

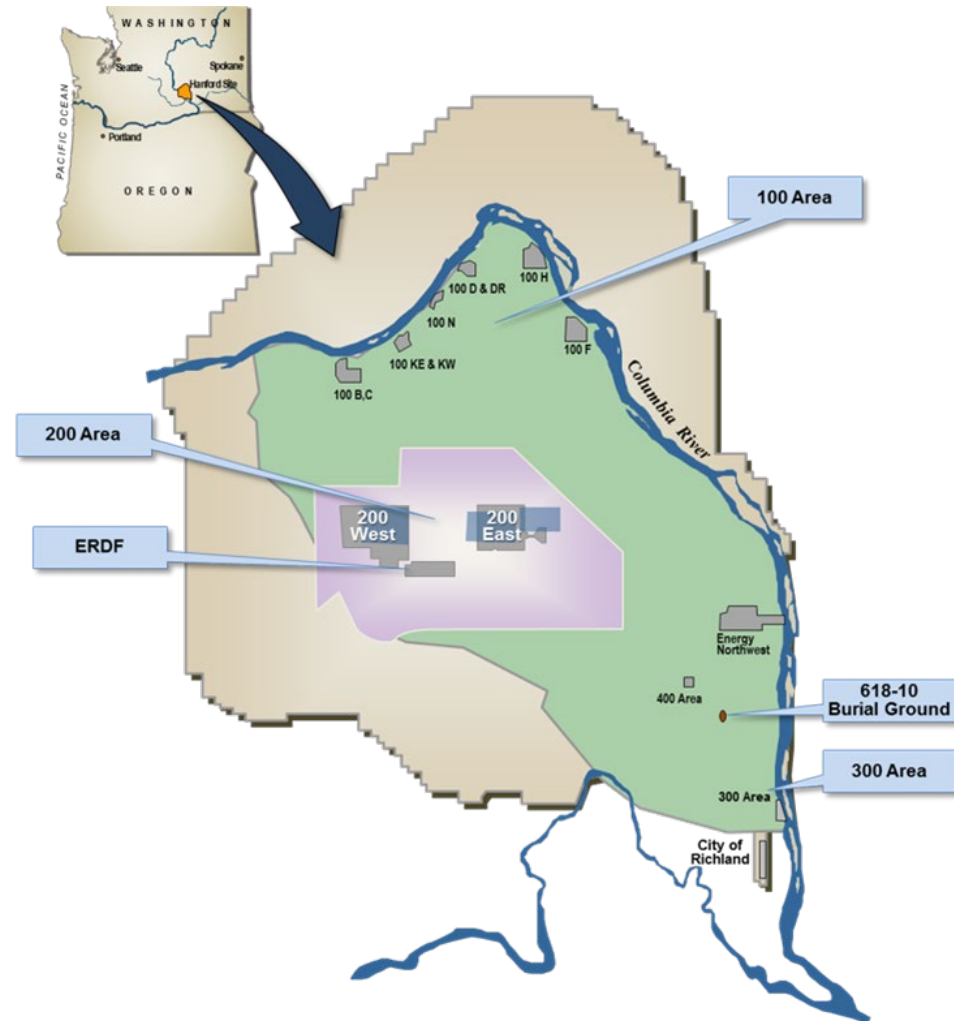


Retrieval and Management of TRU Sludge at Hanford K-Basin

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Hanford Site





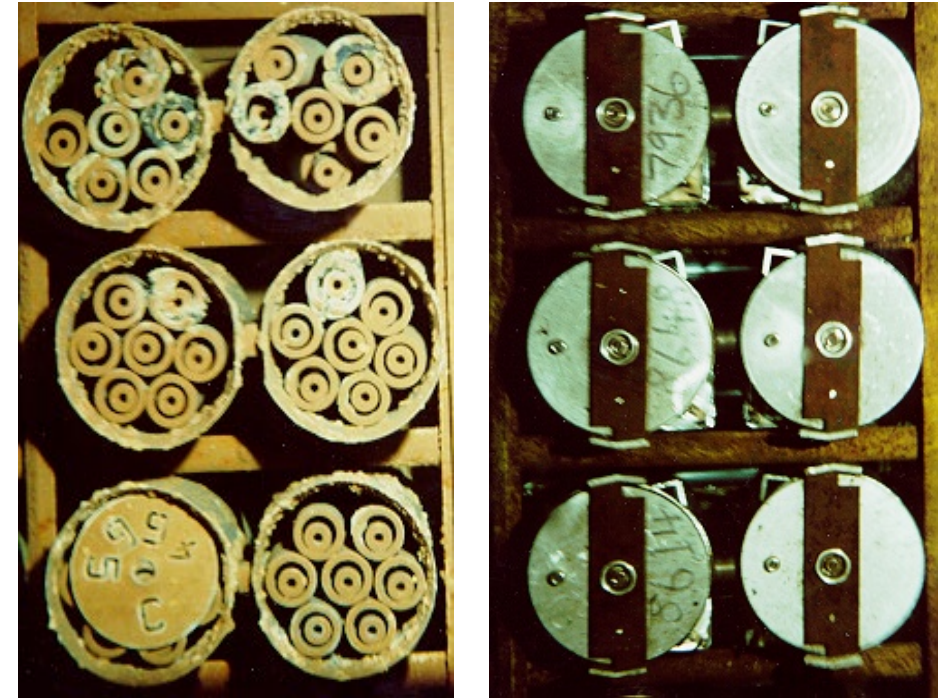
Hanford 100-K Area





Background

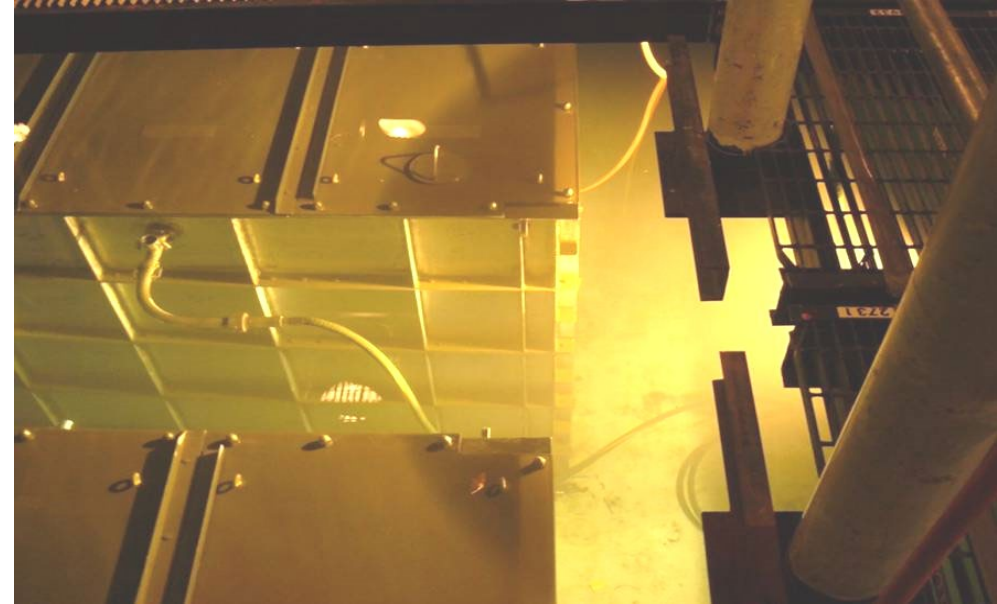
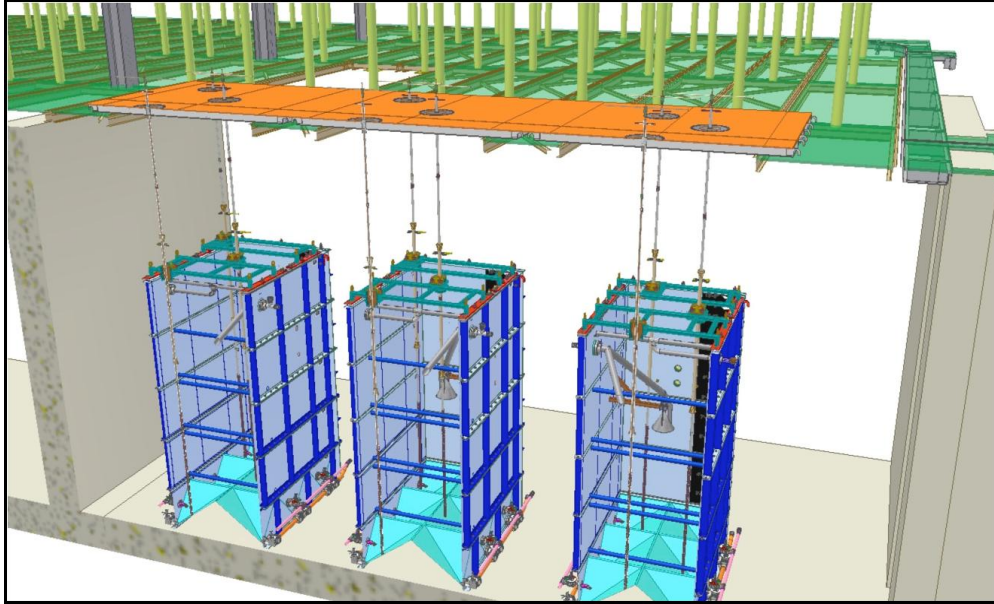
- K East (KE) and K West (KW) Basins operated from 1955-1971
- Basins were later reactivated for storage of N Reactor fuel prior to processing at the PUREX Facility
- 2100 metric tons of spent fuel left stored under water in K Basins when PUREX shutdown in 1990
- Spent fuel removed from basins from 2000-2004 and transported to Canister Storage Building (CSB)
- KE Basin floor sludge transferred into three Engineered Containers (ECs) in the KW Basin in 2007
- KW Basin floor and settler tube sludge vacuumed into three ECs in 2010



K East (left) and K West Fuel Storage Canisters



Sludge Storage



This sludge material includes high density, highly erosive, uranium metal pieces as well as small low-density particles. The sludge is a mixture of tiny fuel corrosion particles, fuel rod and metal fragments, and soil and sand less than ¼-inch in diameter. This sludge has chemical, physical and radiological characteristics that present significant difficulties in providing mobilization and motive force to ensure successful removal and transfer.



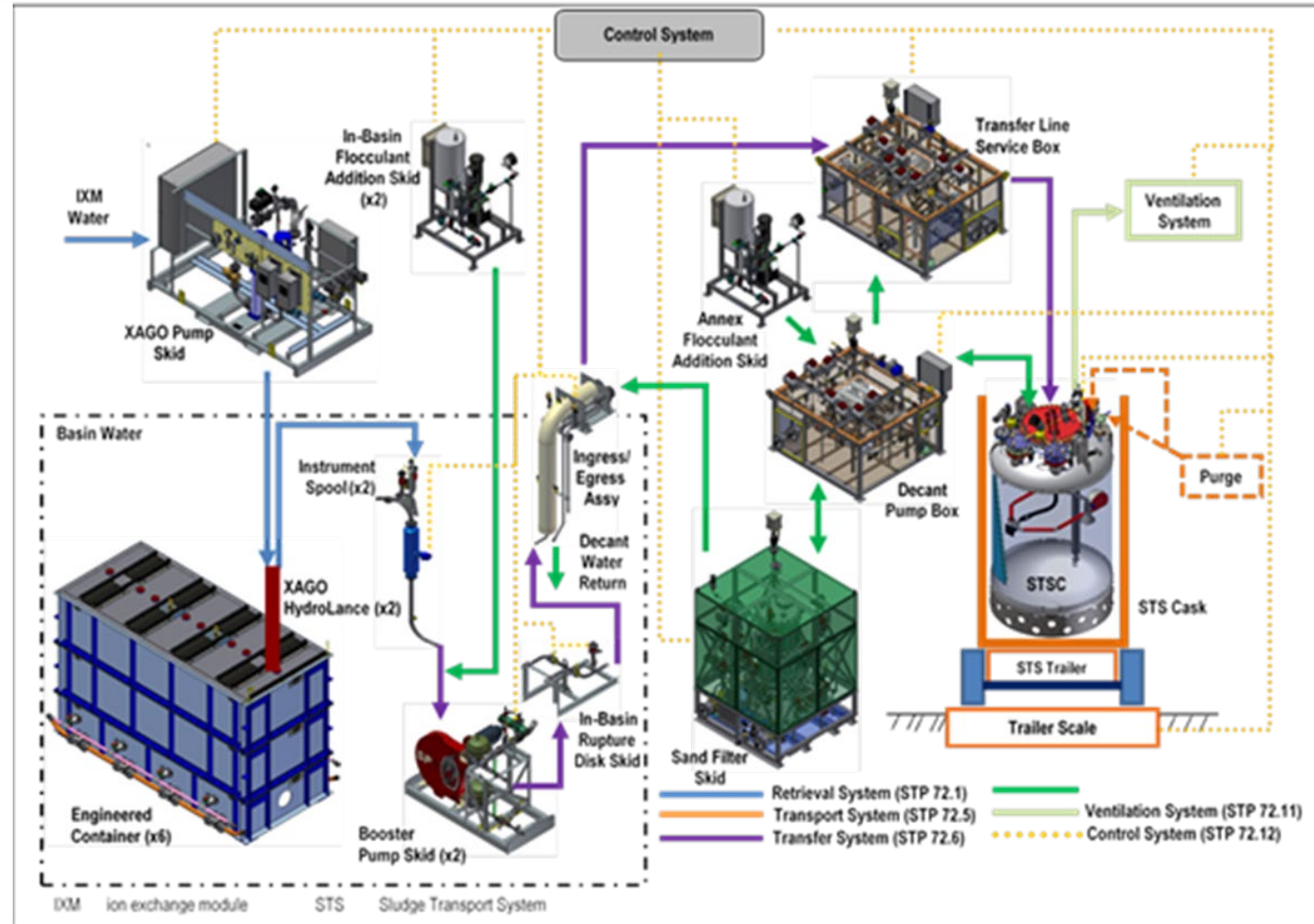
Project Mission

The mission of the Sludge Removal Project was to design and construct the Engineered Container Retrieval and Transfer System (ECRTS) to provide the capability to safely remove highly radioactive sludge from the KW Basin, which poses a threat to the nearby Columbia River.

- New construction of the KW Annex sludge loading facility
- ECRTS installed and commissioned in the KW Basin and Annex
- Hazard Category 2 nuclear facility



Process and Design





Project Management and Risk Reduction

- Sludge sampling and characterization program
 - Reduce source term uncertainty
 - Avoid overly conservative design and safety bases
 - Simulant development
- Technology development program
 - Full scale test facility (MASF) in the 400 Area of Hanford
 - Integrated system testing using bounding range of simulants
 - Equipment demonstration and operator training
 - Approach was used successfully for sludge sampling, settler tube retrieval, and knock-out pot processing



Technology Development

A cold test facility was established at the Material and Storage Facility (MASF) in the Hanford 400 Area. At MASF, engineers created a full-scale, high-fidelity mockup of the K West basin to simulate the facility working conditions, in particular replicating the basin's physical structure, attributes, and dimensions.



MASF was modified to develop design concepts and complete system integration testing.



MASF provided an environment for workers to test technologies that allowed for the removal and transfer of sludge.



Test coordinator performing integrated system testing from the main control panel.

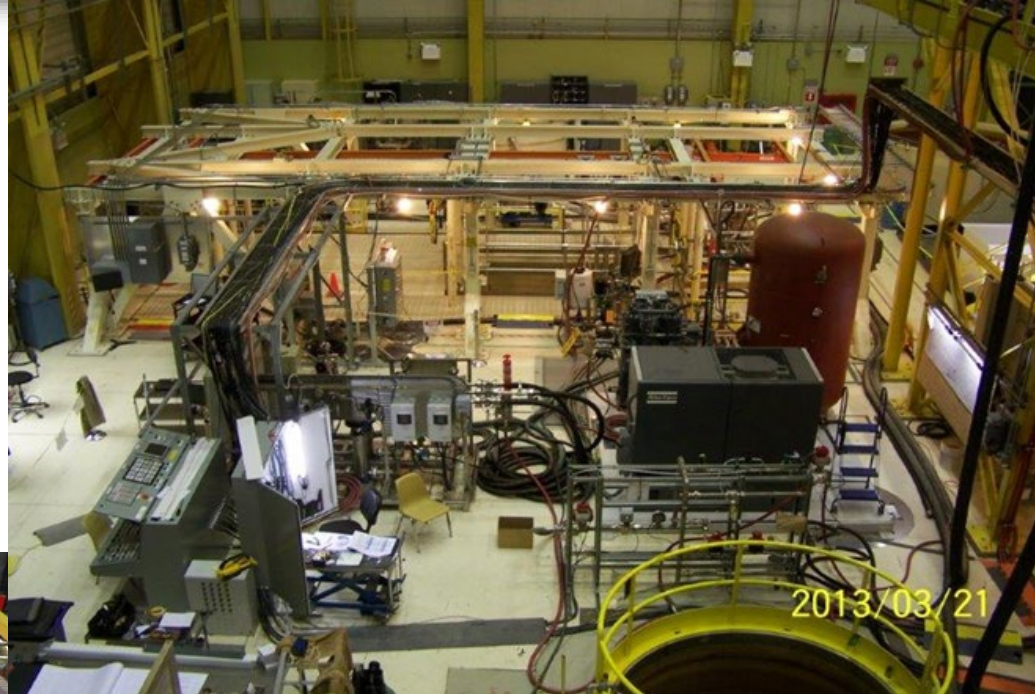


MASF is also being used to support other K Basins deactivation work as well as for other Hanford projects.



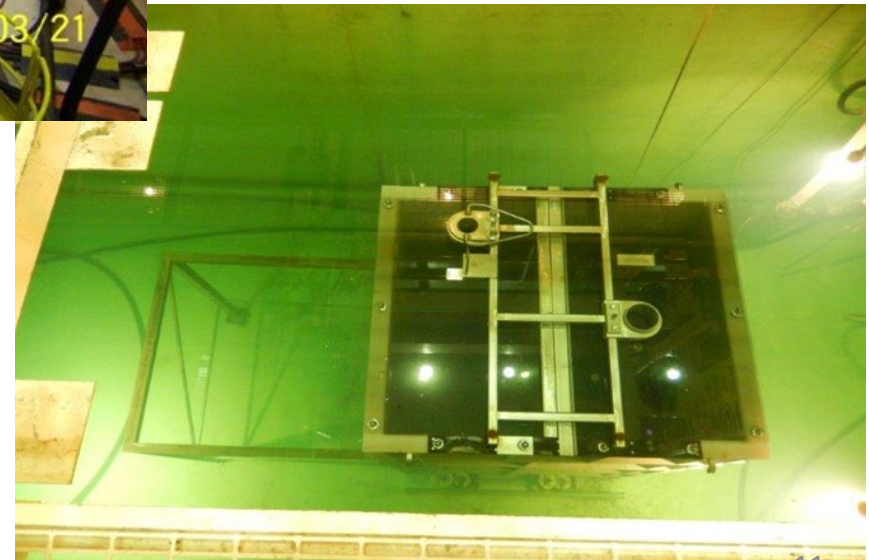
Test Facility at MASF

Sludge Transport and Storage
Container in Sludge Transfer Cask



Engineered Container in Pool

ECRTS Mockup at MASF





Mock-up Testing



KW Basin Mock-up at MASF



KW Basin

Ensuring the components work individually and as an integrated system in a non-nuclear environment avoided the need for remedial design activities after installation. The project concluded that this detailed and extensive planning, engineering, technology development and testing at full-scale was a key element in the successful startup and operation of the system.



K West Sludge Transfer Annex





Project Reviews

- Alternative Analysis for sludge removal was completed in 2009 with a two phase approach recommended:
 - Remove sludge off the river as soon as possible (Phase 1)
 - Treat and package sludge for disposal at WIPP (Phase 2)
- External Technical Review, June 2009
- Technology Readiness Assessment (TRL-4), October 2009
- Technical Independent Project Review, June 2010
- Technology Readiness Assessment (TRL-6), July 2012
- Independent Project Review, October 2013
- Independent Cost Estimate/External Independent Review, March 2016



Lessons Learned

Cold Commissioning in a non-radiological environment allowed identification and resolution of problems prior to field deployment, saving project cost and schedule.

- Problems with system equipment and interfaces were identified and corrected more quickly in a clean environment. For example, an instrument spool flow meter failed after submerging in test pool. Test team able to perform troubleshooting and replacement in non-contaminated environment.
- A template and procedure for in-facility testing was developed, minimizing procedure corrections and delays when system was installed and tested at the basin.
- The MASF test facility was also used for operator training and procedure development. The contractor and DOE readiness review teams noted that operations personnel were well-trained and knowledgeable, and demonstrated good conduct of operations.



Conclusion

- **2009**

Began sludge removal mock-up designs at the Maintenance and Storage Facility

- **2012**

Shipped last of knock-out pot sludge to Canister Storage Building

- **2014**

Completed K West Annex structural steel, structural concrete and roof deck

- **2016**

Completed procurement and acceptance of first sludge transport and storage containers

- **2017**

Completed T Plant modifications for receipt of K Basin sludge

- **2018**

Began shipping sludge from 105-K West Basin to T Plant

The planning and execution of this project demonstrated how the application of DOE Order 413.3B, Program and Project Management for the Acquisition of Capital Assets, DOE-STD-1189-2008, Integration of Safety Into the Design Process, and DOE G 413.3-4, U.S. Department of Energy Technology Readiness Assessment Guide can positively affect the outcome of project implementation in the DOE Complex.

ITEM	BASELINE	AT COMPLETION
Cost	\$311 Million (including fee, MR, and contingency)	\$291 Million
Schedule	November 30, 2019	June 4, 2018
Scope	Design, procure, construct, test and commission an integrated set of processes, systems and facilities to remove radioactive sludge currently stored underwater in the KW Basin	Complete