2C Hanford Tank Waste Operations & Closure

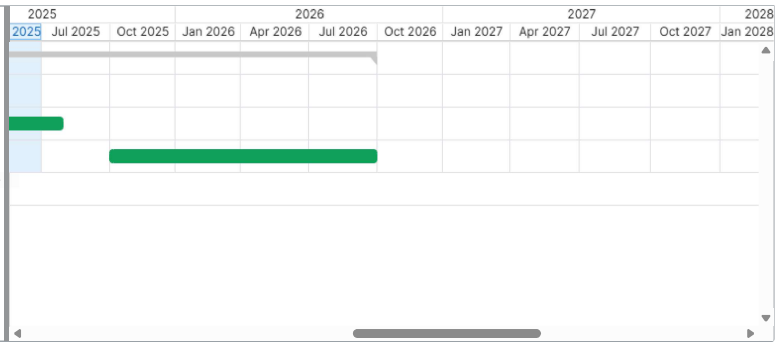
CHIEF TECHNOLOGY OFFICE

TEDS ID: MW-02 Continued

ADDITIONAL TECHNICAL INFORMATION

PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
ETF Brine Solidification and Disposal	1/5/25	9/30/26
ETF Grout Performance Testing	1/5/25	4/3/25
Reporting	2/20/25	7/29/25
Follow on activities as a result of Testing	10/1/25	9/30/26



THREATS AND OPPORTUNITIES

DFLAW-0232-T: WTP radioactive dangerous liquid effluent composition LTA
WARR24-0031-T: Tank Vapors (Excluded)
DFLAW23-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)
DFLAW23-1564-T: Offsite Treatment of ETF Brine/Distillate is LTA
DFLAW23-0232-T: WTP radioactive dangerous liquid effluent composition LTA

MEASURABLE ORGANIZATIONAL VALUE

Successful testing will satisfy WAC and IDF PA requirements for future grout disposal at the IDF.

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

NEAR TERM

A means is needed to clean the ETF process tanks interior walls and roofs without manned entry.

Remotely Operated or Automated ETF Internal Tank Cleaning Device

TEDS ID: MW-10 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

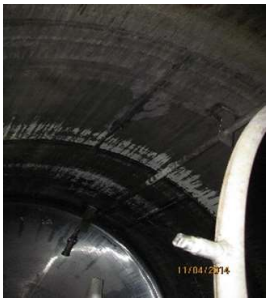
The effluent treatment facility (ETF) process tanks build up scale that cannot be removed by soaking or recirculating with chemicals. This provides a mechanism for accelerated corrosion and inhibits Resource Conservation and Recovery ACT (RCRA) required tank integrity inspections. The ETF secondary waste process tanks are considered at risk. Adequate tank cleaning will allow for a full assessment of the tanks to support replacement for or replacement delay based on ongoing assessments. A functional cleaning technology will mitigate operational impacts and risks of implementing more aggressive manual cleaning techniques including manned tank entries. Cleaning reduces the risk of tank failure by helping to control pitting.

A cleaning device is needed that can be deployable through a 30-in. tank top manway in congested area and operated remotely or automatically. Manned entries into the tank are not an acceptable option. Existing risks associated with manned entry include a potentially oxygen deficient environment while using wire wheels and grinders, fugitive dust created creates an airborne breathing hazard, and a highly likely contamination event if the scale contains radionuclides. Manned entry requires forced air circulation into the tank with a HEPA filter, respirators, impermeable PPE, and a decontamination zone for getting the workers back out of the tank through the lower tank manway. This high-risk evolution can span several shifts to accomplish. The tanks are stainless steel, have bottom drains, and range up to 15 ft wide by 20 ft high.

TECHNOLOGY SOLUTION

One potential technology solution is a Laser Ablation device. Laser ablation is the process of removing material from a solid surface by irradiating it with a laser beam. At low laser flux, the material is heated by the absorbed lader energy and evaporates or sublimates.
Even using a handheld laser ablation device with a manned entry exponentially decreases risk because: a. The laser ablation uses its own high flow rate HEPA filtration vacuum unit that effectively captures all ablated material, thus eliminating the airborne contamination hazard b. The laser ablation unit's vacuum moves enough cubic feet per minute of air to provide more than adequate ventilation to eliminate any potential oxygen deficient atmosphere within the tank. c. The laser ablation unit's vacuum keeps the tank atmosphere at a small negative pressure, thus eliminating the risk of any fugitive airborne contamination that wasn't captured from leaving the tank interior work zone. d. The laser ablation unit is far more effective at scale and oxidation removal than grinding methods, taking less time, and doesn't run the risk of damaging the base metal that a grinder use poses.

Secondary Waste Process Tank



Secondary Process Tank Interior

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Submitted As Grand Challenge?

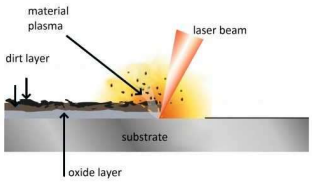
No

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

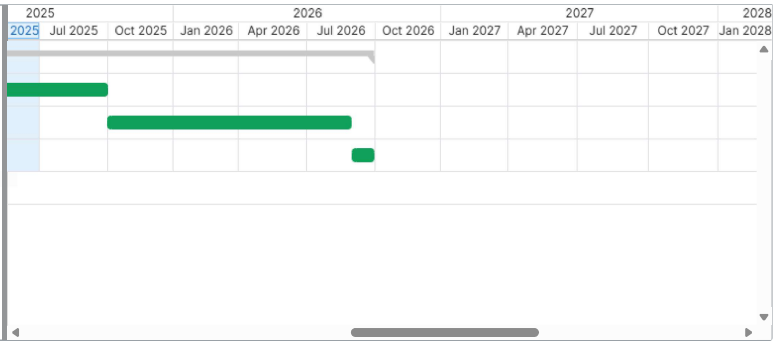
TEDS ID: MW-10 **Continued**

ADDITIONAL TECHNICAL INFORMATION



PRELIMINARY COST ESTIMATE AND SCOPE SUMMARY

Name	Start	Finish
▾ Remotely Operated or Automated ETF Internal Tank Cleaning Devi...	3/30/25	9/30/26
Laser Performance Testing	3/30/25	9/30/25
Develop Deployment Method	9/30/25	8/31/26
Deployment Decision	8/31/26	9/30/26



THREATS AND OPPORTUNITIES

ETFOP24-0023-T: ETF Verification Tank Coating Degradation or Pump Failure (Excluded)
ETFOP24-0026-T: ETF Secondary Waste Receiving Tank Failure (Excluded)
ETFOP24-0029-T: ETF Concentrate Tank Failure (Excluded)

MEASURABLE ORGANIZATIONAL VALUE

TBD

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5.6 Technology Development Funding

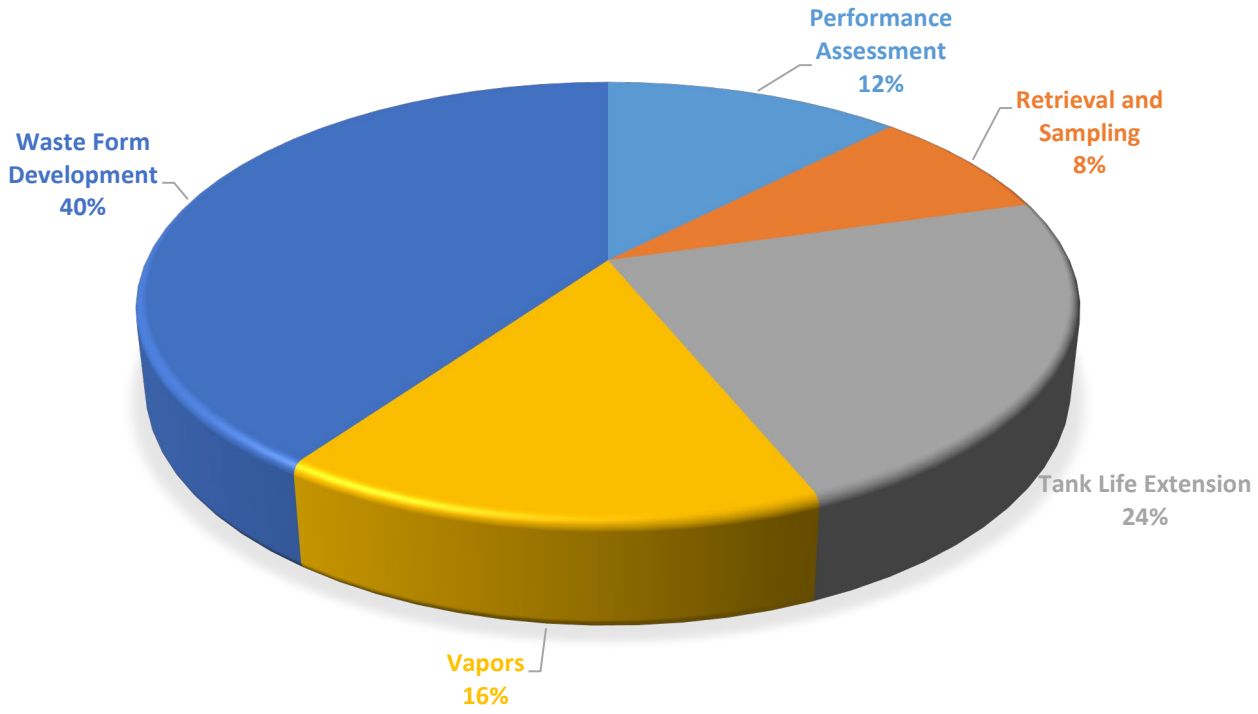
H2C collaborates with the DOE National Laboratory network, academia, and industry experts to develop innovative approaches to enhance our ability to meet the mission needs. Technology development activities are performed and funded primarily through the CTO, however there are some projects that are performed and funded through other organizations. All technology development at H2C is captured in the Catalog Sheets. This section details technology development funding only through the Chief Technology Office.

H2C prioritizes technology development tasks annually. Tasks that are selected for funding seek to increase safety, improve efficiency, and minimize life cycle costs associated with completing the ITDC mission. This section details the following:

- Technology development program funding
- National Laboratory support to funded programs
- National Laboratory, academia, and supplier/contractor support distribution

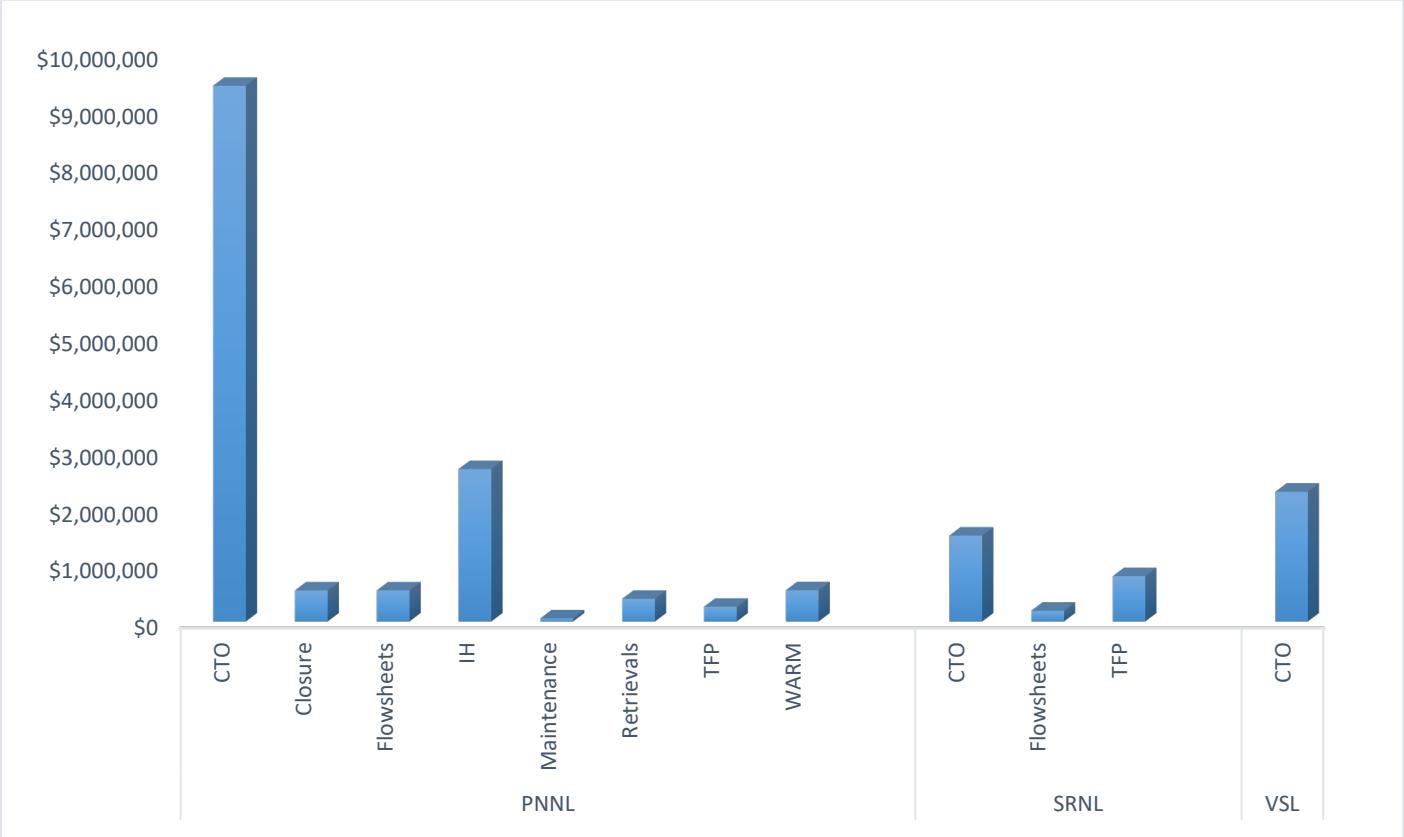
Technology Maturation activities, as reported in the Technology Program Portal (TPP) tool, with budget information for FY2025 is shown in Figure 5-1. The figure shows the total CTO funding per technology area expressed in dollars and depicted in a pie chart as percentages. During FY 2025, technology development funding thought the CTO will be invested in multiple activities in the areas of Waste Form Development, Tank Life Extension, Performance Assessment, Vapors Management and Retrieval & Sampling, with the largest portion allocated to Waste Form Development.

Figure 5-1. CTO-Managed Technology Development and Maturation Scope, FY25 Baseline BCWP



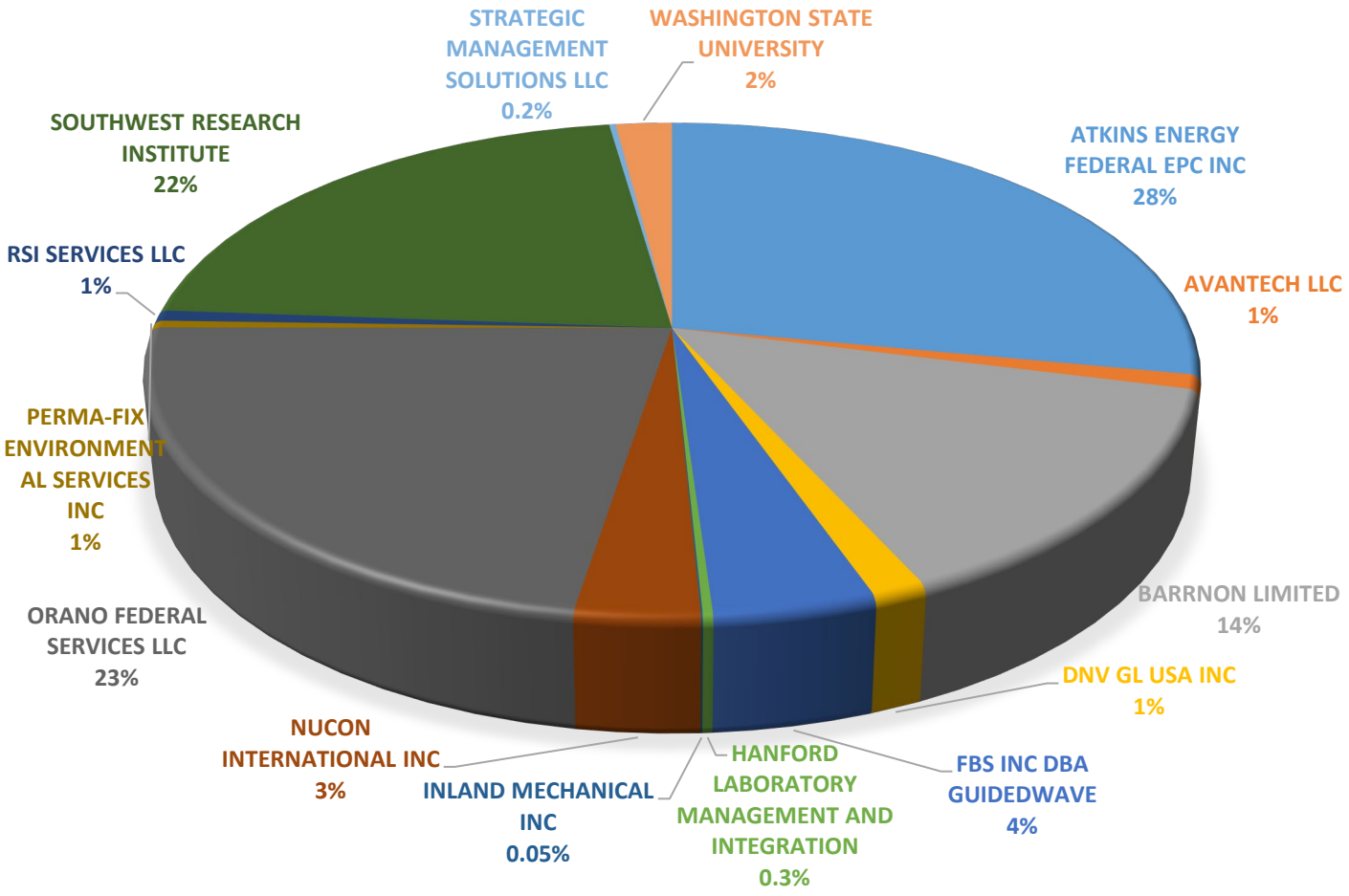
Efforts are made to evaluate all work scope and utilize the appropriate laboratory to support projects based on the laboratory capabilities and past experience. For FY 2024, National Laboratory support was being provided by Pacific Northwest National Laboratory (PNNL), and Savannah River National Laboratory (SRNL). Investments in technology were also made with the academic institution Vitreous State Laboratory (VSL). Activities in FY 2024, supported by the National Laboratories, are shown in Figure 5-2. National Laboratories expertise was and will continue to be utilized in these development programs as well as the other named project areas. National Laboratory support funding distribution for these programs is shown in Figure 5-2. The figure shows the funding levels by participating laboratory and H2C group. For FY 24 the majority of the funding went to PNNL.

Figure 5-2. National Laboratory Support, Actual from FY24



In addition to National Laboratory and academic institution support, H2C also teams with commercial suppliers and contractors. While the national labs are the dominant suppliers with the largest amount of money received in FY24, there were many commercial vendors who made up the remaining budget for technology development. Figure 5-3 shows the distribution of the remaining CTO technology development funding.

Figure 5-3. Technology Development Funding Distribution, Actuals from FY24



Technology development funding is provided primarily by the CTO. When available, some funding may be provided by other organizations such as Tank Farm Projects, the Project Office, and Closure & Interim Measures. Funding provided by other organizations is distributed similarly to CTO distributed funds, however it is not included herein.

6.0 DEPARTMENT OF ENERGY FUNDED RESEARCH

In early calendar year 2023, the Director for Technology Development invited the DOE complex National Labs to submit technology proposals to be considered and selected for discretionary funding. After a thorough review and down selection process, the following projects were selected.

Project	Laboratory
Abatement of Mercury and Iodine in WTP LAW Off-Gas Streams - PNNL80673	PNNL
The Behavior of Non-pertechnetate Forms of Technetium in Grout – PNNL82180	PNNL
Demonstrating Removal, Deployment, and Immobilization of Technetium and Iodine from Actual Hanford Waste – PNNL80668	PNNL
Deployment of In-Line Sampling in Tank Farms – PNNL82209	PNNL
Fixative Spray Alternative for Grout Facility D&D - PNNL82182	PNNL
Increased Hanford Tank Sidewall Integrity Inspections with Robotic Guided Wave & Magnetic Flux Leakage Sensors – PNNL82245	PNNL
Mitigation of Contaminant Release from Residual Tank Waste – PNNL82202	PNNL
Monitoring with Spectral Induced Polarization. PNNL82212	PNNL
New Tools to Estimate Vertical Contaminant Concentration Profiles in Aquifers. PNNL82201	PNNL
Optimizing Tc-99 and Cr(VI) Retention in Grouts Using Ferrous Iron – PNNL82184	PNNL
Ultrasonic Denitrification of Radioactive Waste Streams - PNNL82188	PNNL
FY23 National Laboratory Mission Support	SRNL
Analyte Specific Sensor Development for Long-term Monitoring of Soil and Groundwater	SRNL
CCIM Processing Alternatives for High-Risk Fuel Groups	SRNL
Coatings for Bubbler Life-Extension	SRNL
Consolidated Waste Glass Database	SRNL
Continuous Improvement of Cement Waste Form Technology - Measurement of Ultra-Low Relative Permeability for Grout	SRNL
Continuous Improvement of Cement Waste Form Technology - Replacement of Fly Ash with Natural Pozzolans	SRNL
Disposition Pathways for Non-Aluminum Spent Nuclear Fuel	SRNL
Disposition of Unirradiated Nuclear Materials	SRNL
High Radiation Area Risk Reduction Project - Advanced Technology Applications: Task 1: Program Administration; Task 2 - Radiation Resistant Foam Environmental Chamber Testing & Material Cold Test Plan; Task 3 - Mercury Analyzer with Meteorological Sensor to Identify Mercury Contaminant Trends	SRNL
Large Area Airborne Contamination Monitoring	SRNL
Surface Applied Limestone Gravel to Mitigate Contaminant Transport in the Vadose Zone	SRNL
Remaining Life Prediction of Spent Nuclear Fuel Storage Canisters Exposed to Chloride Induced Stress Corrosion Cracking Environments	SRNL
TMFD Online Alpha Monitors	SRNL
Application of Vitrification Technology to Support Treatment of Fermi-1 Reactor Blanket Material	INL
Technology Maturity Roadmap Development for Intelligent Dry Storage Cask Concepts Using Helical Guided Ultrasonic Wave Closure Weld Interrogation	INL
Techniques to Evaluate the Migration of Chromium in the Unsaturated Zone in Response to Intense Infiltration Events: A LANL Case Study	LANL
Self-Propelled Interior Inspection of Networks of Small Pipes (SPIINe)	SNL
Development of an Advanced Non-Destructive Examination Aerial Inspection System for Long-Term Surveillance of Concrete Structures and Repositories Across the DOE Complex	FIU

Many of these projects directly correlate to Technology Needs identified herein. Technology Needs that are receiving funding for work at the National Labs are annotated as such in their respective Catalog Sheets.

Additionally, in June of 2023, DOE announced its interest in receiving proposals in support of the acceleration of the Hanford Tank Waste cleanup mission. This solicitation requested National Lab lead interdisciplinary teams submit proposals that address opportunities in five focus areas: 1) Waste Retrieval, Transport and Closure, 2) Waste Pretreatment. 3) Waste Immobilization and Disposal, 4) Secondary Waste Treatment, and 5) Mission Enablers. On March 8, 2024 the DOE announced the 13 projects that were awarded funding below.

Project	Laboratory
Enabling High-Level Waste Sludge Delivery Through In-tank Processing in the Southeast Quadrant of the Hanford Tank Farms	PNNL
Expand High-Level Waste Glass processing Envelope	PNNL
Developing a Hanford Grout Modeling Framework and Property Database for Performance Assessments	PNNL
Real-time Liquid/Slurry Waste Sampling & Analysis: With User Interface for Comprehensive Data and Uncertainty Analysis	PNNL
Integrity Monitoring and Assessment, Prediction, Repair, and Corrosion Control of the Hanford Storage Tanks	SRNL
Efficient Electrochemical Denitration and Caustic Generation System for Direct-Feed Waste Pretreatment to Accelerate the Hanford Mission and Operations	SRNL
Direct Stabilization of Low-Activity Waste with Advanced Engineered Cellular Magmatics	SRNL
Technoeconomic Optimization of Hanford Tank Waste: A Data Driven Approach to Inventory, Logistics and Disposition	SRNL
The Surface Chemistry of Plutonium Oxide for Waste Pretreatment	ANL
Digitally Optimized Autonomous Guided Vehicles for Hanford Waste Tank Handling	INL
Dry Retrieval of Tank Waste	LANL
Real-Time In-Line Monitoring for Hanford Tank Waste Treatment	LANL
Improved Fundamental Understanding of Aluminum Chemistry and Interactions of Aluminate Anion with Co-Anions: Applications to In-tank and At-tank Pretreatment of Hanford Tank High-Level Waste Sludge	SNL

7.0 FUTURE TECHNOLOGY NEED DESCRIPTIONS

This section lists those proposed technology needs that are not currently targeted as near-term needs. This means the technology need is still recognized as a need; however, it is not being pursued for development in FY25 or FY26. A technology need may be unpursued for a variety of reasons, including limited available funding and lack of urgency. These technology needs are listed in table format for each of the five basic functional areas. Catalog sheets for these technology needs are one page each and can be found in APPENDIX A.

Table 6-1. Future MTW Technologies

TEDS #	Title
MTW-13	Improve Liquid Observation Well Data Acquisition
MTW-20	Improve Visual Inspection
MTW-40	Improve Sampling Methods of Head Space
MTW-50	Additional Tank Space
MTW-57	Predicting Behavior of Mercury in EMF
MTW-71	Improve Best-Basis Inventory with TWINS Database
MTW-74	Measure Liquid Loss from Evaporation
MTW-75	Reduce or Eliminate Equipment Contamination
MTW-77	Tank Supernate Shielded Sampler
MTW-78	In-Tank Volumetric Nondestructive Examination
MTW-80	Automated Visual Recognition Wireless Remote Video Monitoring
MTW-86	Protective Measures for Waste Transfer System Lines
MTW-88	Liquid Air Interface Sampler
MTW-90	Water/Waste Volume Measurement for 242-A C-A-1 Vessel
MTW-91	Tank-Side Waste Evaporation
MTW-93	Cs Online Monitoring for TSCR
MTW-102	Single-Shell Tank Leak Detection and Monitoring
MTW-103	Transferline Refurbishment
MTW-105	Critical Deposition Velocity for Slurry Transport in Pipelines
MTW-106	Sludge Properties Studies
MTW-107	Retrieved Solids Settling
MTW-108	Tank Mixing Heat Modeling
MTW-109	Settled Solids Layer Characteristics
MTW-110	Settling Solids Interface Measurement
MTW-111	Mechanical Sampler Handling System

Table 6-2. Future RTW Technologies

TEDS #	Title
RTW-10	Hose in Hose Transfer Line (HIHTL) Material Properties
RTW-17	Assess Deep Sludge Pump Reliability for DST Mixer & Transfer Pumps
RTW-19	Removal of SR-90 and TRU
RTW-21	Improve ESP - A Thermodynamic Modeling Program
RTW-23	Waste Transfer Pipe Unplugging

RTW-27	Improved Solubility Modeling
RTW-39	Risk Informed Tank Retrieval Modeling Optimization
RTW-52	Barrier Technology
RTW-53	Improved Configuration Documentation
RTW-55	Low Volume Addition Retrieval
RTW-56	Technology to Support Risk-Based Retrieval & Closure
RTW-57	Plutonium/Absorber Mass Ratios Measurement
RTW-58	Tank Crust Sampler
RTW-59	Retrieval of Sludge from Miscellaneous Underground Storage Tanks
RTW-60	Small Volume Liquid Waste Retrieval Capability for MUSTs

Table 6-3. Future PTW Technologies

TEDS #	Title
PTW-40	Simplified HLW Flowsheet
PTW-42	High-Level Waste Direct Vitrification – Condensate Treatment
PTW-45	Operations Productivity & Analysis Tools
PTW-46	Advance CH-TRU Tank Waste Treatment Technologies
PTW-48	Prevention of Hydrogen Gas Buildup
PTW-49	Feasibility of Removing Nitrates from the LAW Feed
PTW-50	High-Level Waste Solids Segregation
PTW-51	Nitrite-Hydroxide Solubility to Determine Aluminum Solubility in DFLAW
PTW-53	DFLAW Process Operational Troubleshooting
PTW-56	Treated Waste Concentration/Evaporation
PTW-57	In-Tank Solids Suspension
PTW-58	Solids Settling Rate Determination/Solids Washing Techniques
PTW-60	Particle Size Reduction
PTW-61	In-line Slurry Sampling System Development

Table 6-4. Future DTW Technologies

TEDS #	Title
DTW-11	Integrated Disposal Facility Risk Budget Tool Monitoring

Table 6-5. Future MW Technologies

TEDS #	Title
MW-13	Transportation Requirements for New Equipment Disposal
MW-15	At-tank Technetium and Iodine Removal & Disposition

Technology needs that have been overcome by events, developed and implemented, or otherwise deemed no longer in need of development, are considered Retired. A list of Retired TEDS along with retirement criteria can be found in APPENDIX B.

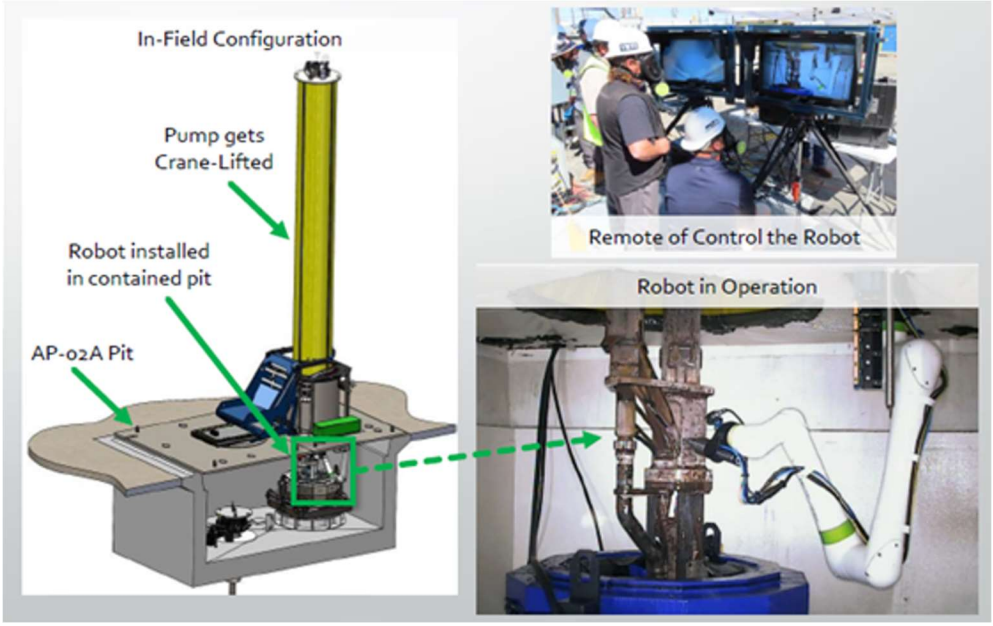
8.0 INNOVATIONS

In addition to the technology development activities, H2C regularly supports the Hanford operations by producing many unique tool designs designated here as Innovations. These Innovations are projects undertaken by various project engineering groups that do not require prolonged development activities. Many of the Innovations are commercially available items that are modified in some way for use in the unique Hanford environment. Innovations range from modified manual extended reach tools to more advanced robotic systems. Below are descriptions of innovative projects undertaken by the previous DOE Prime Contractor to operate the Tank Farms, Washington River Protection Solutions in FY24.

8.1 Robotic Oil Extraction System

The obsolete pump in AP-02A required removal of held up hydraulic fluid (oil) to meet disposal regulations. No design features existed on the pump that allowed the fluid to be drained in an expedient manner. The fluid was held up in multiple steel-reinforced hoses in an unknown orientation with very limited access. A robotic system was developed that allowed workers to make precision incisions in the hydraulic hoses and drain the fluid remotely during pump extraction from the tank. The system consisted of an industrial robotic arm, high-precision spindle, and support equipment. The robotic arm provided workers the flexibility to deal with the unknown orientation of the hoses and perform the draining operations completely remotely.

Figure 8-1. Robotic Oil Extraction System



9.0 SUMMARY, SUCCESSES, AND CONCLUSIONS

HFO is responsible for managing and completing the HTWTM, which is comprised of both the Hanford Site Tank Farms operations, managed by H2C, and the WTP, being constructed by Bechtel National Inc. The HTWTM is to accomplish the following:

- Safeguard and safe management of over 56 Mgal of chemical nuclear waste stored in Hanford Tanks
- Retrieve and treat the waste
- Achieve safe waste disposition to protect the Columbia River and the environment

To reduce the risk and cost associated with these objectives, new technologies are regularly implemented. The identification of these technologies comes from a variety of sources, collected and prioritized in this Roadmap.

9.1 Summary

The Roadmap catalogs technology elements in TEDS for evaluation for each of the ITDC process or functional areas. These TEDS capture specific issues and potential approaches involving the development of new technology or innovative application of existing technology to accelerate threat reduction and reduce life cycle costs. This information is intended to support the FY planning and National Laboratory contracting processes to ensure that HTWTM technology needs are supported as necessary. In addition, the Roadmap provides a basis for strategic planning by identifying opportunities to use technology solutions to enhance mission efficiency.

9.2 Successes

Recent notable technology development accomplishments:

- DTW-10: H2C is managing the Test Bed Initiative (TBI) design, installation, testing, and performing operation of the TBI equipment. Performance validation testing has been completed through a Factory Acceptance Test by the equipment fabricator. The waste, pre-treated by the TBI system, has been collected and shipped offsite for immobilization.
- MTW-11: The guidedwave phased array (GWPA) sensor used in the Remote Air-slot Volumetric Inspection System (RAVIS) completed all qualification testing. A field demonstration of the sensor is scheduled for FY25.
- MTW-77: In a partnership with Atkins, the Hedgehog III, a sample transport system, was designed, fabricated and Department of Transportation (DOT) 7A certified in FY22. To date, three have been procured and several more are planned to be procured by H2C Tank Farm Projects in the near future.
- DTW-08: Additional Glass and Grout sample waste forms were fabricated and deployed in the Lysimeter facility for long term observation. Quarterly samples have been taken and are being analyzed.
- DTW-02: Washington River Protection Solutions in partnership with HLMI, developed a novel method for analyzing organics in waste samples called stir bar sorptive extraction (SBSE). The inherent advantages of SBSE, such as small sample requirement, little solvent use, and ease of application make it easy to apply multiple extraction methods in one analysis batch, with the potential to significantly reduce overall sample analysis time. This method has received Ecology approval and is currently working through the necessary evaluations to be deployed as an approved analysis technique.

- MTW-92: The Cold Spray tank refurbishment system underwent multiple successful performance demonstrations culminating in successful achievement of a PBI demonstrating field readiness. A Field demonstration is scheduled for FY25.

9.3 Conclusions

A revision of this Roadmap occurs annually. The revision is developed in a systematic manner to facilitate sound strategic, programmatic, and fiscal planning regarding existing technology gaps in the HTWTM. Expert personnel are solicited for input from each of the five functional areas of the flowsheet. Input is provided in standardized TEDS format to ensure consistent reporting.

Based on TEDS input, the technology needs may be tied to projects or require development. As the HTWTM mission consists of many interwoven, interdependent unit operations, a technology gap or need in an upstream unit operation can cause impacts throughout many functional areas. The Roadmap reconciles individual technology development activities and combines efforts where possible. This process has been enabled in large part due to efforts of National Laboratory testing and development to meet the growing needs of Hanford to safely treat and dispose of the stored waste.

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APPENDIX A BALANCE OF TECHNOLOGIES CATALOG SHEETS

A.1 Manage Tank Waste

The following are the one-page catalog sheets of the balance of the MTW TEDS.

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Installation of new leak detection and monitoring technology, or new applications of said technology, would be beneficial in identifying fate and transport of liquid waste released from SSTs with active leaks if the instrumentation is sensitive enough to monitor the tank leakage rate.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$5 Million - $10 Million

2 Years - 3 Years

Single-Shell Tank Leak Detection and Monitoring

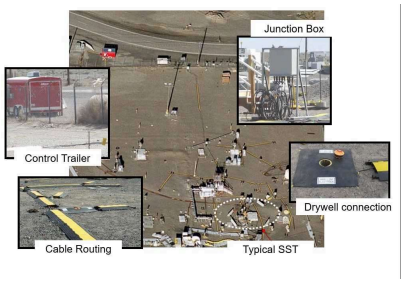
TEDS ID: MTW-102 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

There is a need for improved leak detection and monitoring to respond to and mitigate the ongoing release of mixed waste from the specific leaking single-shell tanks (SSTs) 241-B-109 and 241-T-111 as well as any future leaking SSTs at the Hanford Site. Installation of new leak detection and monitoring technology, or new applications of said technology could be beneficial in identifying fate and transport of liquid waste released from SSTs with active leaks if the instrumentation is sensitive enough to monitor the tank leakage rate.

TECHNOLOGY SOLUTION

A single-shell tank leak detection and monitoring technology evaluation focusing on low-volume leakage was performed and documented in RPP-RPT-64595. The evaluation considered both in-tank and ex-tank technologies, as well as enhancements to currently employed tools. The evaluation and subsequent recommendation is still under review, however it did indicate that the in-tank leakage monitoring currently employed is the best available system at this time.



Current Electrical-Resistivity (ER) Leak Detection Monitoring Technology

THREATS AND OPPORTUNITIES

SSTI24-0001-T: SST Failure

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Transferline Refurbishment

TEDS ID: MTW-103 **Timetable: ≤ 5 Years**

Similar to the Tank farm tanks, the transfer lines are expensive to replace and critical to the Hanford mission for an increasing number of years into the future. Repairing and refurbishing this system is an alternative that could save costs and avoid excessive delay in farm operations. Refurbishment options currently considered include:

pressure-activated sealant, fold-and-form liners, cured-in-place pipe, internal repair sleeve, and expandable metal patching.

TECHNOLOGY NEED

The Tank Operations Contractor is required to evaluate the operability and fitness-for-service of the Tank Farms' Waste Transfer Lines (WTLs). These buried lines, consisting of 2" and 3" I.D primary tubes encased in secondary containment layers, create a network of pipe-in-pipe WTLs totaling approximately 10 miles in length.

Residual water from waste transfers and line flushes has caused corrosion of the WTLs primary pipe, and a number of these have failed encasement pressure testing, indicating that corrosion has damaged the pipe to a point of rupture.

TECHNOLOGY SOLUTION

Transfer line refurbishment efforts are in an exploratory phase where multiple solutions are being considered. Technologies under consideration include but are not limited to:

Pressure-Activated Sealant: The sealant fluid only polymerizes into a flexible solid at the leak site when there is a pressure drop. Delivery methods are flexible, and concerns about pipeline temperature and delivery time are eliminated due to the sealant's unique hardening property.
Fold-and-Form Liners: Thermoplastic pipes are folded into a "C" shape, pulled into the host pipe, and expanded with pressure and heat to restore leak tightness. This technology is limited to smaller pipe sizes due to pull-in requirements.
Cured-In-Place Pipe: A flexible felt liner coated with polyethylene and saturated with thermosetting resin is propelled through the pipe with water pressure, turning it inside out to press against the host pipe. The resin side is pressed tightly to repair the pipe section.

Transfer Line interior degradation, captured through borescope inspection..

THREATS AND OPPORTUNITIES

TLI24-0002-T: Waste Transfer Lines Do Not Pass testing and Require

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

Contractor: Josue Estrada Martinez
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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

The aim is to establish reliable critical deposition velocities for direct-feed slurry transport, ensuring efficient operations and avoiding pipeline plugging through analytical studies, experimental verification, and operational analysis.

Critical Deposition Velocity for Slurry Transport in Pipelines

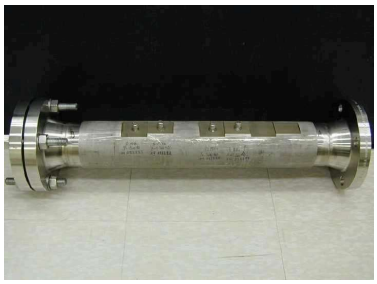
TEDS ID: MTW-105 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

There is a need to determine the bounding critical deposition velocities for slurry transport in pipelines at the Hanford site. Historically, there has been difficulty in transferring waste slurry without a comprehensive understanding of the precise critical deposition. By developing and validating a comprehensive method for identifying and validating critical deposition velocities, the project ensures that future waste slurry transfers will operate with optimal efficiency and dependability.

TECHNOLOGY SOLUTION

Develop and validate experimental and analytical methods for determining bounding critical deposition velocities for Newtonian and non-Newtonian yield stress fluids, mature an in-line critical deposition velocity measurement instrument, and address operational considerations comprise the solution. The objective of this all-encompassing strategy is to decrease uncertainties and enhance the resilience of designs for slurry transfer and flushing systems. Additionally, it aims to develop a consistent prediction methodology for critical deposition velocities by integrating existing data with new analytical and experimental results.



PNNL-20350: Figure 5.1 PulseEcho Spool Piece with 5-MHz and 10-Mhz Transducers Mounted

THREATS AND OPPORTUNITIES

RPP-0015-T: Cross-Site Transfer System Startup is Delayed

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

Contractor: Michael Britton
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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

A comprehensive test and analysis program to understand and optimize sludge properties for efficient feed preparation and transfer to WTP (Waste Treatment Plant).

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

+ 4 Years

Sludge Properties Studies

TEDS ID: MTW-106 **Timetable: > 5 Years**

TECHNOLOGY NEED

There is a need for improved understanding of the physical behaviors and properties of sludge in the Tank Farm waste inventory at Hanford. This knowledge gap could result in possible disruptions to waste transfer and processing. Optimizing the feed preparation process would be aided by comprehensive data regarding solids settling rates, particle size distribution, the composition of suspended and settled solids, yield stress, and the consequences of waste heat capacity on mixer pump operations. Addressing these challenges requires a comprehensive research and testing program to fill in knowledge gaps and facilitate the efficient and secure treatment and disposal of tank waste.

TECHNOLOGY SOLUTION

Address gaps in sludge properties and behaviors, tasks include developing a test plan, conducting multiple rounds of testing on actual tank waste with result assessments, developing Data Quality Objectives for DFHLW, and further testing for comprehensive understanding and mitigation of the identified risks.

THREATS AND OPPORTUNITIES

RPP-0017-T: CH-TRU Waste Treatment Startup is Delayed

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

In order to increase the efficiency of HLW processing, a comprehensive study and implementation strategy are required to improve comprehension and management of the settling, blending, and segregation behaviors of sludge waste.

Retrieved Solids Settling

TEDS ID: MTW-107 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

The development of High-Level Waste (HLW) processing will require data concerning the settling characteristics of solids in the feed preparation tanks. This data will inform processes including solids washing, blending, and concentration. Forecasting and controlling the settling properties of sludge waste will be necessary to guarantee maximum operational efficiency and throughput in the treatment of HLW.

TECHNOLOGY SOLUTION

The settling behavior of sludge solids in feed preparation tanks is crucial for DFHLW processing, with tasks aimed at enhancing understanding and improving equipment and monitoring for retrieved solids, using sludge settling tests outlined to provide data on settling rates across various solids loadings for better characterization and assessment. This includes validation and actual waste samples and blending studies with simulants and segregation studies, respectively.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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US DEPT OF ENERGY

Tank Waste Mixing and Cooling

TEDS ID: MTW-108 **Timetable: ≤ 5 Years**

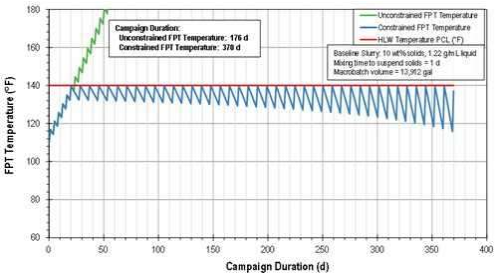
Development of a model to predict and manage waste temperatures in the DFHLW feed preparation tanks, ensuring compliance with temperature criteria for high-level waste (HLW) Vitrification Facility.

TECHNOLOGY NEED

There is a knowledge gap in the proposed Direct-Feed High-Level Waste (DFHLW) flowsheet regarding the feed preparation tank waste temperature increase from mixer pump operations and the ability to cool the DST waste via evaporative cooling before it is fed to the HLW Facility. Preliminary analysis indicates that the waste temperature will exceed the HLW Facility process limit of 140 °F within 23 days of a 176-day campaign. The current alternative is to delay macrobatch transfers until the waste has sufficiently cooled, which will stall operations in the HLW Facility and extend the mission by 110% to 492%.

TECHNOLOGY SOLUTION

Develop alternate techniques and strategies for cooling the waste including enhancing evaporative cooling and installing waste cooling capabilities in the Waste Transfer Vault.



Campaign Duration vs FPT Temperature for a 1 day Mixing Time to Suspend Solids

THREATS AND OPPORTUNITIES

RPP-0040-T: IHLW Glass Mass Differs from Plan

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Developing a comprehensive understanding of settled solids characteristics in feed preparation tanks to improe mobilization and prevent operational delays.

Settled Solids Layer Characteristics

TEDS ID: MTW-109 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

There is a need to identify and forecast the properties of the settled solids layer in the feed preparation tanks subsequent to waste retrieval and blending. Effectively mobilizing settled solids to sustain a consistent feed for the vitrification process is an important factor in ensuring operational success. Variability and uncertainty continue to exist with regard to the behavior of solids during settling. The physical and rheological properties of the settled waste can be significantly altered by washing, as well as blending of wastes. Without an understanding of the resistance of solids that have become immobile, operational inefficiencies could result in waste processing delays and difficulties in maintain throughput.

TECHNOLOGY SOLUTION

Develop a technical foundation for the properties of retrieved settled solids in feed preparation tanks, influenced by retrieval and blending operations, by evaluating mobilization thresholds and shear strength, culminating in a report to guide subsequent mobilization operations.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

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H2C Hanford Tank Waste Operations & Closure

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A solution for precisely determining the interface level between settling solids and overlaying fluid in tank waste management, thereby improving the efficiency of solids concentration processes.

Settling Solids Interface Measurement

TEDS ID: MTW-110 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

A precise method for measuring the interface between settling solids and the overlying fluid in feed preparation tanks is needed. This measurement is used in optimizing the concentration of solids in the tanks, which would allow for efficient decanting operations and reducing the presence of solids in the removed fluid. The variability and uncertainty in the behavior of settling solids combined with limited characterization and monitoring capabilities have been identified as technical challenges.

TECHNOLOGY SOLUTION

Develop the technical basis for measuring the settling solids interface level in feed preparation tanks, involving evaluating and selecting measurement instruments, designing a conceptual test system, and conducting test to inform equipment selection and system design for DFHLW operations.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

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Development of an automated MSHS to ensure safe, efficient, and representative sampling of HLW slurry, minimizing radiation exposure to workers.

Mechanical Sampler Handling System

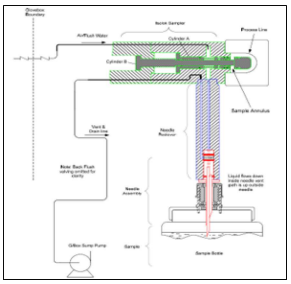
TEDS ID: MTW-111 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

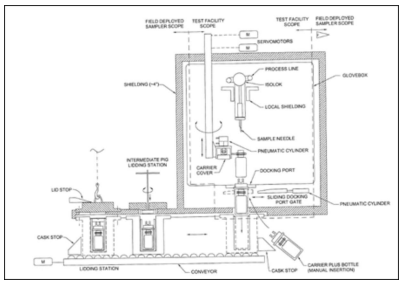
There is a need for high-volume sampling of high-level waste (slurry) with minimal manual intervention to reduce worker radiation exposure. The current system requires pre-sample carriers to be manually inserted which is undesirable due to the high radiation level.

TECHNOLOGY SOLUTION

The proposed solution involves the development and deployment of a Mechanical Sample Handling System (MSHS) equipped with a computer-controlled robotic arm designed to automate the process of sample collection, thereby eliminating the need for manual handling post-sample collection. The current concept for collecting HLW slurry samples includes use of a remote online sampling system such as the Isolok attached to a transfer pipeline, or recirculation loop back into the tank being sampled. This sampling concept collects slurry samples into a glass jar which is preloaded into a carrier. The current concept requires the pre-sample carrier/bottle unit being manually inserted into the sampler dock. This carrier with sample would need to be placed into transport case or cask which would then be transported to onsite lab for analysis. Manual handling of the sample should be very limited or eliminated altogether to reduce radiation exposure to the workers.



Current concept for collecting HLW slurry samples



Schematic of the Isolok Sampling System and MSHS Configuration

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

+ 4 Years

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H2C Hanford Tank Waste Operations & Closure

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Improve Liquid Observation Well Data Acquisition

TEDS ID: MTW-13 **Timetable: > 5 Years**

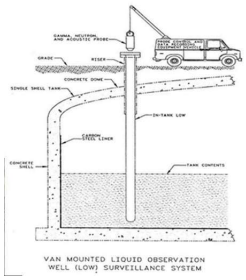
Measurements of tank interstitial liquid levels are time-intensive and are performed on a quarterly basis, which may not allow leaks or intrusions to be detected rapidly. Improved sensor technology and automation would allow for more frequent readings and less time for field crews in the tank farms.

TECHNOLOGY NEED

Liquid observation well (LOW) scans are currently obtained by a four-person crew in a specially outfitted van. They collect scans using either gamma or neutron probes and generate a profile of “counts”, indicative of the presence of water and/or radiation, as a function of depth. These profiles are interpreted to calculate an interstitial liquid level for tank monitoring purposes. Alternative technologies may offer additional information/clarity to better characterize the waste. Additionally, consideration should be given to automating LOW scanning. LOW scans are obtained manually by a field crew, which carries some potential for radiation exposure. An automated approach would reduce worker exposure and allow for more frequent readings - which could help identify leaks or intrusions more rapidly.

TECHNOLOGY SOLUTION

Research and test alternative technologies that can improve the characterization of single-shell tank wastes, and can differentiate between bound and unbound liquid, i.e., that which is held by capillary action or could drain and leak. This capability would provide additional understanding of the tank inventory as well as improve the ability to identify water intrusions.
Additional work would include identifying a potential technology for automated readings and determining if it is logistically feasible after considering the needs of the equipment (calibration, power, communication, etc.).



Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Improve Visual Inspection

TEDS ID: MTW-20 **Timetable: ≤ 5 Years**

Hanford Tank inspections are currently performed manually by reviewing hours of video footage. Improved cameras, lighting, and automated inspection software would save time and improve accuracy of tank defect detection.

TECHNOLOGY NEED

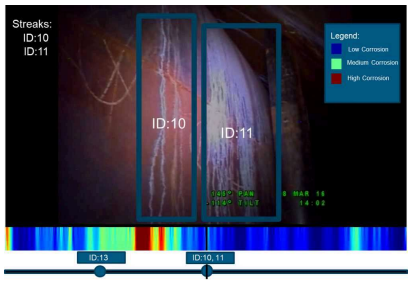
This technology is needed to improve surface inspection and aid in leak detection. Current video camera and lighting cannot provide the level of detail required for tank integrity inspection examination of spontaneous chemical processes and other changes that may be occurring. The current visual inspection approach involves extensive post processing tim. An improved evaluation/inspection of the recordings could also reveal areas of interest for prioritizing future inspections.

TECHNOLOGY SOLUTION

Identify and test an improved video camera and lighting system, a still photography system, a data acquisition system, and a data storage system for tank integrity inspections. The video and still camera systems should, at a minimum, provide:

- Collect high quality images of the annulus in panoramic form to enable effective leak and corrosion detection.
- Sufficient resolution and lighting to identify down to 1/16-in. cracks in the tank concrete dome using existing risers.
- A reproducible indexing system and ability to be deployed by two people (maximum) without a crane.
- Camera lenses and other components that will survive in high temperatures and radiation.

Compact Camera and Light Needed



Machine Learning Identifying Tank Corrosion

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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CHIEF TECHNOLOGY OFFICE

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US DEPT OF ENERGY

Improve Sampling Methods of Head Space

TEDS ID: MTW-40 **Timetable: > 5 Years**

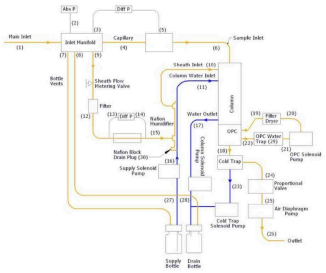
Improved methods and instrumentation are needed to measure particle size distributions of head space particulates. Improved instrumentation is also needed to capture, preserve and analyze head space particulates.

TECHNOLOGY NEED

A program is needed to sample and measure head space particulates. Information gathered would help to mitigate exposure risks in the tank farms. Instrumentation is needed to capture, measure, and preserve aerosolized tank constituents for laboratory analyses. In addition, laminar-flow hood capabilities would be essential to laboratory analyses of particulates.

TECHNOLOGY SOLUTION

Head space sampling methods and instrumentation need to be improved to capture and preserve head space particulates. Deploying cloud condensation nuclei (CCN) technology to measure particle size distributions of head space particulates before and after waste-disturbing activities would enable better estimation of the magnitude of particulate generation during these activities. Impactor technology can be deployed to capture head space particulates. Impactors may also be coupled to CCN instrumentation for real time measurement of particle size distributions prior to particulate capture. This program would design and assemble measuring and sampling (CCN and impactor) technologies for improved understanding of particulate generation to help mitigate personnel exposure risks in the tank farms. The CCN counter is a continuous-flow, thermal-gradient diffusion chamber for measuring aerosols that can act as cloud condensation nuclei. The CCN draws an aerosol sample into a column, where a thermodynamically unstable, supersaturated water vapor condition is created by taking advantage of the difference in diffusion rates between water vapor and heat. Water vapor diffuses from the warm, wet column walls toward the centerline at a faster rate than the heat. The wall temperature along the column gradually increases to create a well-controlled and quasi-uniform centerline supersaturation. Seeking equilibrium, the supersaturated water vapor condenses on the cloud condensation nuclei in the sample air to form droplets, just as cloud drops form in the atmosphere.



Flow Schematic

Cloud Condensation Nuclei Counter

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

EAO24-0012-T: Enrafs, High Level Proves, or Other Monitoring Equipment Becomes Inoperable or Obsolete
WAO24-0008-T: ENRAFs, High Level Probes, or Other Monitoring Equipment Becomes Inoperable or Obsolete

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Additional Tank Space

TEDS ID: MTW-50 **Timetable: > 5 Years**

Development of a retrieval support system which can add capacity for use in continued SST waste retrieval missions and risk reductions of aging tanks. New tank capacity would be used to safely store, stage, transfer and potentially treat retrieved waste as applicable.

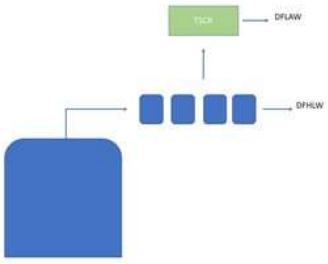
TECHNOLOGY NEED

Currently, single shell tank waste retrieval activities require an existing Double Shell Tank (DST) to serve as a waste receiver tank. Treatment systems like TCSR require multiple tanks to support operations. Future HLW process will also likely require a tank system to perform the needed functions. Existing DST space is limited in many areas of the site and is expected to become even more limited in the time frame before the Waste Treatment Plant (WTP) begins processing waste. A staging tank system that can support waste retrieval needs, DFLAW feed and HLW feed can provide a means to allow continued risk reduction along with provide multiple feed streams in support of the mission. Coupled with a TCSR, this system could also serve as a separation system that receives SST waste, processes the supernate to feed DFLAW and processes the sludge to feed HLW.

TECHNOLOGY SOLUTION

Developing of this type of tank system is a multi-phase activity. Initial efforts will focus on developing permitting, design, procurement, and construction strategies based on the retrieval, DFLAW, and HLW specific needs. After strategy development execution would follow a typical project life cycle with a tailored approach.

Examples of the equipment may include instrumentation, process equipment, and treatment systems including vapor abatement. The staging tank system could be configured to allow for time phases expansion based on mission needs. The initial system could support retrieval with planned expansion to support DFLAW and HLW as needed. This type of system would be particularly useful near SSTs Farms located in remote areas (i.e. T Complex and B Complex).



Feed Tank Flow Diagram

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure
WTO24-0002-T: DST Space Not Available (TOC)
WTO24-0003-T: DST Space not Available

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Predicting Behavior of Mercury in EMF

TEDS ID: MTW-57 **Timetable: ≤ 5 Years**

Operating data from the 242-A Evaporator campaigns is used to predict operations in the Effluent Management Facility (EMF) evaporator. The behavior/impact of the higher mercury concentration on the new evaporator is not known.

TECHNOLOGY NEED

Partitioning of mercury in low-activity waste (LAW) melter off-gas processes, wet electrostatic precipitator (WESP), and submerged bed scrubber (SBS), has not been experimentally determined. Data from laboratory-scale venturi scrubber testing was used to estimate the decontamination factor for the SBS; LAW off-gas processes were assigned a decontamination factor of one. An accurate decontamination factor for mercury in the LAW off-gas system is needed to determine the mercury concentrations of LAW condensate. Furthermore, the Hanford Tank Waste Operating System does not track mercury in the SBS/WESP off-gas condensate recycle. During direct-feed LAW (DFLAW), the mercury concentration is needed to accurately assess the impact on tank farm and the evaporator.

TECHNOLOGY SOLUTION

The approach is to update the assumed partitioning for mercury in the process models to allow better estimates for the condensate during DFLAW operations. Key considerations during the testing will include validation of $HgCl_2$ as the mercury species in the LAW off gas, followed by small-scale and/or large-scale tests to determine mercury partitioning in the SBS and WESP. An assessment of the improved mercury partitioning on the remaining LAW off gas processes are planned to be performed and used to evaluate the impacts of the expected mercury levels during processing in the 242-A Evaporator.

Engineering-Scale Evaporator

THREATS AND OPPORTUNITIES

RPP-0030-T: WTP EMF Throughput Rate Does Not Meet Plan

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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US DEPT OF ENERGY

Improve TWINS Database Interface

TEDS ID: MTW-71 **Timetable: > 5 Years**

Improve the interface for data access within the TWINS database.

TECHNOLOGY NEED

Suggested Tank Waste Information Network System (TWINS) enhancements include:
- Search functionality
- Automated graphic production
- Simpler application for nonexpert users
- Ability to visualize current and historical BBI data
- Ability to compare inventory or concentrations values for specified analytes or radionuclides including the ability to search sample data by metadata.

TECHNOLOGY SOLUTION

Initiate activity with a study to determine best software platforms and most value-added upgrades based on input from the Tank Waste Characterization Group and other data users. The study should also include a cost-benefit analysis for alternate platforms. Based on this information, a down-selection would occur and a budget and schedule would be developed. A modular approach would be utilized to develop and deploy upgrades.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
WSO24-0020-T: Obsolescence of Legacy Software or Hardware Systems
WTO24-0009-T: Software or Hardware Failures/Obsolescence

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H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

Tank breathing rates must be made known in order to evaluate if a tank is leaking. The outcome of tank leak assessments depend on tank breathing rates. SX farm tanks show liquid losses in the 300 to 2,000 gal/yr range, and are due for tank leakage testing through the breathing rate method or an alternative method, if available.

Measure Liquid Loss from Evaporation

TEDS ID: MTW-74 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

SX tank farm breathing rates are needed to be able to estimate liquid loss rates due to evaporation from the SX tanks. Without the breathing rates we likely cannot conclude whether or not selected tanks are leaking, which is undesirable, and will eventually require a more restrictive means of waste retrieval. Tank SX-104 went through leak assessments or evaluations in 1988, 1998, 2008, 2009, 2011, and 2018. An alternative approach was implemented that indicated the liquid loss from SX-104 is the source of liquid coming into SX-106 via an old buried vapor manifold. Tanks in SX farm are planned for retrieval in 2028 per System Plan 8 base case. A retrieval process amenable for a leaking tank should be selected at least 3 to 4 years before that, in the 2024 to 2025 timeframe.

TECHNOLOGY SOLUTION

Tank breathing rates for 12 tanks in seven tank farms not including SX Tank Farm were measured in 1997-1998. The rates were measured by injecting inert gases (He and SF6) into the tank headspace, and then taking periodic headspace gas samples over time to observe the concentration decay. Breathing rates for 10 of 11 tanks, excluding A and AX Tank Farms, were in a nominal 2 to 3 cfm range, while those for three tanks in A and AX Tank Farms had rates in the 10 to 25 cfm range. One tank in BY Tank Farm was measured at 16 cfm, but it is possible to have been affected by an exhauster used during saltwell pumping. These tank breathing tests need to be performed in SX farm tanks in order to provide current tank breathing rates not included during prior testing.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

SSTI24-0001-T: SST Failure
WTO24-0002-T: DST Space Not Available (TOC)
WTO24-0003-T: DST Space Not Available

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Reduce or Eliminate Equipment Contamination

TEDS ID: MTW-75 **Timetable: > 5 Years**

When equipment contacts tank waste and becomes contaminated, it is difficult to handle and can severely limit engineering design options for waste contacting equipment. Reducing or eliminating contamination on small equipment or in-tank instrumentation would open up design options and decrease potential worker exposure.

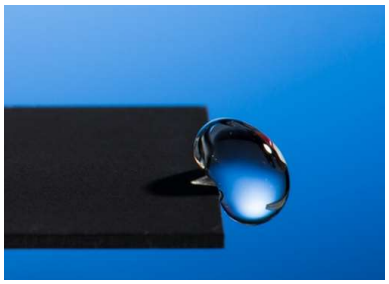
TECHNOLOGY NEED

Any technology that reduces or eliminates equipment contamination reduces the difficulty, time, and expense of dealing with waste-contacting equipment. It also reduces the potential dose workers receive, a critical as low as reasonably achievable (ALARA) principle.

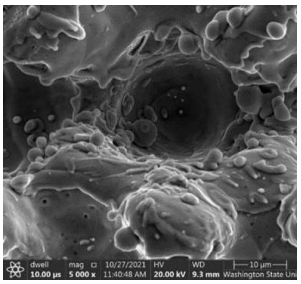
TECHNOLOGY SOLUTION

Application of special hydrophobic coatings to metallic equipment surfaces is used in the nuclear industry to reduce contamination. These coatings keep waste from sticking to the equipment, thus reducing contamination. These coatings can only be used in certain applications because they lack durability, lack adhesion to the substrate, or are chemically incompatible with the waste. Etching nanostructures using femtosecond or nanosecond lasers creates a hydrophobic surface that is permanent and intrinsic to a metal surface. This new strong hydrophobic property could be applied in a cost-effective manner to small equipment or in-tank instrumentation. The following tasks would assess viability:

- Verify that laser-treated metal surfaces effectively shed simulated waste.
- Verify that the treated metal surface is not degraded by waste chemical constituents, exposure to radiation, erosion by insoluble waste particles, reasonable physical impacts.
- Develop methods to speed application and reduce cost.
- Apply treatment to a typical piece of waste-contacting equipment, expose to waste, then measure the contamination and compare to unexposed equipment with the treatment.



Water repelled by laser treated surface



Scanning Electron Microscope Surface Image at 5,000 times magnification

THREATS AND OPPORTUNITIES

EAO24-0008-T: Additional Cost for Abandoned Equipment Maintenance or Disposal
WAO24-0044-T: Additional Cost for Abandoned Equipment Maintenance or Disposal
WSO24-0016-T: Increased Scope for Reusable Contaminated Equipment

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Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

2 Years - 3 Years

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Tank Supernate Shielded Sampler

TEDS ID: MTW-77 **Timetable: ≤ 5 Years**

A large-volume shielded sampler is needed to take 1 L samples of supernatant to support the direct-feed low-activity waste Radioactive Waste Test Platform. An improved transportation system is also needed to transport the larger samples to the laboratory.

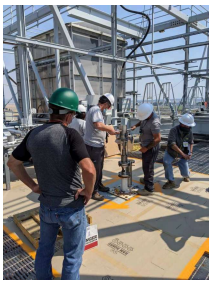
TECHNOLOGY NEED

The current tank farms approach to obtaining supernatant samples is to lower a weighted sample bottle on a wire to required depth and collect a grab sample of 500 mL maximum (typically 250 mL). A large volume sample (1 L) is needed to support the River Protection Project mission, while providing improved shielding to reduce worker radiation exposure. An improved transportation system (Hedgehog III) was developed and DOT-7A certified in FY21.

TECHNOLOGY SOLUTION

The solution proposed is based upon results determined by the RPP-RPT-60607 Sampling and Transportation Study. This development effort has been ongoing since 2018. Most recent efforts have focused on advancing the shielding sampler development through applying laboratory interface requirements (222-S and RPL), finalizing design and fabrication in preparation for FY21 proof of concept testing. The Hedgehog III (HH-III) was fully designed, fabricated and DOT7A certified in FY22. Three HH-IIIs have been procured and planned for delivery to Hanford Tank Farms in May 2025. It is desirable to maintain the waste samples at waste temperature during shipment to prevent solids precipitation. Modifying the Hedgehog III (a.k.a., Hedgehog IV) to incorporate a heat source to maintain representative waste temperature would be preferable. Consideration may be given to this modification after successful deployment of the Hedgehog III.

Shielded Sampler is tentatively planned for FY25 but will likely be delayed due to funding constraints.



Shielded Sampler Functional Testing with Simulant at the Cold Test Facility 2021

Shielded Sampler mounted on a mock 4-inch riser at the Cold Test Facility 2021

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

In-Tank Volumetric Non-Destructive Evaluation

TEDS ID: MTW-78 **Timetable: > 5 Years**

Development of primary tank bottom volumetric inspection capability addresses a current lack of available data to characterize the potential for degradation of the primary tank bottom within DSTs and single shell tanks. The product is expected to aid in determining the state of primary tank bottoms using non-visual examination methods.

TECHNOLOGY NEED

An independent High-Level Waste Integrity Assessment Panel performed a review, and one of the issues identified was the inability of the double shell tank (DST) integrity program to predict a leak; this challenge was highlighted when a leak occurred in tank AY-102. At present, there is no visual or nondestructive examination (NDE) of tank bottoms where the leak occurred in tank AY-102. The method proposed here would supplement the current inspection method under development, which targets DST primary tank bottoms via refractory pad air channels. Inspection through the refractory pad air channels greatly limits the area of the tank bottom that can be reached due to using 24-in. risers for access and obstacles located in the DST annuals space.

TECHNOLOGY SOLUTION

Incorporate a volumetric NDE sensor into either a drill string or push rod for deployment through a riser, through waste, and pressed against the tank bottom. This method would utilize tank risers down to 4 in. in diameter for access to the tank. All other Hanford NDE development restricts access to just the annulus and the under primary tank air channels. Most NDE technologies can easily be fabricated into this size, allowing for the use of several different technologies; each analysis will target a 10-ft-diameter zone for analysis.

NDE Sensor

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$5 Million - $10 Million

+ 4 Years

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Automated Visual Recognition Wireless Remote Video Monitoring

TEDS ID: MTW-80 **Timetable: > 5 Years**

Develop and test a four camera system with automated visual recognition to monitor a variety of manual gauges, indicators, alarm and status panel boards, and/or sump levels that can automatically recognize visual trigger events and generate alerts. Integrate the associated software into an automated Site specific system.

TECHNOLOGY NEED

Hanford Site tank farms contain a variety of workplace hazards, including those associated with chemical vapors emitted from the underground waste storage tanks. DOE workplace regulations specify that contractors must establish procedures to identify existing and potential workplace hazards and to assess the risk of associated worker injury and illness. One effective method to control such hazards is to reduce the time spent in the tank farm environment through the use of automated, remote monitoring systems. In locations where it may not be feasible to fully instrument a system, a secure, simple visual monitoring system could be deployed, along with potential visual recognition to aid Operators in understanding the plant configuration from a remote location.

TECHNOLOGY SOLUTION

Remote wireless video has been successfully demonstrated and used for various applications at the Savannah River Site, using existing site wireless and wired network infrastructure. The video is displayed in real-time at a nearby or remote monitoring location (e.g., a facility control room), reducing the need for a worker entry to hazardous areas. A similar system specifically tailored to the Hanford Site can provide a fully automated and easily retrofittable monitoring system to minimize the potential for worker exposure to potential vapors. The solution would need to meet cyber security and visual acuity requirements, and any machine learning implemented would need to comply with data quality standards and requirements.

Camera Monitor

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

WARR24-0032-T: Tank vapors

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H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

An active system is needed to control encasement environmental conditions and prevent humidity and moisture accumulation.

Protective Measures for Waste Transfer System Lines

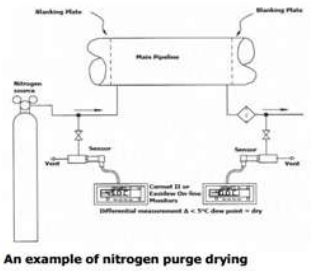
TEDS ID: MTW-86 **Timetable: > 5 Years**

TECHNOLOGY NEED

Transfer line failures may cause schedule delays during the startup of Direct-Feed Low-Activity Waste (DFLAW) operations. Taking increased measures to ensure the integrity of the waste transfer lines would hinder incurred costs from potential transfer line failures.

TECHNOLOGY SOLUTION

Recent visual inspections from within transfer line test risers have shown various degrees of moisture presence and corrosion. Design of these systems and leak detection practices have the potential to foster a corrosive condition within the encasement of the transfer lines by way of their atmospheric venting and drainage. Nitrogen purge drying is a viable option for preventing moisture accumulation in the annulus of the transfer lines.



Example Nitrogen Pipeline Purge Drying System

THREATS AND OPPORTUNITIES

TLI24-0001-T: Waste Transfer Line Failure While Operating

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Liquid Air Interface Sampler

TEDS ID: MTW-88 **Timetable: ≤ 5 Years**

Design and fabricate an interface sampler for use in Hanford tanks to identify the interface with an accuracy of ±1 in. After identification, the device will be able to obtain samples at interfaces. It will be designed to retrieve a 250 ml sample and to fit inside a 4-in. riser located at the top of the tank. The design will comply with ASTM standards and various codes/standards.

TECHNOLOGY NEED

Due to the high ratio of insoluble materials to liquid within a tank, settling will naturally occur. Some materials that do not settle to the bottom of the tank float to the top. There are concerns that organics floating on the surface can lead to an increased risk of pitting at the liquid-air interface. Available Hanford liquid sampling technology cannot detect liquid interfaces nor successfully sample the surface of the liquid, and the depth accuracy is generally limited to about a few inches. A new way to sample liquid-air interfaces and liquid-liquid interfaces is needed.

TECHNOLOGY SOLUTION

A device needs to be able to fit a container through a 4-in. riser with 250 ml. The optimal device would be cylindrical to allow for a large surface area coverage but still be able to fit in the riser used for acquisition of samples. The objective is to keep fluid at the surface from being displaced and disrupted to allow for an accurate surface sample of the fluid. The top of the sampler is to be threaded to fit a regular 250ml bottle so that new transportation does not need to be created. The bottom of the sampler is to be a cylinder for large surface-to-volume ratio. The top of the device can be other shapes or a smaller diameter like a funnel. A funnel design is desirable because it would allow use of a plug to seal the top portion of the cylinder and keep the radioactive waste inside the container with a pour spout for testing in one unit. A closing hatch or door is needed to allow for an open bottom to acquire the sample without disturbing the fluid and causing turbulent flow into the fluid.

Interface Sampler Concept

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

Technology Maturation Level

Prototype

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

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Technology is needed to reliably determine the waste level in the evaporator vessel, C-A-1, during operations. Ideally this device would mount to the tank exterior (on the sides). The technology solution must not degrade tank integrity.

Water / Waste Volume Measurement for 242-A C-A-1 Vessel

TEDS ID: MTW-90 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

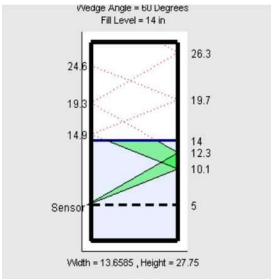
Existing instrumentation for monitoring liquid level is unreliable; therefore, the need exists to develop a new approach.

TECHNOLOGY SOLUTION

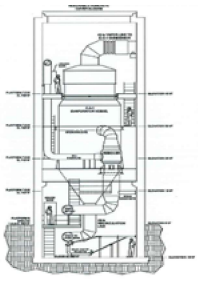
The single transducer employs either multiple piezoelectric elements or mechanical impactors to generate acoustic burst signals with transverse or oblique propagation paths. The transverse propagation path is directly across the tank at the height of the transducer location. The time-of-flight of this echo depends mainly upon the transverse distance (vessel diameter), the liquid temperature and the acoustic properties of the liquid. The estimation algorithm relies on the markedly larger echoes that return from the corner reflectors formed at the interface of the liquid surface and the tank sidewalls.

Primary features of this volume measurement device include:

- External mounting at single point
- Automated calibration for composition and temperature.
- Accurately and precise fill level predictions insensitive to surface foams and crusts.
- Refined fill-level predictions and fill-level trend prediction via Kalman Filter methods



Signal Schematic



Tank C-A-1

THREATS AND OPPORTUNITIES

242AE24-0001-T: 242-A Aging Facility and Equipment Requires Unplanned Repair or Unanticipated Upgrades (DOE)

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Tank - Side Waste Evaporation

TEDS ID: MTW-91 **Timetable: > 5 Years**

A modular, transportable, evaporative system that minimizes risks associated with significant losses of existing 242-A evaporative capacity. Development and deployment plans to use a commercial thin-film evaporator technology modified for nuclear applications. The new WFE could support other potential future missions.

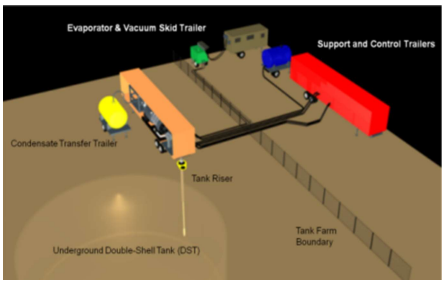
TECHNOLOGY NEED

Additional tank farm waste evaporative capability is needed to mitigate 242-A Evaporator failure risk, provide additional 242-A evaporation capacity, and supply new evaporative capacity to concentrate waste from treatment processes. The proposed technology for this scope is a mobile wiped film evaporator system, relocatable to applicable tank farms. Key development scope involves use of a pilot-scale system to develop the technology followed by use of a full-scale system to validate scale-up of the system.

TECHNOLOGY SOLUTION

The wiped film evaporator (WFE) process uses a horizontal shell encased in a heating jacket. Within the horizontal shell is a rotor with blades that maintain a thin film on the shell wall where energy is transferred from the heating jacket promoting evaporation. The liquid moves horizontally through the shell and is continuously concentrated as volatile components are vaporized leaving non-volatile components that are discharged vertically through the bottom of the WFE. Vapor is discharged vertically through the top of WFE. The WFE shell system is operated under a vacuum allowing the system to perform at a lower temperature, reducing the amount of sensible energy to be transferred.

WFE Test Platform



Proposed Field Location

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure
RPP-0001-T: DST Space Not Available

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Cs Online Monitoring for TSCR

TEDS ID: MTW-93 **Timetable: ≤ 5 Years**

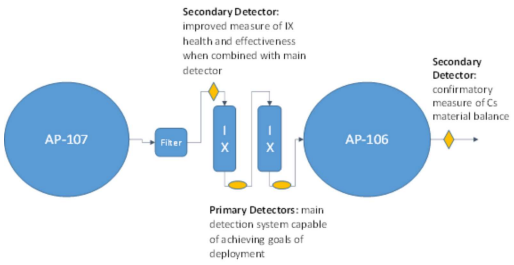
The goal of the work is to identify the appropriate COTS gamma detector(s), demonstrate performance under Hanford waste conditions, develop operational protocols for the user process interface and deploy a reliable and robust gamma detection system available for the TSCR, AMPS, and WARM systems.

TECHNOLOGY NEED

Currently, cesium detection for the tank-side cesium removal (TSCR) system, planned process modules for advanced modular pretreatment system (AMPS) and west area risk management (WARM) utilizes two continuous gamma detectors (for redundancy). The approach requires a long delay period of nominally 1 hour to allow for the ingrowth of Ba-137m, the short-lived daughter of Cs-137 that is detected by gamma spectrometry, to attain secular equilibrium with the parent isotope. This delay is accomplished through a baffled tank which contains approximately 300 gallons in volume. This piping section holds the product stream for enough time to allow for 137mBa decay before the gamma level is analyzed downstream by the monitors. Additionally, individual column performance data is not obtained since monitoring first requires a long delay which is not present between columns. The capability to monitor individual columns and a process that does not require a delay tank is needed to increase use efficiency for the ion exchange media and reduce system piping complexity.

TECHNOLOGY SOLUTION

A significant opportunity exists to consider the use of multiple detectors in an integrated feedback system that focuses on near real time (NRT) prediction of the cesium content at different locations in the process system, rather than a conservative ion exchange (IX) column cesium breakthrough trigger. Leverage existing staff experience and capabilities at Pacific Northwest National Laboratory (PNNL) in nuclear detection in the area of online process monitoring; a robust near-real-time monitoring solution can be developed based upon commercial-off-the-shelf (COTS) technologies.



Multiple Detectors in an Integrated Feedback System

THREATS AND OPPORTUNITIES

RPP-0025-T: Tank Farms Per-Treatment (TFPT) Throughput/Availability is Less than Planned

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

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A.2 Retrieve Tank Waste

The following are the one-page catalog sheets of the balance of the RTW TEDS.

H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Evaluation of Hose-in-Hose Transfer Line (HIHTL) Material Properties

TEDS ID: RTW-10 **Timetable: ≤ 5 Years**

Improve the life expectancy of hose-in-hose transfer lines through testing that encompasses all the degradation mechanisms experienced in the field and uses the entire hose assembly. Completion of this scope will provide monetary savings and also reduces worker exposure to dose from the waste as replacement of the hoses becomes less frequent.

TECHNOLOGY NEED

All WRPS retrieval technologies use in tank pumps to transfer radioactive tank waste. Waste slurry is pumped from the single shell tanks through rubber hose in hose transfer lines (HIHTL) to valve boxes for re-routing the waste to the double-shell tanks. The effective service life of the HIHTLs is a function of the EPDM and the polyester reinforcement braiding resistance to the chemicals and radiological exposure from the tank waste in conjunction with the effects of operating degradation mechanisms, such as temperature and pressure. The HIHTL lifetimes are set to ensure hose integrity during the forecasted operation time but the calculated life expectancies are only as good as the degradation testing inputs. Due to the complexity of degradation mechanisms for the radioactive waste these calculated life expectancies have been conservatively shortened since material testing using actual Hanford Site waste is difficult and typically published data does not combine both chemical and radiation exposure with the operating degradation mechanisms. Additional testing that combines the chemical and radiological degradation mechanisms along with the in field temperature and pressure exposure is needed to better predict the HIHTL service life.

TECHNOLOGY SOLUTION

The development approach includes preparation of specifications and a statement of work to award a contract with Florida International University (FIU) for a continuation of their testing of the materials used in hoses and the hose assemblies themselves. The research includes testing to meet the physical requirements (e.g., pressure, flexibility, temperature) of the hoses and also determines the chemical and radiological degradation.

Inner Hose Specimens post burst test

THREATS AND OPPORTUNITIES

ARTVS24-0510-T: Waste temperatures exceed limits

DAO24-0020-T: Hose-in-hose transfer lines (HIHTL) shelf life expires or HIHTL failure

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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Assess mixer pump performance and test the limits of performance of full-scale mixer.

Assess Pump Reliability for Mixing and Transfer Pumps

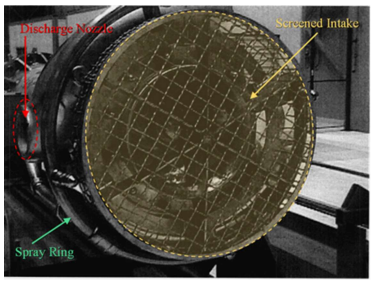
TEDS ID: RTW-17 **Timetable: > 5 Years**

TECHNOLOGY NEED

The need is to assess mixer pump performance and test the limits of performance of full-scale mixer to determine gaps and develop technology-based solutions to ensure reliability.

TECHNOLOGY SOLUTION

A program plan will be developed that will use small-scale testing as a predecessor to full-scale testing, assess system performance of an optimized system configuration and operations, and test the limits of performance of a full-scale mixer.



Inlet of a Deep Sludge Mixer Pump

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$5 Million - $10 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

DAO24-0008-T: Pump Failure
DSTI24-0001-T: DST Failure
WTO24-0021-T: Pump Failure

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H2C Hanford Tank Waste Operations & Closure

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Strontium-90 and transuranic precipitation can be performed in the Tank Farm Double Shell Tanks, bypassing the WTP Pretreatment Facility, to increase mission efficiency.

Removal of SR-90 and TRU

TEDS ID: RTW-19 **Timetable: > 5 Years**

TECHNOLOGY NEED

A process is being developed by the Waste Treatment and Immobilization Plant (WTP) for removing strontium-90 (Sr-90) and transuranic (TRU) waste. The implementation of this process has been found to complicate and reduce the efficiency of the flow of material through the Pretreatment Facility since the facility requires dilution of Double Shell Tank (DST) waste into 5M sodium. Tank Farms would instead prefer Sr-90 and TRU removal to occur at a higher molarity in an effort to conserve space. This can be achieved by performing the removal process directly in the Tank Farm DSTs, allowing for efficient implementation and the optimization of more concentrated solutions.

TECHNOLOGY SOLUTION

The development approach is threefold:
- Laboratory testing of a modified approach using concentrated supernatant.
- Consider use of the Radioactive Waste Test Platform for testing with real waste.
- Small-scale tank testing to confirm that the reaction dynamics are functional and understood for a full-scale tank. This work was completed using 13.7L of dilute and filtered AN-107 Supernatant and TSCR facility prototypic operations. See PNNL-36241.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

RPP-0019-T: CH-TRU Waste Treatment Throughput Rate is Less Than Adequate

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H2C Hanford Tank Waste Operations & Closure

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WRPS currently uses ESP. However, the ESP database needs continuous improvement as ongoing data becomes available.

Improve ESP-a Thermodynamic Modeling Program

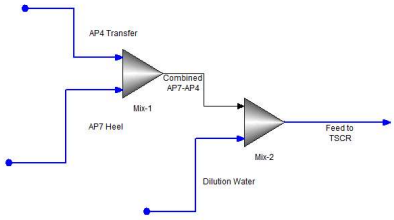
TEDS ID: RTW-21 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

OLI Studio and Flowsheet programs (used to be known as ESP for Electrolyte Simulation Program) are routinely used for process decision making such as how much water or chemicals to add during waste retrieval, what solids form, etc. The current MSE database in OLI has vastly expanded over the years but, for Hanford tank waste application, still needs improvements/additions in areas such as aluminum solubility and metal/metal oxides/hydroxides dissolution in oxalate, as well as sulfate, phosphate, and fluoride salt solutions. It has been found that OLI consistently under-predicts the solubility of Aluminum or oxalate in tank waste due to complex multi-component interactions. It is likely that WRPS will require the use of more robust, custom databases by collecting and incorporating experimental data.

TECHNOLOGY SOLUTION

The OLI software developer, OLI System Inc., could be commissioned to investigate and develop needed customization of the MSE database. Data collection will be performed as necessary if literature research finds experimental data lacking.



OLI Flowsheet

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Waste Transfer Pipe Unplugging

TEDS ID: RTW-23 **Timetable: ≤ 5 Years**

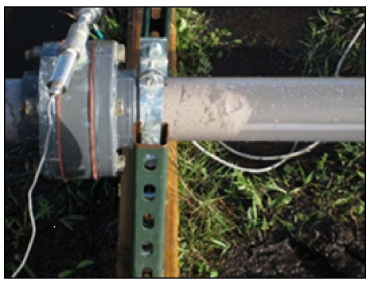
A method of unplugging transfer pipelines at the tank farms is needed. Methods of unplugging to include mechanical devices or pulsed fluidic systems could provide a functional solution to free obstructions.

TECHNOLOGY NEED

A plugged transfer line can impact several waste transfers including tank retrieval efforts, feed to the 242-A Evaporator, cross-site transfers and feed of waste to the Waste Treatment and Immobilization Plant. While measures are taken to mitigate the potential for a plugging event, including maintaining critical velocities of flow and using heat trace to prevent cooling and precipitation, plugging events have historically occurred. The implications of a plug that cannot be removed are equivalent to a failed transfer line that must be removed from service. This puts a strain on the system's ability to support the mission efficiently and cost effectively.

TECHNOLOGY SOLUTION

Evaluation of market options and/or technology development of a unique solution for pipeline unplugging of the various primary pipe configurations throughout the tank farms waste transfer system would address the risk associated with the potential loss of the ability to transfer waste.



Pipeline

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
TLI24-0001-T: Waste transfer line failure while operating
WTO24-0024-T: Flush system failure

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Improved Solubility Modeling

TEDS ID: RTW-27 **Timetable: ≤ 5 Years**

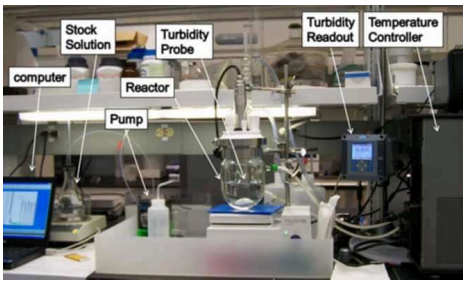
Currently, solubility modeling is able to predict some precipitation with moderate accuracy in waste simulants containing only a select list of analytes. The purpose of the proposed tests is to provide the underlining solubility data needed to adjust the model parameters so that the model can predict precipitation with acceptable accuracy.

TECHNOLOGY NEED

There are several key components, such as aluminate, oxalate, fluoride and phosphate in Hanford Site tank waste, the solubility of which can be a driver in long-term mission planning. Many external groups have recommended improvements in the chemistry modeling used in long-term mission planning simulations. Having inadequate chemistry can lead to inadequate predictions of processing problems due to line or equipment plugging, movement of tank waste, mission end dates, and the quantities of immobilized low-activity waste and immobilized high-level waste.

TECHNOLOGY SOLUTION

Solubility experiments need to be conducted to better understand tank chemistry. Simulants could be used with the potential for real waste samples being used as well. Solubility experiments must be conducted to a high level of precision and accuracy so that the data can be used to develop thermodynamic models.



Laboratory Setup

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

DFLAW-1095-T: TSCR and WFD systems unable to meet WTP feed demand during operations
DFLAW-1096-T: Tank farm feed rate less than TSCR demand
DFLAW23-1095-T: TSCR and WFD Systems Unable to meet WTP Feed Demand during Operations.
DFLAW23-1096-T: Tank Farm feed rate less than TSCR demand

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H2C Hanford Tank Waste Operations & Closure

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This optimized risk model enhances the risk outcomes from the system model by including other relevant factors (i.e., waste volume, leak status, waste type, worker impacts from retrieval, and cost of retrieval) which will reduce the overall costs of tank retrieval and make the management of space in the double-shell tank system easier.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

Risk Informed Tank Retrieval Modeling Optimization

TEDS ID: RTW-39 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

A volume-based retrieval standard has been used as defined in the Tri-Party Agreement and Consent Decree. Single-shell tanks (SSTs) vary significantly in their risk characteristics. Retrieving tanks that do not pose a significant risk increases mission cost and increases worker exposure. The objective of the work is to develop an analysis capability that would provide the technical basis for DOE to apply a risk-informed strategy for future tank retrievals and closures.

TECHNOLOGY SOLUTION

This proposed technology development will provide the technical basis and regulatory approach for developing a risk-informed set of retrieval requirements to replace the current volume-based retrieval requirement. This will ensure that mission resources are applied to achieve real risk reduction and avoid retrieval actions that do not have a risk reduction benefit. Specific research objectives include:

- Adapt existing performance assessment models for Waste Management Area (WMA) C and WMA A-AX (Prototype SST system model has developed and tested for tank farms in 200 West area. Full documentation of this SST model is in the process of being completed).
- Evaluate other factors that could be important in determining the risk impacts and benefits of retrieval (Prototype SST system model is being used to examine the risk impacts and benefits of retrieval in order to support development of an overall retrieval strategy for the 200 West tank farms).
- Develop the regulatory approach and basis for modifying the Tri-Party Agreement's existing volume-based retrieval approach.
- Identify incremental sampling analysis for WMA A-AX tanks that could better inform this retrieval strategy.

THREATS AND OPPORTUNITIES

AXRTVS24-0801-T: No waste stream path identified for removed equipment
DFLAW-0008-T: Inadequate DST space
DFLAW23-0008-T: Inadequate DST Space

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Subsurface Barrier Technology

TEDS ID: RTW-52 **Timetable: > 5 Years**

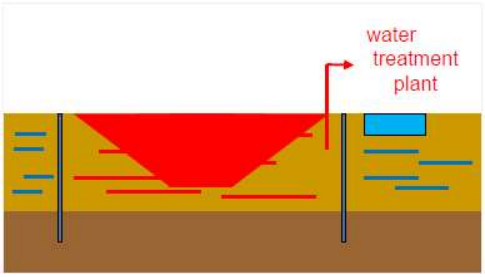
Subsurface barrier technology is in the planning stage, requiring development from the ground up. Completion of the research would produce a report that presents deployable subsurface barrier options to allow existing retrieval techniques for leaking tanks.

TECHNOLOGY NEED

Decades of developing and operating a nuclear production facility has resulted in uncontained hazardous and radioactive tank waste migration to the groundwater due to waste storage, transfer and retrieval activities. Currently, there is still potential for future spills, tank leaks and active migration of past and future leaks. Subsurface barrier technology would provide a boundary between the waste source and ground water. The subsurface barrier could limit the spread of contamination near the surface, in the tanks or beneath the tanks and inhibit the natural migration of hazardous waste toward groundwater. Minimizing the spread of the leaked radiological and hazardous waste would help expedite the cleanup efforts at Hanford. Additionally, for actively leaking tanks, this technology would allow the use of conventional and new retrieval methods.

TECHNOLOGY SOLUTION

The development approach for subsurface barrier research includes performing market research and preparing a report on the potential barrier technologies in support of single-shell tank retrieval. One technology identified is to use direct push technology to inject material to act as a barrier during tank waste retrieval.



Cut-off system diagram from Bauer

Cutter Equipment for Vertical Mining Cut-off Walls from Bauer

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

EAO24-0009-T: Degradation of Interim Surface Barriers or Other Water Diversion Infrastructure
SSTI24-0001-T: SST Failure
WAO24-0005-T: Degradation of Interim Surface Barriers or Other Water Diversion Infrastructure
WAO24-0005-T: Degradation of Interim Surface Barriers or Other Water Diversion Infrastructure

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Three-dimensional flash LIDAR will improve tracking capabilities. The system will map important mission features (e.g., waste, equipment, waste containers).

Improved Configuration Documentation

TEDS ID: RTW-53 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

There are many applications with which improved configuration and documentation are required. Three-dimensional flash light detection and ranging (LIDAR) will improve tracking capabilities and radiological mapping to provide 3D dose source locations. The system will map important mission features (e.g., waste, equipment, waste container disposal, dose). Currently, extensive expenditure of time and material are required to provide this information.

TECHNOLOGY SOLUTION

Retrieval Application – This development process will use various simulated wastes to determine if it can map contours under water and any other limitations would then need to occur.

IDF Application – This development process will need to demonstrate standoff capability to map waste disposal of containers of glass, low-activity waste melters, secondary waste disposal packages, and other items disposed of at the Integrated Disposal Facility (IDF). The data collected will be required to interface with the Waste Management Information System.

Equipment Application – This demonstration process will need to show accurate configuration and radiological dose 3D mapping of equipment and pit liners to allow remote in-service inspections to satisfy regulatory and code requirements and abandoned equipment removal planning.

Integrated Disposal Facility

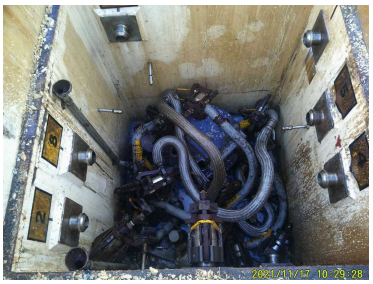

Photo of a typical SST pit with shield blocks removed

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure
WARR24-0036-T: Unexpected field conditions
LYSM-0012-T: Unexpected Field Conditions (Included)

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Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

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Low Volume Addition Retrieval

TEDS ID: RTW-55 **Timetable: > 5 Years**

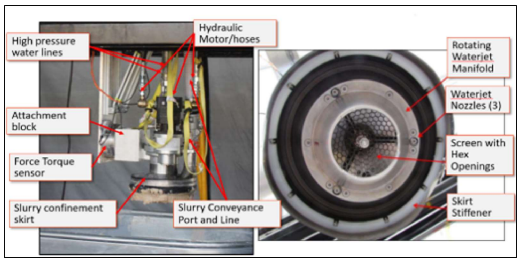
A high-pressure low volume sluicing technology would allow greater efficiency and opportunity for hard heal removal in single shell tanks. Mobilization of compacted solids can require excessive use of liquids which consequently increases overall waste volume. A system that can optimize water usage to mobilize solids is desirable and may become necessary as more tanks are retrieved.

TECHNOLOGY NEED

Wet retrieval methods for solids such as sluicing must minimize the amount of new liquid introduced into the target tank. Technologies that recycle/use existing supernate to effectively mobilize and remove sludges, hardpan and saltcake are preferred.

TECHNOLOGY SOLUTION

The low volume high pressure liquid addition (i.e confined sluicing) retrieval concept should be considered to supplement existing retrieval technologies, such as the ERSS, which relies on a separate transfer pump to convey waste. Although the ERSS was successfully used for retrieving certain SSTs and tank AY-102, the retrieval/closure operations continually work to enhance its performance. Excessive water usage during wet retrieval can be detrimental.in terms of increasing overall waste volume and the subsequent need for evaporator runs.



Early stages of development simulant retrieval with HWEE mounted on X/Y scanner

Most recent proof of principle testing with HWEE mounted on an articulated mast

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$5 Million - $10 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

SSTI24-0001-T: SST Failure
ARTVS24-0505-T: Retrieval tank leaks
WTO24-0002-T:
WTO24-0003-T:

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H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

The proposed technology has the potential to greatly reduce the amount of liquids introduced to double-shell tanks during retrieval by optimizing retrieval endpoints and reducing the number of retrieval operations conducted.

Technology to Support Risk Based Retrieval and Closure

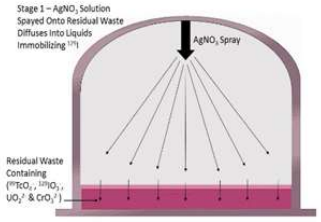
TEDS ID: RTW-56 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

The retrieval of tank waste to the maximum extent technically and economically practical is required. In the tanks that have been retrieved to date, retrieval has been sufficient to reduce the amounts of contaminants left in the tanks to levels that, if and when released from the tanks, would not create a hazard to human health or the environment in the future. However, there may be circumstances in the future when retrieval to the maximum extent technically and economically practical is not sufficient to remove enough waste to be protective of human health and the environment. If this were to occur, a solution is needed to mitigate the impact prior to taking final closure actions.

TECHNOLOGY SOLUTION

One potential option to developing alternative retrieval technologies is to treat the residual waste in situ to render the risk-driving constituents in the residual waste less mobile. Alternatively, a developed solution could be proposed prior to retrieving tank waste to the maximum extent technically and economically practical in efforts to reduce the volume of retrieval-generated waste sent to the DST system when DST tank space is limited.



Application of Getters

THREATS AND OPPORTUNITIES

ARTVS24-0511-T: Insufficient DST availability

AXRTVS24-0801-T: No waste stream path identified for removed equipment

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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H2C Hanford Tank Waste Operations & Closure

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Technology capable of sampling and/or directly measuring plutonium-to-neutron absorber mass ratios in retrieval waste streams to support criticality safety control strategies for retrieval operations.

Plutonium/Absorber Mass Ratios Measurement

TEDS ID: RTW-57 **Timetable: > 5 Years**

TECHNOLOGY NEED

Technology for measuring plutonium-to-neutron absorber mass ratios is needed to support the criticality safety evaluation of retrievals from the SY-102, TX-118 and TX-109 tanks that have high inventories of particulate plutonium. The neutron absorbing materials of primary concern are iron, manganese and boron-10, while additional absorbers, such as nickel, silicon, aluminum and sodium are secondary concerns. Ideally, the measurement technology would be able to quantify the plutonium in either the large particle or co-precipitated forms.

TECHNOLOGY SOLUTION

Capability to measure plutonium/absorber mass ratios would establish compliance with evolving interpretations of requirements under the ANSI/ANS 8.14, Use of Soluble Neutron Absorbers in Nuclear Facilities Outside Reactors, criticality safety standard. The standard is being extended, under limited conditions, to be applicable for insoluble neutron absorber materials, such as the iron and manganese credited for ensuring safety of the plutonium in the tank waste. The standard requires verifications of fissile plutonium and absorber inventories during processing.

Current tank waste sampling techniques provide plutonium/absorber inventories under only static tank conditions. As waste is retrieved, some separation of plutonium/absorbers occurs, for example, due to different dissolutions rates under caustic or acidic conditions. Monitoring of dynamic conditions as waste is retrieved can assess effects of plutonium/absorber separation as waste solids dissolve or assess effects of particulate plutonium segregation of lighter absorber materials due to fluid dynamic conditions.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

SSTI24-0001-T: SST Failure

AXRTVS24-0801-T: No waste stream path identified for removed equipment

DSTI24-0001-T: DST Failure

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H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

Caustic Limits report suspects the crust interstitial liquid for certain DSTs could be outside of the operating specification document chemistry limit. Currently there is no known method for sampling tank crust.

Tank Crust Sampler

TEDS ID: RTW-58 **Timetable: ≤ 5 Years**

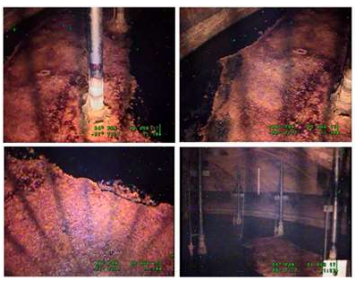
TECHNOLOGY NEED

A sampler that provides a solids core or grab sample of the crust or floating layers in tanks, so an evaluation (analysis) of the crust can ascertain tank compliance with OSD-T-151-00007 tank waste chemistry limits.

TECHNOLOGY SOLUTION

Develop a core or grab sampler that can obtain a sample of the crust material. This sampler would be an attachment to a drill string or a suspended grab sampler. The sampler must penetrate the floating material with minimal disturbance and draw the surrounding layer or a portion of the crust into the sample container.

WSU designed Crust Samplers



Tank 241-AN-107 as of October 1, 2020

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

The Hanford Tank Farms have many Miscellaneous Underground Storage Tanks (MUSTs) that can have anywhere from one hundred to a few thousand gallons of sludge that must be retrieved from the tanks prior to closure. New technologies are needed for small tanks or the ability to adapt existing technologies to small tanks. A complication is that many of these tanks are remote and not attached to any piping system, so economical methods to transport the waste to double-shell tanks is also required.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

Retrieval of Sludge from Miscellaneous Underground Storage Tanks

TEDS ID: RTW-59 **Timetable: > 5 Years**

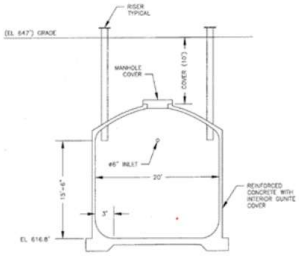
TECHNOLOGY NEED

The Hanford Tank Farms has many MUSTs that can have anywhere from a hundred to a few thousand gallons of sludge that must be retrieved from the tanks prior to closure. A complication is that many of these tanks are remote and not attached to any piping system, so economical methods to transport the waste to double-shell tanks is also required Specific retrieval methods for small MUSTs (< 5,000 gallons) do not exist except to try and adapt retrieval technologies designed for very large single-shell tanks that cost tens of millions of dollars to deploy. That is not economically practical for tanks with just a couple of hundred gallons of sludge.

TECHNOLOGY SOLUTION

Retrieval technology for retrieving MUSTs will require deployment down a small diameter < 4 inches and be capable of retrieving very hard and dense waste materials. Riiser access is limited.

- Generate a high-level specification to guide retrieval solution options.
- Submit an Expression of Interest to determine vendor availability.
- Generate a Statement of Work and initiate a request for procurement (RFP).
- Perform vendor selection and initiate contract.



Example Miscellanious Underground Storage Tank

THREATS AND OPPORTUNITIES

RPP-0023-T: Inactive Miscellaneous Underground Storage Tank (IMUST) and Miscellaneous Underground Storage Tank (MUST) Closure Differs from Plan

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US DEPT OF ENERGY

Identify and develop the technology to ship small quantities of radioactive and mixed liquid waste across site from small miscellaneous underground tanks to a double-shell tank.

Small Volume Liquid Waste Retrieval Capability for MUSTs

TEDS ID: RTW-60 **Timetable: ≤ 5 Years**

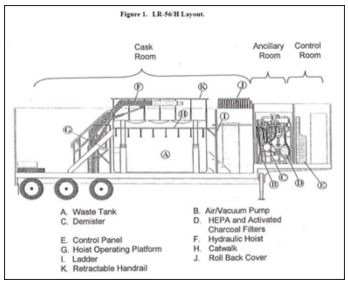
TECHNOLOGY NEED

The Hanford tank farm have more than 100 small miscellaneous underground tanks (MUSTS) that have waste in them that will have to be retrieved before closure. Our current technology for retrieving waste involves hose in hose transfer lines, which are not practical for remote MUSTS that have only a few hundred to a few thousand gallons. A more economical method of transporting liquid waste from these small tanks with little waste is needed.

Identify and develop a technology for transporting small volumes (up to 1000 gallons) of highly radioactive liquids. This could be a highly shielded truck and trailer as shown in the figure, a highly shielded tote, or even a method to convert the liquid waste to a double-shell tank compliant solid waste.

TECHNOLOGY SOLUTION

Identify and develop a technology for transporting small volumes (up to 1000 gallons) of highly radioactive liquids. This could be a highly shielded truck and trailer as shown in the figure, a highly shielded tote, or even a method to convert the liquid waste to a double-shell tank compliant solid waste.



Example Transport Trailer LR-56

THREATS AND OPPORTUNITIES

RPP-0023-T: Inactive Miscellaneous Underground Storage Tank (IMUST) and Miscellaneous Underground Storage Tank (MUST) Closure Differs from Plan

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Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

A.3 Process Tank Waste

The following are the one-page catalog sheets of the balance of the PTW TEDS.

H2C Hanford Tank Waste Operations & Closure

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The proposed HLW phased approach builds off of the current DOE strategy enabling the processing of HLW solids in the absence of pretreatment. This approach represents an opportunity to reduce the amount of glass produced, which in turn reduces the mission length and cost of the HLW glass management.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

+ $10 Million

+ 4 Years

Simplified HLW Flowsheet

TEDS ID: PTW-40 **Timetable: ≤ 5 Years**

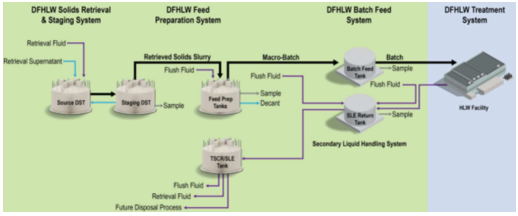
TECHNOLOGY NEED

The current high-level waste (HLW) flowsheet represents a complex, highly coupled system. An optimized HLW flowsheet would allow better for coordination of the Waste Treatment and Immobilization Plant (WTP) Low-Activity Waste (LAW) and the High-Level Waste Facilities, enabling more process flexibility, more efficient use of facilities, and earlier processing of HLW. These attributes represent an opportunity to reduce the amount of glass produced, which in turn reduces the mission length and cost of the HLW glass management.

TECHNOLOGY SOLUTION

Studies and planning are required to adequately define the waste acceptance criteria (WAC), update qualification algorithms, gather data to support the design basis, etc. These studies and planning activities are:

- Develop WAC for the HLW Vitrification Facility.
- Develop an appropriate set of simulants for testing the optimized HLW flowsheet.
- Perform laboratory- and engineering-scale demonstrations.
- Develop glass property-composition data and models.
- Update glass formulation and qualification algorithms for the revised waste feed.
- Perform laboratory-scale demonstration of the optimized HLW flowsheet with actual waste samples.
- Collect data to support design based on design data needs documented in the detailed engineering study.



Schematic of Proposed Optimized HLW

THREATS AND OPPORTUNITIES

RPP-0039-T: WTP-HLW throughput rate does not meet plan

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

Improve High Level Waste Delivery to Vitrification Facility

TEDS ID: PTW-42 **Timetable: > 5 Years**

Investigate optimization of HLW delivery to WTP, bypassing the WTP Pretreatment facility and enabling early immobilization of HLW decoupled from other immobilization operations. Operations would include a staged startup and could facilitate continued progress on other River Protection Project mission functions. The type of technology has been demonstrated and successfully implemented at the Savannah River Site.

TECHNOLOGY NEED

Current River Protection Project system models (Tank Operations Process Simulator [TOPSim] and Hanford Waste Treatment and Immobilization Plant [WTP] Dynamic Flowsheet Model [G2]) show the WTP High-Level Waste (HLW) Facility frequently idling while waiting for waste feed delivery and pretreatment (PT) processes. A key objective of the PT process is to remove a large fraction of the non-radioactive chemical components from the tank waste prior to HLW vitrification to reduce the amount of HLW glass produced and ultimately the project cost. Aluminum and chromium are the two primary insoluble chemical components to be removed from the sludge in the PT process, and their removal requires long cycles of leaching and washing. Even without extensive sludge washing and leaching, capability will be needed for mixing, dewatering, and possibly conditioning solids for transfer to the HLW vitrification facility. Capability will also be needed for managing liquids removed from the waste or returned from the vitrification facility.

TECHNOLOGY SOLUTION

An optimized HLW process will be evaluated and potentially adopted as an improved flowsheet for managing Hanford tank waste. A solids receipt and mixing vessel near the HLW Facility would be required to receive sludge transfers from the tank farms and transfer decant solution back. Soluble waste components may be removed via solid/liquid separation methods and returned to the DST system for processing as LAW. Minimizing tank waste supernate fed to HLW vitrification with HLW solids allows for higher waste loading in the HLW glass, improved glass performance, reduced canister count, and mission duration. The capability to receive returns and effluents from the HLW vitrification process allows for process flexibility, optimizing water utilization across the Tank Farms and WTP, reducing freshwater usage and the amount of water needing treatment through the 242A Evaporator and ETF.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

RPP-0039-T: WTP-HLW Throughput Rate Does not Meet Plan

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H2C Hanford Tank Waste Operations & Closure

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Operations Productivity and Analysis Tools

TEDS ID: PTW-45 **Timetable: > 5 Years**

The goal of this project is to demonstrate a novel method of selectively sequestering the pertechnetate (Tc (VII)) ion (TcO4-) from radioactive liquid waste by absorbing the water-soluble technetium-99 (99Tc) isotope into porous organic frameworks (POFs) or porous aromatic frameworks (PAFs) with appropriate functional groups.

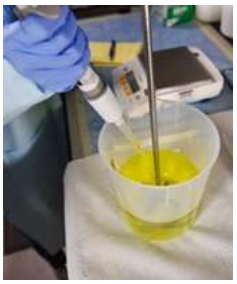
TECHNOLOGY NEED

The efficient capture and immobilization of technetium-99 (99Tc) is a challenge to performance and risk assessment for the Hanford Site because possible contamination levels in groundwater are proportional to ~26,500 Ci of 99Tc currently stored in 177 tanks. Based on the current WTP process flow sheets, almost all (i.e., >90%) 99Tc will be present in the liquid LAW that will be sent to the LAW melter. However, a significant fraction of the 99Tc volatizes at high glass-melting temperatures and is captured in the off-gas treatment system. Development of a highly selective and efficient sorbent for the removal of 99Tc from the liquid secondary waste from LAW melter off-gas condensate is needed. In addition, a viable option is needed to immobilize sorbent loaded with 99Tc into a stable waste form.

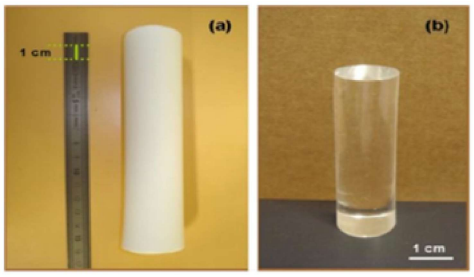
TECHNOLOGY SOLUTION

The objective of this project is to develop and demonstrate a new class of porous aromatic frameworks (PAFs) that has a high sorption capacity and selectivity for the TcO4- from liquid waste and can be subsequently stabilized in a low- cost cementitious waste form. Our goals are to:

- Synthesize aqueous stable PAF with high density of quaternary ammonium salts.
- Evaluate the TcO4- selectivity over other competing anions with batch experiments.
- Develop and evaluate stabilization of the Tc-laden PAF in low-cost cementitious waste form.
- Demonstrate the selectivity and sorption kinetics TcO - from liquid LAW under realistic conditions.



Experiments



Experiments

THREATS AND OPPORTUNITIES

RPP-0025-T: Tank farms pre-treatment (TFPT) throughput/availability is less than planned

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

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H2C Hanford Tank Waste Operations & Closure

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Advance CH-TRU Tank Waste Treatment Technologies

TEDS ID: PTW-46 **Timetable: > 5 Years**

Synergistic retrieval and treatment/packaging technology is needed to lessen the risk of the current wet retrieval and low-temperature, high-vacuum dryer treatment, while minimizing waste needing returned to double shell tanks. A less complicated drying system coupled with a mechanical treatment protocol is envisioned.

TECHNOLOGY NEED

The Transuranic Tank Waste Project Technology Approach Planning report (RPP-56063) was prepared in February 2014 and examined multiple technology approaches to treat contact-handled transuranic (CH-TRU) waste based on Expressions of Interest from 14 firms. These were binned in five technology areas: retrieval, treatment, packaging, characterization/storage/shipping, and onsite transportation. This report identified pros and cons of the varied approaches; however, its significant value was in identifying the need for overall integration of technologies after down-selection in Critical Decision-1 (CD-1). For purposes of this technology development, it is assumed needed only for retrieval and treatment.

TECHNOLOGY SOLUTION

The existing dryer technology needs re-evaluation in concert with a retrieval strategy. A typical mechanical treatment system is shown below. The Washington River Protection Solutions, LLC (WRPS) Engineering organization initiated (2018) a Systems Engineering Evaluation effort to narrow down options and coordinate a synergistic approach to include retrieval, packaging and shipment with the treatment technology, improving upon a 2014 study.

Existing Dryer

Mechanical Treatment System

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$5 Million - $10 Million

2 Years - 3 Years

THREATS AND OPPORTUNITIES

RPP-0017-T: CH-TRU waste treatment startup is delayed
RPP-0018-T: CH-TRU waste treatment availability is less than adequate
RPP-0019-T: CH-TRU waste treatment throughput rate is less than adequate
RPP-0020-T: CH-TRU waste treatment product quality is less than adequate
RPP-0021-T: CH-TRU waste treatment facility secondary liquid waste does not meet ETF WAC

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Additional testing will be required to support waste processing at higher sodium molarities.

Prevention of Hydrogen Gas Buildup in Ion Exchange Columns

TEDS ID: PTW-48 **Timetable: > 5 Years**

TECHNOLOGY NEED

To prevent accumulation of hydrogen gas in ion exchange process systems the columns are operated under sufficient back pressure and flow rate to keep hydrogen in solution. The current hydrogen solubility data limits the sodium value to less than 6M Na. Although increasing Na levels result in increased CST usage, additional data for sodium molarity values up to the WTP limit of 7 M Na could allow for additional flexibility in operations. Additionally, alternative ion exchange media that is less sensitive to Na levels could allow for operation up to 7 M Na resulting in less dilution required for the waste feed. The additional hydrogen solubility data could also provide for further refinement of the current pressure and flow calculations allowing operational flexibility.

TECHNOLOGY SOLUTION

The technology solution is to perform testing to obtain the needed hydrogen gas solubility data. Key elements include:
- Identify and develop simulants at molarities above 6M sodium.
- Perform testing utilizing the approach demonstrated in PNL-10785, Solubilities of Gases in Simulated Tank 241-SY-101 Wastes,
with selected simulants.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

DFLAW-1095-T: TSCR and WFD systems unable to meet WTP feed demand during operations
DFLAW-1096-T: Tank farm feed rate less than TSCR demand
DSTI24-0001-T: DST Failure (Excluded)
DFLAW23-1095-T: TSCR and WFD Systems Unable to meet WTP Feed Demand during Operations
DFLAW23-1096-T: Tank Farm feed rate less than TSCR demand

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Feasibility of Removing Nitrates from the LAW Feed

TEDS ID: PTW-49 **Timetable: ≤ 5 Years**

Conduct a study to examine the feasibility of removing nitrates from the LAW feed stream prior to vitrification. The study would evaluate the status and applicability of aqueous-phase nitrate destruction processes for pretreatment of Hanford tank waste with the goal of nitrogen oxide (NOX) abatement required for the melter off-gas.

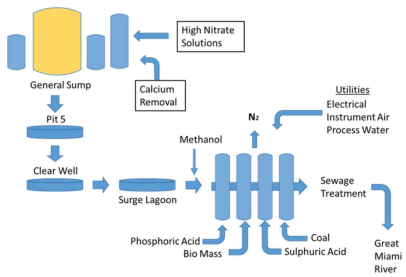
TECHNOLOGY NEED

Nitrates in Hanford tank wastes, when processed through the Hanford Tank Waste Treatment and Immobilization Plant (WTP), will generate significant amounts of nitrogen oxide (NOX) in the vitrification process off-gas. The NOX must be subsequently reduced to nitrogen gas through selective catalytic reduction (SCR), which uses anhydrous ammonia as a gaseous reductant. NOX and ammonia represent the top two chemical hazards in the WTP's Low-Activity Waste (LAW) Vitrification Facility. Both chemical hazards could be completely removed from the LAW facility by removing the nitrates in the liquid feed stream before they are fed to the melter, resulting in potentially removing a safety function within the LAW facility.

TECHNOLOGY SOLUTION

This study evaluates the feasibility status and applicability of aqueous-phase nitrate destruction processes with the goal of substantially reducing the extent of NOX abatement required. Specifically:

- Assess potential techno-economic benefits of the most promising nitrate destruction method(s).
- Review current state-of-the-art and historical nitrate destruction technologies applied to high nitrate process wastes and tank wastes.
- Identify one or more promising process options and process configurations.
- Develop conceptual process flowsheets for the most promising process options and conduct techno-economic assessments.
- Identify uncertainties, risks, and opportunities associated with the options.



Fernald FMPC Biodenitrification Process

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP-LAW throughput rate does not meet plan
RPP-0035-T: WTP-LAW throughput rate does not meet plan
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

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Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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High Level Waste Solids Segregation

TEDS ID: PTW-50 **Timetable: > 5 Years**

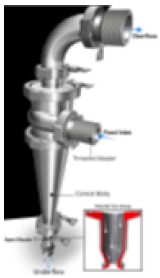
Address the strict particle size limit by either increasing the limit indicated in Interface Control Document (ICD)-19 by replacing the Waste Treatment and Immobilization Plant (WTP) sampling system or separating particle sizes with a hydrocyclone.

TECHNOLOGY NEED

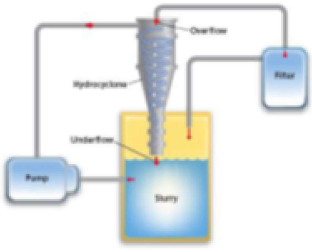
Simple and reliable technologies are needed to ensure high-level waste (HLW) feed meets the 310 µ particle size-density criteria listed in ICD-19, Interface Control Document for Waste Feed as driven by the samplers currently used by Waste Treatment and Immobilization Plant (WTP). Larger particles would cause damage to the septums in the sample bottles.

TECHNOLOGY SOLUTION

The strict particle size limit is the result of a limitation of the sampling system set in place by WTP. An effective means to lift the restriction may be to install a replacement sampling system that is capable of capturing larger particle sizes. ICD-19 would also need to be changed accordingly to adjust for a larger size limit. Alternatively, a new process unit will be required to treat the waste to remove larger particles. Hydrocyclones are the most widely used unit operation to size-classify particles in a wet grinding circuit. Hydrocyclones separate particles from a slurry over a range of particle sizes (nominally 5 to 500 µ). Separation is accomplished by feeding a slurry tangentially into the cone shaped hydrocyclone. The rotating flow creates centrifugal forces within the stream and accelerates the settling rate of dense/large particles. The denser/large particles settle to the bottom of the cone and exit in the underflow. The less dense/smaller particles exit the top of the cone in the overflow. The underflow is cycled back into the grinding circuit and the overflow is moved forward for processing.



Hydrocyclone Example



Hydrocyclone Example

THREATS AND OPPORTUNITIES

RPP-0039-T: WTP-HLW Throughput Rate Does Not Meet Plan

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

3 Years - 4 Years

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Nitrite-Hydroxide Solubility to Determine Aluminum Solubility in DFLAW

TEDS ID: PTW-51 **Timetable: ≤ 5 Years**

To determine if aluminum will precipitate and foul the direct-feed low-activity waste process, we need solubility interaction factors between all major constituents in the liquid phase with both the aluminate ion and nitrite ion. We are currently missing the nitrite-hydroxide interaction factor.

TECHNOLOGY NEED

Aluminum precipitation has fouled ion-exchange columns treating Hanford waste (Barton et al. 1986; PNNL-21109). The Savannah River Site has also experienced process problems with aluminum precipitation from supernatants (SRNL-STI-2013-00700). This plugging has occurred because aluminum has precipitated where it was not anticipated. The Flowsheet Maturation Plan (RPP-PLAN-58003) has proposed that a better aluminum solubility model be developed so that aluminum precipitation can be better anticipated. The plan suggests that new solubility data be generated that is specifically targeted at determining solubility model parameters. The plan indicates that one of the most important solubility model parameters that is currently unavailable is the nitrite-hydroxide liquid phase interaction parameter and indicates that this can be determined by measuring the solubility of sodium nitrite in solutions containing sodium hydroxide over a range of temperatures and hydroxide concentrations.

TECHNOLOGY SOLUTION

The nitrite-hydroxide interaction coefficient can be determined from either solubility data or water activity in mixtures of aqueous solutions of nitrite and hydroxide. It is assumed that this would measure solubility rather than water activity because solubility is conceptually simpler. However, if a laboratory can measure water activity instead, that would work just as well for model parameterization, as long as they can ensure that it is a measure of water activity at equilibrium. To get a statistically significant interaction parameter over the temperature interval of 20 to 85 °C, three to four data points over the whole solubility range recorded for at least four different temperatures are required.

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

RPP-0025-T: Tank farms pre-treatment (TFPT) throughput/Availability is less than planned

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Technology solutions are needed to provide the resources and capabilities for rapidly resolving DFLAW operational issues and supporting start up/future operation of WARM and feeding waste managed as high-level to the vitrification facility.

DFLAW Process Operational Troubleshooting

TEDS ID: PTW-53 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

Lessons learned from other DOE operations have shown significant delays that result from process upsets and/or significant variations from flow sheet projections. To mitigate delays, technologies are needed to provide troubleshooting capabilities and reduce risks to commissioning, startup, and operations. Areas of operational uncertainty include, but are not limited to, waste feed pretreatment, glass former reliability, melter capability, foaming control, off-gas treatment, and secondary waste management.

TECHNOLOGY SOLUTION

Technology development required to provide troubleshooting capabilities to mitigate uncertainty include the following:

- Maintain radioactive and nonradioactive test facilities (i.e., radioactive waste test platform) to support pretreatment filtration and ion exchange, which were developed as part of PTW-38.
- Provide and maintain melter/headspace and off-gas treatment train (e.g., submerged bed scrubber, wet electrostatic precipitator, other elements) testing capability to gain operational assurance. This equipment should allow for rapid troubleshooting of startup and operational problems.
- Evaluate the need for and develop testing facilities to manage secondary waste formulation and handling.
- Identify and evaluate direct-feed low-activity waste (DFLAW) process issues and conduct testing to determine mitigation strategy (e.g., foam control).
- Identify and evaluate DFLAW mechanical issues and conduct testing to determine mitigation strategy (e.g., agitator).
- Support start up processing of West Area Risk Managment efforts in West Area.
- Support closing data gaps associated with waste managed as high-level waste and it's feed to the

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

+ $10 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

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Treated Waste Concentration/Evaporation

TEDS ID: PTW-56 **Timetable: > 5 Years**

A modular concentration or evaporator system that can be utilized with treated product (low activity waste) generated by the process modules for the WARM program. The system development and deployment would utilize a commercially available Mechanical Vapor Recompression (MRV) evaporator. This MRV evaporator could be used to concentrate dilute sodium molarity LAW wastes produced in West area to ensure economical disposal.

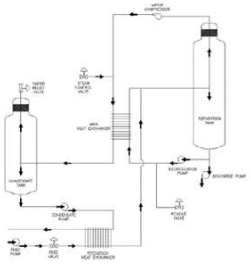
TECHNOLOGY NEED

Treated LAW concentration capability is needed to support processing of dilute or low sodium concentration wastes. Retrieval and processing of the salt cake wastes by the West Area Risk Management (WARM) system may result in an end product that is dilute. The dilute treated product could result in a significant volume expansion of the final waste form increasing disposal costs. A commercially available packaged Mechanical Vapor Recompression (MVR) evaporator can be used to bring the feed into a more optimal range for economical disposal. Key activities would include testing on a pilot scale system followed by development of a full-scale system.

TECHNOLOGY SOLUTION

The proposed MVR process uses a commercially available packaged evaporator. The MVR process uses a compressor to increase the pressure of the vapor drawn from above the waste surface generating an increase in temperature which is then used to heat the waste medium being concentrated. This in turn creates more vapor that is recompressed to continue the cycle. The cooled vapor is then pulled off as condensate which can be used to support waste retrievals. This process allows for concentration while operating near atmospheric pressure and limited energy input for operation.

Commercial Package MVR



MVR Principle

THREATS AND OPPORTUNITIES

RPP-0035-T: WTP-LAW Throughput Rate Does Not Meet Plan

Technology Maturation Level

Modify Existing Technology

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

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In-Tank Solids Suspension

TEDS ID: PTW-57 **Timetable: ≤ 5 Years**

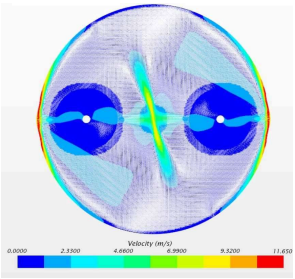
In-tank mixing capability will aid in obtaining representative samples of direct-feed high-level waste. Computational Fluid Dynamics(CFD) modeling will be utilized to aid in DST mixer pump optimization. This CFD effort will significantly decrease the amount of small-scale mixing test that will be required to design a DFHLW feed preparation system.

TECHNOLOGY NEED

There is a need for the ability to homogeneously suspend solids in existing DSTs so that representative samples of the slurry can be taken, solids retention and accumulation at the bottom of the tank is minimized, and the slurry can be efficiently transferred to the WTP HLW Vitrification Facility.
Previous solids mixing work (e.g., Small-Scale Tank Mixing Demonstration, AZ-101 Pump Test) did not sufficiently demonstrate the solids suspension to satisfy the need identified for DFHLW operations.

TECHNOLOGY SOLUTION

As a first step in the development of in-tank solids suspension for DFHLW, CFD modeling will be utilized to define the optimum DST mixer pump configuration to maximize the potential to meet the solids suspension requirements needed for sampling and transport. This configuration may include the number of mixer pumps, the location of mixer pumps, the rotational speed of the mixer pumps, the number of nozzles per mixer pump, the nozzle diameter, the nozzle velocity, minimum and maximum slurry height, transfer pump placement, and transfer pump inlet height. CFD results would then be used as input to small-scale mixing demonstrations. The CFD modeling effort will reduce the effort needed in the small-scale mixing demonstrations and will result in a DFHLW process design that has less risk of working sub-optimally or being over-designed.



CFD Model Example

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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Solids Settling Rate Determination/Solids Washing Techniques

TEDS ID: PTW-58 **Timetable: ≤ 5 Years**

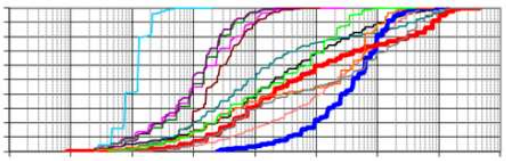
Currently, the settling rates of Tank Farm waste solids is not well known and is not predictable. If a HLW pretreatment system based in Tank Farms is to be developed, solids settling rate information will be needed. The purpose of these tests is to determine settling rate information for SE quadrant sludge solids so that settling time can be accounted for in the design of a HLW Tank Farm based pretreatment system.

TECHNOLOGY NEED

The current knowledge of settling rates for Tank Farm waste solids is poor. Because Tank Farm transfer operations are infrequent, the assumption that settling would be nearly complete prior to the next operation has been acceptable. However, if a Tank Farm pre-treatment system for HLW operations is to be designed to include solids settling, more information is needed. The settling rate of different solids in current tank waste as well as in low ionic strength solutions at various temperatures is needed. This information is needed to determine the size or number of washing tanks needed to maintain the required processing rate.

TECHNOLOGY SOLUTION

The initial project will involve running washing and settling experiments on actual tank sludge solids waste in hot cells to determine the settling rate of the solids as well as the effect of washing and mixing on the settling rate and the particle size. Once solids settling rates and the effects of washing and mixing are accurately determined, additional engineering analysis and technology review will be required to determine an appropriate solids washing tank system configuration to maximum the processing rate.



Cumulative Volume Percent vs. Settling Velocity

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

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Particle Size Reduction

TEDS ID: PTW-60 **Timetable: ≤ 5 Years**

A process for reducing particle size in waste sludge to improve mixing, sampling, and transferring efficiency in double-shell tanks (DSTs).

TECHNOLOGY NEED

There is a need to address uncertainties in DFHLW feed preparation tank equipment's ability to mix and suspend solids without processing issues, due to gaps in waste qualification and potential operational constraints from large or dense particles, with particle size reduction technology as a possible solution.

TECHNOLOGY SOLUTION

Assess the significance of particle size reduction for the DFHLW flowsheet by evaluating the feasibility of grinding waste, defining process criteria, characterizing waste feed for system design, identifying suitable size reduction technologies, and outlining protocols for laboratory evaluations,

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

+ 4 Years

THREATS AND OPPORTUNITIES

RPP-0015-T: Cross-Site Transfer System Startup is Delayed

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Developing an in-line slurry sampling system to ensure waste meets acceptance criteria to enhance operational efficiency and safety.

In-line Slurry Sampling System Development

TEDS ID: PTW-61 **Timetable: ≤ 5 Years**

TECHNOLOGY NEED

There is a need to implement an enhanced in-line slurry sampling system to provide more efficient, accurate, and representative sampling in slurry feeds. This technology would facilitate faster feed qualification times by delivering real-time or near real-time analytical data, thereby streamlining the process by reducing the duration and accommodating the varied feed profiles expected.

TECHNOLOGY SOLUTION

Develop and demonstrate an in-line slurry sampling system using the ISOLOK sampler integrated with a full-scale test loop. This solution involves assessing the current state of technology, developing a test plan, procuring and handling simulants equipment procurement and construction, executing tests, and documenting results to ensure the system's reliability, representativeness, and operational efficacy.

Technology Maturation Level

Prototype

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

3 Years - 4 Years

THREATS AND OPPORTUNITIES

RPP-0038-T: WTP HLW Hot Commissioning is Delayed

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A.4 Manage Waste

The following are the one-page catalog sheets of the balance of the MW TEDS.

H2C Hanford Tank Waste Operations & Closure

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HANFORD SITE
US DEPT OF ENERGY

Transportation and Packaging Requirements for Contaminated Equipment Disposal

TEDS ID: MW-13 **Timetable: > 5 Years**

Proposed technology is unknown. It will depend on what waste or samples Waste Treatment and Immobilization Plant plans to ship during its lifetime. A waste shipping container is needed. If the plant plans to ship highly radioactive, very large, or heavy items it will need to have a package designed and built.

TECHNOLOGY NEED

Any equipment developed (e.g. Waste Treatment Plant melters and bubblers, HEPA filters, etc.) will at some point, need to be replaced and disposed of. An appropriate waste package is needed to enable transportation and disposal. Sampling or non-destructive analysis methods need to be considered. Sampling/analysis methods will be used to confirm that wastes will meet disposal facility waste acceptance criteria (WAC) as well as regulations and requirements for packaging and transportation to the disposal facility.

TECHNOLOGY SOLUTION

Identify unique equipment or samples that need to be taken and ensure a transportation package exists for that item. Examples are tank waste samples larger than one liter or high-dose high-curie large equipment.

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$0 - $1 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

GMAIN24-0002-T: Excess and Disposal (MEMRR) (Excluded)

DFLAW23-0357-T: Spent/Failed LAW Melter disposal capability not available when needed

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H2C Hanford Tank Waste Operations & Closure

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At-Tank Technetium and Iodine Removal and Disposition

Fabricate and test ion exchange resins tuned to selectively retain Technetium and Iodine using a monolithic column configuration for deployment at-tank or in-tank.

TEDS ID: MW-15 **Timetable: ≤ 5 Years**

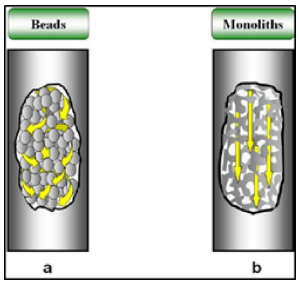
TECHNOLOGY NEED

Tc-99 and I-129 are long-lived, highly mobile radionuclides that are volatile at glass melting temperatures. They will likely be a component in the waste treatment and immobilization (WTP) off-gas treatment system secondary wastes unless removed prior to entering the glass melter. Removing Tc-99 and I-129 from off-gas secondary wastes would remove potential problem contaminants from the integrated disposal facility (IDF) waste inventory which could in turn and protect the Columbia River.

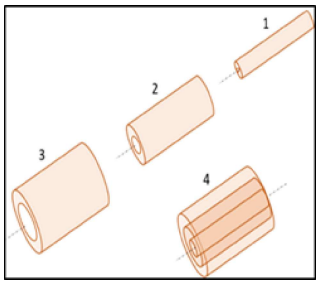
TECHNOLOGY SOLUTION

Work is needed to develop, mature, and deploy technology for “tunable” Tc- and I-selective IX resins. Monolithic columns create a “single large particle” that fills the column entirely as a continuous skeleton with a series of connected pores that allow no void. The monolithic column develops a network of channels in the continuous phase of a porous material that shows high axial permeability, a large internal pore surface area and less back pressure than that of conventional packed columns.

The Monolithic Column figure depicts three preparation steps. Different parameters can be applied to control porous properties. These include polymerization temperature, the choice of pore-forming solvent or porogen, the type and amount of crosslinking monomers and polymerization time.



Conventional (a) and Monolithic (b) IX Column "cut-away" showing resins



Monolithic Column

THREATS AND OPPORTUNITIES

DFLAW-0232-T: WTP Radioactive Dangerous Liquid Effluent Composition LTA
DFLAW23-0232-T: WTP radioactive dangerous liquid effluent composition LTA

Technology Maturation Level

Laboratory Testing

National Laboratory Involvement?

Yes

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

2 Years - 3 Years

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A.5 Dispose Tank Waste

The following are the one-page catalog sheets of the balance of the DTW TEDS

H2C Hanford Tank Waste Operations & Closure

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US DEPT OF ENERGY

Technology is needed that would accurately verify waste inventory (radionuclide inventory) and physical characteristics of containers (external dose, heat, etc.) for containers coming into the IDF.

Integrated Disposal Facility Risk Budget Tool Monitoring

TEDS ID: DTW-11 **Timetable: > 5 Years**

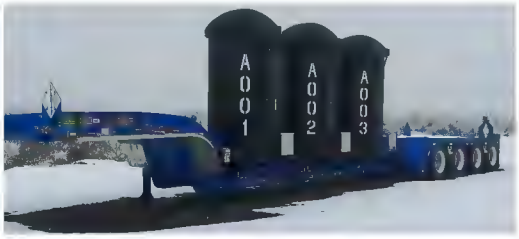
TECHNOLOGY NEED

Software development is needed to allow the waste generator to accurately input radionuclide and chemical inventory data directly into the Waste Management Information System (WMIS) and have the software verify the data input is within the limits of the waste profile. This need applies to both immobilized low-activity waste (LAW) glass and secondary waste streams.

TECHNOLOGY SOLUTION

Provide a software to more accurately track radionuclide, chemical inventory, and physical properties of the containers to efficiently manage the disposal of LAW in the Integrated Disposal Facility (IDF). This technology solution must interface with WMIS to more effectively manage the IDF waste acceptance process.

Integrated Disposal Facility



LAW Canisters

Technology Maturation Level

Research and Concept

National Laboratory Involvement?

No

Rough Order of Magnitude Cost & Duration?

$1 Million - $5 Million

0 Years - 2 Years

THREATS AND OPPORTUNITIES

RPP-0047-T: Supplemental LAW Radioactive Secondary Solid Waste Not Able to Be Treated or Disposed as Planned

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APPENDIX B TEDS RETIREMENT SUMMARY

The Roadmap is a living document. It is updated on an annual basis or as conditions warrant. As work has progressed, several TEDS sheets have been "retired." Reasons for retirement can be as follows;

- No longer needed – Risk no longer exists
- No longer needed – mission need changed
- Reclassified as non-technology Development
- Combined with another TEDS
- Deemed unsuccessful – no longer pursued
- Risk accepted - need has been met

TEDS that have been retired are captured on Catalog sheets similarly to TEDS that are Near-Term or Future. The following are the one-page catalog sheets for retired TEDS.

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Develop a new annulus visual inspection system that would be deployed through each open riser access point at a double-shell tank to expedite visual inspection acquisition and post-processing.

Improved DST Annulus Camera System

TEDS ID: MTW-09 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

The High-Level Waste Integrity Assessment Panel recommended in its second workshop (RPP-ASMT-57582, Second Workshop of the High Level Waste Integrity Assessment Panel: Extent of Condition and Balance of Program) that in order to improve data gathering, WRPS should increase visual observations in the annulus. Annulus visual inspection was the first sign that tank AY-102 leaked. Similarly, visual inspection may be the first sign of another tank leak. In order to provide earlier warning of new or developing leak sites, visual inspections should be conducted more often than every 3 years.

NEED RESOLUTION

An improved camera system was identified as necessary to the completion of MTW-20, developed visual inspection, and was therefore involved in the scope of that near-term project. As the requirements of MTW-20 exceed those initially outlined were, this TEDS was combined with MTW-20 and retired.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

THREATS AND OPPORTUNITIES

TFIRR-0045-T: DST Failure in East Area
TFIRR-0046-T: DST Failure in West Area

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Knowledge of tank waste slurries physical properties is critical to waste transfers, waste treatments, effluent management and melter feed operations. Particle size analysis and viscosity are currently investigated. However, slurry properties are needed to ensure waste slurries perform according to current system design pressures.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Slurry Property Investigation

TEDS ID: MTW-36 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

Technology is needed to further understand slurry properties of actual tank waste to investigate particle density, particle settling rates, shear strength, cohesiveness and erosiveness. Currently, needed particle size analyses are obtained by laser interferometry viscosity and shear strength is measured by viscometry.

NEED RESOLUTION

MTW-41, Analytical Method Development for Chemicals of Concern, includes a variety of possible methods of development, and therefore includes this scope.

Development and Implementation

Particle Size Analyzer X-Ray Microtomography

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Waste Not as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

The 222-S Laboratory improved instrument capabilities and sample preparation methods to better identify solid and liquid phases in tank wastes and to improve ALARA considerations.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Tank Waste Characterization and Identification

TEDS ID: MTW-37 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

Updated and new instrumentation is expected to improve routine analyses of tank wastes, infrastructure (piping, tanks, pumps), vadose zone sediments, as well as analysis of unique samples, to better support the, RPP mission. Improved technologies enhance the detection and identification of liquid and solid phases and organics in tank wastes including those with short range order (e.g., nanoparticles). Instrument improvements may also aid waste processing and support technology developments for direct-feed low operations.

NEED RESOLUTION

Updated instruments have been acquired and implemented, enhancing analytical capabilities. These advancements support improved routine analyses of tank wastes and infrastructure, improving management of tank wastes.

Infrared Microscopy

Raman Microscopy

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Tank Waste Not as Expected (Different than Modeled) - Takes Longer or Cannot Be Retrieved
TFIRR-0045-T: DST Failure in East Area
TFIRR-0046-T: DST Failure in West Area
TFIRR-0047-T: SST Failure in East Area
TFIRR-0048-T: SST Failure in West Area

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Implementation of commercial large-pore high-silica zeolites (HS series) in personal protective equipment for the removal of nitrosamines from the tank vapors can help protect tank farms personnel by reducing exposure to the hazardous constituents of the tank vapors and address short- and long-term health concerns.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

Yes

Nitrosamine Monitoring and Reduction

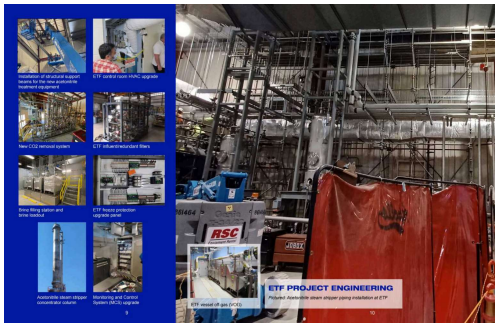
TEDS ID: MTW-59 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

The vapor resolution program calls for implementation of methods to anticipate, recognize, evaluate and control chemical hazards associated with ongoing emissions of tank vapors. The tank vapor is a complex mixture of reactive volatile organic chemicals, submicron aerosols, volatile metal/metalloid compounds, and other compounds. Nitrosamines, potential carcinogen, are present in the tank vapors due to the high concentrations of inorganic nitrogen-containing species in the tank waste and their radiolysis degradation products, which readily react with organics. Any tanks or tank farms such as A-N Tank Farm, with high organics could contain increased nitrosamine levels.

NEED RESOLUTION

The need for nitrosamine monitoring and reduction was met by the installation of an Acetonitrile Destruction system at the Effluent Treatment Facility. Steam stripping has been selected as the preferred treatment method. The ETF team has designed the process to remove the acetonitrile, contain it, store it in tanks, and to load-out totes of distillate for offsite shipping. This work was completed in FY23 as part of a group of ETF construction projects.



THREATS AND OPPORTUNITIES

RPP-0006-T: SST Retrieval System Performance Does Not Meet Requirements Due to Controllable Causes
WRPSC-0012-T: Personal Protective Equipment Availability Impacts Field Work Execution

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

A PTR-MS mounted in a Mobile Lab is planned to allow for analysis of high-level waste tank vapor concentrations in worker breathing spaces, exhausters, passive breather filters, etc. This will support the vapor management strategy.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

Mobile Proton Transfer Reaction - Mass Spectrometer

TEDS ID: MTW-68 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

A mobile laboratory equipped with state-of-the-art trace gas analyzers is needed to provide the ability to accurately measure chemical of potential concern (COPC) concentrations to 10% of the occupational exposure limit and provide high temporal resolution (2 seconds). Analysis of chemical vapors at trace levels is not possible using available Industrial Hygiene (IH) detectors/instruments. In addition, current IH direct read instruments and off-line samples have low temporal resolution (0.5 minutes to hours).

NEED RESOLUTION

The initial need for the Mobile Proton Transfer Reaction - Mass Spectrometer (PTR-MS) was its integration into a mobile analytical laboratory (Mobile Lab) to facilitate the analysis of High-Level Waste (HLW) tank vapor concentrations in worker breathing spaces. This need was meant to support the Comprehensive Vapor Action Plan (CVAP). This need was combined with the need in MTW-79, educe Manual Data Collection Entries into Tank Farms. MTW-79 meets the technology need for collecting vapor-related data within the worker breathing zone; thus, reducing exposure to the workers.

PTR-MS: The PTR-MS is an exceptionally sensitive device used for real-time measurement of whole

Mobile Lab: The Sprinter Van has been retrofitted with the necessary power lines, gas plumbing,

THREATS AND OPPORTUNITIES

WRPSC-0003-T: Tank Vapors Controls Impact Project Execution

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Viable technology for in-service Inspection of the Hanford DSTs is crucial to development and maintenance of an effective aging management regime.

Multi-Use Robotic Manipulator System

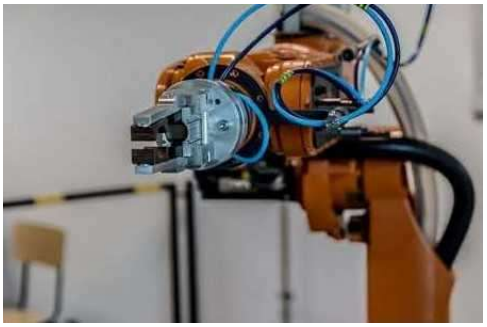
TEDS ID: MTW-81 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

The complexity of the double-shell tank (DST) configurations is such that many of the structural elements and features of most concern to engineers and inspectors are located in inaccessible, hard to reach areas (e.g., DST annulus). In addition, the radiochemical conditions in the tanks are hazardous, ruling out manual access techniques. There is a pressing and immediate need for proven, robust and radiation tolerant remote systems to access the tanks to deploy cameras and other nondestructive examination (NDE) instrumentation to remotely inspect and gather data on the tank condition. The overall goal of this project is to demonstrate the use of a commercially available, radiation tolerant, multi-use manipulator system for repairing and inspection tasks on the Hanford single-shell tanks, DSTs, and pits.

NEED RESOLUTION

Resolution achieved through combining with MTW-98 Remote Tools for Waste Storage Tanks, which focuses on designing a robotic arm with interchangeable components. Combining the objectives and resources of MTW-81 with MTW-98, a viable technology framework for repairs and inspection will be established for the DSTs.



Robotic Arm

Tooling Designed for Pit Work

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

National Laboratory Involvement?

No

Submitted as Grand Challenge?

Yes

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Surface profilometry is a commercially available technique used to extract topographical data from a surface. This can be a single point, a line scan or a full three-dimensional scan. The purpose of profilometry is to get surface morphology, step heights and surface roughness.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

Remote Surface Examination

TEDS ID: MTW-85 **Reason No Longer Needed - Mission Need Changed**

TECHNOLOGY NEED

Improved non-contact inspection methods that expand facility integrity knowledge are of high interest. Current noncontact methods deployed are limited to various visual inspection camera systems. Expansion of the inspection toolset to include system such as a highly accurate and precise compact laser profilometry system would allow better characterization of surface topography at target inspection locations. Possible applications for such a technology includes the concrete dome and liner wall of single-shell tanks, the region above the liquid surface within double-shell tank primary containment and the annulus of double-shell tanks. Use in these environments would provide additional understanding not currently possible with a camera, including size and depth for observed surface anomalies.

NEED RESOLUTION

There are multiple laser scanners already in use for inspecting the interior of tanks that are continually being improved. These laser scanners are well suited for understanding the general condition within a tank. It has been determined that highly detailed information on surface condition is not a useful level of information in the SSTs and DSTs have numerous UT-based technologies that would be the preferred method of inspection.

Compact Laser Profilometry System

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

The existing Tank Farm Operations support software, eSOMS, would be either upgraded or replaced to include all operating procedures. The system will be "smart", enabling tank farms operators to automatically record and enter readings obtained during the performance of operating procedures.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Tank Farm Smart Operating Procedures

TEDS ID: MTW-99 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

Tank farms operators record measurements by using the Rounds process as identified in relevant tank farm procedures. The eSOMS software, also known as E-Rounds, facilitates automated process at the tank farms. The current tank farm operating process is comprised of both a mobile application (rounds application) and a web application, the latter of which is accessed through a desktop browser. This system is partially automated and does not include all operating procedures. Operators automatically record and manually enter readings from some of their procedure rounds, saving time when compared with paper Rounds. However, the system needs to be fully automated to include automatic entry of readings from the operator rounds for all operating procedures. This improve efficiency and also reduce errors associated with manual transfer of data and information.

NEED RESOLUTION

A pilot was completed that aimed at enhancing efficiencies within Tank Farm Operations by integrating a new or upgraded system for data entry processes. Implementation is on hold for funding.

THREATS AND OPPORTUNITIES

WRPSC-0010-T: Complex Integration of Field Work
WRPSC-0032-T: Complex Integration of Field Work

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

FT uses an illumination source that induces a temperature rise at the inspection surface, generally in the form of an high intensity pulse. Changes in material property can cause a change, thermal indication which can be read by an infrared camera.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Increased NDE Volumetric Inspection

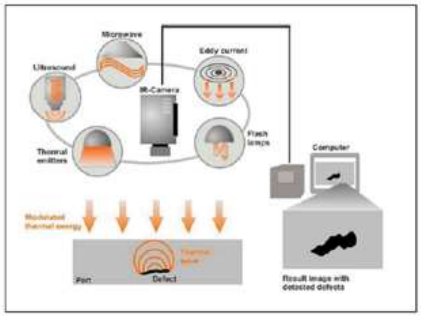
TEDS ID: MTW-100 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

There is a need to develop nondestructive examination (NDE) systems to increase the volumetric NDE of the aging Hanford tanks. Current systems only inspect about 2% of the double-shell tanks (DSTs). This amount was deemed acceptable when general corrosion was thought to be the primary means of degradation. Localized corrosion is now the mode degradation thought most prevalent. As such, the inspection regime needs to extended to a greater extent of the tank.

NEED RESOLUTION

Resolution achieved for MTW-100, through its combination with MTW-10. This targets the improvement of a variety of inspection techniques for DST primary tank walls, including where the application of Flash Thermography (FT) technology is most important.



FT System Elements

THREATS AND OPPORTUNITIES

TFIRR-0045-T: DST Failure in East Area
TFIRR-0046-T: DST Failure in West Area
TFIRR-0047-T: SST Failure in East Area
TFIRR-0048-T: SST Failure in West Area

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

A method to assess and mitigate possible issues with the Waste Transfer System, which is necessary to the safe retrieval and treatment of the tank waste is needed.

Transfer Line Unplugging

TEDS ID: MTW-112 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

The Waste Transfer System is critical to the safe retrieval and treatment of the tank waste. In some isolated instances, transfer lines have become plugged with limited number of techniques for addressing the issue aside from installing a new transfer line. A method is needed to assess and unplug the lines to avoid costly replacement.

NEED RESOLUTION

This need has already been captured in RTW-23.

THREATS AND OPPORTUNITIES

RPP-0017-T: CH-TRU Waste Treatment Startup is Delayed

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Contractor:

Phone:

Email:

H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

A new laboratory Information Management System (LIMS) would improve data entry and information acquisition.

Laboratory Information Management System (LIMS)

TEDS ID: MTW-116 **Reason: No Longer Needed - Risk No Longer Exists**

TECHNOLOGY NEED

There is a need for a custom Laboratory Information Management System to create efficiencies and improve accuracy of the data entered into and used by the lab. The system currently employed is aged and introduces room for human performance errors.

NEED RESOLUTION

Management has decided to go another direction.

THREATS AND OPPORTUNITIES

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

RETIRED

Existing technology could be modifted to safely inspect the Tank Farms remotely. Examples include drones with attached cameras, and cable-mounted cameras

Remote Tank Farm Above Ground Inspections

TEDS ID: RTW-03 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

During construction and retrieval operations, tank farm inspections are required, creating radiation exposure and other safety hazards for personnel. Personal protective equipment required for vapor safety, such as self-contained breathing apparatus, has created other worker safety issues. Additionally, the time and cost associated with manned entries is significant. The ability to conduct remote monitoring, from the Operations control trailer, would be beneficial. Ideas for remote field inspection include: drones, static-mounted cameras, mobile wire-mounted cameras, and remote operated vehicles.

NEED RESOLUTION

The primary need was to enhance worker safety and mitigate hazards by reducing the reliance on manual labor. An onsite drone program already exists, there is no need for further development.

Drone with Onboard Camera

THREATS AND OPPORTUNITIES

WRPSC-0011-T: Unexpected Field Conditions Encounterd
WRPSC-0002-T: Resources Not Available when Required (TOC)

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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US DEPT OF ENERGY

RETIRED

Technology for drilling multiple enlarged holes in tank domes for risers up to 4 ft in diameter is necessary. Research, design, and development of the cutting system will ensure the dome cores are removed utilizing governing safety criteria.

Development of New Riser Installation System

TEDS ID: RTW-12 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

The goal of this work is to develop a method that is safer, more efficient, and more cost-effective for the tank farm personnel to implement than previous core cutting efforts. In addition, hard to access risers and pits no longer need to be used for retrieval. The rotary core cutting system will provide more efficient core cutting in the tank domes. Core cutting will support future work of installing new risers for tank waste retrieval, which will minimize the need to remove existing equipment and allow installation of and additional access for other new retrieval equipment.

NEED RESOLUTION

The Tank Dome Core Cutting System (TDCCS), designed to help protect workers from radiological exposure during future tank waste retrieval preparations has been delivered and utilized at the Hanford Site. The need for the Development of New Riser Installation System has been addressed. The base machine is a drill rig that, once deployed, will cut a larger access hole in a tank dome for the installation of a riser without needing workers to get close to the dome. The system has been successfully deployed in the field.

Caissons Installed and Concrete Core Removed

TDCCS with Core Drill Attachment

THREATS AND OPPORTUNITIES

AAXRC-0043-T: Equipment in Risers is more Difficult to Remove than Anticpated
AAXRC-0051-T: Damage to Tank/Equipment Installation or Removal

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

The technology required to ensure particle size requirements for high-level waste feed are met is currently available, but may not be in a configuration required for deployment in Hanford Site tanks. Work to be performed here would take the technology to Technology Readiness Level 9.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Evaluate Back-Up Options for HLW Delivery from the Tank Farms

TEDS ID: RTW-15 **Reason No Longer Needed – Risk No Longer Exists**

TECHNOLOGY NEED

The waste acceptance criteria limit on maximum particle size in high-level waste feed to the Waste Treatment and Immobilization Plant Pretreatment Facility is 310 micrometers. To meet this waste feed parameter a size segregation and/or size reduction technology should be developed for deployment in the double-shell tanks to support feed delivery to the Pretreatment Facility. An alternative would consider using the double-shell tank mixer pumps and an appropriately selected transfer pump elevation to perform the necessary particle size segregation.

NEED RESOLUTION

The need for technology to ensure particle size in HLW feed meets acceptance criteria came from a time when ICD-19 (Tank Farms to Pretreatment Facility) was still in effect. Recently, much of the ICD-19 WAC was removed from the requirements going forward, including particle size.

Small-Scale Testing Platform

THREATS AND OPPORTUNITIES

DFLAW-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

An integrated feed qualification program will allow for identification of gaps in capabilities and support an assessment of technology options that most appropriately fill the need.

Develop an Integrated HLW Feed Qualification Plan

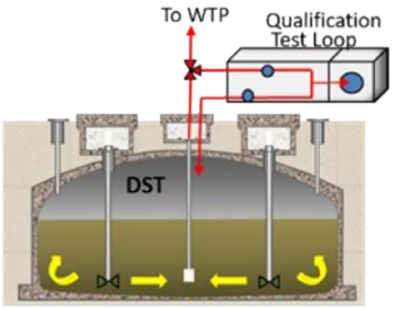
TEDS ID: RTW-16 **Reason No Longer Needed – Mission Need Changed**

TECHNOLOGY NEED

The integrated high-level waste feed qualification program should be mature and completed long before the feed qualification samples are collected. To ensure the program is developed and operationally ready, tank farm characterization and/or simulant testing elements need to be performed well in advance of the operational need date.

NEED RESOLUTION

The technology development needs to support a robust HLW feed qualification plan is encompassed in the Flowsheet Maturation Plans (FMPs) controlled and released through the Flowsheet Definition & Analysis group. These FMPs break down and identify technology gaps and potential solutions. Those gaps that require technology development have been captured in additional TEDS entries.



Sampling Qualification Test Loop

THREATS AND OPPORTUNITIES

RPP-0039-T: WTP-HLW Throughput Rate Does Not Meet Plan
DFLAW23-0206-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Develop a twofold approach that uses models and engineering evaluation of ventilation system heat removal capacities, then evaluate alternate mixer pump configuration that use more bu smaller pumps to mobilize waste, resulting in less heat input.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Reduce Mixer Pump Waste Heating

TEDS ID: RTW-18 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

There is a risk that AW and AN Tank Farm tanks may exceed Technical Safety Requirement (TSA) heat limits. Either improved heat removal or reduced heat input is needed. An evaluation of the trade-off to improve heat removal by new or modified systems or reduce heat input by changing the mixer pump configuration, may identify new technologies to resolve the heat load risk.

NEED RESOLUTION

This need was combined with MTW-108 which focuses on feed preparation tank waste temperatures increases from mixer pump operations and the ability to cool the waste before it is fed to a treatment facility.

THREATS AND OPPORTUNITIES

DSTI24-0001-T: DST Failure

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Currently, improved solubility modeling ability to predict oxalate and fluoride precipitation in waste simulants containing only a select list of analytes is poor.

Improved Solubility Modeling of Oxalate, Fluoride, and Other Simple Mixtures

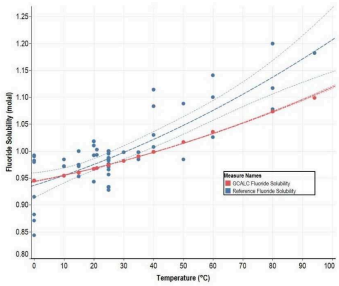
TEDS ID: RTW-28 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

Oxalate, fluoride, and the precipitates formed from those related ions, are key components in tank waste and their solubility can be a driver in long-term mission planning, such as the use of TOPSim. Many external groups have recommended improvements in the chemistry modeling used in long-term mission planning simulations. Having inadequate chemistry can lead to inadequate predictions of processing problems due to line or equipment plugging, movement of tank waste, mission end dates, and the quantities of immobilized low-activity waste and immobilized high-level waste.

NEED RESOLUTION

The combination of RTW-28 Improved Solubility Modeling of Oxalate, Fluoride, and Other Simple Mixtures and RTW-27 Improved Solubility Modeling is an approach to addressing the challenges associated with solubility modeling for oxalate and fluoride precipitation in waste stimulants. This will mitigate the risks associated with inefficiencies and contribute to optimization of long-term strategies.



Fluoride Solubility Data

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Waste Note as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

RETIRED

Currently, improved solubility modeling ability to predict phosphate precipitation in waste simulants containing only a select list of analytes is poor.

Improved Solubility Modeling of Phosphate

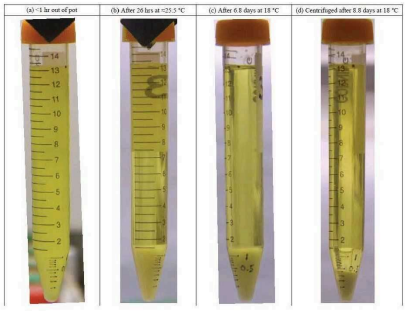
TEDS ID: RTW-29 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

Phosphate is a key component in tank waste, and phosphate solubility can be a driver in long-term mission planning. Many external groups have recommended improvements in the chemistry modeling used in long-term mission planning simulations. Having inadequate chemistry can lead to inadequate predictions of processing problems due to line or equipment plugging, movement of tank waste, mission end dates, and the quantities of immobilized low-activity waste and immobilized high-level waste.

NEED RESOLUTION

Resolution for the technology need in RTW-29 Improved Solubility Modeling of Phosphate focuses on the improvement of solubility modeling capabilities. Following the improvements in chemistry modeling capabilities for predicting phosphate precipitation in waste stimulants.



Phosphate Solubility Experiment

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Waste Note as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

RETIRED

A waste feed delivery strategy is needed that includes sampling and detection of plutonium particles that addresses potential criticality concerns.

In-Tank Sampling Technologies for Plutonium Particles

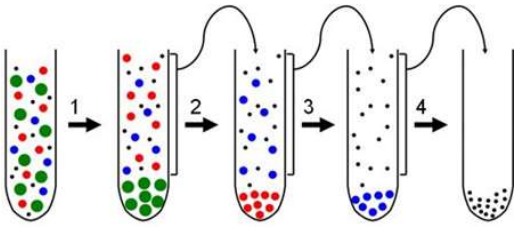
TEDS ID: RTW-31 **Reason No Longer Needed – Risk No Longer Exists**

TECHNOLOGY NEED

While numerous reports, such as RPP-RPT-50941 and RPP-RPT-54469, discuss the particulate plutonium inventories in the tank farms, uncertainties remain about the processing origins, conditions of formation, distributions and quantities of this plutonium {especially the plutonium-bismuth particles}. Criticality safety requirements mandate providing capabilities to detect and characterize the particulate plutonium that will be retrieved, blended and transferred in the waste feed to the Waste Treatment and Immobilization Plant {WTP}. The tank farms do not currently have the capability to sample for plutonium particulates with the representativeness and accuracy necessary for compliance with the criticality safety requirement.

NEED RESOLUTION

Particulate Plutonium sampling in WTP feed has been determined to be no longer needed as WTP feed control strategy is indeterminate. This reinforces the nature of waste management strategies and the need for ongoing adaptability in addressing complex safety and operational challenges.



Differntial Centrifugation

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Waste Note as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

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Develop the technology for delivering soluble neutron poisons into those tanks having high particulate plutonium inventories as a criticality safety control strategy. Demonstrate the chemical stability and e.ffectiveness of the neutron poisons.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Criticality Safety Control Strategy for Particulate Plutonium

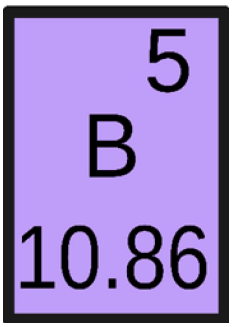
TEDS ID: RTW-32 **Reason No Longer Needed – Risk No Longer Exists**

TECHNOLOGY NEED

Development of the technology to deliver neutron poisons will provide a criticality safety control strategy for retrievals of waste from tanks such as SY-102, TX-109, and TX-118. Development will address outstanding issues of chemical stability of the neutron poisons in the caustic waste environment. Design criteria for monitoring instrumentation that arise from the ANSI/ANS-8, Fissionable Material Outside Reactors, standard on soluble poison additions will also be addressed as required under DOE O 420.1C, Facility Safety.

NEED RESOLUTION

In the Process Hazards Analysis (PrHA) meeting conducted on December 19, 2022, it was determined that Criticality Safety Control Strategy for Particulate Plutonium is obsolete as a consequence of the control strategy down selection process.



Potential Neutron Poison

THREATS AND OPPORTUNITIES

TFIRR-0046-T: DST Failure In West Area
TFIRR-0048-T: SST Failure in West Area
TFIRR-0045-T: DST Failure in East Area
AAXRC-0011-T: Waste Note as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Instrumentation for the proposed plutonium monitoring is readily available, but the means of deployment need further development for tank farms conditions. Detector shielding and calibration may be technical issues.

Instrumentation for Detecting Plutonium Accumulations in Tanks

TEDS ID: RTW-33 **Reason No Longer Needed – Risk No Longer Exists**

TECHNOLOGY NEED

A capability to detect the presence of plutonium accumulations on a tank bottom is needed as part of the required control strategy for addressing criticality safety issues. The technology would be deployed to ensure safety during retrieval of the SY-102 sludge and the TX-118 salt cake, as both tanks hold significant inventories of particulate plutonium. The capability to detect plutonium accumulations would address specific criticality requirements of DOE O 420.1C, Facility Safety.

NEED RESOLUTION

The waste contained within both tanks has evaluated, and neither are expected to realize the risk anticipated and take an excessive amount of time to be retrieved. This risk is deemed unlikely to be realized.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

THREATS AND OPPORTUNITIES

AAXRC-0011-T: Waste Not as Expected (different than modeled) - Takes Longer or Cannot be Retrieved

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An ergonomic cockpit environment to control robots in waste tanks is needed. Develop similar forms of task analysis, metrics, and a computer simulator for the training and operational benefit of tank farm retrieval operators as those used for measuring and modelling robotic surgical skills.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

Yes

Computer Simulator to Measure Retrieval Operator Skills

TEDS ID: RTW-43 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

Improvement in the efficiency of tank retrieval operations based upon improvements to the human-machine interface are needed. A system is needed that records operator action; this will lay the groundwork for a future low cost integration effort to add operation control action logging to the existing operational waste retrieval system.

NEED RESOLUTION

This need has been met by a Commercial Off-The-Shelf (COTS) product. This approach leveraged existing technology in the market, avoiding the time and resources associated with developing a new system.

Simulator

THREATS AND OPPORTUNITIES

AAXRC-0044-T: Inability to Adequately Staff the Project

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Modular treatment has been shown to have the capability to increase low-activity waste loading by nearly 30%.

Modular Tank Waste Treatment

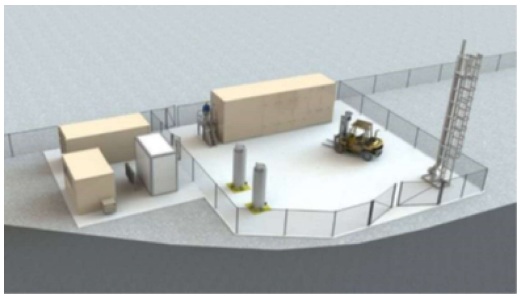
TEDS ID: RTW-54 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

Due to containing more technetium-99 and pumpable liquids, the west area is shown to have a higher groundwater risk. Modular treatment has been proposed to have the capability to increase low-activity waste loading by about 30% and may allow for concurrent waste treatment. In addition to these benefits, modular treatment could provide a backup plan to the current mission strategy as well as the potential to shorten the duration of the mission.

NEED RESOLUTION

The West Area Risk Management Project (WARM) will add operational capabilities based on the technology developed during and lessons learned from Tank Side Cesium Removal(TSCR) system and the Advanced Modular Pretreatment System (AMPS) projects to enable near-term retrievals, tank waste treatment, and management of double-shell tank space in the 200 West Area tank farms. The WARM project will accomplish this by creating additional Double Shell Tank (DST) space for both laboratory waste, Single Shell Tank (SST) retrievals and relieving demand on the Direct Feed Low Activity Waste (DFLAW) program by establishing a parallel and near-term capability to remove, treat, and transport tank waste from the 200 West Area.



Modular Treatment Facility Sketch

THREATS AND OPPORTUNITIES

ARTVS24-0511-T: Insufficient DST availability
DSTI24-0001-T: DST Failure
SSTI24-0001-T: SST Failure

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

Yes

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H2C Hanford Tank Waste Operations & Closure

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Design and develop a mission level simulation-modeling platform, to replace the G2 platform (upon which Hanford Tank Waste Operations Simulator (HTWOS), TOPSim, and the WTP G2 model are built) and to handle the anticipated influx of modeling requests after the start of DFLAW.

Advanced Dynamic Simulation Modeling Platform

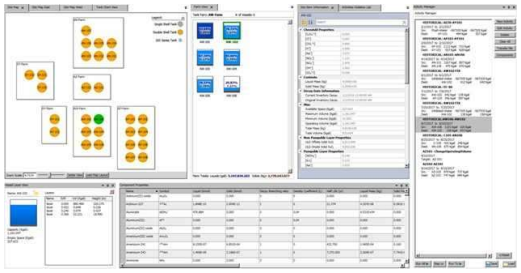
TEDS ID: PTW-24 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

ORP requires modeling analysis to support long-term strategic and near-term operational planning, including the System Plan, the Multi Year Operating Plan, Analysis of Alternatives, Tri-Party Agreement negotiations, Double-Shell Tank (DST) Space Plan, Retrieval Plan, and Waste Feed Delivery Plan. Independent management assessment report FY2015OSM0131, *Assessment Report – System Planning Tools and Processes*, concluded that the deficiencies of the current G2-based system represent short-term challenges and long-term risks to the organization, and that it will need to be replaced within 5 to 7 years.

NEED RESOLUTION

The original technology need was centered around funding the replacement of the G2 Platform. The original goal was the allocation of resources for the replacement of the G2 Platform. Due to a fully funded, Level of Effort, software development group. The ability to plan and replace the G2 platform has been addressed.



Input Screen for the Near-Term Operations Tool

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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Deploy high- to mid- fidelity consolidated Operators Training Simulator (OTS) in TOC for process monitoring and controls. Use OTS as platform for new process development.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

High- to Mid-Fidelity Consolidated Operators Training Simlator

TEDS ID: PTW-26 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

A technology is needed that improves operator proficiencies in running processes such as waste transfers, evaporator runs, exhauster operations, LAW-PS, etc.

NEED RESOLUTION

The development phase for OTS is completed. The current technology and modeling software, recognized as an industry standard, fully meets needs and requirements. The technology is fully implemented and in use.

High-Fiedlity OTS

THREATS AND OPPORTUNITIES

WRPSC-0010-T: Complex Integration of Field Work
WRPSC-0002-T: Resources Not Available When Required

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

HANFORD SITE
US DEPT OF ENERGY

RETIRED

Develop a common set of productivity and analysis tools that gather data from a variety of sources and transforms it into real time, reliable information for tank farm decision makers.

Operations Productivity and Analysis Tools

TEDS ID: PTW-28 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

The strategy is to provide Tank Operations Contractor (TOC) with tools to improve facility status control, the quality of their communications and reduce the time required to determine the status of the facility. Examples of the tools being employed are:

1. Operations Tracking Tools (OPS Tracker) – Gather the status of completed and non-completed.
2. Maintenance Work Tools – Work package and Round Sheets and with filtering options Operations.
3. Electronic Turnover – Provides shift personnel a web platform to document the plant status at shift turnover.
4. Limiting Condition of Operation (LCO) Tracking Program – Shows when the LCO was entered and lists the Required Actions and time needed to exit the LCO.
5. Electronic Rounds – Provides Operators hand-held data collection devices, which eliminates data transcription errors and provides instant feedback for out of specification readings.
6. System Deviation – Shows all active temporary modifications, bypasses and logbook instructions.
7. Survey Maps – Provides the ability to display and update electronic radiological maps for each tank farm.

NEED RESOLUTION

The need for operational efficiency within the Tank Operations (TOC), strategic initiative integrated tools designed to improve facility status control, communication quality, and operational responsiveness has been met through the development of a new set of HPI improvement tools. New tools include a PI Core Sight Display, Alarm & Analysis Tracking Tool, Industrial Hygiene Communications Board Kiosk, and Laboratory Information Status Board.

Alarm & Analysis Tracking Tool

THREATS AND OPPORTUNITIES

WRPSC-0010-T: Complex Integration of Field Work
WRPSC-0011-T: Secondary Solid Waste Management LTA (Tank Farms and WTP)

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Create a VWB workflow using existing tools that simulate waste processing, track data, simulate and provide analysis consistency. Team National Labs and Hanford and Savannah River contractors on integration, and tool development. Contractors will lead software development and direct workflow requirements, integrate chemical detail into process flowsheet to address waste acceptance criteria and include waste properties, multiphase flow, and complex plant layouts and processes.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

Yes

Virtual Workbench for Waste Processing

TEDS ID: PTW-39 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

This training simulator could benefit several Grand Challenge topics. Is there a method to remove and store cesium / strontium from the Low-Activity Waste Pretreatment System, temporarily store it and reintroduce it into Pretreatment Facility or a High-Level Waste Vitrification Facility flowsheet at some point in the future? Is there an economical or innovative method to move waste tank slurry from the more remote single-shell tanks that can operate under today's nuclear safety rules? Is there a sampling and waste acceptance strategy that would simplify the Waste Treatment and Immobilization Plant (WTP) design strategy without significantly impacting throughput or mission life?

NEED RESOLUTION

The initial need was to develop a virtual workbench for developing strategies to simplify waste processing. This need has been addressed by the completion of PTW-26, High- to Med-Fidelity Consolidated Operators Training Simulator. The Consolidated Operations Training Simulator is currently being fully utilized by Operations and Engineering to review and validate procedure changes and facility modifications.

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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Establish real-time monitoring process control for DFLAW, including demonstrated plant instrumentation to reduce the need for extensive process control samples. Sampling and analysis will be limited to periodic verification and confirmation.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

Yes

Real-Time Process Control for DFLAW

TEDS ID: PTW-54 **Reason Combined With Another TEDS**

TECHNOLOGY NEED

Process control for direct-feed low-activity waste (DFLAW) operation relies on process sample collection and analysis for composition information. The process cycle times for many vessels in the Low-Activity Waste Vitrification Facility and Effluent Management Facility is very short, requiring an increased number of samples to support operations. Additionally, the sampling and analysis duration coupled with the increased number of samples will challenge operations. This burden on the laboratories and impact on the process cycle time has the potential to impact operational throughput.

NEED RESOLUTION

This need was consolidated with MTW-76, Online Monitoring. These needs and solutions work together and are being pursued by the National Labs.

LIBS Probe

THREATS AND OPPORTUNITIES

DAO24-0019-O: Live Process Monitoring to Reduce Sample Analysis Needs (Excluded)
DFLAW-0363-T: WTP LAW Throughput Is Less Than Adequate
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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US DEPT OF ENERGY

RETIRED

Design and develop dynamic chemical process modeling capabilities to aid in operational flow sheeting of Tank Side Cesium Removal (TSCR), Effluent Treatment Facility (ETF) and Waste Treatment and Immobilization Plant (WTP) operations.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

Chemical Process Modeling Software to Support DFLAW Operations

TEDS ID: PTW-55 **Reason No Longer Needed - Risk No Longer Exists**

TECHNOLOGY NEED

RPP-44491 identifies the need for operational flow sheeting software that is dynamic, uses a rigorous thermodynamic database, is supported commercially and contains an accurate representation of Waste Treatment and Immobilization Plant (WTP) operating logic so that transient behavior is predicted correctly. This has been expanded to include the need for a dynamic chemical process model of tank-side cesium removal (TSCR) and the Effluent Treatment Facility (ETF).

NEED RESOLUTION

Support for DFLAW modeling software will always be needed and is considered 'routine' maintenance. The integral role that Direct Feed Low-Activity Waste (DFLAW) modeling software plays in the operational efficacy and safety of processes such as the Tank Side Cesium Removal (TSCR), Effluent Treatment Facility (ETF), and the Waste Treatment and Immobilization Plant (WTP) has been highlighted.

THREATS AND OPPORTUNITIES

DFLAW-0232-T: WTP Radioactive Dangerous Liquid Effluent Composition LTA
DFLAW-0106-T: Staged Treated LAW Feed to WTP Does Not Meet Waste Acceptance Criteria for Cesium-137
DFLAW-0075-T: Secondary Liquid Waste Volumes are Higher than Expected
DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate
DAORR-0023-T: Complex Integration of Operations
DAORR-0025-T: Tank-side Cesium Removal (TSCR) and Waste Feed Deliver (WFD) Systems Unable to Meet WTP Feed Demand during Operations

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H2C Hanford Tank Waste Operations & Closure

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In response to recent lessons learned, an evaluation is needed to provide evidence of the suitability of piping joint options in waste processing applications.

Evaluation of Piping connections for Strong Caustic and Salts

TEDS ID: PTW-59 **Reason Reclassified As Non-Technology Development**

TECHNOLOGY NEED

There is a need to evaluate effective piping connections in lines that transport strong caustic and salt heavy waste. Multiple instances of joint leakage have occurred suggesting a compendium of applicable joints with proven effectiveness would be valuable for the upcoming implementation of the technology that was demonstrated by TSCR.

NEED RESOLUTION

This activity was incorrectly added as a TEDS. This activity is being taken care of as an evaluation of existing technology.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

THREATS AND OPPORTUNITIES

AMPSP-0005-T: Internally Driven Requirements Change during AMPS Design

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

Technology development for software upgrades to accommodate identification and tracking of Waste Treatment and Immobilization Plant (WTP) solid secondary waste that can be disposed at the Integrated Disposal Facility (IDF).

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

Upgrade Solid Waste Information and Tracking System

TEDS ID: MW-12 **Reason No Longer Needed - Risk No Longer Exists**

TECHNOLOGY NEED

Regulations require waste to be tracked and managed. The Solid Waste Information and Tracking System {SWITS) is currently used by all contractors to track and manage waste. SWITS needs to be upgraded to handle the waste generated by the Waste Treatment and Immobilization Plant {WTP).

NEED RESOLUTION

The implementation of the Solid Waste Information and Tracking System (SWITS) with both the Waste Treatment and Immobilization Plant (WTP) and the Central Plateau Cleanup Company (CPCCo) was achieved by prolonging SWITS' application to include WTP through user and location additions, eliminating the need for further development. Both CPCCo and WTP now actively use SWITS, rendering additional upgrades unnecessary.

SWITS Database Menu

THREATS AND OPPORTUNITIES

WRPSC-0010-T: Complex Integration of Field Work (TOC)

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H2C Hanford Tank Waste Operations & Closure

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The Test Bed Initiative is being conducted to demonstrate the programmatic efficacy of off-site commercial treatment and out-of-state disposal for treated mixed low-level waste from Hanford tanks.

National Laboratory Involvement?

No

Submitted as Grand Challenge?

No

Evaluation of Commercial Treatment and Offsite Disposal

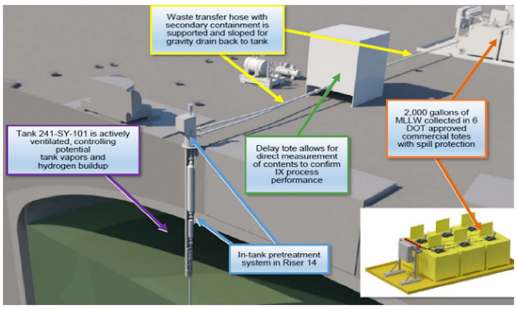
TEDS ID: DTW-10 **Reason Risk Accepted Need Has Been Met**

TECHNOLOGY NEED

The Department of Energy (DOE) is evaluating potential benefits to enhance Hanford's tank waste mission to reduce risk, cost, and inform a needed supplemental treatment decision for Hanford's tank waste mission to gain regulatory, stakeholder, and public acceptance, providing a pathway for commercial treatment and disposal.

NEED RESOLUTION

The Test Bed Initiative (TBI) project will be demonstrating the feasibility of retrieval, pre-treatment and shipment of the Hanford tank waste. The design and fabrication were completed for the Test Bed Initiative system in 2019, which includes a pump, filter, ion exchange column, control system, transferlines, and totes to receive the treated waste. WRPS is managing the TBI Design, installation, testing and performing operation of the TBI equipment. Performance validation testing has been completed through a Factory Acceptance Test by the equipment fabricator. The waste, pre-treated by the TBI system, will be sampled and shipped offsite for immobilization.



TBI System Design

THREATS AND OPPORTUNITIES

DFLAW-0362-T: WTP LAW is not ready to receive treated tank waste feed when DFLAW support projects are ready to start operations

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate

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H2C Hanford Tank Waste Operations & Closure

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RETIRED

Evaluation of Natural Analogues to Support Tailored Grout

TEDS ID: DTW-12 **Reason Risk Accepted Need Has Been Met**

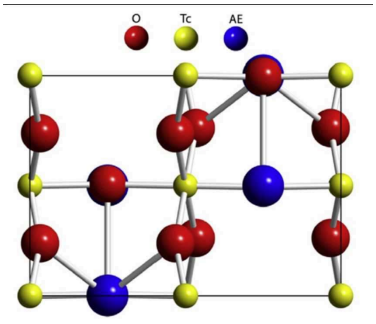
Grout can be tailored to enhance durability when amended with phases intended to sequester specific troublesome radionuclides such as technetium and I-129. Many of those phases are analogues to natural minerals which are inherently stable. This activity would evaluate the natural analogue data to show that tailored grouts could be more durable than glass for key risk-driving radionuclides.

TECHNOLOGY NEED

Develop and qualify a tailored grout waste form for supplemental immobilization of Hanford low-activity waste (LAW). This waste form is needed to sequester specific troublesome radionuclides such as technetium and iodine-129.

NEED RESOLUTION

The need for a tailored grout was satisfied by the 222-S laboratory with their creation of a grout formulation that was based on natural analogues that are known to be geologically stable for billions of years. Additional grout formulation has been ongoing since this development.



Model of Tc incorporation in SrTcO3

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

Yes

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate

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H2C Hanford Tank Waste Operations & Closure

CHIEF TECHNOLOGY OFFICE

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RETIRED

A central electronic repository for experimental results, technology reports, and lessons learned associated with the development and application of cementitious waste forms for radioactive wastes is needed to facilitate the use of the most up-to-date information in decision making. The repository should be made accessible across the DOE complex through a web-based interface that facilitates locating, searching, and retrieving information.

National Laboratory Involvement?

Yes

Submitted as Grand Challenge?

No

Complex-Wide Database for Cementitious Waste Form Properties

TEDS ID: DTW-14 Reason No Longer Needed - Mission Need Changed

TECHNOLOGY NEED

Multiple DOE laboratories and contractors are developing and testing cementitious formulations for solidifying a variety of liquid and solid wastes. A central repository for this information along with a web accessible database interface is needed to facilitate access.

NEED RESOLUTION

This is currently being funded by DOE EM HQ with PNNL developing the database. The contact is Dr. Matt Asmussen (matthew.asmussen@pnnl.gov).

THREATS AND OPPORTUNITIES

DFLAW-0363-T: WTP LAW Throughput is Less Than Adequate
DFLAW23-0363-T: WTP LAW Throughput is Less Than Adequate

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