LOW-ACTIVITY WASTE PRETREATMENT SYSTEM
ADDENDUM B
WASTE ANALYSIS PLAN

CHANGE CONTROL LOG

Change Control Logs ensure that changes to this unit are performed in a methodical, controlled, coordinated, and transparent manner. Each unit addendum will have its own change control log with a modification history table. The "**Modification Number**" represents Ecology's method for tracking the different versions of the permit. This log will serve as an up to date record of modifications and version history of the unit.

Modification History Table

Modification Date	Modification Number

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ADDENDUM B
WASTE ANALYSIS PLAN

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ADDENDUM B
WASTE ANALYSIS PLAN

TABLE OF CONTENTS

TABLES

FIGURES

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B. WASTE ANALYSIS PLAN

B.1 Introduction

This Waste Analysis Plan (WAP) addresses the sampling and analyses necessary to manage waste at the Low-Activity Waste Pretreatment System (LAWPS) Operating Unit Group (OUG) according to requirements included in the *Hanford Facility Resource Conservation and Recovery Act Permit, Dangerous Waste Portion*, WA7890008967 (Permit), and Washington Administrative Code (WAC) 173-303. The LAWPS OUG contains the Tank Side Cesim Removal (TSCR) system which is comprised of a Process Enclosure that accepts waste and contains the process piping, filter and Ion Exchange Columns (IXC) which removes Cs-137 through a non-elutable media; an Ancillary Enclosure contains the caustic totes, demineralized water system and compressed air system; and the Control Enclosure is the operations location for the system where waste processing activities are monitored.

B.2 Purpose

The purpose of the WAP is to ensure the waste processed through the TSCR system is managed in accordance with WAC 173-303-300. Record keeping requirements applicable to the Hanford Facility are described in Permit Attachment 6, *Reports and Records*. Records specific to TSCR will be managed in the LAWPS Operating Record that is kept as part of the Hanford Facility Operating Record WAC-173-303-300(2)(b).

The WAP also ensures the waste analysis is comprehensive and reflects the outcome of the *Integrated DFLAW Feed Qualification Data Quality Objectives* (DQO), RPP-RPT-59494 (as amended), and sample analysis performed on the tank waste feed stream to be treated in the TSCR system. Sampling and analysis criteria identified in the DQO related to meeting Resource Conservation and Recovery Act (RCRA) requirements are included as an integral part of this WAP.

Regulatory requirements and operational issues addressed in this WAP establish boundary conditions for waste to be received and treated through the TSCR system. These boundary conditions establish limits for waste characteristics such as waste content and waste compatibility. Waste that exceeds the boundary conditions would not be acceptable for treatment without further actions, such as blending with other waste or water. Any necessary pre-treatment such as blending would occur at the Double-Shell Tank (DST) System OUG.

B.3 Scope

This WAP discusses sampling and analysis of waste to determine the acceptability of the waste in DST "feed qualification tank(s)" for processing first at TSCR prior to its acceptance at the Waste Treatment and Immobilization Plant (WTP) Low-Activity Waste (LAW) Facility. A "feed qualification tank(s)" means one or more tanks in the DST system, which may not be the "direct" feed tank 241-AP-107. Refer to additional discussion in Section B.7 for "feed qualification tanks." Note: 241-AP-107 is the first feed qualification tank. Subsequent qualification tanks may be selected from the 241-AP Farm or other DST tanks as necessary to support operations.

B.3.1 Feed Qualification Tank Acceptance Process

This process determines the acceptability of feed waste from the DST system prior to acceptance of the waste for treatment at the TSCR system and the WTP LAW facility. Note: waste in the feed qualification tanks will be required to meet the WTP LAW facility waste acceptance criteria except cesium and solids concentration.

B.4 Direct Feed Low-Activity Waste Pretreatment Systems Process Description

Phase 1 of the LAWPS OUG consists of the TSCR system. This process unit will provide pretreatment of DST supernatant prior to transfer to the WTP LAW vitrification facility for treatment using double-walled waste transfer lines. The TSCR system will use dead-end filtration to separate solids from the supernatant as a means to protect the IXC. Then, a multiple IXC system will remove soluble radioactive cesium (Cs) from the liquid. The resulting treated LAW stream then is transferred to DST 241-AP-106 for temporary storage before being fed forward to the WTP LAW facility for vitrification. Solids accumulated in the filters will be periodically back-washed and returned to DST 241-AP-108.

A more detailed description of the TSCR system process operations is provided in Addendum C, "Process Information."

B.5 Waste Characterization

The TSCR system will treat supernatant from the selected 241-AP Farm feed qualification tank. Waste feed qualification is based on both sample analysis and process knowledge. The contents of the DST system "feed qualification tanks" are sampled to demonstrate acceptability for processing through the TSCR system with the results evaluated against the waste acceptance criteria before processing proceeds. To meet the TSCR system waste acceptance criteria, the contents of several tanks could be blended together in the feed qualification tank prior to acceptance.

B.5.1 General Constituent Description

The mixed waste to be stored and treated through the TSCR system is an aqueous solution containing dissolved inorganic salts such as sodium, potassium, aluminum, hydroxides, nitrates, and nitrites with some tanks having detectable levels of heavy metals such as lead, chromium, cadmium, and mercury. The radionuclide content includes fission products such as Sr-90 and Cs-137, and actinide series elements such as uranium and plutonium. Small quantities of ammonia and organics, such as acetone, butanol, and tri-butyl phosphate, could be present. The physical consistency of the waste in the DST system ranges from aqueous supernatant to thick sludge. The only waste feed to the TSCR process unit is aqueous supernatant; tank waste sludge is not processed as part of the Direct-Feed LAW (DFLAW) Program.

B.5.2 Classification of Waste

The waste entering the TSCR system is classified as a mixed waste because it contains a radioactive component and a chemical component that designates as a dangerous waste. The treated waste from TSCR system processing is designated and assigned the listed dangerous waste numbers for waste stored in the DST system as follows.

- Waste generated from the treatment process includes solids return to DST, treated LAW, spent IXC, and various secondary solid waste (e.g., solid waste maintenance debris such as pumps and valves). Each waste stream is mixed waste since they are derived from the DST system listed dangerous waste due to waste numbers F001 through F005. The streams may also exhibit the dangerous waste characteristic of corrosivity (WAC 173-303-090).

Any waste sampling and analysis for purposes of designating treatment residues generated from TSCR operations are conducted pursuant to WAC 173-303-170, which is outside the scope of this Addendum.

B.5.3 Dangerous Waste Numbers

The TSCR system process is specifically designed to accept DST system waste directly from feed tank 241-AP-107. Waste acceptable for transfer to the TSCR system could be assigned any of the dangerous waste numbers found in Addendum A, "Part A Form." These numbers are identical to those in the DST system and 204-AR Waste Unloading Station Part A, with the exception of ignitability (D001) and reactivity (D003). Because the TSCR system accepts only aqueous phase supernatant waste feed, the characteristics of ignitability and reactivity do not apply since the waste does not exhibit those

characteristics. In addition, the TSCR system utilizes no chemical reagents or processes that could impart the characteristic of ignitability or reactivity to the treated LAW waste. Process knowledge and historical data demonstrate that the solids returned to the DST system contain the same dangerous waste constituents as the waste feed, so the same dangerous waste numbers are applicable to the feed and solids return with the exception of that noted previously.

Table B-1 lists the dangerous waste numbers assigned to the LAW transferred to the WTP LAW facility for vitrification. The treated LAW is designated with listed dangerous waste numbers F001 through F005 because it is derived from DST system waste assigned these waste numbers. In addition to the F001 through F005 numbers, treated LAW transferred to WTP LAW facility may designate for one or more applicable toxicity characteristic dangerous waste numbers.

Table B-1. Waste Designation for Feed Stream and Treated Low-Activity Waste

Waste Number	Characteristic/Source	Basis for Designation
F001	Spent halogenated solvents	1,1,1 trichloroethane
F002	Spent halogenated solvents	Methylene chloride
F003	Spent nonhalogenated solvents	Acetone, and methyl isobutyl ketone
F004	Spent nonhalogenated solvents	Cresols
F005	Spent nonhalogenated solvents	Methyl ethyl ketone

B.6 Waste Acceptance Process

This section describes the actions performed before every campaign to determine the feed qualification tank waste is acceptable for treatment through the TSCR system.

The TSCR system will treat supernatant from the selected 241-AP Farm feed qualification tank (or other suitable DST), that must be accepted at both the TSCR system and WTP LAW facility. DST 241-AP-107 continually feeds the TSCR system, which in turn produces treated LAW. Treated LAW is transferred back to DST 241-AP-106 for temporary storage and subsequent feed to the WTP LAW facility. All feed must follow this process for waste acceptance. Evaluation of data produced from the sampling and analysis of feed qualification tank waste are documented in a process control plan, process memo, and associated engineering calculations, which are maintained in the LAWPS Operating Record. Process control plans are prepared to describe and define the specific controls required for waste processing. Each process control plan includes the information described below:

- **Waste Feed Description** – describes the source, volume, and any potential blending data.
- **Objectives** – details the volume estimates and specific gravities expected for each quantity of qualified feed.
- **Feed Qualification Tank Sampling and Analysis Evaluation** – describes the actual sampling and analysis data for each feed qualification tank. This evaluation includes a review of data against the TSCR and WTP LAW facility waste acceptance criteria, and other health and safety controls beyond the scope of the Permit for operation of the TSCR system.
- **Process Controls and Recommendations** – describes the operational limits and conditions based on the objectives and feed qualification tank analytical data.

B.7 Feed Qualification Tank Waste Acceptance Process

This section describes the waste acceptance process that occurs in a feed qualification tank. The following activities are performed to determine if waste feed will meet the TSCR system waste acceptance criteria.

B.7.1 Selecting Feed Qualification Tanks

The DFLAW program has designated 241-AP-107 as the dedicated TSCR system feed tank with the feed qualification tanks being selected from the 241-AP Farm. However, other DST tanks may be used in this capacity if necessary. The initial feed will consist of supernatant waste currently contained in DST 241-AP-107. Subsequently, chemical adjustments and feed qualification activities are performed in the selected feed qualification tanks. As processing empties 241-AP-107, the next quantity of qualified feed will be transferred from the qualification tank, added to the 241-AP-107 heel contents (nominally 24 inches) of supernatant above the solids level), and fed forward to TSCR for processing.

B.7.2 Feed Qualification Tank Sampling

Through development of a tank Sampling and Analysis Plan (SAP), as depicted in Figure B-1, the waste in the tank is sampled and analyzed, and the data is evaluated to confirm waste acceptability. Once developed, SAPs will be kept in the LAWPS Operating Record. Feed qualification tanks are sampled and analyzed to confirm waste acceptability. This WAP reflects the rationale for determining the number of samples in the *Integrated DFLAW Feed Qualification Data Quality Objectives*, RPP-RPT-59494 (as amended).

The minimum number of samples recommended from a statistical analysis of the projected tank waste composition is four (4). This number is considered a minimum because the statistical analysis uses, as inputs, past Tank Farms supernatant sample results and modeling predictions to estimate the standard deviation and mean concentrations of DFLAW feed. Given some uncertainties, additional samples are to be collected to account for the uncertainty in the statistical analysis inputs. Based on Tank Farms operating experience, additional samples are also needed as a contingency for unexpected sample losses. Therefore, six (6) samples of aqueous feed qualification tank waste supernatant from one tank riser will be collected. These samples are adequate to ensure the resulting waste characterization data are of sufficient quantity and quality for the data's intended use.

The six (6) liquid samples will be collected from various subsurface depths in the tank such that the samples are approximately equally weighted (i.e., the samples represent equal volume of waste in the tank). Therefore, sample locations vary for each tank of waste depending on the total liquid depth and will be specified in the SAP. The subsurface samples taken at different depths account for any potential vertical gradient due to density difference. Sampling will be conducted through a single riser because lateral stratification has not been observed in past DST operations as documented in the 242-A Evaporator operating RCRA permit. No solids or sludge samples from the qualification tanks are collected as only supernatant will be treated through TSCR. The samples are sent to a laboratory for analysis and the analytical results are compared to the TSCR waste acceptance criteria.

The number of samples specified in the DQO report provides a planning basis for future tank characterization efforts. Actual feed composition of staged feed may be different from the prediction. Therefore, the number of samples may also be determined for actual staged feed on a tank by tank basis using the latest composition estimate for that feed.

B.7.3 Assessing Feed Qualification Tank Sampling and Analysis Results

Feed qualification tank sampling and analysis, in conjunction with the waste acceptance criteria in Section B.9, are used to assess whether established limits (action values are defined in the *Integrated DFLAW Feed Qualification Data Quality Objectives*, RPP-RPT-59494 [as amended]), and the TSCR system unit-specific conditions and Addendum B, "Waste Analysis Plan" would be exceeded. Based on the results, three possible options are implemented:

- Waste is acceptable for processing within the TSCR system without further actions.
- Waste is unacceptable for processing, but is acceptable if blended with other waste to be processed to satisfy TSCR waste acceptance criteria.
- Waste is unacceptable for processing, and additional evaluation and corrective actions are necessary to establish acceptance.

B.8 Process Effluent Dangerous Wastes Generated From Treatment

Mixed waste streams that are generated as the result of the TSCR processes and are returned to the 241-AP Farm include: treated LAW for transfer to the WTP LAW facility (via 241-AP-106), feed return from TSCR back to AP Farm tank 241-AP-107, solids from filter back-pulsing (to 241-AP-108), and TSCR drain line returns associated with IXC change-out (to 241-AP-108). Sampling of these returns is not necessary under this WAP in order to return the waste back to the DST system as these streams originated from the 241-AP Farm and only differ from the supernatant feed by containing slightly higher solids (with the exception of treated LAW).

Gamma monitoring of treated LAW is performed to confirm that the waste meets the WTP LAW facility cesium waste acceptance criteria.

B.9 Tank Side Cesium Removal System Waste Acceptance Criteria

Waste acceptance criteria for TSCR has been established from regulatory requirements, existing tank waste sample analyses data, and engineering design specifications. Waste acceptance criteria are maximum values of a waste analyte that, if exceeded, informs the operator that management of the waste requires further attention. The rationale for selecting a given analyte for inclusion in this WAP, as required by WAC 173-303-300, is determined in this section for each analyte and/or test. The rationale is depicted in Figure B-1.

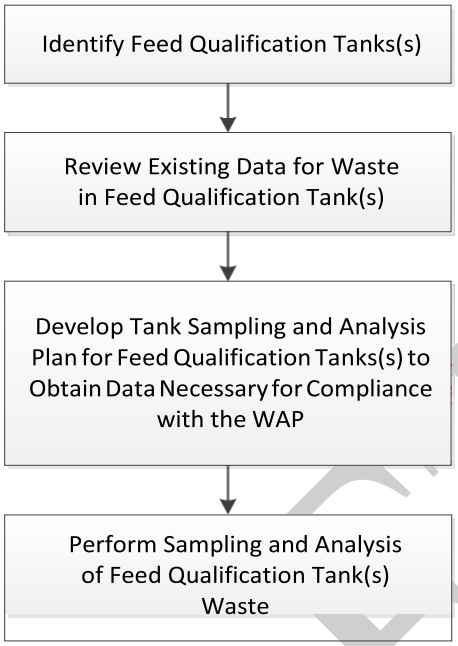

Figure B-1. Tank Side Cesim Removal Waste Acceptance Process

B.9.1 Feed Qualification Tank Waste Acceptance Criteria

The following sections discuss waste acceptance criteria for feed qualification tanks to be processed through the TSCR system.

B.9.1.1 Compatibility

WAC 173-303-640(10) and WAC 173-303-395(1) requires waste handling be conducted to prevent an uncontrolled reaction that could damage the TSCR tank system structural integrity or threaten human health or the environment. To verify there will be no adverse effects prior to blending the contents of different tanks into the 241-AP-107 feed tank, compatibility assessments are performed prior to each waste transfer. These waste transfer compatibility assessments are not within the scope of this WAP.

B.9.2 Feed Qualification Tank Parameters

The following table establishes feed qualification tank analyte parameters. Sample analysis results in excess of the action levels requires additional assessment in accordance with Section B.7.3.

Table B-2. Feed Qualification Tank Waste Analysis Parameters

Feed Acceptance Property	Analytical Parameter	Suggested Analytical Method	Action Level
Cesium-137 Concentration	Cs-137	Gamma energy analysis	≤ 0.3 Ci/L
Cesium-137: Total Cs Ratio	Cs	Inductively coupled plasma/mass spectrometer for Cs-133 (Total Cs is the sum of Cs-133 and Cs-137)	≤ 0.24
Maximum Feed Temperature	N/A	N/A	≤ 35°C Not performed on feed qualification samples. To be measured in-line or estimated from tank waste temperature.
Slurry Density	Density	Gravimetric	≤ 1.35 g/ml
Slurry Viscosity	Viscosity	Viscometer	≤ 8cP
Sodium Molarity Range	Na	Inductively coupled plasma/atomic emissions spectrometer	5-6 M Sodium molarities exceeding this value could be allowed but would have to be evaluated on a case-by-case basis.
Phosphate Molarity	PO_4	Ion chromatography	≤ 0.1 M
Suspended Solids	Total suspended solids	Total suspended solids	< 1.5 wt.%

Note: Radionuclides are not subject to dangerous waste regulation and are included for information only.

B.9.2.1 Feed Qualification Tank Sampling Quality Assurance and Quality Control

For each feed qualification tank waste sample, a sample solution is drawn from the sample riser using one or more sample bottles. Sample bottles are pre-cleaned, glass bottles sealed with Teflon™[1] caps or septum caps. Each sample bottle is labeled with a unique identification number. Once taken, the sample is capped and placed into a shielded shipping cask. A custody seal or tape is used to verify that the sample was not tampered with during shipping.

For qualification feed tank sampling quality control, one field blank and one field duplicate are taken during the sample event. An equipment blank is not needed because the weighted bottle method is used, the sample bottle is the sampling device and the field blank serves the same function as an equipment blank. A trip blank is not required because volatile organic analysis is not performed on the samples. The field blank uses the same type of sample bottle as the waste samples and is filled with reagent-grade water before shipment to the field. The field blank and field duplicate are analyzed for the same chemical parameters as the waste samples (i.e., not including density, viscosity, and total suspended solids). Field QC samples and evaluation criteria are summarized in Table B-3.

[1]Teflon is a trademark of E.I. DuPont de Nemours & Company

Preservatives are not used with qualification feed tank samples because of concerns with high radiation exposure that would result from additional handling of sample solutions. Also, tank waste samples are caustic and preserving by adding acid might alter the sample characteristics (e.g., precipitation of solids changes the liquid composition). It is not practical to refrigerate the bulky, shielded sample pigs and shipping containers. Biological activity, generally the largest problem in environmental samples, is unlikely in qualification feed tank samples because of the high salt content, pH, and radioactivity of the sample.

The chain of custody is documented on a data sheet that includes a unique sample number, date and time sample was taken, and signature of the sampler. When possession of the sample is transferred to other persons, such as the shipper or laboratory, the signature of the relinquisher and receiver are recorded, along with date and time of the transfer. The receiver at the laboratory also verifies that the custody seal or tape is intact. The chain-of-custody data sheets are included in the operating record.

B.10 Analytical Methods and Quality Assurance and Quality Control

This section provides information on the analytical methods and Quality Assurance/Quality Control (QA/QC) for feed qualification tank samples, including discussions concerning laboratory selection and analytical methods.

B.10.1 Laboratory Selection

Because of the nature of the samples, it is anticipated that feed qualification tank waste sample testing will be conducted at the 222-S Laboratory Complex. Other laboratories at the Hanford Facility could be used provided they are equipped to handle such samples and are accredited to perform the required analysis. Laboratory selection depends on availability, analytical needs, accreditation, and the ability of the laboratory to meet Permit and QA requirements.

B.10.2 Analytical Methods

The analytical methods for testing feed qualification tanks are included in Table B-2. Performance-based specifications rather than procedure-based specifications are used for determining the appropriate analytical methods. This allows for necessary adjustments to the methods for Hanford Facility-specific issues; related to high radioactivity of the sample matrix, while ensuring acceptable data quality. Because of the high radioactivity, the analytical method can deviate from those in national standards such as *Test Methods for Evaluating Solid Waste*, SW-846.

B.10.3 Laboratory Quality Assurance and Quality Control

Any laboratory performing analyses in support of feed qualification shall conduct work in accordance with a laboratory QA plan. The QA plan is reviewed by Department of Energy (DOE) and/or its Tank Farms contractor for acceptability.

Laboratory QC monitors the quality of the analytical methods. Specifically, QC results are compared to established evaluation criteria to determine if the analytical system performs properly when the analysis is conducted. Evaluation criteria, typically included in the laboratory QA plan, could be administrative limits specified in the standard methods upon which the laboratory procedure is based or performance-based limits established through statistical process control (SPC). SPC limits are statistically determined by multiple analyses over time. The U.S. Environmental Protection Agency encourages the use of performance-based criteria so SPC limits should be used whenever available. All data not meeting the QC acceptance criteria shall be flagged with appropriate qualifiers and discussed in the narrative of the data report.

Appropriate QC checks are typically recommended in the standard methods but not all the QC checks are performed on all methods; e.g., matrix spike and matrix spike duplicate analysis is typically not performed on radiological methods. Laboratory QC includes:

- A preparation blank sample (also called a method blank sample) is used to monitor contamination resulting from the sample preparation process. Preparation blanks are generally high-purity reagent grade water subjected to the same processing as the field samples.
- A laboratory control sample is used to monitor the effectiveness of the sample preparation process. The laboratory control sample consists of a media similar in nature to the matrix of the sample being processed and the analytes-of-interest at known concentration (e.g., a standard).
- A matrix spike sample is a sample that has been spiked with the analytes of interest and is processed in the same manner as the sample. The matrix spike is used to estimate method accuracy in a specific sample matrix.

At a minimum, frequency for QC analyses (duplicates, matrix spikes, blanks, laboratory control samples) shall meet requirements in the standard methods. Where standard methods are not available, (e.g., radionuclide analyses), the frequency will meet requirements established in laboratory QA plans and/or procedures. Duplicate analyses shall be performed for all chemical analyses (i.e., not including density, viscosity, and total suspended solids). Laboratory QC samples and evaluation criteria are summarized in Table B-3.

Table B-3. Field and Laboratory Quality Control Requirements

QC Type		Minimum Frequency	Required Analyses	Acceptance Criteria
Field QC	Duplicate	Each sampling event	Same as tank waste samples (listed in Table B-2 except density, viscosity, and total suspended solids).	RPD ≤ 20%
	Equipment blank – not required	N/A	N/A	N/A
	Field blank	Each sampling event	Same as tank waste samples (listed in Table B-2 except density, viscosity, and total suspended solids).	Blank result ≤ 5% of sample result.
	Trip blank – not required	N/A	N/A	N/A
Laboratory QC[(a)]	Preparation (method) blank	Each batch	Method specific	Per laboratory QA plan, preferably SPC limits.
	Laboratory control standard	Each batch	Method specific	Per laboratory QA plan, preferably SPC limits.
	Matrix spike	Each batch	Method specific	Per laboratory QA plan, preferably SPC limits.
	Duplicate/matrix spike duplicate	Each batch	Method specific	Per laboratory QA plan, preferably SPC limits.

Note:

[(a)] Not all QC checks can be performed for each analytical method. Consult the laboratory QA plan to determine applicability.

Abbreviations: QA = quality assurance, QC = quality control, RPD = relative percent difference, volatile organic analysis, SPC = statistical process control, N/A = not applicable.

B.10.4 Data Evaluation

An initial data review is performed by the laboratory in accordance with the laboratory QA Project Plan. Data rejected because of major errors are discarded and reanalysis performed. Minor anomalies found during the data review are included in the data report with appropriate qualifiers.

The reported data are reviewed further by the data users (Tank Operations Contractor/WTP personnel). This review focuses on data completeness, sample integrity prior to analysis, and quality of analysis. The review include but is not limited to the following checks:

- Verify all required analyses were performed.
- Verify unbroken chain-of-custody from sampling through analysis.
- Verify analyses were performed within the required holding times.
- Review field blank results to verify samples were not compromised by contamination.
- Verify sample results meet the specified Required Detection Limits.
- Verify field a QC results are within the acceptance criteria.
- Review sample results that are flagged with QC qualifiers.

Usability of data not meeting requirements or criteria is evaluated on a case-by-case basis. This evaluation is based on the actual quality of the data in question and the impact of using such data.

B.10.5 Sampling Analysis Plan

A SAP will be developed to provide clear directions to the sampling organization and the laboratory for sample collection and analysis in support of decision to transfer and accept the staged feed. Information in the SAP will be organized in a manner that make it easier for these organizations to review the requirements and perform the work. The SAP may include the following information or cite the appropriate reference for the information, as appropriate:

- Sample locations (e.g., riser and depths for the feed tank), sample quantity, and sample handling.
- Sample integrity requirements (e.g., sample labeling, chain-of-custody, special sample handling, holding times).
- Information for shipping radioactive samples.
- Requirements for receiving and initial handling of the samples by the laboratory.
- Subsampling and/or compositing in the laboratory for analyses.
- Suggested analytical methods for analysis.
- Data reporting requirements.
- Change control requirements.

A SAP may be prepared for each tank of staged feed. Alternatively, a standing SAP may be prepared for multiple tanks of staged feed. The standing SAP contains requirements that do not change from tank to tank (e.g., analyses, QA/QC, data reporting requirements). The requirements that change with each tank of feed (e.g., sample identification numbers, sample locations) will be developed as needed and implemented accordingly. As SAPs are completed, they will be maintained in the LAWPS Operating Record.