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Revision 5

Integrated Waste Feed Delivery Plan: Volume 3 – Project Plan

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TERMS

Abbreviations and Acronyms

BBI	best-basis inventory
CD	critical decision
CH-TRU	contact handled transuranic waste
DFLAW	direct-feed low-activity waste
DOE	U.S. Department of Energy
DST	double-shell tank
EMF	Effluent Management Facility
EROM	Enterprise Risk and Opportunity Management
ETF	Effluent Treatment Facility
FY	fiscal year
HLW	high-level waste
HIHTL	hose-in-hose transfer line
ICD	interface control document
IWFDP	Integrated Waste Feed Delivery Plan
LAW	low-activity waste
LAWPS	low-activity waste pretreatment system
LERF	Liquid Effluent Retention Facility
OR	operations research
ORP	Office of River Protection
RPP	River Protection Project
SST	single-shell tank
TOC	Tank Operations Contract
TWCS	tank waste characterization and staging
TWINS	Tank Waste Information Network System
WFD	waste feed delivery
WRF	waste retrieval facility
WRPS	Washington River Protection Solutions, LLC
WTP	Hanford Tank Waste Treatment and Immobilization Plant
WTP-HLW	Hanford Tank Waste Treatment and Immobilization Plant, High-Level Waste Vitrification Facility
WTP-LAW	Hanford Tank Waste Treatment and Immobilization Plant, Low-Activity Waste Vitrification Facility
WTP-PT	Hanford Waste Treatment and Immobilization Plant, Pretreatment Facility
WTS	waste transfer system

Units

gal	gallon
in.	inch
kgal	thousand gallons
wt%	weight percent

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE), Office of River Protection (ORP) manages the River Protection Project (RPP) at the Hanford Site. The RPP mission is to safeguard the nuclear waste stored in 177 underground tanks and to manage the waste safely and responsibly until the waste can be prepared for delivery to and treatment at the Hanford Tank Waste Treatment and Immobilization Plant (WTP), where the waste feed will be separated into low-activity waste (LAW) and high-level waste (HLW) fractions for immobilization prior to final disposal.

This Integrated Waste Feed Delivery Plan (IWFDP) describes the commissioning, infrastructure upgrades, and near-term and long-term waste transfer/pre-process operations necessary to provide Hanford tank waste feed to the WTP. The IWFDP is based on a phased-approach for performing the RPP mission. The IWFDP focuses on the startup, commissioning, and initial operating phase of the WTP LAW Vitrification Facility (WTP-LAW) as projected by a Tank Operations Contract (TOC) life-cycle planning tool. The IWFDP also includes information on treatment of tank waste, including HLW at the WTP Pretreatment Facility (WTP-PT) and via a direct-feed mode described in RPP-RPT-59581, *Selected Scenarios for the River Protection Project System Plan Revision 8*.

WTP-LAW vitrification will be performed in the direct-feed mode prior to commencement of HLW vitrification. The direct-feed low-activity waste (DFLAW) approach involves the delivery of tank farms supernatant liquid to tank side cesium removal (TSCR) system, where solids and cesium are removed via filtration and ion-exchange, respectively, and then returned to the tank farms. Tank Farms delivers the pretreated feed to WTP-LAW for conversion to borosilicate glass, followed by on-site disposal at the Integrated Disposal Facility. Secondary liquid waste streams are generated during the vitrification process and either recycled in the facility or routed to the Liquid Effluent Retention Facility (LERF) for subsequent treatment in the Effluent Treatment Facility (ETF). The total projected volumetric flow requires the waste feed delivery (WFD) planning process to coordinate across the entire double-shell tank (DST) system and with 200 East and 200 West Area single-shell tank (SST) retrievals during the DFLAW period, which is scheduled to commence hot operations in January 2022.

The IWFDP will be implemented through programs that coordinate and integrate across multiple Hanford Site prime contractor work scopes. The Mission Integration and Waste Feed Delivery organization, which leads and performs planning, analysis, and integration activities, developed and will update the IWFDP, as required, and has responsibility for maintaining the IWFDP.

1.1 PURPOSE, SCOPE, AND OBJECTIVES

The purpose of the IWFDP is to describe how the Tank Operations Contractor will retrieve, prepare, and deliver qualified Hanford tank waste to the WTP to support DOE guidance and to meet contractual requirements identified in the TOC (DE- DE-AC27-08RV14800, *Tank Operations Contract*) to integrate with life-cycle mission process modeling.

With regard to the IWFDP as a whole (per DE-AC27-08RV14800):

> *The Contractor shall prepare, submit for DOE-ORP approval, and implement an Integrated Waste Feed Delivery Plan (IWFDP) (Deliverable C.2.3.1-2) to provide*

> *optimum and reliable pretreatment (if needed), blending/mixing, retrieval and delivery of feed to DOE-ORP treatment facilities. This Plan shall include the needs of commissioning, near-term, and long-term operations and projected waste transfer/pretreatment operations. It should provide adequate information so that infrastructure requirements and upgrades can be identified.*

Specific to IWFDP, Volume 3 – Project Plan (this volume):

> ***IWFDP – Project Plan***. *This product will describe the infrastructure and facility changes required to support implementation of the Campaign Plan and summarize the rationale for those changes. It should provide information relative to long lead procurements and provide planning time for substantial infrastructure changes. Revisions to this document should be made within 180 days of each revision of the Campaign Plan that affects established infrastructure and facility changes.*

The work identified in this IWFDP encompasses the full extent of the WFD scope, from preparations for commissioning, initiation of feed to TSCR and the future tank waste characterization and staging (TWCS) capability, and preparation of feed and feed delivery systems as outlined in Volumes 1 and 2 of this plan (RPP-40419-VOL1, *Integrated Waste Feed Delivery Plan, Volume 1 – Process Approach,* and RPP-40149-VOL2, *Integrated Waste Feed Delivery Plan, Volume 2 – Campaign Plan*).

Volume 1 of the IWFDP contains the process approach, which documents how to prepare and deliver appropriate feed to each treatment facility. Volume 2 of the IWFDP provides the campaign plans, which identify paths that waste will take and the order of waste sources that will be fed to WTP.

Volume 3 of the IWFDP (this volume) provides the basis for upgrading the equipment and infrastructure for the DSTs, organized by support function to DFLAW operations and the balance of the RPP mission. The scope defined in the IWFDP includes both near-term and long-term activities. The scope may be divided into individual projects to optimize the execution strategy. The individual tank farms projects will remain responsible for scheduling and execution of the work scope and compliance with the established requirements. This revision implements a graded approach with significant detail concerning project work required within the next five years. Pre-conceptual information is included on the planned Tank Waste Characterization and Staging (TWCS) capability for HLW treatment along with the Supplemental Treatment for LAW. No discussion is included to address Contact Handled Transuranic waste (CH-TRU) treatment.

2.0 SYSTEM CONDITIONS AND REQUIREMENTS

The DST system operates in a manner to ensure (1) safe and compliant storage of existing DST wastes, (2) safe and compliant receipt and storage of wastes from sources outside the DST system (e.g., 222-S Laboratory, SST retrievals), and (3) safe and compliant waste feed to and receipt of waste from the 242-A Evaporator. The DST system currently satisfies a requirements baseline that includes the approved tank farms safety basis (RPP-13033, *Tank Farms Document Safety Analyses*) to ensure safe DST system operations. The DST system hardware and operations reside in both the 200 West and 200 East Areas on the Central Plateau of the Hanford Site.

A brief description of each DST farm supporting WFD operations and summaries of the DST farm condition on a tank-by-tank basis are provided in:

- RPP-15131, *System Design Description for AW Tank Farm Double-Shell Tank Waste Storage (DSA Based)*
- RPP-15132, *System Design Description for AN Tank Farm Double-Shell Tank Waste Storage (DSA Based)*
- RPP-15133, *System Design Description for AP Tank Farm Double-Shell Tank Waste Storage System*
- RPP-15134, *System Design Description for SY Tank Farm Double-Shell Tank Waste Storage System*
- RPP-15135, *System Design Description for AY/AZ Tank Farm Double-Shell Tank Waste Storage System (DSA Based)*.

To complete the RPP mission as described, new facilities and capabilities are required to prepare and deliver feed to the final treatment and disposal facilities. How these new facilities fit into the RPP flowsheet is described in RPP-RPT-57991, *One System River Protection Project Integrated Flowsheet*. Key facilities supporting the full IWFDP include:

- **Tank Side Cesium Removal (TSCR) –** Supports the early treatment of LAW waste and reduction of total tank farm waste sodium inventory providing a pathway to remove solids and Cs^+ from supernatant waste allowing the Treated LAW to undergo final treatment and disposal.
- **Tank Waste Characterization and Staging (TWCS) capability –** Supports HLW slurry mixing, sampling, conditioning, blending, and staging of waste before being fed to WTP-PT and/or directly to the WTP HLW Vitrification Facility (WTP-HLW)
- **Supplemental LAW (SLAW) –** Provides LAW treatment capacity above and beyond WTP-LAW allowing WTP operations and the RPP mission to not be rate limited by LAW processing.
- **Waste Retrieval Facility (WRF) –** Supports retrieval of geographically isolated SSTs (B and T Farm complexes).
- **Supplemental Transuranic Treatment Facility –** Provides pathway for the treatment of contact handled, transuranic (CH-TRU) waste.

2.1 DOUBLE-SHELL TANK SYSTEM CONDITION FOR WASTE FEED DELIVERY

The DST system maintains the safe storage of waste contained in the tanks with margin to mitigate a future tank leak (HNF-3484, *Double-Shell Tank Emergency Pumping Guide*). Some tanks have limited, controlled use in the DST system due to tank integrity (AY-102), safety issues (Waste Group A tanks), or contain feed for treatment facilities (AP-105 and AP-107) (HNF-SD-WM-OCD-015, *Tank Farms Waste Transfer Compatibility Program*). Additional guidance for controlled use of AP-106 will be needed following repurposing.

Tank waste can be transferred between tanks in the same farm relatively easily, and between farms with valve lineups. The 242-A Evaporator is currently the only engineered pathway for reduction of waste tank volume through the evaporation of water and concentration of tank waste. The WFD Program will establish a pathway to deliver tank waste for final treatment at WTP-LAW and the WTP-HLW.

2.2 SYSTEM REQUIREMENTS

The basic requirement of the IWFDP is to describe the pathway for tank waste to be transferred to and processed at a treatment facility for final disposition. The waste requires separation into LAW and HLW fractions to allow for separate treatment and disposal. This separation was to occur within WTP-PT, but technical issues have delayed its completion. As such, ORP has committed to immobilizing tank waste as soon as practical at WTP-LAW through DFLAW operations. During DFLAW, the separation of LAW and HLW will occur at TSCR or Tank Farm Pre-Treatment (TFTP). Tank farms infrastructure requires upgrades including new transfer lines, jumpers, and transfer pumps to support waste transfers to facilities outside of tank farms and handling of off-normal operations return streams.

2.2.1 Tank Farms Technical Baseline

The tank farms technical baseline is maintained using the engineering processes described in TFC-PLN-03, “Engineering Program Management Plan.” The integrated requirements baseline portion of the technical baseline, and its relationship to the system requirements applicable to this project plan, are discussed in this volume.

The technical requirements baseline is developed via analyses of requirements levied on the contractor responsible for operating the tank farms through the TOC. Technical requirements analyses translate the contractual requirements in the TOC into system-level and equipment design requirements. For example, the design requirements relate to system or equipment interface constraints; performance and design features related to safety (nuclear and industrial); environmental protection; operability, reliability, and maintainability; material compatibility; constructability; and standardization and human factors. This translation results in the requirements baseline currently documented in the following DST system and subsystem specifications:

- HNF-SD-WM-TRD-007, *System Specification for the Double-Shell Tank System*
- HNF-4155, *Double-Shell Tank Monitor and Control Subsystem Specification*
- HNF-4157, *Double-Shell Tank Utilities Subsystem Specification*
- HNF-4159, *Double-Shell Tank Maintenance and Recovery Subsystem Specification*
- HNF-4160, *Double-Shell Tank Transfer Valving Subsystem Specification*
- HNF-4161, *Double-Shell Tank Transfer Piping Subsystem Specification*
- HNF-4162, *Double-Shell Tank Transfer Pump Subsystem Specification*
- HNF-4163, *Double-Shell Tank Diluent and Flush Subsystem Specification*
- HNF-4164, *Double-Shell Tank Mixer Pump Subsystem Specification*
- RPP-SPEC-45605, *Double-Shell Tank Ventilation Subsystem Specification*
- RPP-SPEC-47615, *Double-Shell Tank Process Waste Sampling Subsystem Specification*.

This requirements baseline (i.e., the specifications cited in this section) will continue to be evaluated and updated to ensure that it is consistent with the current and future revisions to RPP-RPT-57991 used in IWFDP Volumes 1 and 2, and any modifications to the requirements in the TOC.

2.2.2 Development of Waste Feed Delivery System Requirements

Formal requirements for the WFD delivery system are documented in multiple specifications and system description documents. Specific requirements for DFLAW and TSCR are included in the following documents:

- RPP-SPEC-62029, *Waste Feed Delivery: Waste Feed Delivery Upgrades (Project T1P190) Specification*
- RPP-SPEC-61910, *Specification for the Tank-Side Cesium Removal Demonstration Project (Project TD101).*

Key interface requirements are defined between the Tank Operations Contractor, ORP, and Bechtel National, Inc., as the prime contractor for engineering, procurement, construction, and commissioning of the WTP. Specifically applicable to the IWFDP are:

- 24590-WTP-ICD-MG-01-019, *ICD 19– Interface Control Document for Waste Feed*
- 24590-WTP-ICD-MG-01-030, *ICD 30 – Interface Control Document for Direct LAW Feed*
- 24590-WTP-ICD-MG-01-031, *ICD 31– Interface Control Document for DFLAW Effluent Returns to Double-Shell Tanks.*

2.3 TANK FARMS LIFE EXPECTANCY

The DST farms were designed and constructed between 1968 and 1986, with a 40-year design life. The System Plan enabling assumption is that life extension work currently planned will allow the DST system to continue to provide safe storage for the remainder of the treatment mission (ORP-11242, *River Protection Project System Plan*). The first DST constructed, AY-102, developed a leak of the primary tank and has been subsequently emptied and removed from active service.

3.0 LOW-ACTIVITY WASTE FEED DELIVERY SYSTEM

During fully integrated operations of the WTP, the WTP-PT separates tank waste into HLW and LAW fractions. While HLW contains the majority of the radioactivity, the LAW consists of the bulk of the volume to be treated by WTP. Technical challenges have delayed the completion of the WTP-PT. In response, ORP has directed the treatment of LAW through a phased approach. The following sections present the infrastructure upgrades necessary to support treatment of LAW during the discrete phases of the RPP mission. The first phase includes “Near-Term Operations” prior to DFLAW and the 5-year period encompassing operations where supernatant from tank farms is treated at TSCR and WTP-LAW, and is discussed in detail in the *One System River Protection Project Integrated Flowsheet* (RPP-RPT-57991). The second phase, will cover post-TSCR DFLAW operations. The third phase, “Balance of Mission,” covers the time from start-up of full WTP Facilities operations to the end of the RPP Mission. During the Balance of Mission Phase, low activity waste is treated through three pathways: treatment at WTP-LAW via WTP-PT; treatment at Supplement Treatment via WTP-PT; or treatment at Supplemental Treatment via TSCR.

3.1 DIRECT-FEED LOW ACTIVITY WASTE FEED DELIVERY

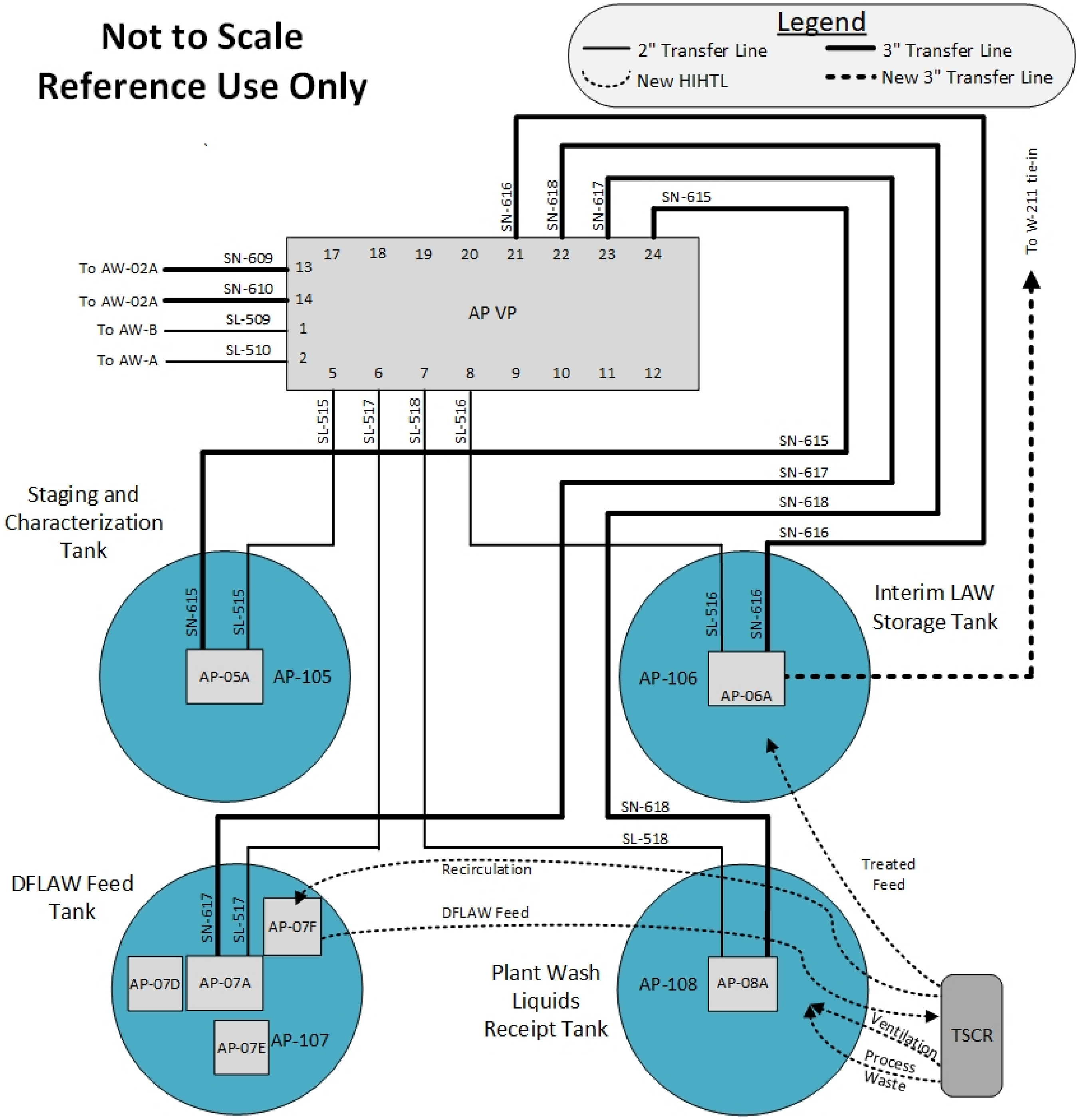
The existing tank farms infrastructure requires upgrades to meet the performance, operational, and functional requirements of the DFLAW Program. The following sections present the specific upgrades required on a function-by-function basis. The upgrades described are those necessary to execute the DFLAW Program. As the design of the facilities associated with DFLAW progresses, performance requirements may result in future refinements that will be addressed in subsequent revisions of this plan.

Previously issued reports and documents address numerous decisions that provide the enabling assumptions or bases for establishment of the DFLAW Program plan. These documents establish the bases for progressing with planning, design, and construction activities for the projects supporting WFD. RPP-46811, *Direct Feed of the Low Activity Waste Program – Functions and Requirements*, defines the overall functional requirements of the DFLAW system. RPP-SPEC-60547 establishes the high-level functions and requirements to execute the tank farms upgrades necessary to initiate DFLAW operations.

Waste fed to TSCR must meet the feed characteristics and waste acceptance criteria. The waste acceptance criteria for TSCR encompass the waste acceptance criteria for WTP-LAW, with the exception of solids content and cesium concentration, which will be adjusted at TSCR.

Volume 1 of the IWFDP describes an updated approach to delivery of waste to WTP and the receipt of process returns, including filtered solids and during off-normal conditions dilute feed from the Effluent Management Facility (EMF). Figure 3-1 presents the subset of the DST system supporting DFLAW operations which are described in the following sections.

Figure 3-1. Double Shell Tank System Supporting Direct-Feed Low Activity Waste Operations



3.1.1 Tank Side Cesium Removal System

As currently conceived, four DSTs in AP Tank Farm are dedicated to TSCR and the DFLAW system that prepares, stages, characterizes, and pretreats tank waste supernates to ensure compliance with 24590-WTP-ICD-MG-01-030, *ICD-30 – Interface Control Document for Direct Feed Low-Activity Waste*, (ICD-30). The system then provides interim storage of the pretreated waste and will deliver it to the WTP LAW. The system will utilize the DSTs for the following purposes:

- Staging and characterization tank (tank 241-AP-105)
- DFLAW feed tank (tank 241-AP-107)
- Interim pretreated LAW storage tank (tank 241-AP-106)
- Plant wash liquids receipt tank (tank 241-AP-108)

The TSCR system provides for the early production of immobilized low-activity waste (ILAW). Tank supernatant waste will be pretreated within the TSCR system to remove cesium before being fed directly to WTP LAW. AP-107 will be used to send qualified feed to the TSCR Process Enclosure and receive returns from TSCR. The waste in AP-107 consists of a settled solids layer up to 23 in. from the bottom of the tank, with the remainder being supernatant liquid. These current settled solids are most likely precipitates from 242-A Evaporator campaigns.

AP-107 currently has a slurry distributor 28 in. from the bottom of the tank and transfer lines connecting a transfer pump in central pump pit, AP-07A, to the AP valve pit (H-14-107346 Sh 2). The tank also has three unused mixer pump pits (AP-07D, E and F), as shown on Figure 3-2.

The TSCR System will process waste by filtering solids to protect the ion exchange columns and removing cesium to the level required by WTP LAW and send this LAW Feed to AP-106. AP-106 will be used as the Interim LAW Storage Tank (ILST) and receives treated LAW processed through the TSCR System via hose-in-hose transfer line (HIHTL) and a future drop leg in AP-106 Riser #2, as shown in Figure 3-3. AP-106 will require new transfer pumps dedicated to and capable of delivering waste to WTP LAW.

Process waste streams produced by the TSCR System will drain through a HIHTL to Riser #15 and into AP-108. A vent line from the TSCR System IX columns will also enter AP-108 through Riser #15 as seen in Figure 3-4.

Figure 3-2. Tank 241-AP-107 Grade Level Plan View

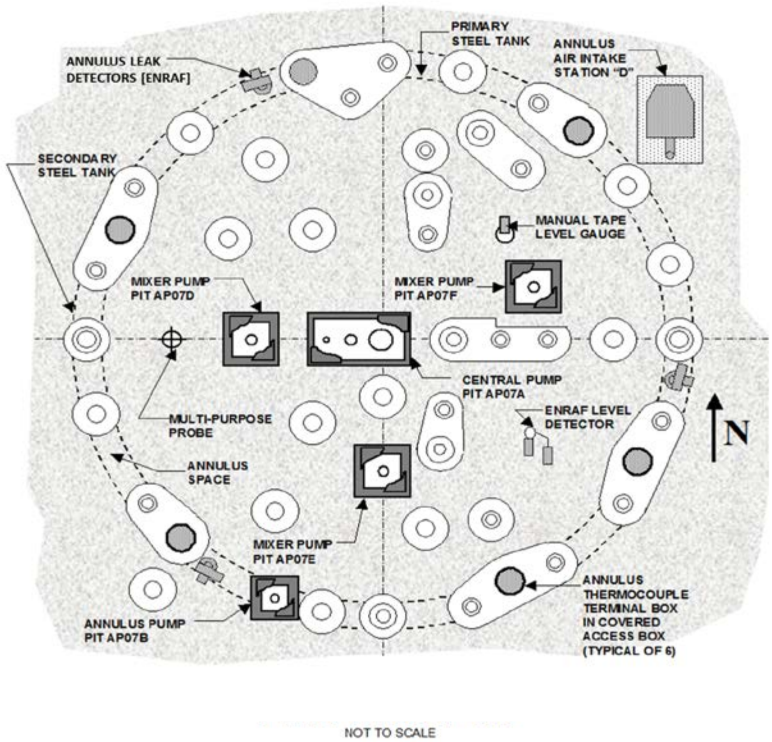


Figure 3-3. Tank 241-AP-106 Grade Level Plan View

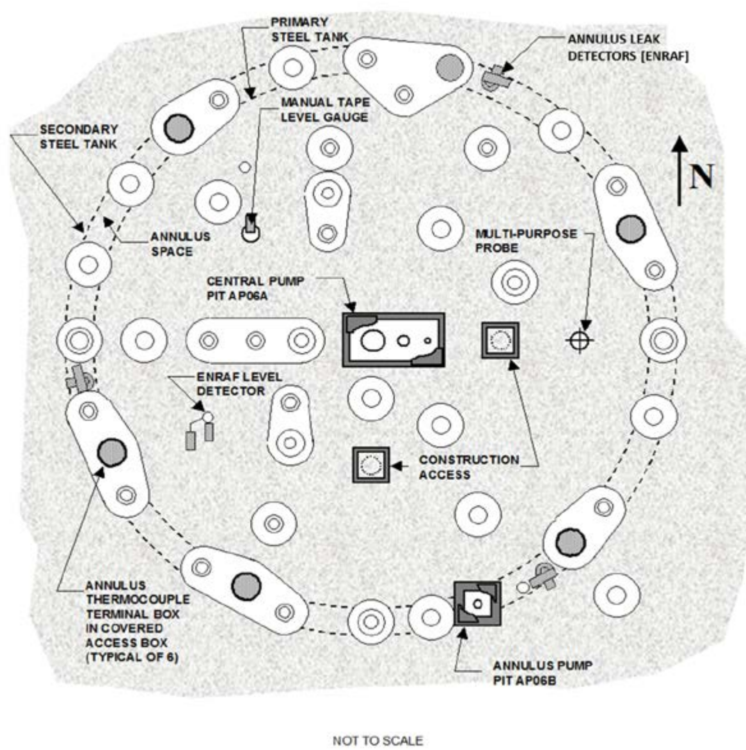
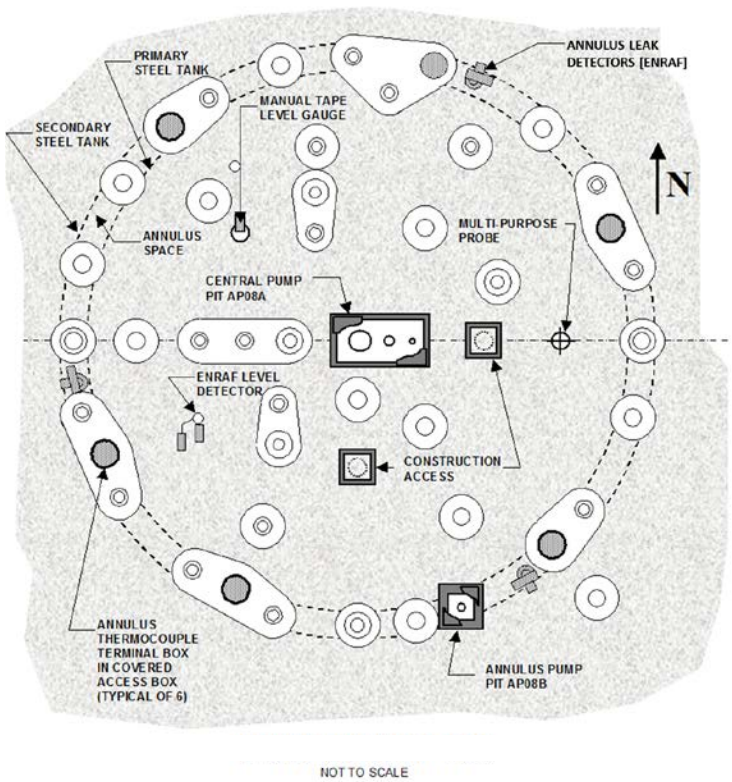


Figure 3-4 Tank 241-AP-108 Grade Level Plan View



To meet the requirements for TSCR operations, the following upgrades need to be completed:

- Install new HIHTL, pumps, and instrumentation from the TSCR interface to pump pit AP-07F: one to feed supernatant liquid containing marginal suspended solids, and one to serve as the recirculation loop for the feed to TSCR (RPP-SPEC-62028).
- Install a new drop leg and below grade connections in AP-108 Riser #15 for the TSCR System process returns and flushes and IX Column vent line.

The TSCR filter located before the ion-exchange column has backflush capabilities to clean the filter and flush the filter to AP-108. Flushing requirements are identified and managed through TFC-ENG-STD-26, “Waste Transfer, Dilution, and Flushing Requirement.” The TSCR filter rejects solids, which are then returned to AP-108. RPP-RPT-49362, *Entrained Solids in Double-Shell Tank Transfers*, indicates that most feed batches will not contain any appreciable solids, so the buildup of solids in the AP-108 over time should be of little concern.

3.1.2 Staging and Characterization Tank

Tank AP-105 will be used as the feed staging and characterization tank for DFLAW. Feed campaigns are typically staged in AP-105 to be conditioned, recirculated to mix heel and new supernatant liquid, and then sampled (RPP-RPT-59494, *Integrated DFLAW Feed Qualification Data Quality Objectives*). Samples are analyzed to qualify feed campaigns for delivery to TSCR and WTP-LAW, and to prepare a preliminary glass formulation prior to transfer into AP-107.

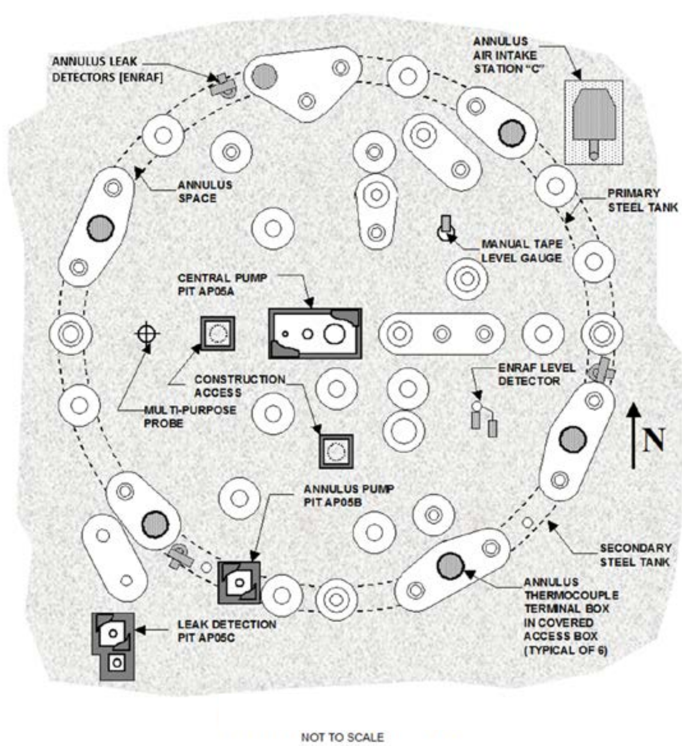
TSCR has the same waste acceptance criteria as WTP-LAW except for cesium and solids concentrations, as these are removed by the TSCR process before being transferred to WTP-LAW. Once a feed campaign is sent to AP-107, the staging and characterization tank will be ready to receive further supernatant for qualification.

AP-105 tank has a transfer pump installed (Figure 3-5); however, the pump may require a replacement prior to DFLAW operations. To meet the requirements for DFLAW operations, AP-105 requires

- Pumps to recirculate supernatant prior to sampling and transfer qualified feed via the existing transfer system to the feed tank that will minimize entrained solids during transfers
- Access for routine grab samples from a single riser for feed qualification.

Once the DFLAW Program begins, samples will be taken as described in RPP-RPT-59314, *Integrated DFLAW Feed Qualification Program Description*. AP-105 will be mixed by recirculation prior to each sampling event (RPP-RPT-59494), and recirculation needs to minimize the suspension of solids, although very few are anticipated. The pump inlet location will be balanced to allow for the largest campaign size possible while avoiding entrainment of additional solids into the feed tank. Waste residing in or transferred to AP-105 may require conditioning to meet waste acceptance criteria prior to transfer to AP-107, including possibly dilution and chemical adjustment.

Figure 3-5. Tank 241-AP-105 Grade Level Plan View



3.1.3 Off-Normal EMF Returns

Operation of the WTP LAW melters will create off gas that contains mostly water and waste constituents that do not readily convert to LAW glass. Due to their dilute nature, the off gas liquids will undergo evaporation at the EMF with contaminated plant wash liquids. During off-normal operations, AP-102 may receive filtered EMF feed when EMF is off-line but melter operations continue. Current projections are based on initial data from the WTP operations research (OR) model and indicate returns of less than 300 kgal during DFLAW operations (WRPS-1700288).

The EMF interface is controlled by ICD-31 and is a part of the Tank Farms WFD Upgrades scope. Returns from EMF shall be evaluated as part of the waste feed qualification process to align with the tank farms chemistry controls.

During the course of DFLAW operations, sufficient space must also be available in AP-102 to receive the off-normal EMF returns.

3.1.4 Direct-Feed Low-Activity Waste Infrastructure

For effective DFLAW operations, the supporting infrastructure requires the following to be completed:

- Install a new drop leg in AP-106 Riser #2 for LAW Feed transfers.
- Install a new transfer pump, jumpers, and instrumentation in AP-106 dedicated and capable of delivering waste to WTP LAW.
- Install a new drop leg in AP-102 (AP-02D) to connect with WTP W-211 Transfer Lines for off-normal returns from WTP LAW EMF
- New line from AP-06A to the W-211 and modifications to W-211 transfer lines to connect to the WFD System.

The TSCR project and ongoing WFD DST upgrades projects have established an interface agreement (RPP-RPT-60603) that identifies key interface points between the projects and the operations teams. Waste transfers will occur frequently during DFLAW operations. Operational control of the tank farms will remain with the central control room in 200 East Area.

The AP Farm ventilation system has been upgraded with additional capacity by projects T1P12 and T1P83, AP Exhauster Upgrades Project. The additional capacity is sufficient to support planned DST operations during DFLAW. Other upgrades have been performed or are planned for AP and AW Farms in the near-term that improve overall reliability, availability, and maintainability of the DST system. These upgrades include installation of (1) in-pit heaters to reduce the manpower required to maintain pit temperatures during winter months, (2) safety-significant annulus flow monitoring, and (3) tank farms wireless automation systems to allow for improved monitoring in the central shift office. Similar upgrades have been or are currently planned for implementation in the SY and AN Farms.

To support full DFLAW operations, mission critical spares will be needed for ease of replacement of failed components. Adequate storage facilities currently do not exist to hold and maintain the mission critical spares for the DFLAW program. Critical spares, when identified, should be integrated with the OR modeling results. Some of these components are likely to be long-lead, and procurement should begin as part of the overall preparations for DFLAW hot commissioning.

The current planning assumption for electrical power is that completion of the upcoming electrical power upgrades will supply sufficient power to TSCR and WTP, and that existing tank farms power is sufficient to support tank farms operations during execution of the DFLAW program. This electrical grid upgrades scope is handled by contracted infrastructure and support group.

Additional pretreatment capacity beyond the TSCR demonstration phases will be required to support DFLAW until the start-up of the WTP PT Facility and WTP HLW Vitrification Facility. This pretreatment capacity may be provided by continued TSCR operations or the replacement or supplementing of TSCR with a similar pretreatment system. As the pretreatment system has not been determined, the term “Tank Farm Pretreatment” (TFPT) is being used for this post-TSCR pretreatment capacity.

3.2 LOW-ACTIVITY WASTE FEED TO HANFORD TANK WASTE TREATMENT AND IMMOBILIZATION PLANT PRETREATMENT AND SUPPLEMENTAL TREATMENT

The majority of the waste inventory held in Hanford tank farms is low activity waste and is significantly larger than the volume that can be immobilized in the WTP LAW Facility. In order for the integrated WTP Facilities to operate effectively, additional LAW treatment capacity is necessary beyond WTP LAW. Therefore, both WTP-LAW and Supplemental Treatment convert low activity waste into storable waste forms: glass for WTP-LAW, glass or grout for Supplemental Treatment.

Following completion of DFLAW operations, a dedicated transfer line will be needed transfer supernatant directly from the DST system to WTP-PT. During full WTP operations, supernatant will be delivered to the WTP-PT for filtration, removal of cesium, and delivered to WTP-LAW.

Supplemental LAW provides additional LAW treatment capacity beyond that of WTP-LAW. No treatment technology has been selected to treat the additional LAW. The capacity of Supplemental Treatment is assumed to be sufficient to ensure that it does not drive the RPP mission duration. It is assumed that Supplemental Treatment receives “excess” pretreated LAW from the WTP PT Facility as well as directly from a supplemental pretreatment source (TSCR or TFPT).

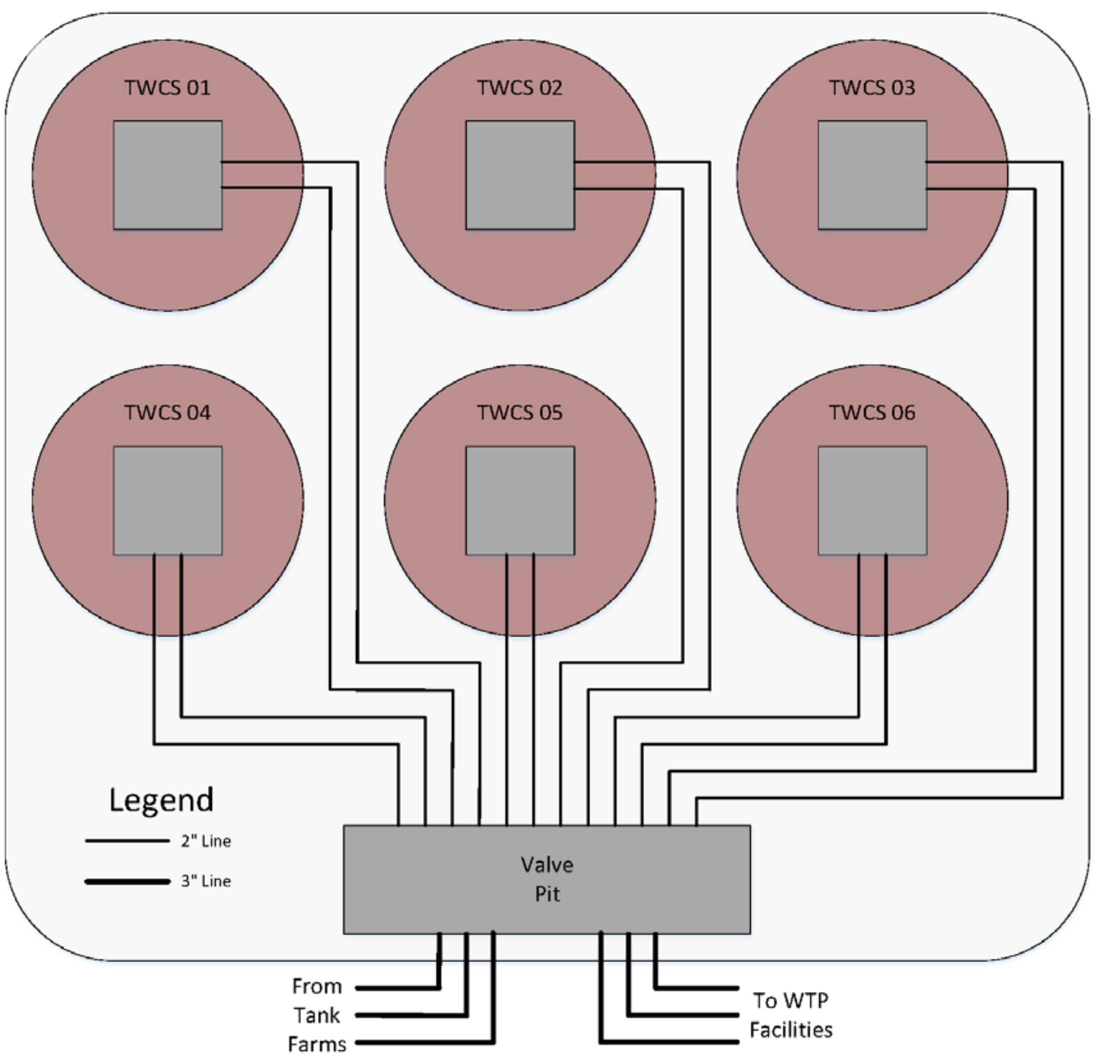
4.0 HIGH-LEVEL WASTE FEED DELIVERY

The baseline scenario of System Plan 8 includes a TWCS capability between the DST system and the WTP-PT for HLW feed delivery. As described in the approved Justification of Mission Need (JMN) (Whitney, 2015) for TWCS, a conditioning, blending, mixing, and sampling capability is needed before WTP-PT in the treatment process flow to address hard-to-handle solids. The IWFDP provides only a summary-level description of the TWCS capabilities; further detail will be developed as the project matures. Outside of TWCS, additional upgrades will also be necessary in the DST system to deliver waste to the TWCS.

4.1 TANK WASTE CHARACTERIZATION AND STAGING CAPABILITY

In June 2015, DOE formally approved the JMN for the TWCS capability (Whitney, 2015). Figure 4-1 presents a pre-conceptual representation of the TWCS system and the proposed interconnectivity.

Figure 4-1. Tank Waste Characterization and Staging



Current planning and assumptions are that TWCS will consist of six 500,000 gal tanks and meet the functional requirements outlined in the JMN. The TWCS capability will be designed to help resolve the technical issues associated with HLW solids at WTP. TWCS will provide the ability to adequately mix, stage/blend, sample, and characterize HLW slurry feed prior to delivery to WTP. TWCS will be located between AP Farm and WTP-PT with a transfer system connecting all three to provide feed. As additional design input is received, the balance of mission operations will be redefined accordingly and incorporated in the IWFDP and System Plan.

The timing of TWCS depends on the operational startup strategy for WTP-HLW. The baseline plan that is being modeled for the next revision of the System Plan (RPP-RPT-59581) states that in order to meet commitments for treatment of waste identified in the Consent Decree (2016), TWCS must be available to receive HLW from Tank Farms by June 30, 2032. The formal request for approval of the JMN identified project costs up to $690 million, with a schedule duration up to eight years. Requirements for the function and design of TWCS may differ depending on the intended destination of TWCS characterized waste.

4.2 DELIVERY TO TANK WASTE CHARACTERIZATION AND STAGING FROM DOUBLE-SHELL TANK SYSTEM

Implementation of TWCS into the planning baseline for the RPP mission mitigates risks to the ability to adequately stage, sample, characterize, and deliver feed to WTP-PT as identified in previous revisions of the IWFDP.

Within the DST system, tanks will require the installation of mixer pump(s) capable of suspending sludge solids and concentrated slurry material. Tanks with significant accumulation of solids may require the installation of multiple adjustable height mixer pumps to provide adequate suspension of waste slurry. Mixer pumps may also be required for salt cake dissolution of Waste Group A tanks. Mixer pumps have been used previously in some Hanford tanks and to support salt cake dissolution in SY-101; they have also been tested in AZ-101.

DSTs will also require the installation of a slurry transfer pump capable of moving dense sludge solids through the existing slurry transfer system, and receiving DSTs will require a slurry distributor. In addition, to support retrieval of remote SST farms, WRFs, associated transfer lines and other infrastructure are required to stage and move retrieved waste into the DST system.

Figure 7-3 (Section 7.3) presents the overall DST utilization matrix supporting WFD from the DST system. Additional detail will be developed as more information becomes available regarding the treatment and disposal of HLW through WTP.

5.0 WASTE TRANSFER SYSTEM

The waste transfer system (WTS) is a key component supporting activities necessary to accomplish WFD to the WTP. The WTS consists of the transfer lines, valve and pump pits, and in-pit connections necessary to safely move tank waste in the DST system.

Figure 5-1 provides a visual representation of the transfer route capabilities required for the preparation and staging of waste feed in the DST system to support WTP operations. Each of the DST farms are shown along with the general waste type or purpose of each of the 27 active DSTs. The DSTs are interconnected through a series of three-inch inner diameter supernatant lines and two-inch inner diameter slurry lines. These lines are buried and are typically connected to the central pump pit of each DST[1] and farm-specific valve pits. Additional pits are shown in several DSTs with specific connectivity or functionality. For example, AP-02D connects the AP Farm valve pit to the AZ Farm valve pit, allowing the transfer of waste between farms not otherwise connected. See the individual piping plans or the DST Routing Board (H-14-107346) for specific connectivity within the pits.

5.1 WASTE TRANSFER SYSTEM DURING DIRECT-FEED LOW-ACTIVITY WASTE OPERATIONS

During DFLAW operations, the WTS will be used to transfer and prepare supernatant feed to the DFLAW DST system, as described in Section 3.1. To maintain and support SST retrievals, dilute supernatant liquid will be fed to the 242-A Evaporator for concentration. Support of these activities will be primarily focused on the AP valve pit, AW-B valve pit, and the AP-02D pit.

The transfer system, shown in Figure 3-1 (Section 3.1), depicts the new and existing transfer lines specifically supporting DFLAW operations. A new 3-in. transfer line will connect AP-106, the ILST, to the W-211 Transfer Lines to handle feed to WTP LAW.

Supernatant liquid will be delivered to the staging and characterization tanks via the existing DST transfer system depicted in Figure 5-1, where the waste will be conditioned, recirculated, and sampled for feed qualification. Qualified feed will be transferred via HIHTL to TSCR initially and then via W-211 Transfer Lines to the WTP LAW. During DFLAW operations, the supernatant liquid transfer lines (depicted as SN-) will be used for the majority of waste transfers.

5.2 WASTE TRANSFER SYSTEM DURING FULL WASTE TREATMENT AND IMMOBILIZATION PLANT OPERATIONS

Previous project work installed W-211, three 3-in. transfer lines from the DST system to the WTP interface point. The W-211 lines will initially be used to feed DFLAW campaigns. Further analysis will be done to assess the possibility of the W-211 lines being repurposed to their original design use or if a new transfer route will be required. W-211 lines can be repurposed, it is assumed that TWCS will install a valve pit to connect to at least one of these existing transfer lines to receive HLW slurry from the DST system prior to delivery to WTP-PT. Hot

[1] Central pump pits are typically denoted as the "A" pit in a given DST. Example the central pump pit in AP-105 is denoted AP-05A

commissioning feed will be prepared, qualified and delivered to WTP-PT from TWCS. Additionally, LAW transfers would utilize these previously installed transfer lines for delivery of tank farm supernatant to the WTP-PT LAW receipt vessels.

Within the DST system, HLW slurry will be transferred via existing 2-in. slurry lines to prepare feed and deliver to TWCS (Figure 5-1). Where 2-in. slurry lines are unavailable, the 3-in. supernatant lines will be used. Incidental blending may occur within the DST system but current planning is that intentional blending or segregation of waste slurry will occur and be managed within TWCS.

The current DST retrieval sequence blends material from multiple DSTs and multiple tank farms to optimize glass waste oxide loading in TWCS. Each 200 East Area DST farm may require transfer lines capable of moving suspended sludge solids to TWCS. Transfers from 200 West Area are expected to use the existing cross-site transfer lines to move slurry to 200 East Area DSTs prior to delivery to TWCS.

5.3 CROSS-SITE TRANSFER LINE

The cross-site transfer lines consist of approximately 7.5 miles long slurry and supernatant transfer line designed to transfer waste from between the 200 West Area and 200 East Area tank farms. Each line is an encased 3-in. inner diameter, stainless steel pipe. The cross-site supernatant line (SNL-3150) connects the SY-A valve pit to the AN-01A central pump pit (Figure 5-1). The cross-site slurry line (SLL-3160) connects the SY-B valve pit to the AN-04D pit. The cross-site slurry line was installed at the same time as the supernatant line but was never commissioned.

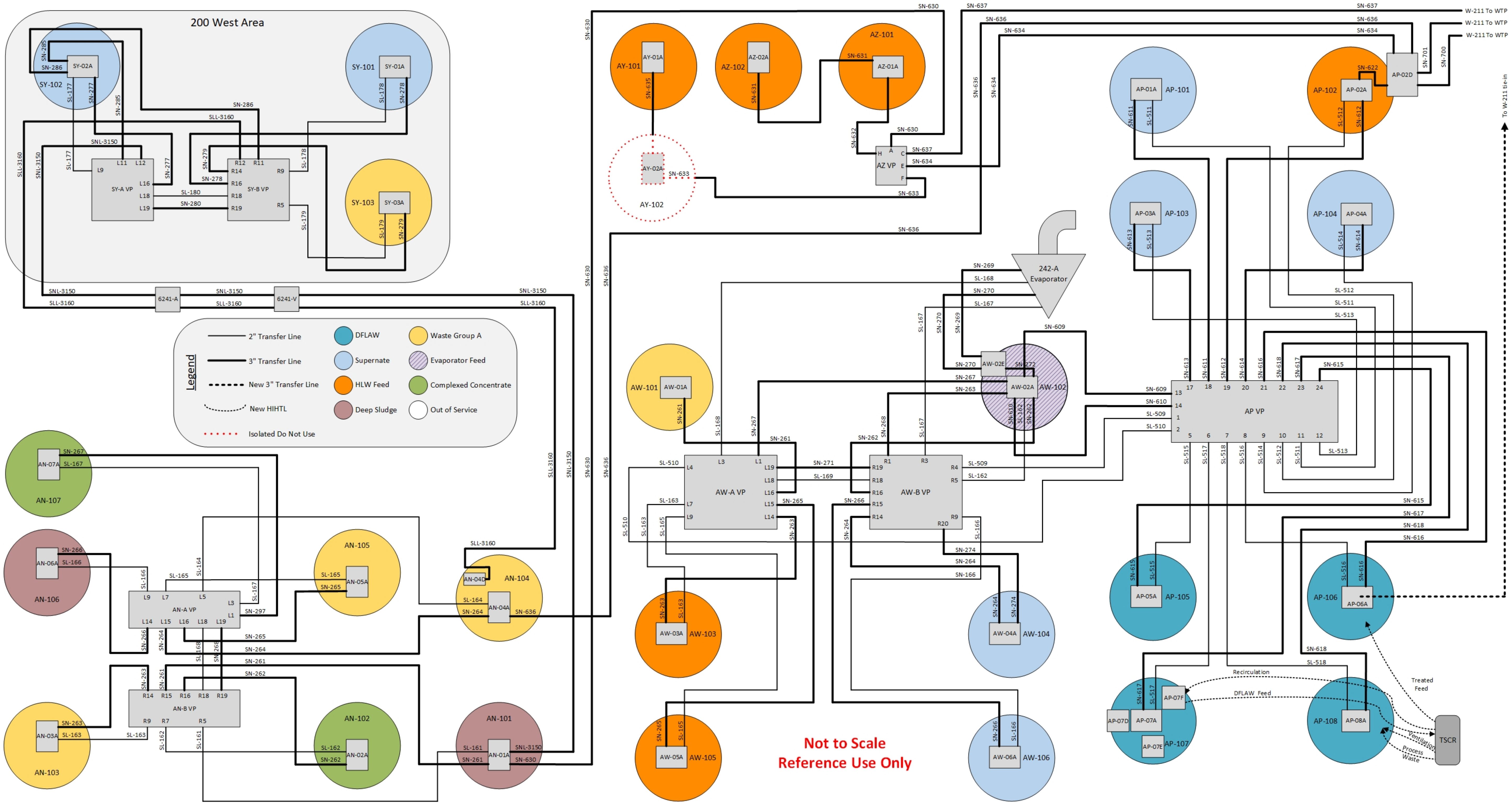
As of 2006, the primary piping, encasement, encasement drain line, and test riser assemblies of SNL-3150 were compliant (RPP-7846, *241-AN Transfer Line SNL-3150 Acceptance Test Report*). However, SNL-3150 has not been used in the interim. Pneumatic encasement testing must be performed on all fit-for-service transfer lines either every 10 years or prior to next use, whichever is longer, as required in RPP-RPT-52206, *Tank Farms Waste Transfer System Fitness-for-Service Requirements and Recommendations*. Given that the last pressure test was in 2006 (documented in RPP-7846), SNL-3150 must pass a pneumatic encasement test prior to next use.

Other items to note concerning the supernatant liquid cross-site transfer line include:

- SNL-3150 contains a leak detection cable that has alarmed and the encasement may contain up to 9.6 gallons of liquid(RPP-RPT-52206).
- As documented in PER-2005-2132, "Damaged Pull Ports," several pull ports for the cross-site encasement leak detection system were found to be damaged in 2004 and 2005. No leak tests have been performed to check the integrity of the encasement of SNL-3150 (RPP-RPT-52206).
- RPP-27591, *Volume 2: IQRPE DST System Integrity Assessment – Pipeline Integrity*, details a corrosion analysis of two sections of tested pipeline. The results indicate that as of 2007, corrosion of the primary line was not a concern.

To support the full RPP mission, both transfer lines must be placed into active service. The supernatant line is required prior to initiation of retrieval activities in the 200 West Area to allow for mitigation of SY-103, which is a Waste Group A tank, and subsequent retrieval of SST waste from S and SX Farms into SY Farm. The cross-site slurry line is required to avoid creation of deep sludge tanks in SY Farm. Project T1P181 is currently working to reactivate the Replacement Cross-Site Transfer System SNL-3150 to support required waste transfers.

Figure 5-1. Double-Shell Tank Waste Transfer System



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6.0 RISK AND OPPORTUNITY MANAGEMENT

Risks and opportunities associated with successful execution of the IWFDP will be captured and addressed in accordance with WRPS-57232, *Enterprise Risk and Opportunity Management (EROM) Framework*. The risks and opportunities for the DFLAW program are managed through RPP-PLAN-60093, *One System Direct Feed Low Activity Waste Program Risk and Opportunity Management Plan*. The IWFDP is critical to mitigation of risks associated with the DFLAW Program, specifically those related to the ability to deliver feed to WTP LAW as required. Additional detail is captured in the appropriate project or programmatic risk registers when developed to support specific project execution.

7.0 PATH FORWARD

The project and process approaches are described in RPP-40149-VOL1, and this document present an updated assessment of the IWFDP reflecting changes and improvements in RPP-RPT-57991. The previous revision recommended several actions that have been implemented or are currently in the process of being implemented, resulting in significant improvement in DFLAW operations from a project cost and executability perspective.

7.1 STATUS OF PREVIOUS RECOMMENDATIONS

Table 7-1 identifies each recommended improvement or refinement proposed and the current status of that activity. Through close integration of the Mission Integration and Waste Feed Delivery organization, TSCR project team, and the DST upgrades project, several key initiatives have resulted in optimization of the DST upgrade project scope required to support DFLAW operations.

Table 7-1. Status of Ongoing Actions (2 pages)

Action	Status	Disposition
Evaluate and recommend option(s) to minimize downtime associated with the AP-107 transfer pump (TSCR feed pump)	Complete	Redundant pumps have been included in the design specification for the TSCR feed tank.
During operations, maintain jumper spares to support key transfers and timely routing of returns from EMF; jumpers are identified in RPP-RPT-58962[a]	Ongoing	Critical spares will be identified as part of the DST upgrades project scope based on the latest OR model results.
Implement equipment and ready spares identified as necessary to support DFLAW transfer, as described in Section 5.0 and RPP-RPT-58962[a]	Ongoing	Critical spares will be identified as part of the DST upgrades project scope based on the latest OR model results.
Implement dedicated cesium eluate return transfer route, as described in RPP-RPT-58957[b]	Complete	Dedicated transfer route to cesium eluate return tank is included in the design specification. NOTE: This action, though complete, is no longer relevant because the TWCS exchange media is not elutable.
Perform analysis of solids behavior in AP-107 during operations and evaluate solutions that optimize TSCR throughput and overall system reliability through development of a AP-107 operating strategy	Ongoing	AP-107 core sampling has been deferred. Design development, including a computational fluid dynamics model and grab sampling of AP-107 solids layer, is planned to provide optimum elevations for feed pump inlet and filtered solids receipt.

Table 7-1. Status of Ongoing Actions (2 pages)

Action	Status	Disposition
Evaluate transfer line routing improvements that can be implemented with cost and schedule savings, along with potential reliability improvements to the DFLAW process	Complete	Consolidation of DFLAW tanks in AP Farm enables use of dedicated routes for feed and process return lines.
Mitigate AN-104 during DFLAW operations	Ongoing	This activity is included in the planning basis, with the flowsheet to be developed in FY 2020.
Deploy in-tank treatment to precipitate ^{90}Sr and transuranic elements in AN-102 and AN-107	Planned	WRPS Mission Integration & Waste Feed Delivery will perform an analysis to determine the method and viability of this recommendation during FY 2019.
Install new cross-site transfer system	Ongoing	Project is ongoing by WRPS Engineering to repair cross-site transfer system.
Repurposing of AP-106 for use as Interim LAW Storage Tank	Ongoing	Project and Plan for AP-106 Repurposing in development and actions planned for FY19 and FY20.
Develop functional capabilities for TWCS	Ongoing	Early development of functional capabilities will better define and establish good engineering practices

[a] RPP-RPT-58962, 2016, *Direct Feed Low Activity Waste Operations Research Model Part B Results Report*, Rev. 0, Washington River Protection Solutions, LLC, Richland, Washington.

[b] RPP-RPT-58957, 2016, *Direct Feed Low Activity Waste Operations Research Model Part B Bases and Assumptions*, Rev. 1A, Washington River Protection Solutions, LLC, Richland, Washington.

DFLAW = direct-feed low-activity waste.
DST = double-shell tank.
EMF = Effluent Management Facility.
FY = fiscal year.
OR = operations research.
WRPS = Washington River Protection Solutions, LLC.

7.2 FUTURE REFINEMENTS

The project scope described in this volume directly supports successful execution of the RPP mission as described in Volumes 1 and 2 of this plan and in alignment with the RPP Integrated Flowsheet (RPP-RPT-57991). As design of the DST upgrades for DFLAW progresses, new opportunities may be identified. The potential near-term cost savings of those opportunities must be balanced with the long-term operational risk and life-cycle cost. Table 7-2 presents additional opportunities for improvement.

Table 7-2. Opportunities for Improvement

Action	Target	Description of Benefit
Identify storage facilities for critical DFLAW spare equipment	End of FY2020	Minimize downtime after equipment failures / end of life expectancy by having critical spares available and centrally located

CD = critical decision.
DFLAW = direct-feed low activity waste.
DST = double-shell tank.
EMF = Effluent Management Facility.
FY = fiscal year.
LAWPS = low-activity waste pretreatment system.
TWCS = tank waste characterization and staging.

7.3 INTEGRATION OF UPGRADES WITH PLANNING

The Washington River Protection Solutions, LLC (WRPS) Multi-Year Operating Plan (MYOP) establishes a near-term schedule to correspond with the process strategy and campaign plan in RPP-40149-VOL1 and RPP-40149-VOL2. The MYOP provides the basis for the scope and schedule of the infrastructure upgrades necessary to execute the RPP mission. The Multi-Year Operating Plan is integrated with the IWFDP and the RPP Integrated Flowsheet (RPP-RPT-57991)

Figure 7-1 presents the high-level project schedule to support the DFLAW phase of the RPP mission. This schedule presents an integrated overview of project activities necessary to prepare and deliver feed to TSCR. This work must be integrated with ongoing field activities for both waste transfers and preparation of the first and second feed campaigns. Subsequent work is required in the Staging and Characterization Tanks to support preparation and sampling for early feed campaigns. Sustained feed delivery for DFLAW requires the availability of more supernatant than is currently in AP Farm. As discussed in RPP-RPT-58854, *Future Tank Retrievals Alternatives Analysis*, the preferred source is targeted salt cake tank retrievals within S and SX Farms. To accommodate retrievals of those SSTs and the solids buildup in the receipt DSTs, it is necessary to mitigate two Waste Group A tanks and restore the cross-site transfer lines. A high degree of uncertainty exists within the planning basis for all three activities, therefore work is planned to begin as early as practical to avoid disruption of DFLAW Operations.

Figure 7-2 presents the IWFDP schedule from the FY19 to FY35. Based on current planning, the transfer system infrastructure should be in place in each DST farm and future work should be simplified. The JMN for TWCS provides the current enabling planning assumption of eight years from commencement of CD-1 work to completion of readiness activities. The planning schedule for work associated with TWCS and the work within the 200 East Area DST Farms is outlined to support the current Consent Decree (2016). The planning schedule presents the first five HLW feed delivery projects within the DST system. It is prudent that these activities will be duplicated for the remainder of the HLW feed tanks.

Figure 7-3 presents the DST Functions and Utilization outlining the function the tanks will fulfill over the next 10 years to support completion of the RPP mission. This figure assists in current and future planning of tank utilization, upgrades and operations needed to complete the RPP mission.

The IWFDP focuses entirely on feed delivery concepts and the planning basis to the WTP. No discussion has been included for the treatment of remote-handled or contact-handled transuranic waste. The technical basis described in the System Plan (ORP-11242) and the RPP Integrated Flowsheet (RPP-RPT-57991) discusses this disposal pathway in additional detail. As alternate treatment process(es) may evolve and be incorporated in the RPP Integrated Flowsheet, they will be included in the IWFDP.

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Figure 7-1. Direct-Feed Low-Activity Waste Integrated Waste Feed Delivery Summary Schedule

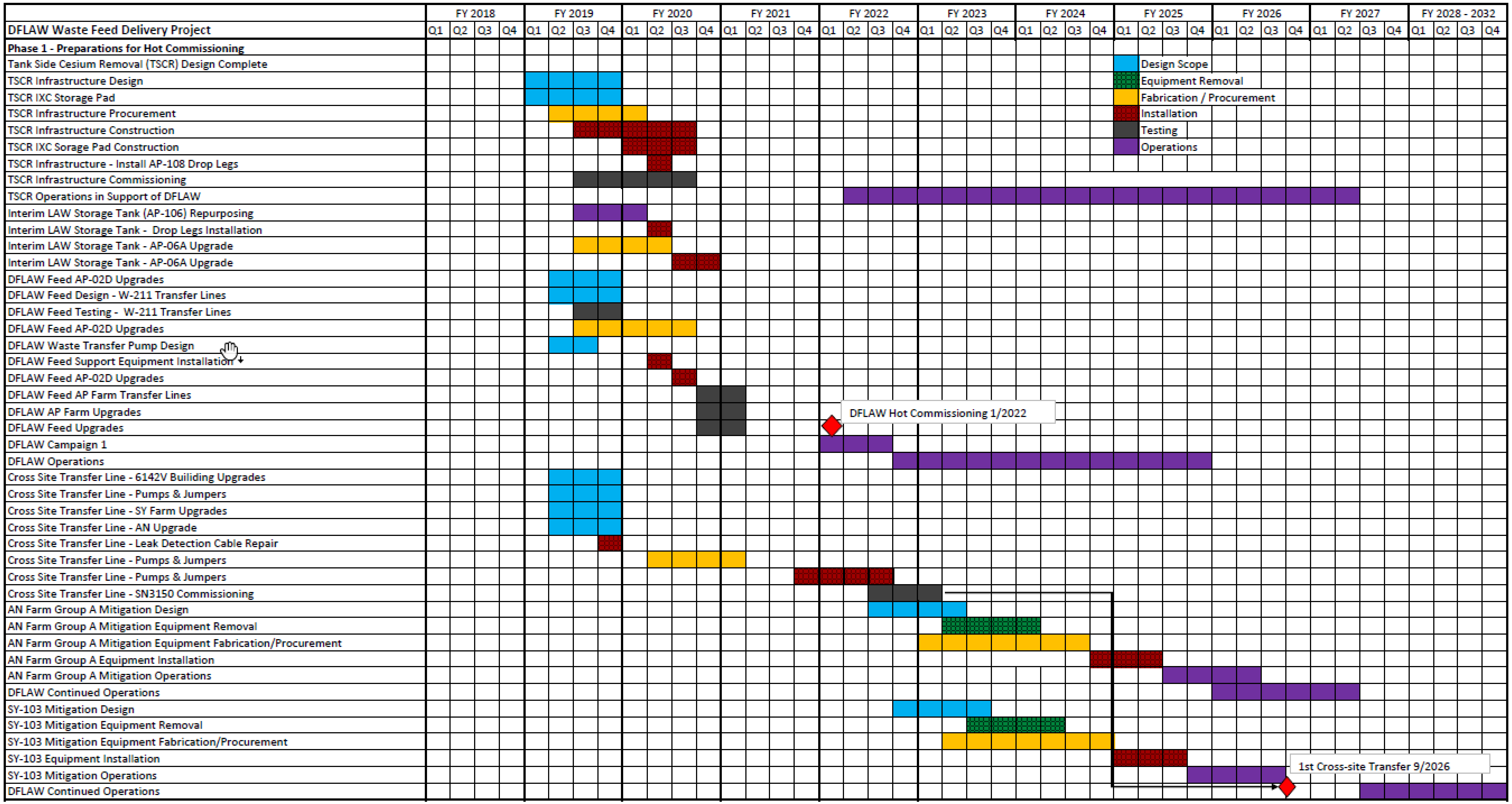


Figure 7-2. High-Level Waste Integrated Waste Feed Delivery Summary Schedule

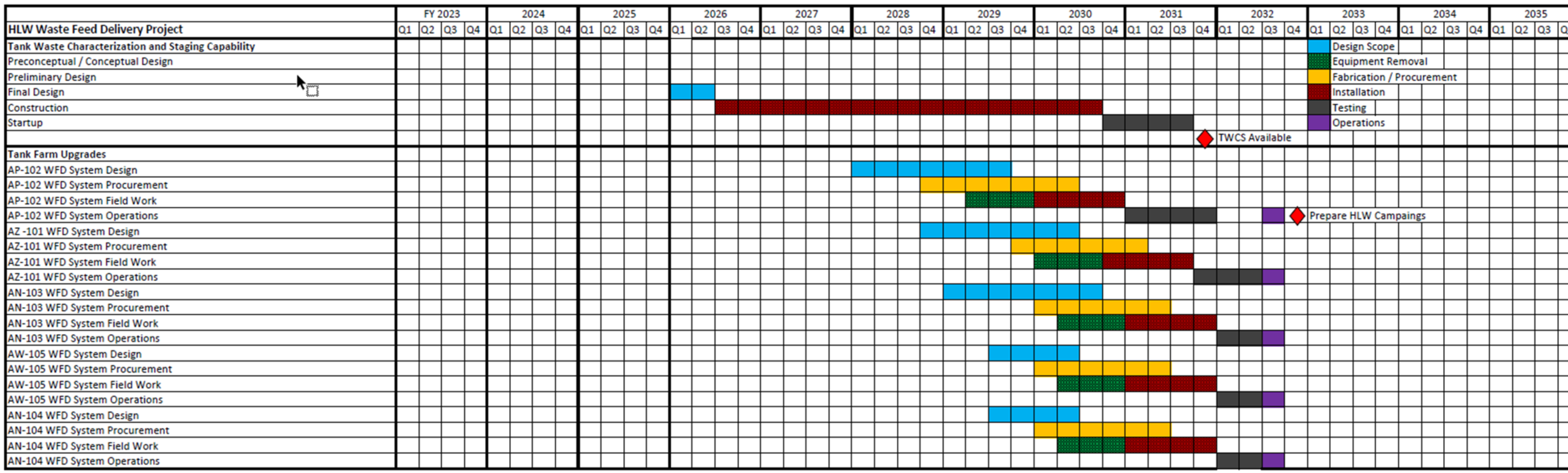
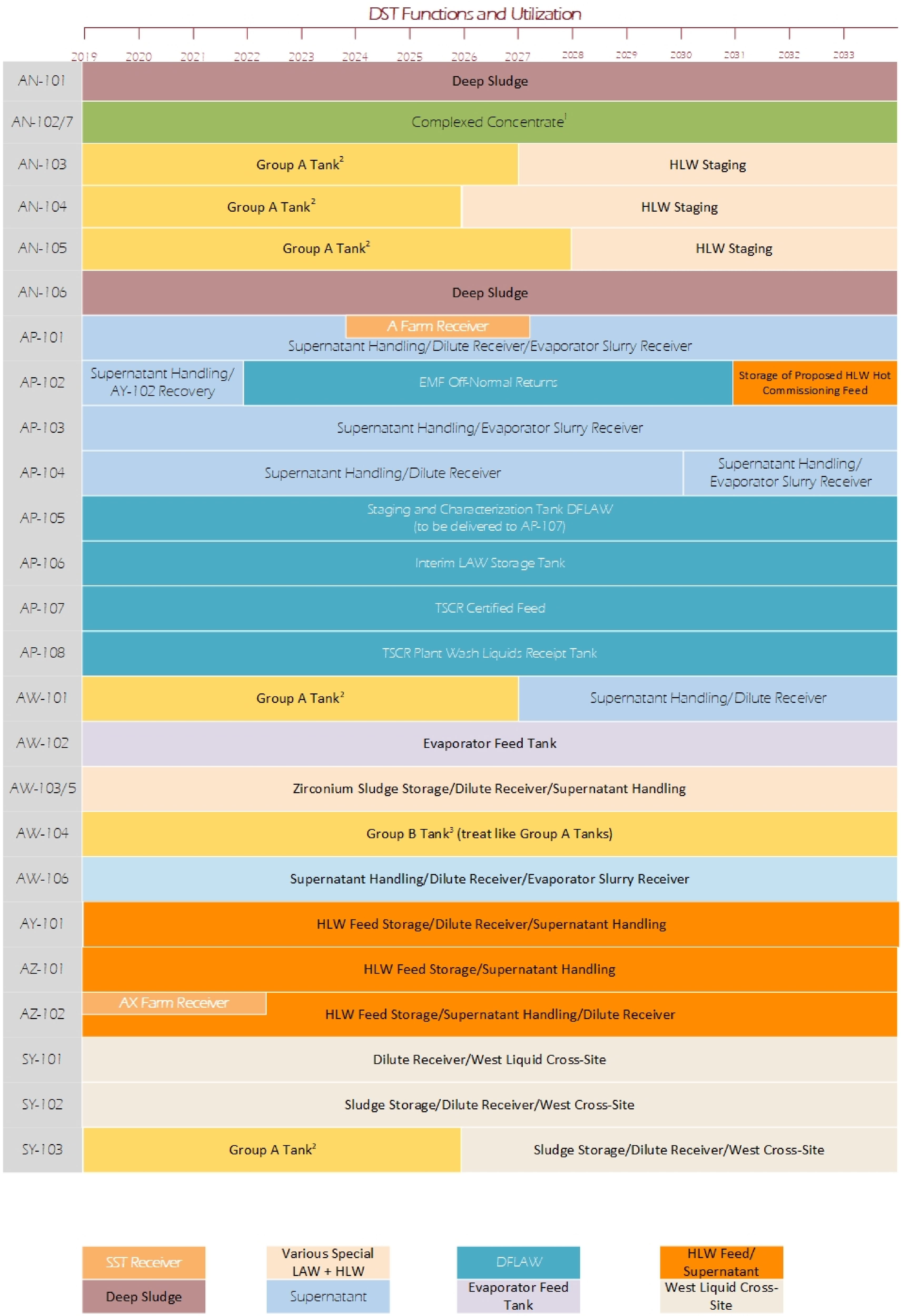


Figure 7-3. Double-Shell Tank Functions and Utilization



[1] Complexed Concentrate – Tanks that currently store waste that includes high concentrations of complexed Sr-90 and TRU in supernatant.
[2] Group A Tank – A tank, that because of its waste composition and quantities, has the potential for a spontaneous BDGRE and is conservatively estimated to contain enough flammable gas within the waste that if all were released into the tank headspace, the concentration of the flammable gas would be a flammable mixture.
[3] Group B Tank – Tanks, that due to their waste composition and quantities, are conservatively estimated to contain enough flammable gas within the waste that if all were released into the tank headspace, the concentration of the flammable gas would be a flammable mixture, but would not have the potential for a spontaneous BDGRE.

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