Direct Feed Low Activity Waste (DFLAW) Program: Development, Progression and Risk Management
16476

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ABSTRACT

This Direct Feed Low-Activity Waste (DFLAW) Program paper describes the key programmatic elements to enable the startup of treatment and disposal of Hanford tank waste through a phased startup of the Hanford Tank Waste Treatment and Immobilization Plant (WTP). Specifically the DFLAW Program consists of the Low-Activity Waste (LAW) vitrification facility, and the direct feed to LAW of treated tank farm supernatant from the Low-Activity Waste Pretreatment System (LAWPS). This document identifies the overall strategy, objectives, and processes of the U.S. Department of Energy (DOE), Office of River Protection (ORP) and all supporting DOE subcontractors, and describes the scope of the program elements. In addition gaps, risks, and opportunities to successful integration for commissioning of all needed systems and facilities to produce immobilized LAW product (ILAW) are described. The scope of the DFLAW Program extends up to the point that LAW Facility hot commissioning is complete and all DFLAW systems are fully operational.

The DFLAW Program coordinates, integrates, and monitors all the activities necessary to successfully commission and start up the WTP LAW facility. This involves integrating the readiness of all the plant, personnel and program/procedures that support startup of hot commissioning of tank farms systems, WTP systems, waste treatment and disposal systems, and site utility, infrastructure and services. Multiple Hanford contractors have responsibilities to execute and perform scope under the umbrella of the DFLAW Program.

The primary focus of the One System organization, comprised of WTP Project and Tank Operations Contract (TOC) personnel, is to manage the coordination and integration across the interfaces of the work scope described above.

INTRODUCTION

The mission of the Hanford River Protection Project (RPP) is to retrieve and treat Hanford tank waste and close the Tank Farms to protect the Columbia River. The U.S Department of Energy (DOE), Office of River Protection (ORP) manages the River Protection Project. As two prime contractors to ORP, Washington River Protection Solutions, LLC (WRPS) and Bechtel National Inc. (BNI) have the responsibility to manage Tank Farm operations, and engineer, procure, construct and commission the Waste Treatment and Immobilization Plant (WTP) respectively.

When fully constructed, the WTP will employ a separation process whereby the waste streams from the Tank Farms are processed in the Pretreatment (PT) Facility to separate the Tank Farm waste stream into a low-activity waste stream and a high-level waste stream. The high-level waste stream is delivered to the High-Level Waste (HLW) Facility, combined with glass former material, and sent to a high temperature melter for formation of the immobilized high-level waste (IHLW) glass product. The low-activity waste stream is delivered to the Low-Activity Waste (LAW) Facility, combined with glass-former material, and sent to a high temperature melter for formation of the immobilized low-activity waste (ILAW) glass product. In addition to the PT, HLW, and LAW Facilities, the Analytical Laboratory (Lab) provides analytical services and the Balance of Facilities (BOF) supplies utility services.

In order to begin waste treatment during completion of design and construction of the HLW and PT Facilities, the LAW Facility will be completed and placed into operation first, supported by portions of the Lab and those BOF systems needed for operation in the Direct Feed LAW (DFLAW) configuration. This phased approach provides the best opportunity for beginning tank waste treatment as soon as practicable, while the remaining technical issues associated with the WTP are resolved. In the DFLAW configuration, low-activity waste feed will be provided to the LAW Facility directly from the Tank Operations Contractor (TOC) via a new process system called the LAW Pretreatment System (LAWPS). LAWPS will be designed, constructed, and operated by the TOC and will perform many of the treatment functions for DFLAW in lieu of the PT Facility. Liquid effluents from the LAW Facility and Lab, which are transferred to the PT Facility in the original operating configuration, will be managed in the Direct Feed LAW scenario by the addition of a WTP capability for management of liquid effluents called the Effluent Management Facility (EMF).

In addition, other Hanford facilities and projects are required to support DFLAW, including Tank Farm Double-Shell Tank (DST) upgrades, Integrated Disposal Facility (IDF) upgrades, ILAW Transporters, Liquid Effluent Retention Facility (LERF) and Effluent Treatment Facility (ETF) modifications and utility infrastructure upgrades.

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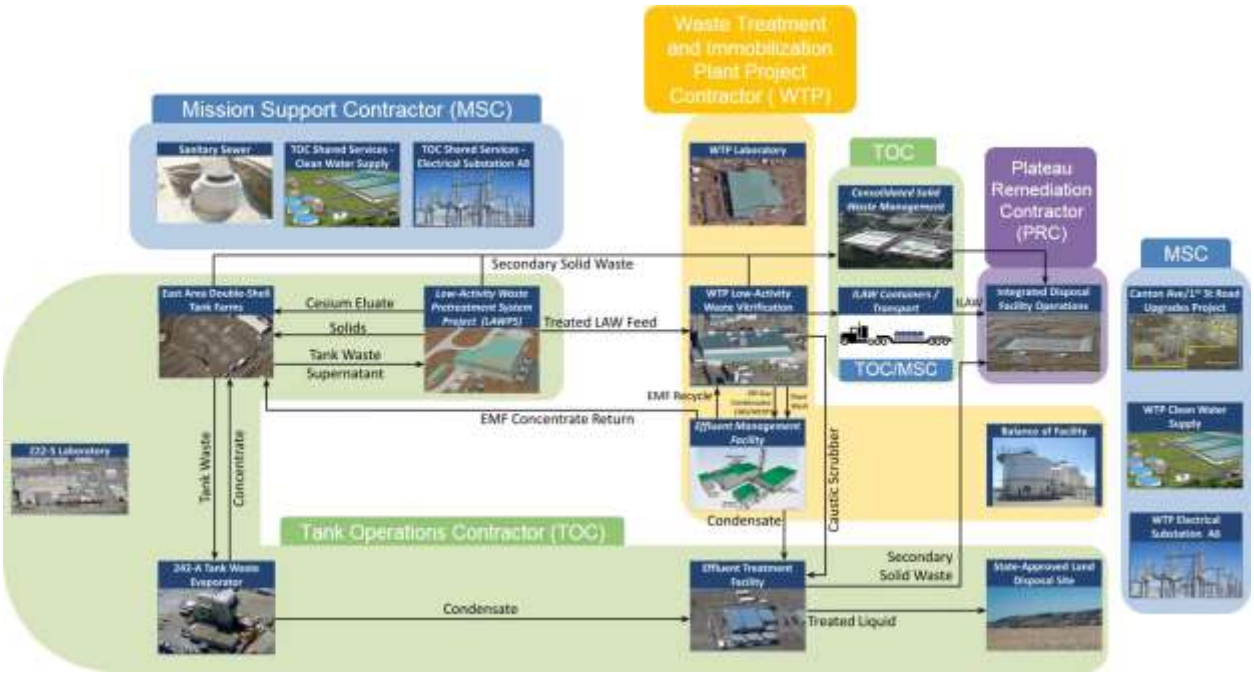


Figure 1 – Facility Scope Diagram for the DFLAW Program

INTERFACES

One of the key objectives of DFLAW Program management is the coordination and integration across the interfaces between the contractors responsible for execution of DFLAW supporting scope and activities. Coordination of the interfaces between contractors is assisted by formal and specific intercompany documentation such as Interface Control Documents (ICDs), Memorandums of Understanding (MOUs), and Administrative Interface Agreements (AIAs).

BNI is responsible for the WTP interface management program through the preparation and maintenance of the WTP Interface Management Plan (IMP). This plan provides governance of the program that will be executed by a series of ICDs, and the definition, development, management, issue resolution, approval, and documentation of external interfaces between the WTP Contractor and the WTP

interface partners. These interfaces are for services, equipment, energy, data, or materials transferred between the WTP Contractor and other WTP interface partners that are not controlled through other means (e.g., Memorandum of Agreement controlling Fire & Emergency Response Services, and Badging). The IMP performs the following functions:

- Defines the scope of the WTP interface management program
- Describes the processes through which the WTP interface management program will be implemented
- Identifies the WTP interface partners
- Defines the roles and responsibilities of all WTP interface partners
- Describes the means to identify and resolve ICD issues
- Describes the means to identify and track resolution of open items.

A diagrammatic representation of the ICDs executed by this program is given in Figure 2.

Figure 2 – WTP Interface Control Documents

DFLAW PROGRAM ELEMENTS

Major Elements central to DFLAW Program

The major elements central to the DFLAW Program are:

- DST Upgrades/DFLAW Transfer Lines
- Tank farm Support Facilities (242-A Evaporator and 222-S Analytical Laboratory)
- LAWPS
- WTP LAW/BOF/Lab, including EMF
- ILAW Transporter/IDF
- LERF/ETF
- Site Utilities and Infrastructure

These are described in more detail below.

DST Upgrades/DFLAW Transfer Lines

Upgrades are required in the DST Tank Farms in order to provide the capabilities to handle waste feed preparation, qualification and delivery to the LAWPS facility, along with the capabilities to handle the return of segregated streams and liquid effluents. New Transfer Lines between DST Tank Farms, LAWPS and WTP are also required to provide the ability to feed and receive the DFLAW wastes. The upgrades to the DSTs include activities similar or identical to previous tank farm upgrade projects such as:

- Removal of old/redundant equipment
- Transfer pump, jumper, valve pit, pump pit, riser, ventilation, electrical and lighting upgrades
- Capability for sampling supernatant

Five new pipe-in-pipe, bermed or buried transfer lines are required to support DFLAW as follows:

- Supernatant from tank farms to LAWPS
- Filtered solids concentrate return from LAWPS to tank farms
- Cesium product return from LAWPS to tank farms
- Treated supernatant feed from LAWPS to WTP LAW
- Secondary liquid effluent return from WTP to tank farms

Features of these new transfer lines include secondary containment, leak detection, shielding, flushing, freeze protection and drainage capabilities.

Figure 3 – DST Upgrades and new Transfer Lines

Tank Farm Support Facilities (242-A Evaporator and 222-S Analytical Laboratory)

The 242-A Evaporator will be operated to create sufficient DST space to support DFLAW, SST retrievals and tank farm operations. Concentrated waste from the 242-A evaporator is returned to the DSTs; condensate from the evaporator overhead will be transferred and collected in the LERF and then treated in ETF.

222-S Analytical Laboratory is a full service laboratory capable of handling highly radioactive samples for the purposes of organic, inorganic and radiochemistry analysis. For DFLAW, 222-S Laboratory performs the supernatant waste sample analysis to demonstrate waste compliance to the relevant waste acceptance criteria and data quality objectives. In addition the 222-S Laboratory will perform waste qualification analysis.

Figure 4 – 242-A Evaporator and 222-S Laboratory

LAWPS

LAWPS is a new capital line item project, approved for Critical Decision 1 (CD-1) in May 2015 and managed by TOC, which provides pretreatment capabilities for tank farm supernatant wastes. Pretreatment of the tank waste in LAWPS will take place in below-grade vaults, where insoluble radioactive solids will be removed using filters and soluble cesium will be removed using an ion-exchange system. The high-level solid waste and cesium will be returned to the tank farms, while treated waste will be held in lag storage tanks until it is sampled and confirmed to meet the

waste acceptance criteria for the LAW Vitrification Facility. The LAWPS design includes three 124,000-gallon storage tanks for the treated LAW tank waste; each tank will hold enough waste to feed the LAW Vitrification facility for a week of operations.

Figure 5 – Low-Activity Waste Pretreatment System Concept

WTP LAW/BOF/Lab

In the WTP LAW Facility, low activity supernatant waste will be mixed with silica and other glass-forming materials. The mixture will be fed into the LAW Facility's two melters and heated to 2,100 degrees Fahrenheit. The melters are approximately 20 feet by 30 feet and 16 feet high—the world's largest radioactive waste melters. Complete with installed refractory layer and glass mixture, in operation the melters will each weigh about 500 tons. In the DFLAW configuration, the concentrate receipt vessel receives waste feed from the Low-Activity Waste Pretreatment System; a melter feed preparation vessel mixes the waste feed with glass formers; and another melter feed vessel supplies the mixed waste feed to the melters. The three off gas treatment vessels are;

1. a submerged bed scrubber to cool melter off gas and remove large particulates,
2. a wet electrostatic precipitator to remove finer particulate, and

3. a submerged bed scrubber condensate vessel to store and recirculate liquid between a scrubber and the vessel.

The molten glass mixture will be poured from the melters into stainless steel containers, which are 4 feet in diameter, 7 feet tall and when full will each weigh nearly 7 tons. The filled containers will be disposed in a regulatory-permitted facility on the Hanford Site, the Integrated Disposal Facility (IDF).

Figure 6 – WTP Low-Activity Waste (LAW) Facility and Melter

WTP's BOF is made up of 20 facilities and systems plus interconnecting piping, electrical, and other utilities whose purpose is to provide essential support functions to WTP's four nuclear facilities. The support utilities include systems for electrical power distribution; backup power; compressed air; steam; chilled, process, potable, and fire water; and communication and control. To support Direct Feed LAW, certain of WTP's BOF systems will undergo adjustments to temporarily bypass the PT and HLW facilities and scale them down to levels appropriate to the program's lower operational demands, compared to capacities that will be needed during full plant operations. For example, the steam plant will utilize fewer boilers to support DFLAW, resulting in energy and cost efficiencies.

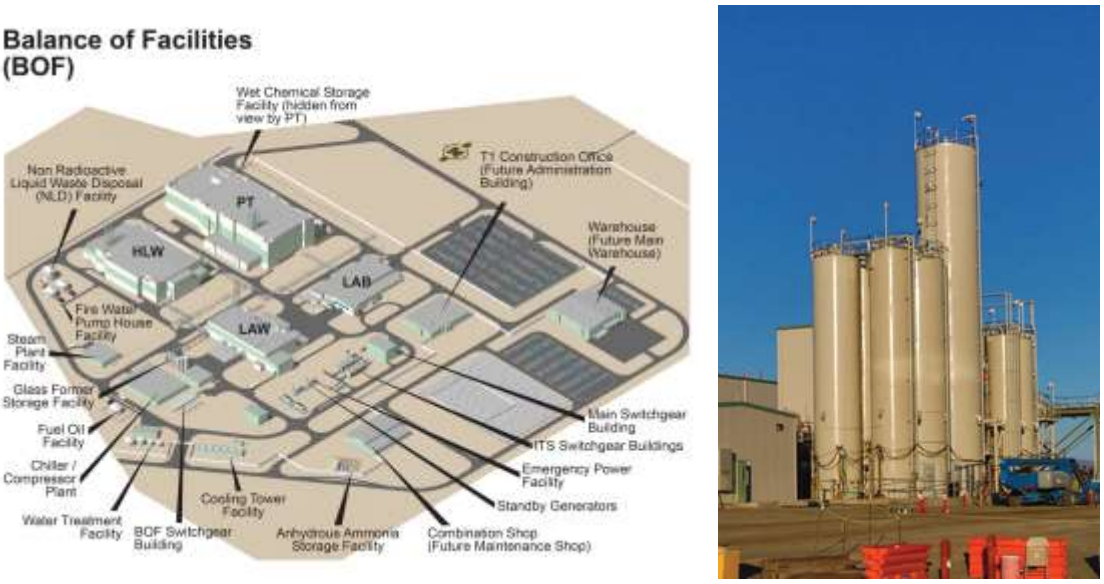


Figure 7 – WTP Balance of Facilities (BOF) and Glass Former Silos

WTP's Lab facility's key function is to ensure that glass produced by the WTP's vitrification facilities meets all regulatory requirements and standards. At peak plant capacity, the Lab will analyze approximately 10,000 waste samples annually. During the DFLAW program however, the Lab will be solely focused on low-activity waste sampling and analysis. Samples will be used initially to confirm the correct glass-former "recipe" that will produce a consistent glass form. Samples also will be taken throughout vitrification production to ensure a glass product that meets regulatory requirements and quality controls. The Lab contains 14 radiological laboratories that will support operation of the LAW Facility and other DFLAW requirements. Once the LAW Facility is operational, the Lab will be operated 24 hours per day and staffed with chemists, technicians, radiological controls monitoring personnel, and other support staff.

Figure 8 – WTP Laboratory (Lab) and Radiological Laboratories

During DFLAW operations, liquid effluents accumulated in the LAW radioactive liquid waste disposal system vessels and the LAW secondary off gas/vessel vent process system tank will be diverted to the LAW Effluent Management Facility (LAW EMF). The LAW EMF will collect and treat liquid effluents from the LAW Facility and Analytical Laboratory and concentrate the waste through evaporation. The concentrate will then be recycled back to the LAW Facility or returned to DSTs, and the condensate will be sent to the Hanford Site's Liquid Effluent Retention Facility/Effluent Treatment Facility (LERF/ETF) for further processing.

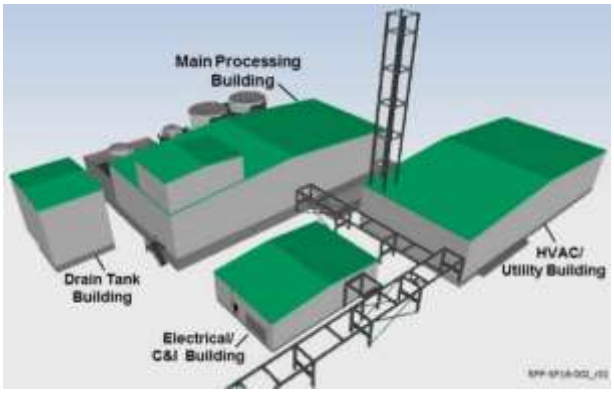


Figure 9 – Effluent Management Facility Concept

ILAW Transporter/IDF

A new dedicated transport system is required to transfer the WTP LAW glass container product from the LAW Facility export bay to the IDF. The ILAW Transporter scope includes design, specification and procurement of tractor/trailer and glass container handling unit(s) for ILAW container transport. Considerations for design include thermal, radiological and Department of Transport (DOT)/Hanford Transportation Safety Document requirements. Multiple systems may be required for lag staging prior to IDF disposal in order for the glass containers to cool sufficiently to meet the IDF waste acceptance criteria.

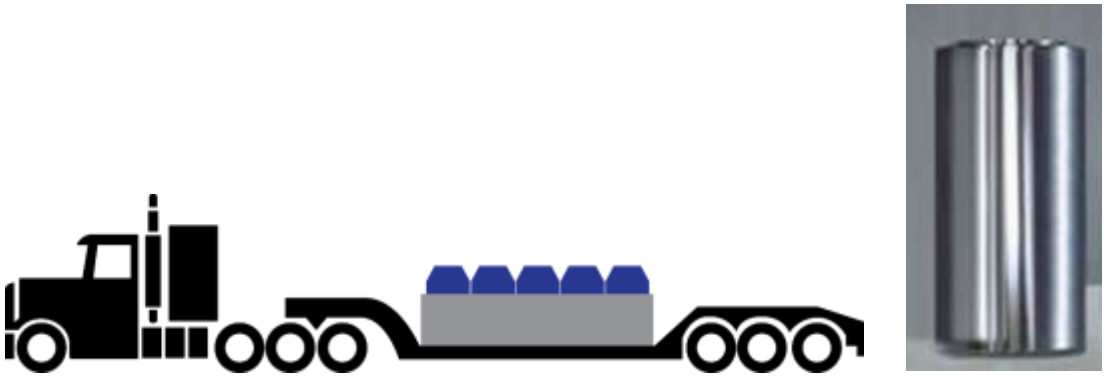


Figure 10 – ILAW Transporter Concept and LAW product container

The Integrated Disposal Facility (IDF) is a permitted mixed waste disposal facility that will be used to dispose of ILAW glass product and other secondary solid wastes. The facility has been constructed, but it is necessary to perform activities to prepare for operations. These include the preparation of the IDF Performance Assessment (PA), the ILAW Waste Incidental to Reprocessing (WIR) Evaluation, necessary revisions to regulatory permits and safety basis and the demonstration of readiness of plant, personnel and procedures necessary to safely and compliantly operate as a waste disposal facility.

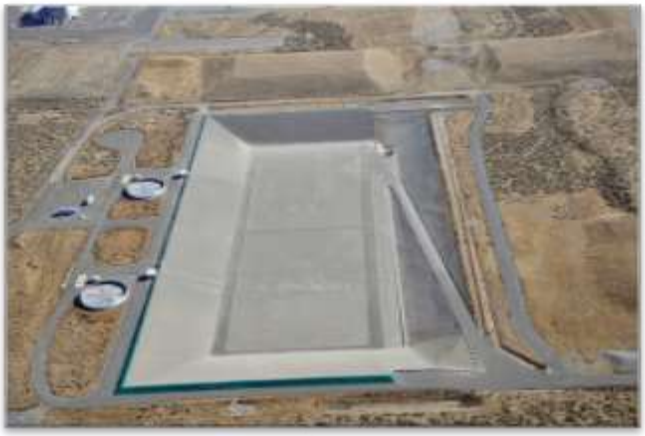


Figure 11 – Integrated Disposal Facility (IDF)

LERF/ETF

The Liquid Effluent Retention Facility (LERF) comprises three storage basins for collecting waste water from a number of Hanford sources, including 242-A Evaporator overheads and leachate from solid waste disposal facilities. For DFLAW, the overheads from the EMF evaporator will also be discharged to the LERF basins. The Effluent Treatment Facility (ETF) receives waste water from the LERF and treats it to remove radioactive and hazardous contaminants. Once the waste water has been treated, it is stored until tests confirm the liquid is acceptable for discharge at the State Approved Land Disposal Site. The ETF can treat up to 28 million gallons of waste water each year.

Figure 12 – Liquid Effluent Retention Facility (LERF) and Effluent Treatment Facility (ETF)

Site Utilities and Infrastructure

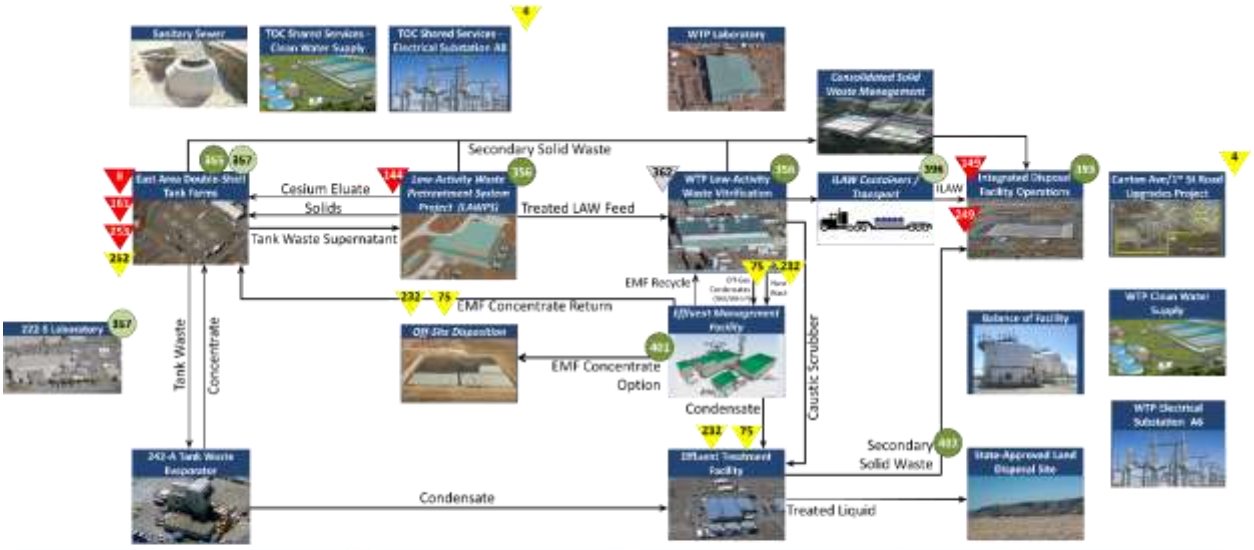
Site Utility and Infrastructure upgrades are required to support DFLAW and comprise electrical, water, sewage system and road upgrade projects, including:

- Electrical upgrade projects include increased electrical capacity for 200 East tank farms (ongoing) and LAWPS electrical connection
- Water upgrades include ring main upgrades and LAWPS connection
- Sewage system upgrade includes LAWPS connection
- Road upgrade project includes 1st Street/Canton Ave upgrade connecting WTP with IDF

DFLAW RISK AND OPPORTUNITY MANAGEMENT

Risk management is an integral part of the program and project management function, which is to allocate resources to achieve program goals within an acceptable level of risk. The primary objectives of risk management are to identify risks that could impact successful completion of the DFLAW Program and deploy mitigation strategies to minimize the impacts of the identified risks, and create opportunities to proactively manage or leverage technologies to achieve efficiency and effectiveness within an acceptable risk envelope. The mitigation strategies include assigning appropriate resources for managing the identified risks. A Risk and Opportunity Management Plan (ROMP) has been prepared for the DFLAW Program, which describes the structured approach to the identification and management of program risks and opportunities. The DFLAW Program ROMP is complementary to the individual Capital Project risk and opportunity management processes, and focusses on the interface and programmatic elements associated with the DFLAW Program. A DFLAW Program Risk and Opportunity Register provides the tool for monitoring the scope and status of the identified risks and opportunities, and is monitored, maintained and updated on a regular basis.

The key DFLAW Program Risks and Opportunities are shown diagrammatically in Figure 13.



RISKS

Owner	Risk #	Title	Initial Impact Level
WRPS	8	Inadequate DST space	High
WRPS	161	DST upgrades construction delays	High
WRPS	252	DST operating permits not ready when needed	Medium
WRPS	144	LAWPS is not ready to start when DFLAW is ready to start operations	High
PRC	149	IDF permits needed to operate delayed	High
WRPS	249	WIR evaluation approval delayed	High
BNI	75	Secondary liquid waste volumes higher than expected	Medium
WRPS	251	DST upgrade issue identified at commissioning	High
MSA	4	Site infrastructure less than adequate	Medium
BNI	362	WTP not ready to received feed when needed	Pending
WRPS	232	Secondary liquid waste management less than adequate	Medium

OPPORTUNITIES

Owner	Opp #	Title	Benefit Level
PRC	393	IDF canister heat generation limit raised at IDF	Medium
WRPS	401	Alternative treat/dispose path for EMF evaporator bottoms created	Medium
WRPS	402	Alternative treat/dispose path for LERF/ETF waste created	Medium
WRPS	356	Increase molarity of feed to WTP LAW up to 8M Na	Medium
WRPS	396	Change the specification of the transporters	Low
WRPS	355	Reduce complexity of DST operations	Medium
WRPS	357	Waste feed sampling and analysis optimization for qualification and WAC	Low

Figure 13 – DFLAW Program Risks and Opportunities

CONCLUSIONS

The DFLAW Program coordinates, integrates, and monitors all the activities necessary to successfully commission and start up DFLAW. This involves integrating the readiness of all the plant, personnel and program/procedures that support startup of hot commissioning of tank farms systems, WTP systems, waste treatment and disposal systems, and site utility, infrastructure and services. Multiple Hanford contractors have responsibilities to execute and perform scope under the umbrella of the DFLAW Program and the key interfaces require coordination and integration.

DFLAW Program Risk and Opportunity Management program objectives are to identify risks and opportunities that could impact successful completion of the DFLAW Program and deploy mitigation strategies to minimize the impacts of the identified risks, and create opportunities to proactively manage or leverage technologies to achieve efficiency and effectiveness within an acceptable risk envelope.

Successful management of the DFLAW Program by the startup of multiple new and existing facilities, systems and infrastructure will result in the earliest possible startup of tank waste treatment and the production of ILAW glass for safe long-term storage and disposal.