

## **One System Overview – 16579**

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### **ABSTRACT**

The U.S. Department of Energy (DOE), Office of River Protection (ORP) is responsible for managing and completing the River Protection Project mission, which is to “safeguard the nuclear waste stored in Hanford’s 177 underground tanks, and to manage the waste safely and responsibly until it can be treated in the Waste Treatment and Immobilization Plant for final disposition.” The Office of River Protection’s work scope is currently performed through two primary contracts:

- The Tank Operations Contract, held by Washington River Protection Solutions LLC, (WRPS) includes the construction, operation, and maintenance activities necessary to safely store, retrieve, and transfer tank wastes; provide supplemental tank waste treatment; provide storage and/or disposal of primary and secondary waste streams; design, construction and commissioning of the Low-Activity Waste Pretreatment System; and support ORP to integrate Hanford Tank Waste Treatment and Immobilization Plant (WTP) completion and startup with Tank Farms operations.
- The WTP Contract, held by Bechtel National, Inc. (BNI), includes the design, construction, and commissioning of a Pretreatment Facility, two vitrification facilities (one for high-level waste and one for low-activity waste), a dedicated analytical laboratory, and supporting facilities to treat radioactive tank wastes by immobilizing them into a stable glass waste form.

One System was established as a means to improve the integration between the tank farms and the WTP project to support its safe and successful startup. One System’s scope and purpose focus on mission integration consistent with DOE’s plans to treat tank waste in phases, starting with direct feed of the low-activity waste stream to the WTP’s Low-Activity Waste (LAW) Vitrification Facility (referred to as DFLAW).

The One System organization now has four major focus areas:

- Flowsheet Integration – Integrated River Protection Project (RPP) flowsheet development and management; developing a gaps, risks, and opportunities management plan and technical roadmap; and waste feed qualification.
- Mission Analysis and Planning – Strategic planning, system planning, and modeling integration.

- WTP Startup, Commissioning, and Operations Integration – Interface Control Document (ICD) management, coordinating facilities startup-to-commissioning-to-operations, contract directives and standards identification, and DFLAW program integration.
- Project Integration and Controls – Integrated schedule, metrics/dashboards monitoring, and One System risk register.

ORP established the DFLAW Program Office in February 2015 as one of its key performance goals. ORP staff, along with contractor managers, have identified roles and responsibilities for the each of the four major focus areas. One System has established an Executive Council and Governance Board to drive program progress and make decisions on DFLAW. This approach allows appropriate government and contractor senior management involvement in the DFLAW Program. Monthly critical path analysis on the integrated DFLAW schedule is being performed. Interface control documents specific to DFLAW have been developed, and system planning and modeling tools are being used to help define the DFLAW flowsheet.

## **INTRODUCTION**

Radioactive and chemical wastes from nuclear weapon production are stored in underground tanks at the Hanford Site, located in the state of Washington. The waste tanks contain a complex and diverse mix of radioactive and chemical waste in the form of sludge, salts, and liquids, necessitating a variety of unique waste retrieval, treatment, and disposition methods. Generically, the tank waste can be characterized as the following:

1. Sludge – Insoluble materials largely consisting of metal hydroxides and oxides that precipitated when acidic wastes from spent nuclear fuel processing and other activities were neutralized and converted to high pH for storage in carbon steel tanks. The sludge waste makes up the largest component that will be processed via high-level waste (HLW) vitrification into a stable glass form.
2. Supernatant – Liquid waste with high sodium content and high pH.
3. Saltcake – a mixture of salts that precipitated from supernatant as the specific gravity was increased by evaporation to reduce tank storage space requirements. Saltcake must be re-dissolved and processed as supernatant waste. The supernatant and saltcake contain the majority of highly radioactive Cs which must be separated and processed with the sludge

stream into HLW glass. The decontaminated supernatant will be processed via low-activity waste (LAW) vitrification into a stable glass form.

4. Potential contact-handled transuranic waste (CH-TRU) – a mixture of sludge and saltcake consisting of some 1.4 million gallons in 11 specific single-shell tanks (SSTs). The material in these tanks is being reviewed to determine the potential to transfer to WIPP versus processed on-site into HLW and LAW glass fractions.

In order to begin immobilization of tank waste as soon as practicable, a Direct Feed LAW (DFLAW) flowsheet has been initiated. In the DFLAW configuration, LAW feed will be provided to the LAW Pretreatment System (LAWPS). The LAWPS will separate the HLW and LAW fractions and provide qualified feed to the LAW Vitrification Facility.

Successful startup and operation of DFLAW requires the completion of engineering, design and construction of numerous facilities, flowsheet stewardship, programs integration across facilities, generation of a series of permits, and development of the regulatory framework to dispose of the waste forms generated. This paper discusses the program integration efforts, critical for the success of DFLAW, through the One System approach and highlights the successes over the past fiscal year.

One System was established as a means to improve integration between the tank farms and the WTP project to support the safe, efficient and successful startup of waste disposition operations. One System's scope and purpose focus on mission integration consistent with DOE's plans to treat tank waste in phases, starting with DFLAW.

### One System Approach

There are numerous activities required to support a successful startup. In the case of DFLAW, these activities involve two DOE offices, five different prime contractors, the National Laboratories, and multiple subcontractors (Figure 1). One System is responsible for ensuring all these activities are integrated, occurring at the proper time and in the proper sequence, to support startup in the most efficient manner. The existence of One System does not create any new scope for the DOE. It simply brings dedicated focus to integration activities and allows the



**Fig.1.** One System integrates two DOE offices, five prime contractors and the National Laboratories to deliver a single integrated program

individual performing organizations to effectively and efficiently execute project work.

The major complexity of the DFLAW program is not in technical challenges, rather it's the oversight and management of the numerous entities and activities that need to be aligned to make DFLAW a success. With One System firmly in place and taking a programmatic view, key risks and opportunities are being identified that might otherwise go unnoticed. The One System approach was recognized as a best practice concept by a recent WTP project peer review.

### **One System Strategic Objectives**

Working closely with ORP, One System established the following seven strategic objectives to safely and effectively deliver DFLAW (Table I). These objectives act as the basis for planning and executing the One System scope.

**TABLE I.** One System's Strategic Objectives

<b>Strategic Objective</b>	<b>Description</b>
<b>Integration</b>	Establish prioritized sets of fully integrated activities and timing to integrate Tank Farms and WTP to meet DOE objectives for startup and commissioning of WTP.
<b>Contract Alignment</b>	Identify those DOE directives and contract changes needed to align the WRPS and BNI contracts and establish an optimum or necessary time to have each item aligned.
<b>Transition</b>	Recommend actions to more effectively or efficiently conduct the transition to startup, commissioning, and operations.
<b>Flowsheet Management</b>	Establish long-term Tank Waste Disposition Integrated Flowsheet stewardship and technical management involving National Laboratories.
<b>System Planning</b>	Provide for the integration of Tank Farms and WTP system planning and modeling, with a focus on the waste feed qualification requirements.
<b>Interface Control</b>	Manage the WTP Interface Control Documents.
<b>Skills Requirements</b>	Coordinate the establishment of operational skills required for operator positions.

## **ONE SYSTEM – DRIVING DFLAW FORWARD**

In support of DOE's objective to treat and dispose of tank farm waste in a phased approach as soon as practical, starting first with DFLAW, One System has defined the DFLAW Program. The integrated flowsheet and the system planning and modeling results show that DFLAW is a workable solution for delivering immobilized LAW. One System continues to optimize the flowsheet and modeling, collaborating between the Tank Operations Contractor (TOC) and the Hanford Tank Waste Treatment and Immobilization Plant (WTP) contractor, and engaging the National Laboratories to build confidence in the DFLAW Program.

### **DFLAW Program**

The DFLAW Program is designed using existing or planned facilities that will deliver the tank farm waste to the LAW Facility for vitrification and disposal; handle the secondary wastes; and provide necessary support such as laboratory analysis, infrastructure and utilities. The DFLAW Program scope includes the following:

- Twelve processing/support facilities - Table II below lists these facilities, the current status of the facility, and activities required for the facility to be ready for DFLAW.
- Three Operational Readiness Reviews –
  1. Waste feed delivery from double-shell tanks (DST) to the Low-Activity Waste Pretreatment System (LAWPS), LAWPS operations, and transfer to the LAW Vitrification Facility
  2. Delivery of pretreated waste from LAWPS to the LAW Vitrification Facility, vitrification of the LAW, management of secondary liquid and solid wastes, and loading and transportation of the Immobilized LAW-filled containers for disposal
  3. Receipt of containers and operations of the Integrated Disposal Facility (IDF).
- Twenty-one DOE/headquarter authorizations
- Five new environmental permits
- Nineteen permit modifications
- Four Regulatory Approvals - Waste Incidental to Reprocessing (WIR) evaluation, Toxic Substances Control Act Risk Based Disposal Authorization, Immobilized LAW (ILAW) Treatment Variance, and the IDF Performance Assessment

- Twenty waste feed transfer campaigns processing 9,800 metric tons of sodium generating over 6 million gallons of tank space and producing over 10,000 ILAW containers.

**TABLE II. DFLAW Program Facility Status and Required Activities**

<b>DFLAW Facilities</b>	<b>Status / Activities</b>
<b>Double Shell Tanks</b>	<b>Upgrades Required</b> / DFLAW Waste Feed Delivery upgrades (AP & AW-Farms), Air Permits
<b>242-A Evaporator</b>  <b>LAW Pretreatment System</b>	<b>Operating facility</b>  <b>CD-1 Approved, in design</b> / Long-lead procurements, LAWPS RCRA permit
<b>WTP LAW Vitrification Facility</b>  <b>Integrated Disposal Facility</b>	<b>Construction underway</b> / Start-up and commissioning, planning including readiness, RCRA and air permits, LAW Facility Documented Safety Analysis (DSA)  <b>Construction complete</b> / IDF Performance Assessment, upgrades, ORR, RCRA and air permits
<b>WTP LAW Effluent Management Facility</b>	<b>In design</b> / Construction, RCRA and air permits
<b>Effluent Treatment Facility</b>  <b>State-Approved Land Disposal Site</b>	<b>Operating facility</b>  <b>Operating facility</b>
<b>Consolidated Solid Waste Management</b>	<b>Decision complete</b> / 90-Day Storage Pad, RCRA and air permits
<b>222-S Laboratory</b>  <b>WTP Analytical Laboratory</b>  <b>WTP Balance of Facilities</b>	<b>Operating facility</b>  <b>Construction underway</b> / start-up and commissioning, RCRA permit, Laboratory DSA  <b>Construction underway</b> / transitioning to start-up and commissioning, DFLAW upgrades

Startup of DFLAW and successful execution of the other DFLAW-related activities result in significant benefits to the RPP mission.

- **Commence tank waste treatment** – During DFLAW operations, approximately 15 million gallons (Mgal) of LAW will be transferred from the DST system and processed into a suitable waste form for final disposition. This process is projected to produce more than 10,000 ILAW containers.
- **Gain operational experience and collect performance data** – DFLAW commissioning and operations experience can provide valuable insights for startup, commissioning, and operation of the WTP Pretreatment Facility and High-Level Waste (HLW) Vitrification Facility. Operational data for the LAWPS, WTP LAW Vitrification Facility, Effluent Management Facility (EMF), and Liquid Effluent Retention Facility (LERF)/Effluent Treatment Facility (ETF), along with ILAW container performance data, can aid in mission planning and strategy development.
- **Generate tank space** – DFLAW operations will generate approximately 6 Mgal of DST space that can be used to support continued waste feed preparation, SST retrievals, and/or address other emergent issues. The amount of DST space generated is affected by water additions necessary for waste feed delivery and receipt of secondary liquid wastes from LAW processing.
- **Upgrade aging infrastructure** – Tank farms infrastructure upgrades are necessary for DFLAW operations and to provide improved waste preparation and waste feed delivery to support the RPP mission.

### **Driving Tank Waste Treatment and Disposal**

Close integration between ORP, its prime and supporting contractors, as well as the National Laboratories are required for the DFLAW Program. One System is leading the effort to ensure all required work activities are identified, contracts are aligned to work scope, and Laboratories are appropriately engaged. One System is accomplishing this in several ways, including thorough monthly and quarterly program reviews and by working directly with the contractors.

One System continues to use and refine the integrated management tools to monitor and control the program, including an improved set of metrics. These tools allow for early identification of potential impacts and proactive assessment of risks and opportunities, and they increase confidence in the successful delivery of DFLAW (Figure 2).

***DFLAW Integrated Flowsheet*** – The flowsheet defines the DFLAW flow path, identifies major waste flow streams, and evaluates compliance with waste acceptance criteria. Through collaborations with the National Laboratories and subject-matter experts, One System continues to evaluate flowsheet basis and assumptions identifying opportunities for improvements, optimization and use of new technologies. Areas of potential improvement currently being considered include reducing the volume of secondary liquid returns to the DSTs, optimizing waste feed qualification, and reducing the requirements in the flowsheet.

***DFLAW Integrated Schedule*** - In Fiscal Year 2015 the DFLAW Integrated Schedule was developed from a concept to becoming a centerpiece tool recognized for its value in monitoring and displaying program progress. The schedule integrates and logic ties the activities of the five contractors allowing for identification of the DFLAW Program's critical/near-critical path activities providing careful oversight and early assessment of potential impacts.

The schedule has recently been updated to include the DOE reviews and approvals to support key decisions. The visibility of these One System-developed tools are growing.

***DFLAW Integrated Permitting Schedule*** – All key DFLAW Program permitting activities are now integrated into one schedule, giving visibility to DOE, regulator, and contractors to help meet schedule needs.

***DFLAW Program Description Document*** – Following project management best practices, the DFLAW Program Description document identifies the overall strategy, objectives, and processes of the DOE and all supporting DOE subcontractors. It describes the scope, cost, and schedule estimates for all program elements. In addition gaps, risks, and opportunities for successful integration for commissioning



**Fig. 2.** One System's Integrated Management Tools are being implemented to effectively monitor and provide program status

and provide program status



of all needed systems and facilities to produce immobilized LAW product are described. The scope of the DFLAW program extends through the completion of the LAW Facility hot commissioning and systems are fully operational.

***Interface Control Documents*** – The ICDs define the administrative and physical interfaces between contractors necessary to deliver DFLAW. Each interface requirement is well defined, the responsibilities between the contractors and DOE documented, and concurrence obtained from all entities involved in the interface. This formalized process ensures that the program needs and requirements are understood.

***DFLAW Waste Stream Strategy*** – Both liquid and solid secondary waste streams are addressed in the strategy. Each stream's path is defined, from the point of origin to means of disposal.

***DFLAW Risks and Opportunities Management Plan*** – This plan details how DFLAW Program risks and opportunities are identified and managed. The plan results in a single integrated program level risk and opportunity register. This multi-contractor register is used to define the risks, document the appropriate handling actions, and track the actions to closure.

Consistent with our continuous improvement goal, several improvements have been implemented with the One System Risk Management Program:

- Realigned One System Risk Management responsibilities;
- Secured additional risk management support; and
- Established a risk management working group consisting of members from each contractor.

***Technology Roadmap*** - The Technology Roadmap identifies, prioritizes, and plans execution of necessary technologies to accomplish and optimize the tank waste mission at Hanford. This comprehensive, integrated assessment of the technology-related advances ensures successful completion of the tank waste cleanup mission.

***Performance Metrics*** – There are several areas currently being monitored and statused that are leading indicators to the overall performance of the DFLAW Program. These metrics are maintained and reviewed monthly by One System.

During a recent Project Peer Review performed by DOE-HQ that focused on the DFLAW Program and LAW Vitrification Facility, it was noted that One System is an effective management practice.

One System continues to build confidence in the DFLAW Program success. One System has targeted several areas that effectively enhance the program, building confidence in successful delivery of DFLAW (Table III).

**TABLE III.** One System’s Targeted Results Builds Confidence in the DFLAW Program

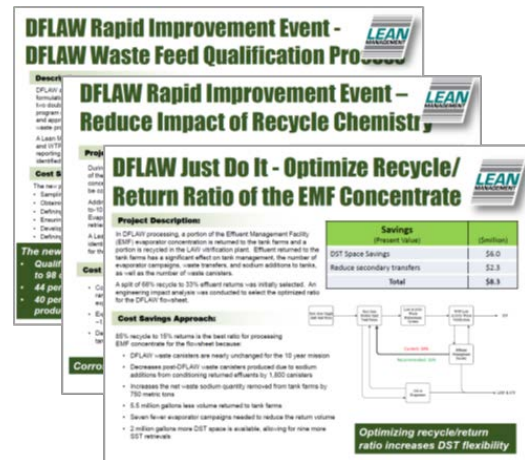
Target	Building Confidence
<b>DFLAW Integrated Schedule</b>	Now contains logic ties between all the contractors and our DOE customer.
<b>DFLAW Flowsheet</b>	A workable flowsheet with no significant technical issues.
<b>Qualified Waste Feed</b>	Evaluated each DFLAW waste feed batch to meet acceptance criteria.
<b>National Laboratory Collaboration</b>	Involving the National Laboratories throughout the DFLAW Program to build confidence in technical solutions.
<b>Metrics</b>	Measuring and monitoring performance of One System and the DFLAW Program.
<b>Risks and Opportunities Identification</b>	Analyzing key program risks and developing mitigation strategies. Identifying opportunities and evaluating strategies to exploit the opportunities.
<b>Program-Wide Reviews</b>	Routinely meet as a group, including DOE customer and involved contractors, for program-wide reviews that include field and program personnel.
<b>Program Element Evaluations</b>	Examine the program elements to identify disconnects, assumptions, inputs, and opportunities.
<b>Innovative Thinking</b>	Using Lean Management Rapid Improvement Events to define process efficiencies and cost/schedule savings opportunities.

### One System Delivers Results

The One System management enables evaluation of the DFLAW mission at a programmatic level, identifying opportunities involving all entities supporting DFLAW, and assessing the overall impacts. Through this integrated management approach, One System has identified over \$300M in cost efficiencies/avoidances and process enhancements in the DFLAW Program. Many of these efficiencies will be carried throughout the complete RPP Mission. The DFLAW Program is structured to provide flexibility to allow for enhancements and future expansions (e.g. addition of alternative treatment and disposal strategies for secondary wastes).

One System has identified opportunities for optimization within the DFLAW Program that have resulted in significant risk reductions, cost savings or cost avoidances, and improved bases for effective operations. Through Lean Management Rapid Improvement Events (RIE), subject-matter experts from around the DOE complex participated in workshops assessing specific aspects of the DFLAW flowsheet, identifying new, innovative approaches and improvements (Figure 3).

- Optimize Recycle/Return Ratio of the EMF Concentration - An engineering impact analysis was conducted to select the optimized ratio for the DFLAW flowsheet. The analysis showed that an 85% recycle to 15% returns is the best ratio for processing EMF concentrate for the flowsheet, reducing the returned volume to tank farms by 5.5 million gallons.
- Develop a Waste Feed Qualification Process for DFLAW - By integrating LAWPS and WTP feed acceptance and ILAW formulation and reporting requirements, qualification times will be reduced by 60%, touch points reduced by 44%, and documentation per campaign reduced by 40%.
- Reduce Impact of Recycle Chemistry - By identifying additional corrosion-control and chemistry acceptance criteria for the DST System, the 242-A Evaporator and WTP, a significant reduction in the conditioning volume can be expected for liquids returned to the DSTs.



**Fig. 3.** One System continues to successfully implement the Lean Management Rapid Improvement Events to quickly evaluate opportunities and impacts to DFLAW

In addition to the RIEs, One System has identified, and is in the process of incorporating, several key innovative approaches that will result in positive impacts to the DFLAW Program.

- Permitting Strategy - Innovative approaches to permitting DFLAW has reduced the number of permits required. This includes developing a general radioactive-air emission application to cover diffuse and fugitive emissions across the tank farms instead of individual air-emission applications for each tank farm upgrade activity. Also, WRPS and WTP will develop a bounding dimethyl mercury health-impacts assessment (HIA) that supports future toxic

air permitting needs for the DFLAW Program, eliminating the need for individual HIAs.

- Secondary Liquid Waste Alternative - Instead of upgrading the ETF to add a waste solidification process to produce a waste form suitable for disposal in the IDF, the powder or brine from the ETF will be shipped to an off-site facility for stabilization and then disposed of at the IDF.
- Consolidated Waste Management Facility - Future modifications or construction costs were avoided by revising the original consolidated solid waste handling strategy proposed to use existing or new facilities and instead relying on a new 90-day storage pad and Hanford facilities, as needed.
- Software Sharing – By sharing software licenses, documentation and data structure in the software between contractors, procurement and maintenance costs will be avoided.
- Alternative Selection of DFLAW Initial Feed - A process review identified a new approach to initial waste feed delivery that would improve DFLAW operational efficiency. By selecting AP-105 tank contents as the initial tank, and blending the AP-107 tank contents (the previous initial tank with higher waste loading), a 10% efficiency in throughput during DFLAW operations is expected.

### **Collaboration with National Laboratories**

One System actively draws from the experience, knowledge, and lessons learned throughout the DOE Complex and other Waste Sites, including collaboration with the National Laboratories. Areas of collaboration include:

- Leadership and resource sharing (leaders, subject matter experts)
- Program management and operations management experience (startup and commissioning)
- Project management and engineering tools, processes, and methods sharing (e.g. flowsheet management)
- Engineering, technologies, and innovation with multi-laboratory collaborations
- Continuous improvements through Integrated Safety Management System, NQA-1, and Lean Management processes.

The National Laboratories are an integral part of the One-System Team in delivering the DFLAW mission, and are a key technical and technology resource for multiple facets of the DFLAW program. The National Laboratories are involved by providing base operations technical support, LAWPS technology maturation, performance assessments, flowsheet optimization, and technology roadmap

development. The One-System manages a cohesive National Laboratories support program through the Chief Technology Office (CTO). The CTO has developed a collaborative program focusing on critical delivery-based National Laboratories support for each of the critical mission areas. In addition, the CTO has enhanced the multiple lab participation which now includes Pacific Northwest National Laboratory, Savannah River National Laboratory, Oak Ridge National Laboratory, Vitreous State Laboratory, Los Alamos National Laboratory, and Idaho National Laboratory.

In terms of base operations, the National Laboratories are providing critical support to the vapors management program including identification, testing, development, and deployment of monitoring technologies. The National Laboratories are providing the critical technology maturation activities in support of the LAWPS project, such as bead-to-wall pressure testing as a design input and support to the integrated scale testing. The National Laboratories are developing the critical waste form performance data packages utilized as input to the Integrated Disposal Facility performance assessment. These data packages provide the stability of the LAW glass waste form and the low-temperature secondary liquid and secondary solid waste forms for modeling purposes. The National Laboratories are embedded within the flowsheet organization to provide continuous support to flowsheet stewardship and optimization, as well as execute the maturation activities. Finally, the National Laboratories are an integral member of the technology roadmap development team identifying technology related items needed to support or enhance the mission.

## **CONCLUSION**

The One System management approach is critical to delivering the DFLAW Program. The success over the past year will continue to be improved upon through collaborations in the DOE complex, including the National Laboratories. The achievements and experiences with the One System approach are being considered for use at other DOE sites.

To deliver DFLAW as scheduled, One System has identified key activities necessary to be executed in fiscal year 2016. The project will be transitioning to start-up and commissioning. A strong push is needed in 2016 to get near-critical path activities complete and keep on the path to DFLAW operations in 2022.