SYSTEM DESIGN DESCRIPTION FOR AY/AZ TANK FARMS DOUBLE-SHELL TANK WASTE STORAGE SYSTEM
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ABSTRACT

This system design description of the AY/AZ Tank Farms double-shell tank waste storage system is intended to be a living compendium of design requirements, design baseline, and system descriptions. The system design description includes references to relevant procedures, drawings, calculations, and supporting documents. It is written to the outline provided in DOE-STD-3024-2011, *Content of System Design Descriptions*. All section headings from DOE-STD-3024-2011 are included. If no information is available or relevant for a section heading, the heading is included as a place holder, and the statement “*Information not readily available*” is inserted. If the information becomes available or required at a later time, it will be included to the extent possible.
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1.0 INTRODUCTION

The history of the tank farms at the Hanford Site centers around the need for tank storage space for radioactive, liquid, and slurry wastes that were generated by reprocessing activities at the Hanford Site. This included waste from recovery of uranium, plutonium, neptunium, various types of laboratory waste, and “aging waste” produced by the Plutonium Uranium Extraction (PUREX) Plant during the years of the Hanford Site’s defense mission. The underground tanks at the 200 Areas tank farms were designed for interim storage of the nuclear wastes until they could be processed for long-term storage. These waste storage tanks are buried round, domed tanks with steel liners and concrete shells.

The AY and AZ Tank Farms double-shell tanks (DST) systems consist of four double-shell, underground waste storage tanks. The tanks are designated as “aging-waste” tanks. The two DSTs in the AY Tank Farm, numbered 241-AY-101 and 241-AY-102, and the two DSTs in the AZ Tank Farm, 241-AZ-101 and 241-AZ-102, are of similar design. The AY and AZ tanks are 1-Mgal tanks, geographically located in the same bounded area. The design was a modified AX Tank Farm single-shell tank (SST) design, which used a tank-in-tank (double-shell) design concept with a stress-relieved carbon steel liner. The design improvements over previous AX Tank Farm tanks were refinements based on high-heat testing of the tank steel and concepts borrowed from other DOE sites. See Section 4.1.1.1 for a more detailed description of tank construction. Other than minor pit modifications and the addition of primary ventilation systems, no substantive structural changes have been made since the original construction.

The AY Tank Farm design occurred between March 1967 and September 1968 and was originally known as Project IAP-614 “PUREX Tank Farm Expansion,” and “PUREX AY Tank Farm”. The AY Tank Farm was constructed between 1968 and 1971 at a location west of the existing AX Tank Farm. Later, AZ Tank Farm design, known as HAP-647 “PUREX AZ Tank Farm,” occurred between January 1970 and September 1972. The AZ Tank Farm was constructed between 1971 and 1977 at a site located to the north of the AX Tank Farm. Figure 1 shows aerial photographs of the AY and AZ Tank Farms taken in January 2011. Figure 2 shows a general plan view layout of the AY and AZ Tank Farms.

The AY and AZ structures, systems, and components (SSC) are described in this document together where similarities exist. Otherwise, the AY Tank Farm and AZ Tank Farm are described separately so that distinctions or differences are clear.
Figure 1. AY and AZ Tank Farms Aerial Views.
Figure 2. AY and AZ Tank Farms Layout Plans.
The purpose of this system design description (SDD) is to provide information related to the specific AY and AZ Tank Farms DST waste storage system in a manner that can be used effectively and efficiently. Chapter 1 identifies the system, including subsystems and components, and discusses the SDD limitations and ownership of the SDD. Chapter 2 provides an overview of the AY and AZ Tank Farms DST waste storage system and includes statements of the safety functions and other functions assigned to the system, the overall classification of the system, and a basic operational overview. Chapter 3 identifies the requirements for the system and the bases for those requirements, and explains how the requirements are met. Chapter 4 provides a detailed description of the subsystems and their components. It also describes in more detail the boundaries and interfaces with other systems, system operations and principles of operation, testing and maintenance introduced in Chapter 2, and any supplemental information.

1.1 SYSTEM IDENTIFICATION

The AY and AZ DST waste storage system includes the primary and secondary tank structure; concrete liner, insulating pad, and foundation; central pump pit; sluice pits; annulus pump pit; leak-detection pit (and well); and monitoring and alarm subsystems associated with the waste storage function.

The scope of this SDD for the AY Tank Farm is represented by Hanford Site Drawings H-14-020506, Sheets 1 through 3, Waste Storage Tank Annulus System (WSTA) O&M System P&ID and H-14-020606, sheets 1 and 2, Waste Storage Tank System (WST) O&M System P&ID.

The scope for the AZ Tank Farm is represented by the Hanford Site Drawings H-14-020507, sheets 1 through 3, Waste Storage Tank Annulus System (WSTA) O&M System P&ID, and H-14-020607, sheets 1 through 3, Waste Storage Tank System (WST) O&M System P&ID.

Waste storage tank (WST) and waste storage tank annulus (WSTA) are subsystem designations used by the Tank Farm Contractor to describe functional elements associated with the tank annulus and primary tank SSCs, respectively. The DST waste storage system description contains all of the functions (process, safety, environmental, and support) of the WSTA and WST subsystems, but this SDD makes no further reference to distinctions between the WSTA and WST and describes the entire DST waste storage system as a whole.

The AY and AZ DST waste storage system is a component of the Hanford Site DST system as defined in HNF-SD-WM-TRD-007, System Specification for the Double-Shell Tank System. Other supporting systems that interface with the AY and AZ DST waste storage systems include the following:

- Waste transfer system
- Electrical distribution system
- Ventilation tank primary
- Ventilation tank annulus
- Emergency annulus pumping system
- Raw water system
- Instrument air system
- Service air system
- Tank Monitor and Control System (TMACs).
- Tank farm MCS
- Chemical (base)
- Fire protection
- Gas characterization
- Glycol cooling
- Retrieval/Closure
- Standard hydrogen monitoring

1.2 LIMITATIONS OF THIS SYSTEM DESIGN DESCRIPTION

The SDD is a central coordinating link among the engineering design documents, the facility safety basis, and the implementing procedures. The SDD is a compilation of information intended primarily for use by facility operation, maintenance, and technical support personnel. The SDD is not a part of the safety basis.

The SDD is formatted to be consistent with DOE-STD-3024-2011 and is based on the best available information, including interviews with knowledgeable personnel. This SDD was written after the system was designed and installed, and operations had begun. It necessarily relies on historic information. Where information was not available or was judged too difficult or impossible to recover or recreate, the following statement is included in the standard format as a placeholder: (Information not readily available). If a future user of the SDD discovers, recovers, or recreates the missing information, they should forward that information to the SDD owner for incorporation.

Chapter 3 of this SDD addresses the system requirements and bases, and provides an assessment of how the design meets the requirements. A formal assessment of how the actual as-built structures, systems, and components (SSC) in the field meet the requirements is beyond the scope of the SDD, all essential and key support drawings were walked down and field verified by one of the RA projects in 2010/2011.

This SDD includes all SSCs for the system that are actually installed in the field, whether or not they are or were ever in operation. Designed or planned facility modifications and additions for ongoing projects were not included in the SDD. The intent is to update or replace this SDD with new project information as part of the project turnover to Operations personnel for beneficial use.

1.3 OWNERSHIP OF THIS SYSTEM DESIGN DESCRIPTION

The owner of this document is the System Engineer for the system described herein who has been formally assigned responsibility by the Engineering Management organization of the Tank
Farm Contractor. Any changes to this SDD document shall be approved by the assigned system engineer.

The Washington River Protection Solutions, L.L.C. (WRPS), system engineer assigned to the waste storage tank and waste storage tank annulus (WST/WSTA) systems is responsible for the accuracy and technical content of this SDD. Any questions on the system or content of this document shall be resolved through the system engineer. Changes to this SDD are controlled by Procedure TFC-ENG-DESIGN-P-07, System Design Descriptions.

1.4 DEFINITIONS/GLOSSARY

Administrative Controls. Administrative Controls (AC) are the provisions relating to organization and management, procedures, recordkeeping, assessment, and reporting; the safety management programs; and the directed action SPECIFIC ADMINISTRATIVE CONTROLS (SAC) and AC Key Elements necessary to ensure safe operation of a facility. The ACs include administrative requirements that ensure Technical Safety Requirement (TSR) requirements are met in the operation of the facility, and the procedures that are followed should a TSR not be met. Also included in the ACs are commitments to maintain safety management programs (SMP). Details of the SMPs are described in the programmatic chapters of RPP-13033. SACs and AC Key Elements are derived from the hazard and accident analyses in RPP-13033, Chapter 3.0.

ALARA. The philosophy of making every reasonable effort to maintain exposures to radiation as low as reasonably achievable (ALARA).

ALARACT. The use of radionuclide emission as low as reasonably achievable control technology that achieves emission levels that are consistent with the philosophy of ALARA.

Aging Waste. High-level, first cycle solvent extraction waste from the PUREX Plant.

Confinement. Engineered barriers (e.g., ventilation systems) designed to prevent or minimize the spread of radioactive and other hazardous materials contained within a nuclear facility or within the normal or off-normal facility effluents.

Confinement Ventilation. In a facility that contains radioactive or other hazardous materials, negative pressure is maintained by a ventilation system. A controlled, continuous airflow pattern is thus maintained from the environment into the facility and out through a filtered exhaust system that traps any entrained radioactive particulate.

Continuous Air Monitor. An instrument that monitors the radioactivity level in the exhaust air stream. A small fan draws a representative sample of the exhaust air stream through the continuous air monitor (CAM) detection chamber, and the radioactivity in the sample stream is measured.

Design Authority. The organization responsible for establishing the design requirements and ensuring that design output documents appropriately and accurately reflect the design basis. The design authority is responsible for design control and ultimate technical adequacy of the engineering design process. These responsibilities are applicable whether the process is
conducted fully in-house, partially contracted to outside organizations, or fully contracted to outside organizations. The Engineering organization fills the role of the “Design Authority” for Tank Farm facilities. All references to Design Authority in other documents shall be interpreted as a reference to the Engineering organization (TFC-PLN-03, Engineering Program Management Plan).

**Design Feature.** Design Features means the design features of a nuclear facility specified in the TSRs that, if altered or modified, would have a significant effect on safe operation. Design Features are normally passive characteristics of the facility not subject to change by operations personnel, and do not require, or infrequently require, maintenance or surveillance. For additional information on Design Features please see HNF-SD-WM-TSR-006, *Tank Farms Technical Safety Requirements*, Section 1.12, “Design Features”.

**Double-Shell Tank.** A tank designed for storing the highly radioactive and hazardous waste produced at the Hanford Site. The primary tank shell contains the waste and is surrounded by a secondary shell to provide waste containment if the primary shell develops a leak.

**Flammable Gas.** Primarily hydrogen and ammonia gas that can be released from the tank waste into the tank vapor space.

**Functional Test.** Functional tests are developed to evaluate the performance of the safety-significant SSCs. Functional tests are performed on selected safety-significant SSCs where it is practical to verify system functional safety criteria.

**Hanford Site.** A 1518 km² (586 mi²) nuclear processing site located in south-central Washington State and operated by the U.S. Department of Energy.

**Head Space.** The vapor-containing portion of a waste tank from the top of the waste surface to the top of the tank dome.

**Limiting Conditions for Operation.** LCOs are the lowest functional capability or performance level of safety SSCs (and their support systems) required for normal, safe operation of the facility. All safety-significant SSCs were developed as Design Features; therefore, there are no LCOs for SSCs in the TSR. Consistent with DOE-STD-1186-2004, SACs that are identified to prevent or mitigate an accident scenario and that have a safety function that would be safety class or safety significant if the function were provided by an SSC may also be included in the TSRs as LCOs. The LCOs identified for tank farm facilities are identified in RPP 13033. Detailed bases for the LCOs are provided in the referenced Chapter 4.0 of RPP13033 and the TSR document.

**Limiting Control Settings.** Limiting Control Settings (LCS) are set-points on safety systems that control process variables to prevent exceeding safety limits (SLs). The specific set-points are chosen such that, if exceeded, sufficient time is available to automatically or manually correct the condition before exceeding SLs.

**Mode.** Modes are used (1) to determine SL, Limiting Control Setting (LCS), LCO, and Administrative Control (AC) applicability; (2) to distinguish facility operational conditions; and
(3) to provide an instant facility status report. Facility operational MODES are not defined for the tank farm TSRs.

**Recovery Plan.** A recovery plan identifies specific activities for restoring inoperable safety equipment to an Operable status or restoring safe operating limits, when required by LCO ACTIONS or ACs. Recovery Plans shall be approved by the U.S. Department of Energy (DOE), Office of River Protection (ORP).

**Safety Basis.** The documented safety analysis and hazard controls that provide reasonable assurance that a U.S. Department of Energy nuclear facility can be operated safely in a manner that adequately protects workers, the public, and the environment (Title 10 *Code of Federal Regulations* (CFR) Part 830.3, “Nuclear Safety Management,” “Definitions”).

**Surveillance Requirements.** Surveillance Requirements (SR) are requirements relating to testing, calibration, or inspection of safety structures, systems, and components (SSC) or conditions. The purpose of SRs is to confirm the availability, operability, and quality of safety SSCs, or to verify that specific plant conditions exist that are required to maintain the facility’s operations within the Safety Limits (SLs), Limiting Control Settings (LCSs), and Limiting Condition for Operations (LCOs). SRs ensure that safety SSCs will function when required or that parameters are within limits (e.g., temperature) to preserve the validity of the safety analysis and the resulting safety envelope. If a safety SSC is out of service or is inoperable, it cannot perform its required safety function.

**System Engineer.** The engineer designated by the organization to each system to which the System Engineer Program applies. The system engineer maintains overall cognizance of the system and is responsible for system engineering support for operations and maintenance. The system engineer provides technical assistance in support of line management safety responsibilities and ensures continued system operational readiness. (DOE-STD-1073-2003)

**Technical Safety Requirements.** The limits, controls, and related requirements necessary for the safe operation of a nuclear facility and, as appropriate for the work and the hazards identified in the documented safety analysis for the facility, includes safety limits, operating limits, surveillance requirements, administrative and management controls, use and application provisions, and design features, as well as a bases appendix. For the tank farms at the Hanford Site, technical safety requirements (TSR) are found in HNF-SD-WM-TSR-006, *Tank Farms Technical Safety Requirements*.

**Waste Characterization.** Performed in each tank (identifying the type, form, and quantity of radiological and chemical constituents) to control the hazards associated with the radioactive waste.

**Waste Concentration.** Concentrating and evaporating low-heat-producing waste to reduce the volume and generate more available space.

**Waste Control.** During storage activities, water or caustic solution (sodium hydroxide) may have to be added when the hydroxyl ion concentration is less than the minimum level required to control corrosion of the primary tank wall and precipitation of fissile material.
Waste Storage. Tanks receive and store waste either from processing activities or from other tanks.

Waste Transfer. Movement of waste though piping systems between storage tanks and/or facilities.

1.5 ACRONYMS

AC administrative control
ALARA as low as reasonably achievable
ANSI American National Standards Institute
ASME American Society of Mechanical Engineers
CAM continuous air monitor
CASS Computer-Automated Surveillance System
CFR Code of Federal Regulations
CH2M HILL CH2M HILL Hanford Group, Inc.
DBE design basis earthquake
DCRT double contained receiver tank
DOE Department Of Energy
DST double-shell tank
Ecology Washington State Department of Ecology
EDMS Engineering Document Management System
FSAR final safety analysis report
HIHTL hose in hose transfer line
HMI human machine interface
LCO limiting condition for operation
LCS limiting control setting
MCS Monitor and Control System
OBE operating basis earthquake
PUREX Plutonium Uranium Extraction (Plant)
RILS Rim Information Locator System
RPP River Protection Project
SAC specific administrative control
SDD system design description
SSC structure, system, and/or component
SST single-shell tank.
TE temperature element
TMAC Tank Monitor and Control System
TOC Tank Farm Operating Contractor
TSR technical safety requirement
WAC Washington Administrative Code
WRPS Washington River Protection Solutions, L.L.C.
WST waste storage tank
WSTA waste storage tank annulus
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2.0 GENERAL OVERVIEW

The tank farm DST system performs a significant part of the River Protection Project (RPP) mission described in RPP-RPT-41742, *River Protection Project Mission Analysis Report*. As stated in the report, the purpose of the DST waste storage systems is to provide safe storage (confinement) for the radioactive, mixed, or hazardous waste assigned to it and to allow for waste transfer, characterization, and monitoring.

The AY and AZ Tank Farms were built to handle high-level radioactive liquid waste. By 1967, the waste streams produced by the PUREX Plant and B Plant processes, as well as waste transferred from older tanks, required additional waste tank storage space. Some of the waste streams from the PUREX Plant were characterized as self-concentrating by boiling. SSTs (in the A Tank Farm) containing self-boiling waste had incurred catastrophic failures in steel liners and excessive stress in concrete base slabs, caused by temperatures in the range of 300 ºF to 325 ºF (with brief periods recorded as high as 500 ºF in 241-AY-101). Thus design temperatures of the new tanks were set to a maximum of 350 ºF. It also was determined that stress corrosion cracking could occur in aqueous solutions of nitrate ions. Full stress relieving by heat annealing was the best known protection against stress-corrosion cracking of carbon steel. (See Letter LET-080167, “Project IAP-614 PUREX Tank Farm Expansion,” dated August 1, 1967). Previous SST designs relied on the steel tank liner for containment and the steel-reinforced concrete shell for structural integrity.

The following design features summarize major design improvements for the new generation of DST tanks over the designs of the previous AX Tank Farm SST design:

- Tank-in-tank concept; primary carbon steel liner with a secondary carbon steel liner forming a 2.5-ft annular space between the tank walls
- In-place heat annealing of the primary liner for stress relief
- Insulating concrete pad beneath the primary tank to provide air flow and leak detection
- Other changes to the footing, base slab, and concrete shell design to accommodate maximum loads as indicated by computer stress analysis.


The design of the tanks, piping, and pumping systems in the tank farms allows waste from any tank in the farm to be transported to and from any other tank in the tank farm and to and from other tank farms. However, the tanks in the AY and AZ Tank Farms serve different purposes. The current use for each tank is listed in Table 1.
Table 1. Current Uses for Tanks in the AY and AZ Tank Farms.

<table>
<thead>
<tr>
<th>Tank</th>
<th>Current Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>241-AY-101</td>
<td>Stores wastes received from DSTs or SSTs. In addition, 241-AZ-301 Catch Tank receives condensate from the 241-AZ-702 ventilation system and periodically pumps the condensate (400 gallons every other day) to 241-AY-101.</td>
</tr>
<tr>
<td>241-AY-102</td>
<td>Stores waste and high-heat waste solids from Tank 241-C-106 and AZ-301 catch pumps condensate from AZ Primary Vent system to AZ-102</td>
</tr>
<tr>
<td>241-AZ-101</td>
<td>Stores supernate waste received from other DSTs as well as stores PUREX aging waste (high heat waste solids only)</td>
</tr>
<tr>
<td>241-AZ-102</td>
<td>Stores supernate waste received from other DSTs as well as stores PUREX aging waste (high heat waste solids only). In addition, 241-AZ-301 catch tank receives condensate from 241-AZ-702 ventilation system and periodically pumps the condensate (400 gallons every other day) to 241-AZ-102.</td>
</tr>
</tbody>
</table>

Note: The most current supernatant waste types in storage for the individual tanks can be found in the monthly HNF-EP-0182, Waste Tank Summary Report, Table A-1.


The waste flows in and out of the DST system are shown in Figure 3. For a comprehensive diagram of the typical AY and AZ DST arrangement of subsystems and components and typical interfaces with other systems, see Figure 4. Figure 5 shows a pictorial view of a section through a waste storage tank, typical for Tanks 241-AY-101, 241-AY-102, 241-AZ-101, and 241-AZ-102.

2.1 SYSTEM FUNCTIONS/SAFETY FUNCTIONS

The AY/AZ DST waste storage system functions are subdivided into the categories of process, safety, environmental protection, and support. The categories are addressed in the following paragraphs.

2.1.1 Process Functions

The process functions of the AY/AZ DST waste storage system are as follows:

- Provide underground storage to isolate the waste from the environment and to avoid human exposure until final disposition
- Provide access to the waste via risers and pits
- Store waste, including waste from the SST system, external waste generators, and other DST tanks
- Characterize Waste in terms of its physical, chemical, and radiological compositions.
- Maintain waste in conditions suitable for safe storage and waste transfer by treating the waste (mixing, aerating, sluicing, chemical processing)
- Detect leakage from the primary tank and provide alarms and alarm annunciation to alert operators to take action
- Detect leakage into the annulus via Enraf ¹ level gauge probes in the annulus.
- Detect leakage into the annulus via CAMs in the annulus exhaust. (CAM systems are not required to be operational and can be shut down or reactivate if needed.)
- Monitor waste temperature in the primary tank, detect off-normal conditions, and provide annunciation to alert operators.

Figure 3. Double-Shell Tank System Site Interface Diagram

¹ ENRAF is a trademark of Enraf B. V. The Netherlands.
Figure 4. Schematic and Boundaries Diagram for a Typical AY/AZ Double-Shell Tank Waste Storage System.
Figure 5. Double-Shell Tank Composite Cross-Section, Typical for AY and AZ Tanks.
2.1.2 Safety Functions (Safety Basis)

There are no Safety Class or Safety Significant equipment specified in RPP-13033, *Tank Farms Documented Safety Analysis*, are associated with the AY/AZ Tank Farm DST Waste Storage System. Programs described in the administrative controls (AC) in HNF-SD-WM-TSR-006, *Tank Farms Technical Safety Requirements*, imply that some general service equipment be functional (e.g., waste level monitoring). Functional requirements for such equipment are discussed in Chapter 3 of this SDD.

2.1.3 Environmental Protection Functions

The environmental protection functions of the AY/AZ DST waste storage system are as follows:

- Contain materials (confinement) and prevent releases to the environment.
- Mitigate the consequences of any accidental environmental releases or leakage.
- Detect leakage from the secondary tank by collecting and monitoring drainage onto the tank foundation pan (leak-detection pit).
- Limit release of aerosols into the atmosphere through proper tank and riser design.
- CAM systems are not required to be operational and can be shut down or reactivated if needed.

2.1.4 Support Functions

The support functions of the AY/AZ DST waste storage system are as follows:

- Provide and maintain waste treatment equipment necessary to support the process functions.
- Provide and maintain monitor and control equipment, including suitable enclosures, control panels, conduit, cable, tubing, valves, and electrical components, necessary to support the system monitor and alarm functions.
- Provide and maintain service connections from other systems interfacing with components of this system.
- Provide shielding for worker protection (passive):
  - Provide adequate tank overburden
  - Provide adequate pit cover blocks
  - Provide adequate riser terminations (plugs).
2.2 SYSTEM CLASSIFICATION

The AY/AZ DST waste storage system is classified as general service. Some SSCs located near DSTs are designated as Safety Significant (Waste Transfer Primary Piping, HIHTL Primary Hose Assemblies, Isolation Valves for Double Valve Isolation, etc.). This Safety-Significant equipment and the related safety functions are described in the waste transfer and ventilation SDDs and so will not be described in this document.

2.3 BASIC OPERATIONAL OVERVIEW

The DST waste storage system operations are basically passive because the tank is intended to safely store high-level radioactive waste. Waste is pumped into the primary tank for interim storage. The waste is monitored for level, temperature, density, and dome-space pressure. The tank structure is monitored for temperature. The annulus space is monitored for liquid that may have leaked from the primary tank. The secondary tank and concrete shell are monitored for temperature and leakage into the leak-detection pit.

The structural integrity of the tank is maintained to allow safe confinement of the waste and prevent the release of radioactive contaminated material to the atmosphere or into the ground. Periodically, the tanks are inspected for corrosion and the risk for leakage is assessed. Occasionally, the waste must be treated by mixing (via mixer pump, waste transfer pump recirculation, or air lift circulators) or aeration (via air lift circulators) to maintain the desired characteristics for storage, or heated (via steam heating coils) to maintain required waste temperatures.

Facility operational modes are not defined for the tank farm TSRs in either the DSA or the TSR. The operational conditions when the tank farm LCOs and associated Surveillance Requirements, ACs, and Design Features are required are specifically stated in the applicability section of the TSRs. In this SDD, Section 3.7.2, “Technical Safety Requirement-Required Surveillance,” identifies required surveillances on associated equipment.
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3.0 REQUIREMENTS AND BASES

This section identifies the requirements for the AY/AZ DST waste storage system. In some subsections, original design and construction requirements are included for information. Where the original requirements are included, they are identified as such. If the requirements are not identified as “original,” they are intended to be the currently applicable requirements for modifications or additions to the system. Modifications and additions to the system shall adhere to the requirements in the following Level-1 and Level-2 specifications:

- HNF-SD-WM-TRD-007 Double-Shell Tank System Specification
- HNF-4155, Double-Shell Tank Monitor and Control Subsystem Specification
- HNF-4157, Double-Shell Tank Utilities Subsystems Specification (including electric, raw and potable, and service and instrument air subsystems)
- 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
- TFC-ENG-STD-07, Ventilation System Standard

The Level-1 specification in this list is HNF-SD-WM-TRD-007. It establishes the functional, performance, design, development, interface, and test requirements for new DST systems that are applicable to the RPP mission described in RPP-RPT-41742 River Protection Project Mission Analysis Report. The remaining specifications are for Level-2 subsystems of the Level-1 system specification. Where applicable, all new work associated with this system shall comply with the codes, standards, and regulations established by the DST system and subsystem specifications.

3.1 REQUIREMENTS

Requirements are results of the engineering design process that define what has been required. Requirements are typically defined on design output documents (such as drawings and specifications) that specify the functions, capabilities, capacities, physical dimensions, limits, set-points, etc. for a structure, system, or component.
3.2 BASES

Bases explain why requirements exist and why they have been specified in a particular manner or at a particular value during the engineering design process. Basis information is delineated in design input information, design constraints, and intermediate outputs, such as design studies, analyses, and calculations. The basis encompasses consideration of such factors as facility mission, facility availability, facility efficiency, costs, schedule, maintainability, and safety. (10 CFR 830).

3.3 REFERENCES

Specific references are essential to understanding and using the SDD. Reference to source documents from which requirements and basis information have been extracted adds traceability to the SDD and improves its credibility. To the extent that such reference documents are available, the source documents that contain the cited requirements or the bases information are referenced in the SDD. If the requirement or basis information is not recorded in a separate document, the documentation no longer exists, or retrieval of such a document is not feasible, the basis notes that a documented reference is not available.

3.4 GENERAL REQUIREMENTS

The AY Tank Farm and the AZ Tank Farm requirements are described in this section together, where similarities exist, and are referred to as “AY/AZ.” Otherwise, the AY Tank Farm and the AZ Tank Farm are mentioned individually so that distinctions or differences are clear.

3.4.1 System Functional Requirements

3.4.1.1 Process Functional Requirements

Requirement: (AY Tank Farm) Provide two 1-Mgal double-shell, underground waste storage tanks to supplement the single-shell salt cake storage tanks and provide additional high-level waste storage capacity in the 200 East Area of the Hanford Site. (AZ Tank Farm) Provide two 1-Mgal double-shell underground waste storage tanks to supplement the single-shell salt cake storage tanks and provide additional high-level waste storage capacity in the 200 East Area of the Hanford Site.

Basis: (AY Tank Farm) ARH-205-1, Design Criteria PUREX 241AY Tank Farm, Section 2, “Design Criteria,” and Letter #MM-041668, “Project IAP-614 PUREX Tank Farm Expansion Location of Tanks,” dated April 16, 1968, which indicates two tanks, rather than four. (AZ Tank Farm) ARH-1437, Design Criteria, PUREX AZ Tank Farm, Section 2, “Design Criteria.”

How Requirement is Met: (AY Tank Farm) Project IAP-614, for two 1-Mgal (nominal) underground waste storage tanks, was completed. Tank 241-AY-101 was placed into service in 1971, and Tank 241-AY-102 was placed into service in 1976. (AZ Tank Farm) Project
HAP-647, for two 1-Mgal (nominal) underground waste storage tanks, was completed. Tank 241-AZ-102 was placed into service in 1975 and Tank 241-AZ-101 was placed into service in 1977. Evidence of correct size and location of the tanks is shown in the as-built design drawing listed in Appendix B.

**Requirement:** Double-Shell Tank leak detection and overfill protection equipment must be able to detect failure of primary or secondary containment structure.

**Basis:** RPP 16922, *Environmental Specification Document* Section 5.4, page 5-6., [WAC 173-303-640(4) & (5)].

**How Requirement is Met:** The primary tank liquid leak-detection systems provide an alarm on detection of tank waste from misroutes or other system leaks into the tank annulus. The alarm is intended to alert operators to take action to stop the accumulation of waste in the annulus. Two mechanisms located in the annulus space provide the leak-detection for the primary tank: the CAM system for the annulus and the Enraf liquid level gauge system. The CAM system is considered supplemental and may not be used as a replacement for primary leak detection systems. Leak-detection for leaks from the secondary tank is monitored through the use of a leak detection pit/well system.

**Requirement:** The primary tanks waste liquid levels shall be controlled between specified maximum and minimum levels per OSD-T-151-00007, Section 1.1, ”Liquid Levels.”

**Basis:** OSD-T-151-00007, Appendix B, discusses the technical basis for the maximum and minimum levels in the tank.

**How Requirement is Met:** Section 4.1.1.9.3, “Waste Level Monitoring,” Discusses level monitoring instrumentation. Maximum liquid height is set by the sidewall process lines and differs for AY and AZ tanks. Minimum levels for both tanks are to prevent annulus contamination by vapor. (Note; other levels within the maximum or minimum tank level may be required for certain operations such as mixing pump operation.)

### 3.4.1.2 Safety Functional Requirements

The bases for the Safety-Class and Safety-Significant requirements are described in RPP-13033.

#### 3.4.1.2.1 Safety-Class Requirement

No Safety-Class requirements are associated with the AY/AZ Tank Farms DST waste storage system.

#### 3.4.1.2.2 Safety-Significant Requirements

No Safety-Significant requirements are associated with the AY/AZ Tank Farms DST waste storage system.
3.4.1.2.3 Other Safety Requirements

Some equipment within the boundaries of the DSTs support safety functions defined in RPP-13033. Such equipment is referenced in HNF-SD-WM-TSR-006, ACs. Also, the TSR specifies Design Features which may be passive systems with no specified Safety Class or Safety Significant classification. Additionally, there are tank farm design and safety features that provide additional Defense in Depth (DID) but are not designated as safety-significant SSCs or TSRs. The following equipment requirements are derived to support the TSR Specific Administrative Controls (SACs), Administrative Control Key Elements, TSR Design Features, and important DID attributes.

Requirement: Monitor the level of waste in DSTs annulus space.

Basis: HNF-SD-WM-TSR-006, LCO 3.5, “The DST annulus waste level shall be ≤ 15in.”

How Requirement is Met: This requirement is met by the operation of DST annulus leak detection probes (Enraf) described in section 4.1.1.9.6.1 “Primary Tank Leak Detection-Annulus Enraf Leak Detectors”.

Requirement: DST waste temperature monitoring shall be performed weekly.

Basis: HNF-SD-WM-TSR-006, AC 5.9.1, “DST and SST Time to Lower Flammability Limit (AC Key Element).”

How Requirement is Met: The tank waste temperature-detection systems support the implementation of the level-dependent tank temperature controls. At least one thermocouple tree with multiple temperature elements was installed in each tank as part of the original construction contract. Operator checks of waste temperatures are conducted during weekly rounds (TF-OR-WR-AZ, AZ Weekly Rounds).

Requirement: Dome Loading Requirements - Establish tank safe operating limits for concentrated loads as described in an Analysis of Record. The purpose of the Dome Loading is to protect the Primary and Annulus tanks from damage or collapse.

Basis: OSD-T-151-00007, Operating Specifications for the Double Shell Storage Tanks, Section 1.6 “Dome Loading” and Dome Loading Calculations for each farm. Calculations for each farm can be found in RPP-20260 (AY Farm) and RPP-20261 (AZ)

How Requirement is Met: The site tracks and controls load additions to ensure that the total applied load does not exceed the documented load limits. Additionally, an electronic Dome Load Log is kept by operations for each tank farm to track changes.

Requirement: Perform Corrosion Mitigation through maintaining waste chemistry within limits.

Basis: OSD-T0151-00007, Section 1.5 “Corrosion Mitigation”.

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How Requirement is Met: The TOC Conducts periodic sampling of the waste in DST’s to determine the nitrite, nitrate, and hydroxide concentrations and to verify that measured concentrations are within the limits established.

3.4.2 Subsystems and Major Components

3.4.2.1 Mixer Pumps

Requirement: In Tank 241-AZ-101, provide two mixer pumps to mobilize and suspend the settled sludge so that it can be retrieved and delivered as feed to the Waste Treatment Plant for pretreatment and vitrification.


How Requirement is Met: Two 300-hp mixer pumps were purchased, tested, and installed in Tank 241-AZ-101 as verified by Tank Farm Operations. Results are documented in RPP-6548, *Test Report, 241-AZ-101 Mixer Pump Test*. (Note 1: Operation of these mixer pumps is not currently authorized. RPP 13033, Section 2.4.1.1 “Waste Tank Designs”.) (Note 2: Mixer pumps shall not be operated with less than 72 in. of waste in the tank. HNF-SD-WM-TRD-007, “Key assumption”)

3.4.2.2 Air Lift Circulator

Requirement: Air lift circulators shall be provided to aid in tank agitation and to delay sludge settling.

Basis: (AY Tank Farm) ARH-205-1, Section 2, “Design Criteria.” (AZ Tank Farm) ARH-1437, Section 2. Data from development tests conducted by Battelle Northwest indicate that the design should include provisions for 22 circulators in each tank. Currently, the air lift circulators are not operating because it has been determined that the agitation is not needed for presently stored waste.

How Requirement is Met: This requirement is part of the original design requirements for the AY/AZ Tank Farms. Hanford Site Drawings for the AY Tank Farm indicate a design for placement of 22 air lift circulators in each AY tank:

- H-2-64447, *Tank Plan Penetration Schedule*
- H-2-64419, *Tank Riser Details*.

Hanford Site Drawings for the AZ Tank Farm indicate design for placement of 22 air lift circulators in each AZ tank:

- H-2-67314, *Plan Tank 101 Penetration & Schedule 214-AZ Tank Farm*
- H-2-67315, *Plan Tank 102 Penetration & Schedule 214-AZ Tank Farm*
- H-2-67349, *Air Lift Circulator and Riser Extension Details*
Some or all of the air lift circulators might be plugged and inoperable. See RPP-RPT-25731, System Health Report for AY/AZ Waste Tank Structures, Mixing and Monitoring, for system status. (Note: Air lift circulators for the AY/AZ tank farms are currently not operational per RPP 13033, Section 2.4.1.1, “Waste Tank Designs”.)

3.4.2.3 Instrumentation

**Requirement:** Provide all instrumentation and facilities required to operate and maintain the AY/AZ Tank Farms. Integral thermocouples shall be installed at the tank wall and tank base to monitor thermal gradients and resulting stresses. Strain gauges shall be installed at selective positions on the primary tank liner to measure responses to thermal changes. Instrument data shall be recorded. Liquid-level tape electrodes and sludge-level detector tapes shall be provided.

**Basis:** ARH-205-1, Section 2, ARH-1437, Section 2.

**How Requirement is Met:** This requirement is part of the original design requirements for the AY/AZ Tank Farms. The instrumentation systems that monitor AY tanks are shown on the following Hanford Site Drawings:

- H-2-64367, Instm Tube Routing & XMTR Enclosure Arrangement & Details
- H-2-64368, Instrumentation In-Tank Temperature and Pressure Assemblies Plan & Details
- H-2-64369, Instrumentation Tank Annulus Leak Detection System Plan & Details
- H-2-64372, Instrumentation Insulating Concrete Plan & Details
- H-2-64373, Instrumentation Concrete Foundation Tank 101 Plan & Details
- H-2-64374, Instrumentation Concrete Foundation Tank 102 Plan & Details
- H-2-64375, Instrumentation Concrete Dome Plan & Details.
- H-2-131329, Instm Wiring/Assembly/Detail Enclosure AY-101 and AY-102

The instrumentation systems that monitor AZ Tank Farm tanks are shown on the following Hanford Site Drawings:

- H-2-67293, Instrumentation Concrete Foundation Tank 241-AZ 1-1 & 102 Plan & Details
- H-2-67294, Instrumentation Tank Annulus Leak Detection System Plan & Details
- H-2-67295, Instrumentation Insulating Concrete Plan & Details
- H-2-67296, Instrumentation Concrete Dome Plan & Details
- H-2-68336, Instrumentation Panel Arrangement & Rear Panel Piping (PLC on sheet 5)
• H-2-68338, Instrm Tube Routing & XMTR Enclosure Arrangement & Details
• H-2-68339, Instrumentation In-Tank Temperature & Pressure Assemblies Plan & Details.
• H-2-92966, Electrical Annulus Exhaust Installation (PLC on sheet 9)
• H-2-131330, Instrm Wiring/Assembly/Detail Enclosure AZ-101 and AZ-102

The strain gauges are no longer operable and have been abandoned. Waste level measurement has been upgraded to primary tank and annulus tanks Enraf level transmitters (H-2-817634) and manual tapes (H-2-95413). P&ID prints may be found in Appendix B Table B-1.

3.4.2.4 Utilities

Requirement: Provide all utilities required to operate and maintain the AY/AZ Tank Farms.

Basis: Utility requirements for electrical, instrument air/service air, and steam come from design criteria documents: (AY Tank Farm) ARH-205-1, Section 2. (AZ Tank Farm) ARH-1437.

How Requirement is Met: This requirement is part of the original design requirements for the AY/AZ Tank Farms. The electrical, air, and water systems for AY/AZ Tank Farm tanks are support systems for the DST waste storage system. The steam system is no longer in service. See requirements in Section 3.4.3 for further detail.

3.4.3 Boundaries and Interfaces

The boundaries and interfaces for the AY/AZ Tank Farms DST waste transfer system, as established by the system engineer, are indicated on Figure 4. Section 4.1.2 describes the interfacing systems and subsystems and their respective boundaries.

Requirements involving boundaries and interfaces outside the tank farm authority and directly related to the DST waste storage system include the following. Further details of interfaces to other systems are contained in Appendix F.

Requirement: Adequate compressed air shall be supplied at the system interface for air lift circulators and instrumentation needs. Additionally, adequate electrical power, steam, and raw water shall be supplied at the interface to other systems to meet the demands of the DST waste storage system.

Basis: Utility interface requirements for electrical and instrument air and service air come from design criteria documents: (AY Tank Farm) ARH-205-1, Section 2.0. (AZ Tank Farm) ARH-1437, Section 2. The operation of the air lift circulator has been terminated because the agitation is not needed for stored waste; therefore, the original air capacity is more than presently required.
(Note: Any utility needs based on demand generally are determined by analysis during design, rather than by criteria. However, the stated criteria that sufficient quantity and quality of service to meet the anticipated demand for utility service is the governing requirement.)

The 241-A-701 air supply system, which feeds the AY/ AZ Tank Farms, was modified about 1993. The new design basis is SD-WM-DB-016, 241A702 Ventilation Sys Accumulator Design Bases. In 1998, the 241-A-702 ventilation system was replaced by the 241-AZ-702 ventilation system by Project W-030. The 241-A-702 system was permanently shut-down and isolated from AY and AZ Tank Farms. Then add in the How Requirement is Met section (3rd paragraph). Project W-030 was built using W-030-C1, Site Preparation of Tank Farm Ventilation Upgrade and W-030-C2, Tank Farm Ventilation Upgrade construction specification documents.

How Requirement is Met: For the electrical capacity, see RPP-15145, Electrical Distribution System for AY/AZ Tank Farm. Raw water has been isolated as shown in ECN-725411-R0. Calculation of flows Information not readily available. Air capacity requirements are met by operational testing and WHC- SD-WM-FDR-006, 241A701 Compressor Upgrade Final Design Review Report.

3.4.4 Codes, Standards, and Regulations

3.4.4.1 Original Codes, Standards, and Regulations

3.4.4.1.1 AY Tank Farm

The following codes, standards, or regulations were required for the original design and construction of the AY Tank Farm, as stipulated in design criteria:

- ARH-205 contains references to the following design standards:
  - ASME VIII, ASME Boiler and Pressure Vessel Code, Section VIII

- ARH-205 contains references to the following material standards:
  - ASTM A515, Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service, Grade 60
  - ASTM A312, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes, Grade 304L (pipe)
  - “ACI design code specifications” (concrete).
3.4.4.1.2 AZ Tank Farm

The following codes, standards, or regulations were required for the original design and construction of the AZ Tank Farm, as stipulated in design criteria:

- HWS-10006, *Hanford Standard Design Criteria*, SDC 1.2
- ARH-1437 contains the following references to design standards.
  - “Normal ACI and ASME Section III design allowable stress shall not be exceeded.”
  - “The design shall conform to good professional practice in providing for the required functional needs, safety provisions and planned technical uses.”

The designer, Vitro Engineering Corporation, Richland, Washington, provided specific codes and standards in the various construction specifications created for the AY/AZ Tank Farms that governed the actual construction of the project. These specifications are listed in Appendix B, Table B-4.

3.4.4.2 Current Codes, Standards, and Regulations

Because of the age of this system (the design life of the AY/AZ Tank Farm tanks is *Information not readily available*), it is expected that most of the original codes and standards will be (or have been) superseded, cancelled, or significantly modified. Therefore, subsequent system modifications or additions will reference the codes and standards that are applicable at the appropriate time.

HNF-1901, *Technical Baseline Summary Description for the Tank Farm Contractor*, summarizes the technical baseline, describes the document hierarchy, and provides additional references and direction for establishing the baseline requirements for current and future projects. The DST Level-1 system specification and the Level-2 subsystem specifications were prepared for future work at the AY/AZ Tank Farms. Where applicable, all new work associated with the AY/AZ Tank Farms DST waste storage system shall comply with the codes, standards, and regulations established by the DST system and subsystem specifications. These subsystem specifications provide an outline of the applicable codes and standards.

The following documents contain specifications and requirements for operation of the AY/AZ DST facility. In general, they are not authorization basis requirements, and may be modified at any time.

- OSD-T-151-00007, *Operating Specifications for the Double-Shell Storage Tanks*
- OSD-T-151-00031, *Operating Specifications for Tank Farm Leak Detection and Single-Shell Tank Intrusion Detection*
- RPP-16922, *Environmental Specifications Requirements*
Violations of specifications shall be reported according to the dispositions described under the recovery action section for each specification.

### 3.4.5 Operability

System operability is based on the facility authorization basis, including RPP-13033, HNF-SD-WM-TSR-006, and other documents. The AY/AZ Tank Farm DST waste storage systems have no operability requirements specified in these authorization basis documents.

### 3.4.6 Performance Criteria

Performance Criteria are delineated in HNF-SD-TRD-007, Double Shell Tank System Specification, Section 3.2.1, “Performance Characteristics”. This document lists the performance criteria and the basis for each criteria in three major sub-sections including; Manage Tank Waste, Retrieve Tank Waste, and Manage System Waste Generated Waste and Excess Facilities. Reference also HNF-2168, *Performance Requirements for the Double-Shell Tank System*, for more details related to the performance criteria of the double shell tanks.

### 3.5 SPECIFIC REQUIREMENTS

Specific requirements are requirements that are unique to the Hanford Site and include nuclear radiation hazards, nuclear criticality safety, ALARA requirements, and any specific commitments that might pertain to the AY/AZ Tank Farm DST waste storage system. The following requirements are current requirements and are subject to revisions, modifications, and reinterpretations imposed by the SDD system and subsystem specifications on any new work that is part of the AY/AZ Tank Farm DST waste storage system.

#### 3.5.1 Radiation and Other Hazards

Original Requirements

- **Requirement**: Personnel shall be protected from radiation by adequate shielding provided by cover blocks or earth cover.

- **Basis**: Derived requirement from past practice at Hanford Site tank farms and the application of ALARA principles and RPP-13033, Section 2.6, “Confinement Systems”.

- **How Requirement is Met**: The pits in the AY/AZ Tank Farms have been designed with concrete cover blocks, and the floors are equipped with drainage features to return spillage back to the primary tank. Cover block thicknesses are 30-in. minimum for the central pump pits, annulus pump pits, leak-detection pits, and the 02E sluice pit, and 24 in. for the remaining sluice pits. The AY Central pump pit has 2 cover blocks (North and South Blocks) each with ¾” lead plate and 16GA steel sheet metal. The sheet metal cover is attached to the top of the lead on each cover block and provides additional shielding. (See H-2-64313 sheet 3 for more information)
Current Requirements

**Requirement:** All new equipment installed in the AY/AZ DST waste storage system shall be designed to perform its intended function under the radiological environments at the Hanford Site.

**Basis:** The radiological environments specified in HNF-2004, Estimated Dose to In-Tank Equipment and Ground-Level Transfer Equipment During Privatization.

**How Requirement is Met:** Future designs will determine how to meet this requirement at the time of design.

**Requirement:** The system shall be designed such that access controls to areas of high radiation meet the applicable requirements.

**Basis:** “RPP-13033, Section 7.6.2.4, “Access Control and Entry System.”

**How Requirement is Met:** The TOC policies establish the requirements to ensure that personnel have the training to work safely in and around radiological areas and to maintain individual exposures to ionizing radiation ALARA. The Access Control and Entry System is used to control access and ensure appropriate training for entry to all radiological areas.

**Requirement:** The system components shall be designed to simplify decontamination and facilitate decommissioning at the end of system life.

**Basis:** DOE-HDBK-1132-99, DESIGN CONSIDERATIONS, section 2.12, “Design of Facilities to Facilitate Ultimate Decontamination and Decommissioning”.

**How Requirement is Met:** Future designs will determine how to meet this requirement at the time of design. The Tank Operator Contractor (TOC) currently is not responsible for decontamination and decommissioning (D&D) activities at the Hanford Site tank farms. See RPP-13033, Section 16.0 for more information.

**3.5.2 As Low As Reasonably Achievable (ALARA) Standards**

**Requirement:** Measures shall be taken to ensure that personnel radiation-exposure levels are ALARA.

**Basis:** RPP-13033, Section 7.4,”ALARA Policy and Programs.”

**How Requirement is Met:** The AY/AZ Tank Farm DST waste storage system procedures require a Job Control System work package that meets the ALARA requirements of RPP-13033. Pits and piping are installed below grade to take advantage of natural shielding to further protect workers. All AY/AZ Tank Farm DST waste storage system activities take place within the tank farm access-controlled area, preventing inadvertent entry to the work area by unauthorized personnel.
3.5.3 Nuclear Criticality Safety

Original Requirements:

During initial operations, a record of the total amount of plutonium transferred to the aging-waste tanks was maintained. The maximum amount of plutonium permitted was restricted based on criticality considerations. (FDM-T-200-00003, Aging Waste Tank Facilities Description Manual, Section 4.1.6)

Current Requirements:

All new equipment modified or installed in the AY/AZ Tank Farms DST waste storage system shall receive, store, and transfer waste in a manner that prevents criticality in accordance with RPP-13033, Section 3.3.2.4.2, “Nuclear Criticality” and CPS-T-149-00012, Criticality Prevention Specification for Tank Farm Operations.

The new equipment or modifications also shall be designed in accordance with the applicable safety classification for subsystems and components using the process described in RPP-12371, Technical Basis for the Nuclear Criticality Representative Accident and Associated Represented Hazardous Conditions.

Nuclear Criticality Safety is key element under administrative control (AC 5.9.5, “Nuclear Criticality Safety”) in RPP-13033.

3.5.4 Industrial Hazards

The functional design criteria for Project B-120, ARH-CD-362, Functional Design Criteria, Additional High-Level Waste Handling and Storage Facilities for 200 East Area, page 12, indicates, in general, that the tank farm should be designed to 29 CFR 1910, Occupational Safety and Health Standards, requirements. Industrial hazards requirements for any new subsystems and components will be derived from the safety basis for that work as well as from the DST system and subsystem specifications described previously. (Note: The Occupational Safety and Health Administration (OSHA) rule 29 CFR 1910.119, “Process safety management of highly hazardous chemicals,” does not apply to tank farm non-radiological (chemical) hazards (i.e., tank farm chemical inventories do not exceed the threshold quantities specified in 29 CFR 1910.119) RPP-33033, Section 3.3.2.3.3, “Worker Safety”).

3.5.5 Operating Environment and Natural Phenomena

3.5.5.1 Operating Environment

Requirement: Equipment installed in the tanks shall be able to withstand, and perform within, the radiological environment inside the tanks.

How Requirement is Met: Equipment installed in the tanks is designed to be compatible with its operating environment.

### 3.5.5.2 Natural Phenomena

**Requirement:** The system shall be designed for the natural environmental conditions where it will be used.

**Basis:** RPP-13033, Section 3.3.2.4.7.1,” Natural Phenomena Hazards.”

**How Requirement is Met:** The system design and applicable procedures conform to the requirements of the listed design-basis documents for the Hanford Site, unless otherwise noted in the design criteria.

See Section 3.6.1 for seismic requirements.

### 3.5.6 Human Interface Requirements

It is Tank Operations Contractor (TOC) policy to conduct human-machine interface activities in a way that ensures the health and safety of employees, subcontractors, and the public, and the protection of the environment (RPP-13033, Section 13.0, “Human Factors”). The process for the systematic evaluation of human factors for the TOC is described in TFC-PLN-09, Human Factors Program.

The TOC personnel assigned to tank farm facilities shall be qualified, competent, and adequately staffed to support safe and effective operations. Management and technical personnel meet the education and experience requirements of DOE O 5480.20A, Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities. The TOC “Procedures and Training” SMP ensures that procedures and training processes have been developed to enhance personnel safety performance, and that work is performed by trained employees operating in accordance with approved procedures. (RPP-13033, Section 17.4.5.3,”Procedures and Training.”)

### 3.5.7 Specific Commitments

The Washington State Department of Ecology’s (Ecology) Administrative Order 98NW-009 (Ecology 1998a), the Notice of Penalty Incurred 98NW-007 (Ecology 1998b), and two subsequent appeals (Pollution Control Hearings Board Department of Energy et al. v Ecology 98-249 and Department of Energy et al. v Ecology 98-250 [Ecology 1998c, 1998d]) concerned, among other things, the inadequacies of the leak-detection system in the tank farms. This concern led to a requirement for a continuous leak-detection system for each of the 28 DSTs. The DOE, Richland Operations Office, Fluor Daniel Hanford, Inc., Lockheed Martin Hanford Corporation, and Ecology entered into an agreement (Settlement Agreement and Stipulated Order of Dismissal (Department of Energy et al. v Ecology) [Ecology 1999]), effective March 15, 1999, with the final due date for a fully compliant DST leak-detection system by December 31, 1999. Section H of the agreement states “Each DST on the Hanford site shall be equipped with three (3) operating leak detector probes placed as equidistantly as possible within the
annulus of each DST. Each adjustable annulus leak detector probe shall be set within ¼ inch from the annulus floor with allowance for normal engineering tolerance.”

In accordance with this settlement, each DST on the Hanford Site was equipped and operated with a complete continuous leak-detection system by December 31, 1999. (NOTE: This commitment has been incorporated into OSD-T-151-00031.

It should be noted that neither Ecology nor the Tank Farm Contractor Environmental Program set the engineering tolerance. Ecology was aware of the tolerance that was established in OSD-T-151-00031 and understands that a leak detector can be up to ½ inch off the floor. The leak sensitivity reduction due to a leak detector at ½ inch versus ¼ inch off the floor is acceptable to Ecology considering the majority of the DST annulus leak detection systems are either conductivity probes on a manual tape (readability of the tape through the flake box housing door to within ¼ inch is the best that can be expected) or Enraf's liquid level gauges. Ecology accepted the value of ¼ inch from the floor of the annulus, and the additional ¼ inch tolerance, as a compromise between the WAC 173-303-640, as referenced in OSD-T-151-00007, Table 1.5.2 “Annulus Tank Ventilation System and Annulus Inspection”, requirement to detect a leak within twenty-four hours (no de-minimus quantity) and the possibility of a false alarm occurring with the leak detector set lower.

It is believed that the ¼ inch tolerance was based on the conductivity probe flake box housing assembly (see Section 4.1.1.9.3.2) and the accuracy achievable when reading the tape through the flake box housing door. From and environmental perspective, the basis would be an increased sensitivity to detecting the leak volume associated with the detector no more than ½ inch off the floor.

The leak-detection system on each DST may not be replaced by, but may be supplemented by, the operation of an annulus ventilation system CAM.

### 3.6 ENGINEERING DISCIPLINARY REQUIREMENTS

This section describes the design requirements and bases related to particular engineering disciplines.

#### 3.6.1 Civil and Structural

Original Requirements:

*Requirement*: The DST shall be designed based on the following criteria.

- The maximum liquid storage capacity shall be 1-Mgal.
- The tanks shall be designed for radioactive waste of viscosity 0.5 to 1.0 cP and a pH of 8 to greater than a pH of 10 (depending on the waste type).
• The primary tank shall be thermally stress relieved after fabrication (see Section 3.6.2).

• The primary tank vessel shall be designed to withstand stresses caused by the most severe combination of the following loads:
  – Hydrostatic loading of 1 Mgal of liquid at 2.0 sp.g.
  – Internal pressures: 6.0 in. w.g. vacuum and 60 in. w.g. positive
  – Thermal loading: 1 Mgal of waste material at 350 °F. Seismic loading: The tank structure shall be design to withstand a Design Basis Earthquake (DBE) of max. 0.25 g. An operating Basis Earthquake (OBE) of 0.12 g. (in both DBE and OBE vertical loading to be 2/3 of horizontal loading.), for the AZ Tank Farm only.

• The secondary tank shall totally contain and support the primary tank and its contents, collect for detection any leakage from the primary tank, and allow adequate annular space between the two tanks for leak detection, ventilation, pumping, and observation (similar configuration as the previously constructed single-shell AX Tank Farm tanks).

• The reinforced concrete shell (including tank foundation) shall support the bottom and walls of the secondary steel tank in addition to the freestanding primary tank and its waste.

• The reinforced concrete shell shall be designed to collect and distribute any leakage from the secondary tank to an adjacent leak-detection pit.

• The reinforced concrete shell shall be designed to withstand stresses caused by the most severe combination loads.

  Basis: (AY Tank Farm) ARH-205-1, Section 2. (AZ Tank Farm) ARH-1437, Section 2.

  How Requirement is Met: The primary evidence that these requirements were met are the analyses referenced in SD-WM-TI-015, Bibliography Of Documents Related To Waste Tank Integrity, and the operating experience and testing that has been accumulated since the AY/AZ Tank Farms began operation.

• Requirement: Primary penetrations shall be provided to allow for tank monitoring, processing activities, waste fill, and pump-out. Annulus access ports shall be provided for annulus pump-out, leak detection, and ventilation.

  Basis: (AY Tank Farm) ARH-205-1, Section 2. (AZ Tank Farm) ARH-1437, Section 2.

  How Requirement is Met: Hanford Drawings H-2-64447 for AY Tank Farm and H-2-67314 and H-2-67315 for AZ Tank Farm show the locations of four sluice pits and a central pump pit per tank (primary), as well as all risers in the primary tank and annulus. The risers in these pits are provided to meet the needs of storage and transfer operations. Other risers (primary) penetrate the dome for tank instrumentation, tank vent, etc. Annulus penetrations are also shown for annulus pump pit, and annulus inspection ports.
Requirement: The primary tanks waste specific gravity or hydrostatic load shall be maintained below the maximum allowable per OSD-T-151-00007, Section 1.2, ”Hydrostatic Load.”

Basis: OSD-T-151-00007, Appendix B, discusses the technical basis for the maximum specific gravity in the tank which includes structural analysis for a seismic event.

How Requirement is met: Tank Operations (TO) transfers procedures checklists verify waste specific gravity by way of Waste Compatibility Assessments. Specific gravity is also measured by; Densitometer readings, Laboratory analysis of DST tank waste sample, and Transfers into DST’s are evaluated and approved by Process Modeling per HNF-SD-WM-OCD-015, Tank Farm Waste Transfer Compatibility Program, to prevent exceeding the maximum bulk specific gravity values specified.

### 3.6.2 Mechanical and Materials

**Requirement:** Full stress relieving by heat annealing of the primary liner shall be performed after fabrication.

**Basis:** (AY Tank Farm) ARH-205-1, Section 2, “Design Criteria.” (AZ Tank Farm) ARH-1437, Section 2, requires heat annealing as protection from stress corrosion cracking could occur in aqueous solutions of nitrate ions. Also refer to letter LET-080167, *Project IAP-614 PUREX Tank Farm Expansion*, dated August 1, 1967.

**How Requirement is Met:** The primary evidence that this requirement was met is the certification of completion (*Information not readily available*), operational experience, and functional testing that has occurred since the AY/AZ Tank Farms began operating.

### 3.6.3 Chemical and Process

Corrosion protection is provided by ensuring acceptable chemical composition of the tank waste, including adding sodium hydroxide and sodium nitrite solutions where required. Chemical composition limits are found in Section 3.7.3, “Non-TSR Inspections and Testing,” and in OSD-T-151-00007, Section 1.5 “Corrosion Mitigation”


### 3.6.4 Electrical Power (original requirement)

**Requirement:** The AY/AZ Tank Farm DST waste storage system shall be provided with electrical power for the operation of monitoring and alarm subsystems and waste treatment equipment.

**Basis:** (AY Farm) ARH-205-1, Section 2. (AZ Farm) ARH-1437, Section 2.
How Requirement is Met: Electrical power is provided as a support system to the DST waste storage system. (Refer to RPP-15145, System Design Description of Electrical Distribution System for AY/AZ Tank Farms.)

3.6.5 Instrumentation and Control

Requirement: All instrumentation and facilities required to operate and maintain the AY/AZ Tank Farms shall be provided (original requirement).

Basis: (AY Tank Farm) ARH-205-1, Section 2. (AZ Tank Farm) ARH-1437, Section 2.

How Requirement is Met: Instrumentation is an integral part of the DST waste storage system and is provided as a support system other interfacing systems. See the Hanford Site Drawings listed in Appendix B for instrumentation drawings.

3.6.5.1 Instrument Air (original requirement)

Requirement: Compressed dry, oil-free air shall be provided to operate instrumentation for the monitor and alarm systems.

Basis: (AY Farm) ARH-205-1, Section 2, (AZ Farm) ARH-1437, Section 2.

How Requirement is Met: Air is provided as a support system to the DST waste storage system.

3.6.6 Computer Hardware and Software

Requirement: The Densitometer shall be able to determine the density of waste solutions.

Basis: Enraf software and hardware design requirements are listed in RPP-8216, System Plan for Enraf Series 854 Densitometers and Related Software, and HNF-1569, System Requirements for One-Time-Use Enraf Control Panel Software.

How Requirement is Met: The baseline software configuration is documented in HNF-1569, System Requirements for One-Time-Use Enraf Control Panel Software, and HNF-2965, Operational Test Report for the AY-102Enraf Densitometer Control and Acquisition System.

3.6.7 Fire Protection

There are no fire-protection requirements specific to the AY/AZ Tank Farm DST waste storage system. Fire protection is supplied by the overall site fire-protection systems. These systems include tank farm fire detection systems, fire hydrants connected to potable and raw water, and portable fire extinguishers. See RPP 13033, Section 2.7.3,”Fire Protection Systems,” for additional information.
3.7 TESTING AND MAINTENANCE REQUIREMENTS

3.7.1 Testability

No specific testability requirements were found to exist for this system.

3.7.2 Technical Safety Requirement-Required Surveillances

TSR-required surveillances are defined in HNF-SD-WM-TSR-006. The TSRs do not specify any safety significant equipment requiring surveillance applicable to the AY/AZ Tank Farm DST waste storage system. There are required surveillances for equipment associated with the DST waste storage system;

Surveillance Requirement: SR 3.5.1 VERIFY the DST annulus waste level is ≤ 15 in. at a frequency of 3 days.

Basis: LCO 3.5 DST Annulus Flammable Gas Control per HNF-SD-WM-TSR-006,

How Requirement is Met: This requirement is met by the operation of DST annulus leak detection probes (Enraf) described in section 4.1.1.9.6.1 “Primary Tank Leak Detection-Annulus Enraf Leak Detectors”. HNF-SD-WM-TSR-006, AC 5.9.1 & AC 5.9.2

Surveillance Requirement: SR 3.4.1 VERIFY the headspace in the tank is < 0 in. w.g. relative to atmospheric pressure. This verification shall take place Prior to the water addition, chemical addition, or waste transfer; and once per 12-hour shift thereafter.

Basis: LCO 3.4 DST Induced Gas Release Event Flammable Gas Control per HNF-SD-WM-TSR-006,

How Requirement is Met: This requirement is met by the operation of Primary tank ventilation system as described in section 4.1.1.9.4 “Tank pressure monitoring”. See also HNF-SD-WM-TSR-006, AC 5.8.1 & AC 5.9.2

Surveillance Requirements:

1. SR 3.1.1 Verify the flammable gas concentration is < 25% of the LFL in the tank headspace. See Table 3.1-1 for the frequency. IH Technicians take flammable gas samples a periodically based on Table 3.1-1 frequency.

2. SR 3.4.1 Verify the headspace in the tank is < 0 in w.g. relative to atmospheric pressure. Prior to the water addition, chemical addition, or waste transfer; and once per 12-hour shift thereafter. Operations monitor tank pressure monitoring system as required.

3. SR 3.5.1, Verify the DST annulus waste level is ≤ 15 in. Frequency 3 days. Operator monitors annulus tank levels every day.
Basis: LCO 3.1 DST Steady-State Flammable Gas Control per HNF-SD-WM-TSR-006,

How Requirement is Met: This requirement is met by the operation of DST annulus leak detection probes (Enraf) described in section 4.1.1.9.6.1 “Primary Tank Leak Detection-Annulus Enraf Leak Detectors”. HNF-SD-WM-TSR-006, AC 5.9.1 & AC 5.9.2

Testing requirements for general service equipment supporting TSR ACs are described in Section 3.7.3.

3.7.3 Non-Technical Safety Requirement Inspections and Testing

The TOC program for in-service surveillance, inspection, and testing activities is implemented through TFC-PLN-29. This maintenance program contains the necessary provisions sufficient to provide reasonable assurance that SSCs are capable of fulfilling their intended function. In-service surveillance, inspection, and testing activities are performed in accordance with TOC procedures documented in a computerized maintenance management system database. (RPP-13033, Section 10, “Initial Testing, In-Service Surveillance and Maintenance”.)

In tank and annulus video inspections and wall thickness measurement using the ultrasonic wall crawler. OSD-7 requires video inspections every 2 years for one tank and 5-7 years for all 28 DST’s. RPP-7574, Double-Shell Tank Integrity Program Plan, drives the wall thickness measurements, primary tank video inspections, etc. The key inspection and testing requirements for each tank are listed in Appendix C, Tables C-3a and C-3b.

3.7.3.1 Waste Composition Limit Requirement

Requirement: The only chemical waste composition limits that apply to double-shell tank waste are found in OSD-T-151-00007, Section 1.5, “Corrosion Mitigation”. The key elements of this program are to maintain nitrite, nitrate, and hydroxide concentrations within the limits as shown in Table 1.5.1-1 in OSD-T-151-00007. The program includes periodic sampling of the waste and maintaining a data base to track waste composition chemicals such as nitrate, nitrite and hydroxide concentrations.

Basis: OSD-T-151-00007, Section 1.5, provided the bases for aging waste chemical composition: Periodic samples are taken to measure the nitrite, nitrate and hydroxide concentrations. Based on the sample results, process engineering can track and trend waste tank concentration and make recommendation on how to adjust a tank’s chemistry to ensure that the waste stays within limits. The technical basis for establishing sampling frequencies is provided in RPP-7795, Technical Basis for Chemistry Control Program.

How Requirement is Met: As noted in OSD, Section 1.5, stored waste is sampled periodically. The combination of the sample analyses for the stored waste and for waste transfers provides the basis for a tank material balance. Chemicals such as sodium nitrite and sodium hydroxide can be added as well as water (if necessary) to maintain the tank’s waste chemistry with TSR requirements.
3.7.4 Maintenance

Maintenance requirements for the AY/AZ Tank Farm DST waste storage system are discussed in Section 4.3.4. The key maintenance requirements for each tank are listed in Appendix C. Waste compatibility assessments are required for each and requirements are listed in TFC-ENG-CHEM-P-13, *Tank Waste Compatibility Assessments*.

3.8 OTHER REQUIREMENTS

Other requirements are those requirements that may be unique to the Hanford Site, such as nuclear and hazardous waste requirements, availability and reliability requirements, quality assurance requirements, and miscellaneous requirements.

3.8.1 Security and Special Nuclear Material Protection

A number of services that support the tank farms are provided on a Hanford Site-wide basis. These services include security. No special nuclear material protection requirements are applicable to this system.

3.8.2 Special Installation Requirements

The following procedures pertain to special installation requirements:

- TFC-ESHQ-RP_MON-C-12, *Temporary Shielding*
- TFC-ESHQ-RP_MON-C-14, *Radiological Contamination Area Controls*
- TFC-OPS-MAINT-C-01, *Tank Farm Operations Contractor Work Control*
- TFC-ESHQ-RP_RWP-C-02, *Radiological Containment*
- TFC-ENG-FACSUP-C-10, *Control of Dome Loading* These procedures may change without notice and should be checked before use.

3.8.3 Reliability, Availability, and Preferred Failure Modes

Some critical sensing instrumentation will alarm on loss of ability to detect (i.e., fail safe). The overall design of the DST waste storage system contains redundant elements. The DST design provides redundant physical containment (tank within a tank). Critical sensing and detecting instrumentation also is designed with primary and backup levels, as well as multiple alarm/indication locations (e.g., at a computer panel at the 241-AZ-271 control room, and any HMI computer connected to the MCS system as well as the TMAC system in the 2750E building).
3.8.4 Quality Assurance

Quality assurance requirements documents that apply to operation, maintenance, or modification of the DST waste storage system include the following:

- RPP-POL-03, Quality Assurance Policy
- TFC-PLN-02, Quality Assurance Program Description
- TFC-PLN-19, Closure Project Quality Assurance Program Plan.

The operations and maintenance procedures will include more subject-specific requirements promulgated by these documents.

3.8.5 Miscellaneous Requirements

No miscellaneous requirements are applicable to this system.
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4.0 SYSTEM DESCRIPTION

The four DSTs in the AY/AZ Tank Farms were built to provide storage space for high-level radioactive waste solutions generated at PUREX and B Plant. The tanks are 241-AY-101 and -102, and 241-AZ-101 and -102.

The AY Tank Farm is located due west of the AX Tank Farm and southwest of the AZ Tank Farm. The AZ Tank Farm is located due north of AX Tank Farm and northeast of AY Tank Farm.

4.1 CONFIGURATION INFORMATION

Appendix B, Tables A-1 through A-4, list all the pertinent drawings and documents associated with this system; the drawings are categorized as to the degree of essential importance for proper configuration management of the system, as indicated in Table 2. Documents and drawings may be accessed via The Document Management & Control System (DMCS).

<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Approval</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-1</td>
<td>Essential drawings and documents- These items make up the basis for the system and must be maintained under configuration control.</td>
<td>The system engineer responsible for the system must approve any changes to these drawings and documents.</td>
</tr>
<tr>
<td>B-2</td>
<td>Support drawings and documents - items supplement the basis and provide a baseline of the system. It includes drawings from other systems.</td>
<td>The system engineer with primary responsibility for the shared system must approve any changes to these drawings and documents if the document is under configuration management.</td>
</tr>
<tr>
<td>B-3</td>
<td>Historical drawings and documents - These items are older “out of date” drawings that show the earlier stages of the system design.</td>
<td>The system engineer responsible for the system must approve any changes to these drawings and documents.</td>
</tr>
<tr>
<td>B-4</td>
<td>Vendor Information</td>
<td></td>
</tr>
</tbody>
</table>

The Tank Farm Master Equipment List located in the CHAMPS work control system is a sortable database listing all of the components in the AY/AZ Tank Farms DST waste storage system, as well as all other tank farm components. The associated piping and instrumentation diagrams are listed in Appendix B.

4.1.1 Description of System, Subsystems, and Major Components

The AY/AZ DST Waste Storage System includes the primary and secondary tank structure; concrete shell, insulating pad, and foundation; central pump pit; sluice pits; annulus pump pit; leak-detection pit (and well), air lift circulators, mixer pump, and monitoring and alarm subsystems associated with the waste storage functions. Figures 4 and 5 are graphical depictions
of the relationships of subsystems and components of this system. Appendix B, Tables B-1 through B-4, list all essential and support drawings necessary for a clear understanding of this system. As each subsystem or component is discussed, references to the pertinent drawings are provided.

4.1.1.1 Double-Shell Tank Design

The criteria for the new double-shell AY Tank Farm tanks required that they be similar to the design of the single-shell AX Tank Farm tanks except for certain modification recommended by Professor K. P. Milbradt of the Illinois Institute of Technology, in Letter Report, “Strength and Stress of Waste Tank Structures.” Vitro/Hanford Engineering Services completed the design of the AY Tank Farm based on the Atlantic Richfield Hanford Company design criteria ARH-205, dated November 17, 1967. The criteria for the AZ Tank Farm tanks required that they be primarily based on, but not limited to, the as-built drawings for the AY Tank Farm tanks. Atlantic Richfield Hanford Company provided the design criteria that were structurally similar to the AY design criteria in ARH-1437, dated January 8, 1970.

4.1.1.2 Double-Shell Tank Structure

4.1.1.2.1 Primary and Secondary Steel Tank

All four DSTs at the AY/AZ Tank Farms were constructed to the dimensions and configurations shown on Hanford Drawings H-2-64310, Concrete Tank Section and Details, and H-2-64449, Tank Elevation & Details (AY tanks); and H-2-67245, Concrete Tank Section & Haunch Reinforcement, and H-2-67317, Tanks 101 & 102 Section & Details 241-AZ Tank Farm, (AZ tanks). Figure 6 is a representation of the essential information from that drawing. The nominal 1.00-Mgal tank capacity occurs at a waste level of 30 ft, 4 in. The primary steel tank rests inside the secondary steel tank and is supported totally by the insulating concrete pad on the floor of the secondary tank. To ensure confinement of the waste, the primary tank is a full encapsulation of its interior; the side fill lines and the dome risers are the only penetrations. The risers are the only access to the interior. The secondary steel tank provides only partial encapsulation, with complete containment to a height of 39 ft, 8 in. from the bottom where the secondary tank meets the primary tank. This still allows for approximately 5 ft. of freeboard above the maximum liquid level in the primary tank, should the annulus ever fill and equalize with the level in the primary tank. The secondary tank meets and touches the primary tank at a point called a working point, where both radii of the curvatures of the haunches are coincident. This joint is not welded or fastened but is covered by an 18-gauge by 14-in. sheet metal flashing that is tack welded to the primary tank. This allows for movement from expansion and contraction between the two tanks after the concrete shell has been cast over the tanks.
Figure 6. Double-Shell Tank Structural Cross-Section (Typical).
The key arrangement drawing that relates to the construction of the two steel tanks and includes details of the tank joints, the center air distribution plenum, and the insulating concrete pad with pipes and slots is Hanford Site Drawing H-2-64447, *Tank Plan 101 Penetrations & Schedule*.

The following key arrangement Hanford Site Drawings relate to the same tank information at the AZ Tank Farm:

- H-2-67314, *Plan Tank 101 Penetrations & Schedule 241-AZ Tank Farm*
- H-2-67315, *Plan Tank 102 Penetrations & Schedule 241-AZ Tank Farm*

### 4.1.1.2.2 Insulating Concrete Pad

The primary tank rests on an 8-in layer of insulating (refractory) concrete that protected the secondary tank bottom and the structural concrete foundation from excessive heat during the annealing process and during storage of radioactive waste. It also provides channeling for any leakage from the primary tank to the annulus for leak detection. The top surface of the insulating concrete pad under the primary tank is grooved with air circulation/drainage slots that extend from an air distribution plenum at the center of the tank to the edge of the primary tank at the annulus area. Four 4-in.-diameter pipes, embedded in the insulation concrete, run radially from the annulus area and connect to the plenum to provide outside air to the plenum. The annulus ventilation system pulls a vacuum on the annulus area, drawing the outside air from the plenum back through the slots in the insulating concrete. This allows the outside air to remove heat generated by the waste from the bottom of the primary tank. The plenum is part of the insulating concrete pad (flush with its surface) and is not connected to the primary tank. Figure 7 shows the general configuration of the insulating concrete pad and the channel and piping scheme. Tanks 241-AY-101 and 241-AY–102 had the outside 2 ft of refractory concrete removed and replaced with structural concrete after fabrication and heat-treating of the tanks was complete, about 1970. The replacement was needed to correct the excessive spalling and cracking of the original refractory concrete. Information confirming the refractory concrete analysis and spalling problems is contained in RPP-19097, *Evaluation of Insulating Concrete in Hanford Double-Shell Tanks*. Photographs are available electronically in the Hanford Site archives showing deterioration and removal of the refractory.

The key arrangement Hanford Site Drawing that relates to the insulating concrete pads at the AY Tank Farm is H-2-64307, *Structural Insulating Concrete Plans and Details*.

The key arrangement drawing that relates to the same information at AZ Tank Farm is H-2-67244, *Structural Insulating Concrete Plans and Details*. 
Figure 7. Tank Insulating Concrete Pad.
4.1.1.3 Concrete Shell and Foundation

The concrete shell and the foundation are two separate components. After the foundations was poured, the steel tank was constructed on top of it, and the risers were installed on the dome, the shell was poured, covering the dome and sides of the secondary tank and resting on the foundation perimeter. The joint between the shell walls and the concrete foundation is a sliding joint with graphite applied to allow for movement between the two. The concrete shell is designed to support all soil loading, dead loads, live (equipment, personnel) loads, seismic loads, and loads caused by temperature gradients between the contained waste and the outside soil. This is essentially a third containment structure for the waste. Any leakage from inside the concrete shell is captured on the concrete tank foundation and routed to drains via drainage channels on the top of the foundation. The drains collect the drainage and convey it to the leak-detection pit collection well. Figure 8 depicts a typical tank foundation pad during construction, showing the waffle-patterned drainage channels.

Figure 8. AW Farm Concrete Foundation Pad (Typical).

The following key arrangement Hanford Site Drawings relate to the tank foundations at the AY Tank Farm:

- H-2-64306, Tank Foundation Plan
- H-2-64310, Concrete Tank Sections and Details
- H-2-64311, Concrete Dome Reinforcement Plan & Details.

The following key arrangement Hanford Site Drawings relate to the same information at the AZ Tank Farm:
4.1.1.4 Risers

Each tank is equipped with risers that penetrate the concrete dome and the top of the primary or secondary tank. The risers provide access into the annulus space and the primary tank for waste treatment, transfer, monitoring operations and ventilation. The number, diameter, and location of penetrations may differ from tank to tank, depending on modifications resulting from mission changes over the years. Most of the risers terminate above grade with a flange cap or an equipment item attached. Some terminate in covered pits. All risers extend downward just through the domed cover.

Tanks 241-AY-101 and 241-AY-102 and Tanks 241-AZ-101 and 241-AZ-102 have 22 annulus risers and 18 annulus penetrations (ventilation piping and side fill lines) while the primary tank has 99 risers (including 22 airlift circulators and 22 thermocouples) and 4 penetrations (side filled lines). Based on Hanford Site Drawings H-2-67314 and H-2-64447. All AY/AZ tanks have pipe penetrations on the sides of the primary and secondary tanks just below the haunch and above allowed waste levels. These penetrations technically are not risers; they provide for waste transfer into the primary tank and ventilation for the tank annulus. Primary tank risers and side pipe penetrations support the following functions: (When noted by parenthesis, the functions are functions of other systems.)

- Sludge measurement
- Liquid-level measurement
- Pumping (WST, WT)
- Thermocouple sensing
- Physical access
- Airflow (ventilation tank primary)
- Slurry distribution (WT)
- Observation and inspection
- Pressure measurement
- Waste return. (WT)
- Waste sampling
- Mixing (air lift circulator)
- Waste transfer lines (side fill lines).

Annulus risers and side pipe penetrations support the following functions: (When noted by parenthesis, the functions are functions of other systems.)

- Physical access
- Air flow (ventilation tank annulus)
- Observation and inspection
- Emergency pumping (emergency annulus pumping)
• Thermocouple sensing
• Leak detection.

Figures 9 through 12 are plan views of all four tanks (two in the AY Tank Farm and two in the AZ Tank Farm), showing all the risers, side pipe penetrations, pits, and grade-mounted equipment currently at each tank. Hanford Site Drawings H-14-010506, Sheets 1-4 Dome Penetration Schedules (WST/WSTA) Tank 241-AY-101 (-102 through -104) (AY), and H-14-010507, Sheets 1-2, Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-101 (-102) (AZ), are the key arrangement drawings relating to the risers on the AY/AZ Tank Farm DSTs.

4.1.1.5 Pits

The following pits are located at the AY/AZ Tank Farms:

• Central pump pits (process pit) (1 for each tank, total 4)

• Annulus pump pits (process pit) (1 for each tank, total 4) For AY Farm H-14-020806, sheets 1-2, Waste Transfer System (WT) O&M System P&ID, and H-2-63796, 241-AY Tank Farm Annulus Pump Pit Arrangement give a good illustration of the physical orientation of the drain and piping. The pump out piping and drain go to the same buried riser, the primary pipe and encasement respectively. For the AZ Tank Farm, the drain and pump out piping go to separate risers, as shown in H-14-020807, sheets 1-2, Waste Transfer System WT O&M System P&ID. Figure 5 shows the configuration of the more unusual AY Tank Farm piping.

• Leak-detection pits (process pit) (one for each tank, four total) (combined structure with two of the encasement leak-detection pits, one for each farm)

• Encasement leak-detection pits (process pit) (one for each farm, two total, both are out of service) (part of the waste transfer system SDD scope) (combined structure with leak-detection pit)

• Sluice pits (process pit) (4 per AY Tank Farm tank, 2 per AZ Tank Farm tank, total 12)

• Condensate valve pit (steam condensate) (for both farms, out of service, total one)

• Sluicing transfer box (process pit) (for both farms, total one) (part of the waste transfer system SDD scope)

• Raw water valve pit (one for AZ Farm and two for AY Farm, total three) (not operational, part of the waste transfer system SDD scope). All raw water valve pits are were put out of service in January of 2008, per HNF-FMP-07-35633-R0 and HNF-FMP-07-35633-R1. Also, the AY raw water pits were isolated from AZ Farm in 2006, as described in ECN-723915-R0, and AY sluice pits were isolated from the AY raw water system in 2001, per ECN-710762-R0.

• Water Service Pits (caissons) Two for each farm (Hanford Site Drawings H-14-021806 and H-14-021807). These pits are currently out of service.
The pits that are under the waste transfer system scope are discussed in the Waste Transfer System SDD, RPP-15137, System Design Description for 200 East Area Double-Shell Tank Waste Transfer System.
Figure 9. Tank 241-AY-101 Grade-Level Plan.
Figure 10. Tank 241-AY-102 Grade-Level Plan.
Figure 11. Tank 241-AZ-101 Grade-Level Plan.
Figure 12. Tank 241-AZ-102 Grade-Level Plan.

PLAN VIEW AZ-102
NOT TO SCALE
Pits in the tank farms provide shielding and sufficient space to safely perform the necessary waste transfer, monitoring, and inspection functions required for the tanks. All of the pits are the reinforced concrete rectilinear type with approximately 12-in. concrete walls and all are covered with 24-in. to 32-in.-thick cover blocks (lids). All pits are buried with tops located above grade. Whenever practical, the operations that occur in process pits are performed remotely for ALARA reasons, using overhead cranes or similar lifting equipment. The pits are designed to accommodate remote operations by allowing sufficient space, providing lifting bails on cover blocks, and including wash-down piping and nozzles embedded in the walls.

All process pits are equipped with a conductivity leak-detection system that includes a leak-detector probe, cable, and leak-detection transmitter enclosure located adjacent to the pit. The detector probe is either floor mounted near the floor drain or attached to the floor drain as part of the floor drain assembly. The cable is routed either through the cable slot at the top of the pit or through embedded conduit. Pit leak detection is discussed in more detail in Section 4.1.1.9.6.4

### 4.1.1.5.1 Central Pump Pits (241-AY-01A, & -02A and 241-AZ-01A, & -02A)

The function of the central pump pit is to provide a safe and convenient space for installing a waste transfer pump and to allow connections to the buried waste transfer piping entering the pit.

The central pump pit, located over the top of the center of the tank, is approximately 12 ft long by 8 ft wide by 9 ft deep (inside dimension and accommodates two risers (42 in. and 4 in.). The pit wall has approximately 18 pipe and conduit penetrations. The risers from the tank are capped with flanged cover plates at or just above the pit floor unless pumps are installed on the risers.

The 42-in., and the 4-in. risers from the primary tank, are located in the pit floor. The 42-in. riser serves as the primary access for waste treatment activities such as waste mixing and slurry distribution. The riser flange is flush with the bottom of the pit floor and is capped with an adaptor flange that will receive a mixer pump. Transfer pumps can be installed in the central pump pits. The 42-in. riser is looped with a spray-ring header just under the adaptor flange. Four nozzles from the spray-ring header extend into the riser to provide a raw water wash-down when equipment is being removed from the tank.

The 4-in. riser flange is flush with the bottom of the pit floor. It receives waste from other tanks or other sources and discharges it into the tank. The drain line extends into the waste and ends 60 in. off the bottom of the tank.

Figure 13 is a three-dimensional plan view of the central pump pit at Tank 241-AY-102 (Project W-320). This pit is not typical of the AY/AZ Tank Farm central pump pits. The following key arrangement drawings relate to the central pump pits at AY/AZ Tank Farms:

- H-2-64313, Structural Pump Pits Plans, Section & Details Tank 241-AY-101 & 102
- H-2-64405, Pipe Plan Tank 101 241-AY-Tank Farm
- H-2-64406, Pipe Plan Tank-102 241-AY-Tank Farm
- H-2-68304, Structural Pump Pits Plans, Section & Details Tank 241-AZ-101 & 102
- H-2-68353, Pipe Plan Tank-102 (AZ Tank Farm)
- H-2-68413, Pipe Plan Tank 101 (AZ Tank Farm)
Project W-314 has installed a new waste transfer system from the AY Tank Farm to the AZ Tank Farm. The waste transfer lines will allow waste to be transferred from AY or AZ tanks through the new AZ valve pit to the Waste Treatment Facility. Each of the central pump pits is connected to the waste feed transfer system. The pits were cleaned and restored. Pits AY-01A and -02A were painted with a protective coating (epoxy paint). Pits AZ-01A and -02A were sprayed with a polyurea foam as their protective coating. New drain plug assemblies and leak detectors were installed, along with vapor seals for all the pit wall nozzles. The pits are being readied for transfer pumps that will be installed by Project W-211 over the next 3 to 5 years. See Drawings H-14-102616, Sheet 1, Drawing List Vicinity Map (AY), and H-14-102666, Sheet 1, Drawing List Vicinity Map (AZ), for the drawing list and vicinity map.

4.1.1.5.2 Annulus Pump Pits (241-AY-01F, and -02F, and 241-AZ –01F, and -02F)

The annulus pump pit is located over a 12-in. riser from the tank annulus area at the perimeter of the tank. It is approximately 5 ft by 5 ft by 10 ft deep (inside dimensions). The pit is essentially buried. The pit wall contains five pipe and conduit penetrations. The riser from the annulus tank is capped with a pump adaptor plate at the pit floor. A 2-in. encased process waste line connects each annulus pump pit with that tank’s central pump pit.
Under normal conditions, a riser cover or shield plug is installed over the 12-in. riser unless an emergency annulus pumping system is installed. Originally one interchangeable annulus pump was provided for the AY/AZ Tank Farms. Currently an emergency annulus pumping system exists to provide a submersible pumping system in any DST emergency annulus pump pit when needed for emergency conditions. All of the emergency annulus pumping system portable equipment, including four emergency submersible pumps, is stored in HO-64-07008, which is an enclosed portable trailer. Flexible jumpers required for the connections in the pit are stored in the 2101-M Spare Parts Warehouse. The pumps and the jumpers are not part of the AY/AZ Tank Farms waste storage system. Emergency annulus pumping is described in RPP-15146, System Design Description for Tank Farms Double-Shell Tank Emergency Annulus Pumping System.

Figure 14 is a three-dimensional plan view of a typical annulus pump pit. The following key arrangement drawings relate to the annulus pump pits at AY/AZ Tank Farms:

- H-2-68309, Structural Annulus Pump Out Pits Plans, Section & Details 241-AZ-01F & 02F
- H-2-64329, Structural Annulus Pump Out Pits Plans, Section & Details 241-AZ-01F & 02F.

Figure 14. Annulus Pump Pit Three-Dimensional Plan View.
4.1.1.5.3 Leak-Detection Pits (241-AY Pit 101 and 102 and, 241-AZ Pit 101 and 102)

The AY/AZ Tank Farms have four leak-detection pits, one for each tank. A leak-detection pit is a deep pit that provides a collection point for any leakage from the secondary tank. Leakage from the secondary tank onto the foundation pad is routed to the leak-detection pit collection well where the liquid level is monitored. Each pit is located approximately 20 ft from the perimeter of the tank. The pit includes a two-compartment concrete pump pit at the surface, a leak-detection well, a radiation-detection well, and a concrete base structure. The pump pit is approximately 5 ft by 5 ft by 10 ft 6 in. deep (inside dimensions). The pit wall has approximately five pipe and conduit penetrations. The leak-detection well extends downward approximately 50 ft from the floor of the pump pit to a depth of 6 ft below the secondary tank bottom. A liquid-level detection system, temperature-monitoring equipment, radiation-detection equipment, and a ventilation cross-tie valve and piping that connect to the annulus ventilation system are provided for each well.

One interchangeable leak-detection pump, P-001 (prefix of pump will depend on farm and pit location), is provided for the AY/AZ Tank Farms. When pump P-001 is not installed, a blind flange or shield plug is installed over the leak-detection well.

The leak-detection pit radiation elements have been disconnected and are not in use. Currently this is the case at all DST farms.

Figure 15 is a three-dimensional plan view of a typical leak-detection pit. Figure 5 shows a section through a typical leak-detection pit. The following key arrangement drawings relate to the leak-detection pits at the AY/AZ Tank Farms:

- H-2-64318, Leak Detection Pit Plan, Sections & Details AY-102
- H-2-64325, Leak Detection Pits Tank AY-101 and Encasement Plan, Sections & Details
- H-2-67248, Sheet 1, Leak Detection Sump Plan & Details 241-AZ-101 & 102
- H-2-67249, Sheet 1, Structural Concrete Leak Detection Pits Plans, Sections and Details Tank 241-AZ-101.

4.1.1.5.4 Sluice Pits (241-AY-101/102-02B/C/D/E AND 241-AZ-101/102-01B/C)

Each AY tanks has four sluice pits, and each AZ tank has two sluice pits. The sluice pits are approximately 7 ft by 7 ft by 10 ft deep (inside dimensions). All pits are located on top of the tank. In the AY Tank Farm the pits are located over a 32-in. riser and in AZ Tank Farm they are located over a 42-in. riser. Each sluice pit has approximately five wall penetrations for pipes and conduit. The pit also has four pit spray nozzles embedded into its walls to provide pit washdown capabilities. The sluice pit floors are flat. The AY and AZ Tank Farm sluice pits have 3-in. floor drains that drain back into the primary tank (see Hanford Site Drawing H-2-68303, H-2-64314, 241-AY Tank Farm Annulus Pump Pit Arrangement). Spray nozzles for decontamination are mounted in each of the four walls.
Mixer pumps are presently installed in tank 241-AZ-101 (Project W-151). Mixer pumps may be installed in spare 42-in. risers (currently buried underground) in the AZ Tank Farm and in spare 34-in. risers in the AY Tank Farm sluice pits.

Sluice pits 241-AY-01D and 02D, and 241-AZ-01C both accommodate waste transfer pumps. Pumps in the AY Tank Farm sluice pits are mounted in 34-in. risers; pumps in the AZ Tank Farm sluice pits are mounted in 42-in. risers. Through the use of jumpers the waste can be routed through the central pump pit to other tanks or tank farms.

Figure 15. Leak-Detection Pit three-Dimensional Plan View.

Figures 9 through 12 show the sluice pit’s location on the plan view of each tank. Figure 16 is a three-dimensional plan view of the sluice pit. The following key arrangement drawings relate to the sluice pit at the AY/AZ Tank Farms:

- H-2-64314, Structural Concrete Sluicing Pit, Plans Sections (241-AY)

4.1.1.5.5 Raw Water Valve Pits
Raw water valve pits 241-AY and 241-AZ are used for water and steam condensate. Raw water is supplied to the tank farms from the main raw water header outside of AZ Tank Farm (see H-14-021807, *Raw Water System (RW) O&M System P&ID*).

The key arrangement drawings related to raw water pits at the AY Tank Farm are H-2-64323, sheets 1-2, *Civil Valves Pits for Water Piping and Condensate Drain* and H-14-021806, *Raw Water System (RW) O&M System P&ID*.

The key arrangement drawings related to raw water pits at the AZ Tank Farm is H-2-68310, *Civil Valve Pits for Steam and Water Piping* and H-14-021807, *Raw Water System (RW) O&M System P&ID*.

### 4.1.1.6 Steam System

Steam is supplied to the tank farms for operation of the steam coils only. The steam condensate drains to the 241-AZ-154 catch tank which has a pumping system to transfer the steam condensate to either the A-8 crib or to 241-A-417 catch tank. All of these systems are out of service and have been out of service for many years. Operation monitors the 241-AZ-154 catch tank with a zip cord.

The key arrangement drawings related to steam system at the AY Tank Farm are H-2-64404, sheets 1-4, *241-AY Steam Line Key Plan and Details* and H-14-021006, *Auxiliary Steam System(AS) O&M System P&ID*.

The key arrangement drawings related to raw water pits at the AZ Tank Farm is H-2-68310, *Civil Valve Pits for Steam and Water Piping*, H-2-68419, *Direct Buried Lines Sections & Details* and H-14-021007, *Auxiliary Steam System(AS) O&M System P&ID*.

General drawing H-2-34669, *Coil Assembly* show the typical design of a steam coil in a 42 inch riser.
4.1.1.7 Mixer Pumps

Two mixer pumps are installed in Tank 241-AZ-101. Mixer pump P-002 is in Riser with EIN AZ101-WST-RISER-001 (due North) and Mixer Pump P-001 is in Riser with the EIN AZ101-WST-RISER-003 (due South).

Both are 42-in. risers and are located just north and south of central pump pit 241-AZ-101. Mixer pumps were not included in the original design, but were added under ECN-163242, *Addition of Mixer Pumps Installed in Tank AZ-101*. The mixer pumps are adapted to fit onto the 42-in. riser in the pit. The mixer pump is of a vertical line shaft type. The pump contains two, 180-degree opposed, horizontal jet nozzles. Each nozzle is 6 in. in diameter and has a flow rate of 5,200 gal/min at 1,000 rpm. The pump is supported in the tank via a pump column, which extends from the pump flange, mounted on a concrete pad on top of the tank riser, to the bottom of the tank. A 300-hp, 1,200-rpm, 480V/3PH/60Hz motor is used to drive the pump. The motor uses a variable-frequency drive unit, which allows the pump to be operated at any desired speed.
The entire pump is mounted on a rotating turntable, which contains a small drive motor and allows the entire pump to rotate approximately 180 degrees, providing for 360-degree mixing coverage around the pump.

The sluice pits in both AY and AZ Tank Farms have large enough risers to accommodate additional mixer pumps if needed.

All pump controls including switches, sensing devices controllers, cable and conduit, and pneumatic and hydraulic systems that are part of the pump control system are considered part of the mixer pump and are included in this system.

Figure 17 is an approximate cross-section of the mixer pump used at the AZ Tank Farm. More accurate configuration of the mixer pump installed can be seen on the Hanford Site Drawing H-2-79252, Sheets 1 and 2 and Vendor Information 22515, Supplement #32, Mixer Pumps.

4.1.1.8 Air Lift Circulators

Each of the AY and AZ tanks has 22 air lift circulators. Circulator number 1 is located at the tank center axis; numbers 2 through 8 are equally spaced about 21-ft radius, and numbers 9 through 22 are spaced on about a 27-ft radius. Numbers 1, 9, 12, 16, and 19 have circulators that are 17 ft long. The remaining 17 circulators are 22 ft long. The circulator lower ends are all 30 in. above the tank bottom (see Hanford Site Drawing H-2-67349).

The air lift circulators consist of two basic components; a vertical circulator pipe 30-in. in diameter, and a foot piece (air nozzle) located within and near the lower end. A 6-in. pipe suspends the circulator from the tank dome and concentrically extends to a point 8 in. above its lower end. The end of the pipe has been swaged to a 1.5-in. ID nipple. A 1-in.-pipe, which supplies the motive air, is a removable insert that extends within the 6-in. pipe to 2 in. below the swaged nipple. The ALC’s have been successfully unplugged using a drill bit attached to a ½” pipe with machined coupling to allow passage through the 1” schedule 80 pipe (work package 2E-99-02665).

The circulators operate on the principle that when air is introduced at the lower end of the circulator, air bubbling up the circulator decreases the specific gravity of the solution within the riser. This results in the hydrostatic head at any point within the circulator being less that at the same elevation outside the riser. An upward motion of the liquid occurs as a result of the lower specific gravity.

Rotameters located in the 241-AY-801A Instrument Building are used to indicate motive air flow rate to the individual circulators. An adjoining raw water header and associated valving are also provided at this location for water flushing of the air lines.
Figure 17. Mixer Pump.

MIXER PUMP (TYPICAL FOR AZ-101 TANK)

NOT TO SCALE
The following key arrangement drawings relate to the air lift circulators at the AY/AZ Tank Farms:

- H-2-67349, *Air Lift Circulator and Riser Extension Details*
- H-2-64419, sheets 1 and 2, *Tank Riser Details*
- H-2-68423, sheet 1, *Tank Riser and Air Lift Circulator Details*
- H-2-68423, sheet 1, *Tank Riser and Air Lift Circulator Details*
- H-14-020306, Sheets 1,3,4,5,6, *Service and Instrument Air System (SA/IA) O&M System P&ID*
- H-14-020307, Sheets 1,3,4,5,6, *Service and Instrument Air System (SA/IA) O&M System P&ID*
- H-14-021806, sheets 1-2, *Raw Water System (RW) O&M System P&ID*
- H-14-021807, sheets 1-2, *Raw Water System (RW) O&M System P&ID*

**4.1.1.9 Monitoring and Alarm Systems**

Safe waste storage and waste transfer require adequate monitoring and alarm activation through the sensing of various conditions of the tank, the annulus, the waste, and the vented air. Originally, a Computer-Automated Surveillance System (CASS) was provided for all tank farm monitoring. Another monitoring system, the TMACs, became functional in 1995 as a replacement of the pressure-, temperature-, and level-monitoring functions of the CASS. The TMACs is being expanded and eventually will fulfill all the CASS functions. The CASS was retired in 1999 because it lacked Year 2000 (Y2K) compliance. Presently, the TMACs only monitors the tank waste levels and primary tank leak detection (Enrafs) in the AY/ AZ Tank Farms. In 2010, the 241-AZ-271 MICON computer system was replaced by the ABB computer system with all miscellaneous interfacing systems successfully integrated into the new computer system.

Field detection and monitoring instrumentation systems for the AY/AZ Tank Farms are located at three primary locations; the 241-AY-801A and the 241-AZ-801A Instrument Buildings and the 241-A-271 Instrument Building. Detection and monitoring of individual tanks within the AY/AZ Tank Farms also is similar. Detection instruments in the tank farm send data to monitors in the AY/AZ Tank Farms instrument enclosures and/or monitors in the 241-A/AY/AZ-801A Instrument Buildings. RPP-13033 provides a comprehensive description of the current instrumentation and surveillance monitoring systems at the tank farms.

**4.1.1.9.1 Instrumentation Panels**

The 241-AY-801A Instrument Building serves the two tanks in the AY Tank Farm and the 241-AZ-801A Instrument Building serves the two tanks in the AZ Tank Farm. Both have panel enclosures that are freestanding and are located in the middle of the control rooms. The panel
fronts are divided into subpanels, each dedicated to one tank and each containing the same instrumentation as follows:

- Weight factor indicator (leak-detection pit) (1 per tank) (out of service)
- Specific-gravity indicator (leak-detection pit) (1 per tank) (out of service)
- Weight factor indicator (encasement drain leak-detection pit) (out of service)
- Specific-gravity indicator (encasement drain leak-detection pit) (out of service)
- RTP2000 PLC computer system for temperature monitoring, tank and leak detection pit liquid level monitoring (Enraf and weight factor instrumentation), and annulus exhauster HEPA filter pressure monitoring located in 241-AY-801A building. The PLC transmits process signals to the MCS with HMI monitors located in 241-AZ-271 control room (installed by W-314).
- Leak-detector probe selector switches (AY only) (out of service)
- Recorders for circulation air flow (out of service)

The following key arrangement drawings relate to the instrument panel in the 241-AY-801A and 241-AZ-801A Instrument Control Buildings:

- H-2-64365, Sheet 1, 241-AY-801A Instrument Panel Arrangement
- H-2-68336, Sheet 1, Instrumentation Panel Arrangement & Rear Panel Piping.

4.1.1.9.2 Transmitter Enclosures

Transmitter enclosures are pad-mounted weather-tight electrical enclosures that include pneumatic, electronic, and/or electric signal-processing systems. They are located on or near tanks and provide a means for receiving primary control monitoring signals from the tanks or pits, converting the signals, and transmitting output signals to the tank farm, PLC’s, HMI’s, TMAC, or 241-AZ-271 control room. Alarm and data signals are routed to the 241-AY/AZ-801A Instrument Buildings via buried cable and conduit or pneumatic instrumentation tubing. Three types of transmitter enclosures exist at the AY/AZ Tank Farms: leak-detection pit transmitter enclosures, tank, tank pressure enclosures and the ventilation-instrumentation (CAM) transmitter enclosures.
4.1.1.9.2.1 Leak-Detection Pit Transmitter Enclosures

Eight leak-detection pit transmitter enclosures serve the four tanks indicated by their corresponding component number. One transmitter enclosure is located next to each leak-detection pit. It accommodates a specific-gravity/weight-factor system for sensing level changes in the leak-detection pit wells. A second transmitter enclosure (installed by Project W-030) near the first enclosure provides signal processing and transmission of two primary tank pressure transmitters. The enclosures contain the following four pneumatic transmitters:

AY101-WSTA-ENCL-001, and -002; and AZ101-WSTA-ENCL-101, and -102 contain:

- Leak-detection pit specific-gravity transmitter
- Weight-factor transmitter, for each encasement leak detection pits in AY Farm and in AZ Farm
- Weight-factor transmitter, for leak detection pits (one for each tank) with weight-factor alarms sent to the MCS HMI monitoring system in the 241-AZ-271 Control Room.

AY101-WST-ENCL-AY101, and –AY102; and AZ101-WST-ENCL-AZ101, and –AZ102 (Installed by Project W-030) contain:

- Pressure transmitter, narrow range, -6 to +4 in. w.g. (transmits signal to high- and low-pressure alarms) to the MCS and to the Micon HMI monitoring systems in the 241-AZ-271 Control Room.
- Pressure transmitter, wide range, -10 to +80 in. w.g. (transmits signal to high- and low-pressure alarms) to the MCS and to the Micon HMI monitoring systems in the 241-AZ-271 Control Room.

Three flow indicators or purge meters inside the transmitter enclosure control airflow to pressure instruments in the following locations:

- Weight-factor dip tube is ~2 inch above the pit floor (high pressure)
- Specific-gravity dip tube is ~12 inch above the leak-detection pit floor plate (medium pressure)
- Reference dip tube (atmospheric pressure).

Air at 20 lbf/in.² (gauge) enters the manifold of the enclosure and is distributed through copper tubing to the flow indicators.

The transmitters for the encasement leak detection pit weight factors, and specific gravity convert hydrostatic pressure differences (across dip tubes) into pneumatic signals. The signal relays in the 241-AY-801A & 241-AZ-801A Instrument Buildings convert the sensed pressures to pneumatic signals. The pneumatic signals annunciate at the respective Instrument Control Building panels and also provide input to the 241-A-271 Control Room. See Appendix E, Table E-1, for the description and location of the system alarms and annunciation indicators.
The transmitters for the leak detection pits (by W-314) and tank pressure convert the pneumatic signal to an electrical signal (4-20 milliamp). The pressure signals are sent to the MCS and the Micon HMI monitoring systems in the 241-AZ-271 Control Room. The weight factor signals are only sent to the MCS HMI monitoring systems in the 241-AZ-271 Control Room.

The leak-detection pit transmitter enclosures are provided with electrical power service from the electrical distribution system and instrument air for the instrument air system.

The following key arrangement and piping and instrumentation diagram drawings relate to the leak-detection pit transmitter enclosures:

- H-2-64367, Sheets 1-3, *Instrumentation, Tube Routing and Transmitter Enclosure Arrangements & Details*
- H-2-64378, *Instrumentation, Tube Routing and Leak Detection Pits Arrangements & Details*
- H-2-68338, Sheets 1-4, *Instrumentation Tube Routing and Xmtr Enclosure Arrangement and Details*
- H-14-020806, Sheets 1,2,5
- H-14-020807, Sheets 1,2,4.

### 4.1.1.9.2.2 Continuous Air Monitor Instrument Enclosures

Four transmitter enclosures, each serving one tank, continuously sample annulus exhaust and test for radioactive contamination at all four tanks. They are located adjacent to annulus ventilation filtration equipment serving each tank. The CAM instrument enclosure locations and CAM service are as follows:

- Enclosure AY102-WSTA-ENCL-102, with AY-CAM-102, serves tanks 241-AY-102
- Enclosure AZ101-WSTA-ENCL-103, with AZ-CAM-101, serves tanks 241-AZ-101

Each CAM unit draws and returns samples from its respective tank annulus exhaust. The sampling and return ports on the duct are located upstream of the filtration equipment. Each CAM instrument enclosure includes a basic stack sampler monitor cabinet, a beta/gamma CAM module, a vacuum pump, a vacuum regulator, a plug assembly which connects the CAM electronics to the auxiliary relay box, a local alarm panel with exterior alarm light, electrical power distribution panel, and cabinet ventilation fan and heater with thermostat.

The results of the sample processing at each CAM module are transmitted to their respective instrument control systems in each building. CAM high radiation alarms are sent to the MCS computer system Located in 241-AZ-271 control room.

The following key arrangement and piping and instrumentation diagram drawings relate to the CAM instrument enclosures at the AY/AZ Tank Farms:
AY Tank Farm:

- H-2-50705, Piping Details TK-101 241-AY Tank Farm
- H-2-64371, Instrumentation Control House Panel Arrangement and Wiring
- H-2-92481, Sheet 7, Annulus Exhaust Sys Connection Diagram AY101-VTA-ENCL-100
- H-2-92481, Sheet 8, Annulus Exhaust Sys Connection Diagram AY102-VTA-ENCL-200
- H-2-92481, Sheet 11, Annulus Exhaust Sys Instrument Loop Diag CAM 101-AY
- H-2-92481, Sheet 13, Annulus Exhaust Sys Instrument Loop Diag CAM 102-AY
- H-14-020506, Sheet 1-2, Waste Transfer System (WT) O & M System P&ID

AZ Tank Farm:

- H-2-67288, Ventilation – Ductwork – Upper Level - Plan and Details
- H-2-68341, Instrumentation Control House Panel Arrangement and Wiring
- H-2-92966, Sheet 9, Electrical Annulus Exhaust ENCL-100 Intcon Diag
- H-2-92966, Sheet 11, Electrical Annulus Exhaust 101 AZ CAM Loop Diagram
- H-2-92966, Sheet 13, Electrical Annulus Exhaust 102 AZ CAM Loop Diagram
- H-2-92976, Sheets 1-3, Tank Farm CAM Enclosure
- H-14-020507, Sheet 1-2, Waste Transfer System (WT) O & M System P&ID
- H-2-92970, Sheet 1, Rad Monitoring Annulus Vapor Sampling

4.1.1.9.3 Waste-Level Monitoring

Waste-level monitoring is provided in all DSTs. The liquid-level monitoring devices used at the AY/AZ Tank Farms include the Enraf Series 854 ATG (advanced technology gauge) and the mechanical tape level gauge (manual level indicator). Figure 18 shows the different liquid-level gauges used at the AY/AZ Tank Farms.
Figure 18. Level Gauges.
4.1.1.9.3.1 Enraf Level Gauge

The Enraf gauge is a supplemental level-measuring device. It is extremely accurate, measuring to 0.01 in. The gauge provides data necessary to maintain strict accountability for all waste volumes. Each tank in the AY/AZ Tank Farms has one Enraf gauge designed to provide liquid level readings, which reports the liquid levels to the PCSACS once a day. The Enraf level gauge can sense waste level in the tank every 10 seconds, every minute, or every hour, as suitable for the storage conditions. The Enraf gauges are monitored by the TMACs.

The key arrangement drawing relating to the Enraf level gauge is Hanford Site Drawing H-2-817634, Sheets 1-9, Instm Enraf Nonius Assy Installation & Riser and H-2-815467, Sheets 1-21 Installation Level Gauge- Electronics.

In 2010 AY-101 and AZ-101 manual tapes were removed and replaced with two new Densitometers. These Densitometers are Enraf with a different displacer and slightly different programmable cards. They are not connected electrically but can be used as backup liquid level devices. In addition, there is a densitometer on AY-102 (See HNF-2965) tank as well which was installed in 1998 by the W-320 project to support the C-106 sluicing project to AY-102

4.1.1.9.3.2 Manual Level Gauge

Each tank has one manual level indicator as a backup to the Enraf level gauge. The manual level indicator has a tape on a reel with a plummet attached. The reel box is permanently attached to the tank riser, and a measuring tape with a plummet is attached to the reel. The tape and plummet are inserted through the hole in the riser flange. The plummet is lowered manually to the surface of the liquid waste until the plummet makes contact with the waste surface and an electric circuit is made that is detected by a portable direct-current meter attached to terminals on the reel box. The operator then manually reads and records the level indicated on the tape as observed through the glass window on the reel box. The zero reading on the manual tape represents the bottom of the tank, or zero waste depth. Measurements are recorded to 0.25-in. depth increments. The key arrangement drawings relating to the manual level gauge are H-2-36382, Instrumentation Waste Tank, Liquid Level Gauge Installation and Riser Schedule, and H-2-95413, Sheets 1-4, Inst Liquid Level Indication & Alarm Installation and Details. All the AY/AZ manual tapes are out of service and only two remain, one on tank AY-102 and one on AZ-102.

4.1.1.9.3.3 Specific-Gravity/Weight-Factor System

The specific-gravity/weight-factor system is used at the AY/AZ Tank Farms to measure the liquid levels in the four leak-detection pit wells and two encasement leak detection pit wells. The system detects any increase in level that might indicate leakage from the secondary tanks. The instrumentation equipment for the specific-gravity/weight-factor system is housed in the leak-detection pit transmitter enclosure located adjacent to the leak-detection pits. This enclosure is discussed in Section 4.1.1.9.2.1. Typically a specific-gravity/weight-factor system consists of three dip tubes, sometimes called bubbler tubes, extending into the liquid storage space, and a signal transmitter station to convert the static pressure signals into pneumatic control signals for remote recording and alarm activation. Two of the three dip tubes extend into the liquid; one terminates about 2 in. above the bottom of the pit well and the other terminates about 12 in. above it. The third dip tube terminates in the air space just above the highest
predictable liquid level. Instrument air is forced through the dip tubes sufficient to bubble the air through the liquid. The pressure required to maintain these flows is converted into a 3 to 15 lbf/in\(^2\) (gauge) pneumatic signal at the signal transmitter station and fed to the instrumentation panel for conversion into level and specific-gravity information. The differential pressure between the two dip tubes below the liquid level converts into the specific gravity of the liquid. The differential pressure between the lowest dip tube and the air space dip tube is the weight factor, which converts into a liquid-level reading.

Specific-gravity/weight-factor systems are provided with instrument air.

Figure 5 shows the bubbler tubing from a transmitter enclosure serving a typical leak-detection pit well. It is shown as part of a typical DST tank section. The following key arrangement drawings, which are similar for all DST tank farms, relate to the specific-gravity/weight-factor systems at the AY/AZ Tank Farms:

- H-2-64378 and H-2-64367, Sheets 1-3 (AY)
- H-2-68338 (AZ).

4.1.1.9.3.4 Sludge-Level Monitoring

A solid or sludge layer is commonly formed in the bottom of the tanks as the waste concentrates and solids precipitate. It is important to monitor the sludge layer depth to determine the overall characteristics of the waste being stored. Operations personnel obtain sludge-level measurements manually. Measurements are taken in at least four riser locations, and the results are averaged to account for differences in sludge levels across the surface of the sludge layer. From four to six risers on each tank are reserved for this purpose. Sludge-level measuring equipment, which is permanently installed in the tank, consists of a given length of cable with a 2 3/8-in.-diameter steel doughnut attached. The riser has a riser cap with a handle for opening and closing. To take a measurement, a measuring tape is attached to the cable and the doughnut. The doughnut is lowered until it contacts the sludge, and the measuring tape is read to a set marker on the riser. The tape, cable, and doughnut are initially set to indicate no sludge when the doughnut rests on the primary tank floor. Modified Enraf level gauge also can be used to measure the sludge layer thickness.

Figure 18 shows a detail of the manual sludge-level gauge used at the AY/AZ Tank Farms. The key arrangement drawing relating to the sludge-level monitoring at AY Tank Farm is H-2-94856, Sludge Measurement 6’’ Riser CAP and Sludge Float. Tank 241-AY-102 has a density Enraf gauge on Riser 055. Periodically tank sludge levels are taken using this instrument. The AZ Tank Farm has a similar drawing. A key document for Enraf density gauges is WHC-SD-WM-TRP-240, Performance Requirements and Verification for ENRAF 854 ATG Density Gauges for Tank AN-107 Caustic Addition.

4.1.1.9.4 Tank Pressure Monitoring

The primary tank pressure, or vapor pressure, is constantly monitored to ensure that a negative pressure is maintained. This is necessary in the event of any planned access into the primary tank through a riser, or any unplanned breach into the primary tank headspace, when outside air infiltrates into the tank instead of contaminated air being released to the environment. Also, the
vapor pressure is monitored to ensure that the internal tank pressure, positive or negative, does not exceed design limits. Pressure Monitoring is only required for TSR controls after a large water addition, chemical addition or waste transfer which is under LCO 3.4 and SR 3.4.1. Prior to every transfer and every 12 hours for at least 7 days (per the Bases section). A pressure probe is installed in the two 4-in. ID No. 5 risers, (each tank in AY and AZ has two identification number 5 Risers) in Tanks 241-AY-101 and 241-AY-102, and Tanks 241-AZ-101 and 241-AZ-102. The Probes are connected via buried ½-in. tubing to the nearby leak-detection pit transmitter enclosure for signal processing and transmitting. Two pressure transmitters are installed in each enclosure for pressure sensing. One is a wide-band (-10 to +80 inches wg) transmitter for recording purposes and the other is a narrow band (-6 to +4 inches wg) for alarm annunciation. The signals are electronically transmitted to the 241-AZ-271 control room. The signals then go into the Micon computer and into the MCS computer system. Both systems can monitor the tank pressure using HMI monitors.

The key arrangement drawings relating to tank pressure monitoring are the following Hanford Site Drawings:

- H-2-131329, Sheet 1, Instrm Wiring / Assembly/ Detail Enclosure AY101
- H-2-131329, Sheet 2, Instrm Wiring / Assembly/ Detail Enclosure AY102
- H-2-131330, Sheet 1, Instrm Wiring / Assembly/ Detail Enclosure AZ101
- H-2-131330, Sheet 2, Instrm Wiring / Assembly/ Detail Enclosure AZ102

4.1.1.9.5 Temperature Monitoring

The typical DST has more than 80 temperature sensors for monitoring temperatures at various locations on the tank, under the tank, in the tank waste, and in the annulus area. With a few exceptions in other tank farms, the sensors or temperature elements (TE) are thermocouples that transmit an electrical signal corresponding to the temperature sensed. Waste temperature is monitored through TEs installed on instrument trees that have been inserted into the waste through risers. The tank structure temperature is monitored through TEs located in permanently installed thermocouple wells that are either attached to or embedded into the tank structure.

4.1.1.9.5.1 Waste-Temperature Monitoring

Thermocouples are used all the AY and AZ tanks to monitor waste temperatures. The location of the thermocouples in the AY tanks and the AZ tanks vary because experience with the AY tanks caused some modifications on thermocouple type and location at the AZ Tank Farm.

Thermocouples are installed in all 22 air lift circulators, which are located approximately 3 in. above the primary tank bottom, a point where movement of waste normally should sweep the immediate area free of sludge. An air lift circulator malfunction, which would allow the sludge to accumulate, would be indicated by a temperature rise at the associated thermocouple. The thermocouples attached to the air lift circulators in Tank 241-AZ-101 could be bent by the forces exerted on them by the mixing pump. It is speculated that the bent thermocouples nearest to the mixer pump are no longer 3 in. above the bottom of the tank floor.

Other thermocouples are installed in wells and are used to measure the temperature ranges in the stored waste at different locations within the tank. The profile thermocouple tree used at the AY tanks and AZ-102 Tank uses three thermocouples per tree. Each thermocouple is located in
a separate thermocouple well and the wells are bundled to fit in a 4-in. riser. Each thermocouple is located at a different height above the tank bottom. The lowest element is approximately 4 in. above the bottom, the next is 158 in., and the highest is 300 in. Each tank contains four profile temperature trees located about 2.5 ft. from the perimeter and spaced evenly circumferentially around the tank.

In Tank 241-AZ-101 the thermocouple trees were changed by Project W-151 because the mixer pump forces might have caused them to fail. The new thermocouples were installed at a different height than in the other three tanks in AZ/AY Tank Farms. In Tank 241-AZ-101 the thermocouples were mounted in a single pipe at levels of 4, 14, and 140 in. off the bottom. Project W-151 added thermocouples to the bottom of seven drywells. All seven thermocouples in the dry wells have failed.

Each of the other 3 tanks contains three sludge temperature probes. A single thermocouple well mounted in a 1 ½-in. stiffener pipe is suspended to approximately 3 in. above the bottom of the primary tank. The sludge temperature probes are located nearer the center of the tank and also spaced evenly circumferentially around the tank. The cables from all of the TEs on the trees connect to the RTP2000 PLC computer system in the 241-AY-801A Instrument Building. Temperatures are recorded manually currently. In the future, operators will be able to record data from the MCS computer system located in 241-AZ-271 control room from the HMI monitors or from other HMI locations in the 200 East Area.

The following key arrangement drawings relate to waste-temperature monitoring at the AY/AZ Tank Farms:

- H-2-64365, Sheets 5-7, 241-AY-801A Instr House IE-0622 Wiring Diagram
- H-2-67349, Sheets 1 and 2, Tank Riser Details
- H-2-67349, Air Lift Circulator and Riser Extension Details
- H-2-93375, Sheets 1-12, Temperature Element Scanning Instrumentation Installation

4.1.1.9.5.2 Tank-Structure Temperature Monitoring

Approximately 101 TEs are installed in thermocouple wells in each tank at the following locations:

AY Tank Farm:

- TE-001 to 025 Insulating Concrete
- TE-026 to 027 Tank Knuckle
- TE-030 to 037 Tank Foundation
- TE-038 to 059 Air Lift Circulators
- TE-060 to 071 Waste Thermocouple Trees (4 trees with 3 TCs ea)
- TE-082 to 105 Tank Dome

AZ Tank Farm:
• TE-001 to 024 Insulating Concrete  
• TE-025 Tank Knuckle  
• TE-026 to 036 Tank Foundation  
• TE-037 to 058 Air Lift Circulators  
• TE-059 to 070 Waste Thermocouple Trees (4 trees with 3 TCs ea)  
• TE-071 to 073 Single Point Sludge TC Tree  
• TE-074 to 085 Tank Dome  
• TE-086 to 097 Tank Wall

### 4.1.1.9.5.2.1 Tank 241-AZ-101 only

• TE-098 to 101 Sludge TC in Drywell  
• TE-102 to 104 Tree TC (local readings only)

The thermocouples and cables are routed to the thermocouple wells permanently attached to the tank structure. The cables are collected together at several junction boxes around the tank. Splices are made at the junction boxes to extend the cable runs underground to the instrument panels in the instrument control buildings, where they terminate at the 241-AY-801A building RTP2000 PLC (AY801A-WT-YYC-101) inside the instrument panel. Temperatures are recorded manually currently. In the future, operators will be able to record data from the MCS computer system located in 241-AZ-271 control room from the HMI monitors or from other HMI locations in the 200 East Area. Procedure TO-040-660, *Obtain/Record DST Tank Temperature Data*, contains directions and information on the operation of the display unit.

The following key arrangement and piping and instrumentation drawings relate to the tank-structure monitoring at the AY/AZ Tank Farms:

### 4.1.1.9.5.2.2 AY Tank Farm:

• H-2-64365, Sheets 5-7, 241-AY-801A Instr House IE-0622 Wiring Diagram
• H-2-64366, Instrumentation Temperature, Strain Gauge & Leak Detection Elements, Terminal Box Installation Detail & Connection Schedule
• H-2-64372, Instrumentation Insulating Concrete Plan & Details
• H-2-64373, Instrumentation Concrete Foundation Plan & Details
• H-2-64374, Instrumentation Concrete Foundation Plan & Details
• H-2-64375, Instrumentation Concrete Dome Plan & Details
• H-2-64376, Instrumentation Tank Cable Routing Plan & Details
• H-2-93375, Sheets 1-12, Temperature Element Scanning Instrumentation Installation
• H-14-020606, Sheets 1-3, Waste Storage Tank Instmt System (WST) O&M System P&ID
• H-14-020506, Sheets 1-3, Waste Storage Tank Instmt System (WSTA) O&M System P&ID
4.1.1.9.5.2.3 AZ Tank Farm:

- H-2-67295, *Instrumentation Insulating Concrete Plan & Details*
- H-2-67296, *Instrumentation Concrete Dome Plan & Details*
- H-2-67297, *Instrumentation Tank Cable Routing Plan & Details*
- H-2-68337, *Instrumentation Temperature, Strain Gauge & Leak Detection Elements, Terminal Box Installation Detail & Connection Schedule*

4.1.1.9.6 Leak Detection

The AY/AZ Tank Farms DST waste storage system includes the following five types of leak detection:

- Primary tank leakage: detected by Enraf Leak Detection
- Primary tank leakage: detected by CAM radiation detection on annulus exhaust
- Secondary tank leakage: detected by specific-gravity/weight-factor level sensing in leak-detection pit well
- Pit leakage (into) during process water transfers: Detected by conductivity probe leak detectors in pits (leak-detection pit only).
- Enraf level gauges that measure primary tank waste level changes.

Pipe-encasement leak detection and leak detection in the central pump pit, sluice pit, and encasement pit is considered part of the waste transfer system and is not included in this system. Leak detection in the annulus pump pit is considered part of the emergency annulus pumping and is not included in this section.

4.1.1.9.6.1 Primary Tank Leak Detection—Annulus Enraf Leak Detectors

The primary tank leak-detector probes, which sense the liquid level in the annulus, is an Enraf gauge mounted permanently to a 12 inch or 24 inch riser above the annulus. Each tank annulus contains three leak-detection locations installed approximately 90 to 180 degrees apart. The lowest detection point is approximately ¼ in. to the annulus floor. For specific design requirements of the Enraf system, see the design drawings in Appendix B and RPP-15157.
The following are key arrangement and piping and instrumentation drawings relating to primary tank leak detection using conductivity Enraf gauges probes in the annulus at the AY/AZ Tank Farms:

AY Tank Farm:
- H-2-64341, sheets 1-2, Electrical Plot Plan & Details UGND Cable Runs
- H-2-95413, Sheets 1 & 5, INSTM Liquid Level Indication & Alarm Installation & Details
- H-2-817634, sheets 1, 6 & 8, INSTM ENRAF Nonius, Assy Installation & Riser Sched
- H-14-020506, Sheets 1-3, Waste Transfer System (WT) O & M System P&ID

AZ Tank Farm:
- H-2-68405, sheet 1, Electrical Site Plan & Details Underground Cables
- H-2-95413, Sheets 1 & 5, INSTM Liquid Level Indication & Alarm Installation & Details
- H-2-817634, sheets 1, 6 & 8, INSTM ENRAF Nonius, Assy Installation & Riser Sched
- H-14-020507, Sheets 1-3, Waste Transfer System (WT) O & M System P&ID

4.1.1.9.6.2 Primary Tank Leak Detection – Annulus Exhaust Continuous Air Monitor

Primary tank leak detection also is accomplished by sensing radiation levels in the annulus ventilation exhaust air. The air sampling occurs at the two ventilation equipment pads where the annulus exhaust air is sampled and monitored in the CAM transmitter enclosure as described in Section 4.1.1.9.2.2. The air samples from the two exhaust ducts are processed in their respective CAM units in the radiation-monitor station. A vacuum pump at the station pulls air from the annulus duct into the CAM analyzer. If contamination is detected, a signal activates a local alarm light, and the alarm horn at the radiation-monitor station. Simultaneously, a signal is transmitted to the 241-AZ-271 Control Room, activating an annunciator on the monitor and control system (MCS) and energizing the alarm light on the HMI monitors.

The following key arrangement and piping and instrumentation diagram drawings relate to primary tank leak-detection using CAM leak detection in the annulus exhaust at the AY/AZ Tank Farms:

AY Tank Farm:
- H-2-64371, Instrumentation Control House Panel Arrangement and Wiring
- H-2-64465, Ventilation Exhaust Equipment Plan and Details
- H-2-92481, Sheet 7, Annulus Exhaust Sys Connection Diagram AY101-VTA-ENCL-100
- H-2-92481, Sheet 8, Annulus Exhaust Sys Connection Diagram AY102-VTA-ENCL-200
- H-2-92481, Sheet 11, Annulus Exhaust Sys Instrument Loop Diag CAM 101-AY
- H-2-92481, Sheet 13, Annulus Exhaust Sys Instrument Loop Diag CAM 102-AY
- H-2-64465, Ventilation Exhaust Equipment Plan and Details
- H-14-020506, Sheet 3, Waste Transfer System (WT) O & M System P&ID

AZ Tank Farm:
4.1.1.9.6.3 Secondary Tank Leak Detection—Specific Gravity/Weight Factor

The six leak-detection pits are equipped with specific-gravity/weight-factor systems that monitor and record liquid levels in the leak-detection wells. This system is described in Section 4.1.1.9.3.3.

4.1.1.9.6.4 Pit Leak Detection

Only the leak-detection system in the leak-detection pit is considered part of the AY/AZ Tank Farm DST waste storage system (this does not include the well itself). However, some of these leak detectors currently are not functional and have been disconnected at their leak-detection transmitter enclosures and replaced with new leak detectors. See P&ID Drawings H-14-020806, Waste Transfer System (WT) O & M System P&ID, and H-14-020807, Waste Transfer System (WT) O & M System P&ID, for current configurations. All conductivity-probe types are accompanied by a leak-detection transmitter enclosure. Several variations of pit leak detectors are in use, and periodically they are modified and changed in the pits. A floor drain seal assembly normally plugs the drain requiring liquid accumulation to a detectable depth before draining occurs. The drain can be lifted to remove residual waste from the pit. The floor drains used in the pump pits are shown on H-14-107429, DST Pit Floor Drain Seal Assembly AY-01A and AY-02A Pits. The valve pit floor drain seals are shown on H-14-103266, Piping Floor Drain Seal Assembly Valve Pit 241-AZ-VP. The AZ Tank Farm floor drain seal modifications are shown on H-2-94792, Floor Drain Seal Modification. A lifting rod is attached to the floor drain assembly body to allow it to be removed or replaced. The pump pit floor drain seal has a 4-5/16" holes in the center to allow flammable gas to vent into the pit. Because the drain lines are submerged into the waste, a hole was necessary to prevent gas pressure build up in the drain line. Some AY/AZ Tank Farm pit leak detectors are freestanding. They include an assembly to hold the probes and adjustable legs to set the probe height above the floor. On these units, unless the floor drain plug is closed, the leak detector may not detect small amounts of leakage.

Figure 19 shows an example of the most common freestanding pit leak detector. The following key assembly, elevation and piping and instrumentation diagram drawings relate to pit leak detectors at the AY/AZ Tank Farms:

AY Tank Farm:

- H-2-34965, Sheets 1-7, Leak Detector Assembly, Typical Details
- H-14-020806, Sheets 1-6, Waste Transfer System (WT) O & M System P&ID
- H-14-100983, Sheets 1 and 2, Instm. Leak Detector Station, Assy. & Details
4.1.2 Boundaries and Interfaces

As mentioned in Section 1.1, the following systems interface with the AY/AZ Tank Farms DST waste storage system:

- Waste transfer system (WT)
- Electrical distribution system (EDS)
- Ventilation tank primary (VTP)
- Ventilation tank annulus (VTA)
- Emergency annulus pumping system (EAP)
- Raw water system (RW)
- Instrument air system (IA)
- Service air system (SA)
- Tank monitor and control system (TMAC).
- Tank Farm MCS
- Chemical (base)
- Fire protection
- Gas characterization
- Glycol cooling
- Retrieval/Closure
- Standard hydrogen monitoring
Figure 19. PIT Leak Detectors.
Appendix F, Figure F-1, provides a graphic overview of the extent of the systems and should be used in conjunction with the accompanying tables. Appendix F, Table F-1, provides a listing of the waste storage subsystems and components that are considered to be part of the DST waste storage system, as well as those that are not and the systems they belong to. Appendix F, Table F-2, describes where interfaces occur and lists the interface points.

4.1.3 Physical Location and Layout

The AY/AZ Tank Farms are located in the 200 East Area between Buffalo Avenue and Canton Avenue just south of the AN Tank Farm. Access to both farms is from Buffalo Avenue. The tank farm layout was shown on Figure 2, included in Chapter 1. Hanford Site Drawings H-2-64301, Civil Plot Plan & Finish Grading, 241-AY Tank Farm, and H-2-68301, Civil Plot Plan & Finish Grading, 241-AZ Tank Farm, provide more detail on tank and structure locations at both farms.

4.1.4 Principles of Operation

The required function of this system is to confine waste and to facilitate waste receipt into and transfer out of the four DSTs included in the system. The system accomplishes its required function by virtue of its design, which includes safety and design factors exceeding the requirements for handling the waste specified for use by the system. These safety and design factors include a primary tank with secondary and tertiary tank (concrete liner) containment structures; mixer pumps (Tank 241-AZ-101 only) to suspend solids in solution and to provide homogeneity; measurement and detection systems for pressure, radiation, liquid levels, temperature, etc.; access to the waste and to equipment, piping, and other components (via pits and risers); interface with necessary supporting systems such as raw water, electrical power, waste transfer, ventilation, etc.; and administrative controls (procedures, surveillances, inspections).

Facility operational modes are not defined for the tank farm TSRs. The operational conditions when the tank farm LCOs and associated Surveillance Requirements, ACs, and Design Features are required are specifically stated in the applicability section of these TSRs.

The principles of operation the equipment itself, including air lift circulators and the monitor and alarm instrumentation equipment, are discussed in Sections 4.1.1.8 and 4.1.1.9 under the appropriate equipment description paragraphs.

4.1.5 System Reliability Features

No “active” system components within the scope of this system have a safety impact on operations other than the essential monitoring and alarm system components that support the safety functions (safety basis) described in Section 2.1.2. Monitoring and alarm component failure modes are such that operator and/or automatic actions will be triggered on loss of the safety-related component’s ability to function as designed. This failure may be the result of loss of electrical power, component failure, or other adverse condition.
4.1.6 System Control Features

The primary function of this system is to maintain waste sufficiently to prevent uncontrolled release from the confines of the system and to ensure that the passive protection features such as shielding, tank integrity, etc., remain effective for the waste composition contained in the system. Therefore, controlling the characteristics of the waste itself is the most important control feature. Because the waste storage system is passive, control comes from supporting and interfacing systems, including ventilation, waste transfer, waste characterization and conditioning, etc.

4.1.6.1 System Monitoring

The DST system depends on the integral monitoring and alarm components within its scope to trigger both automatic and manual control actions necessary to ensure safe operations. The system parameters (temperature, level, etc.) are maintained within the specified range for normal operation. The monitoring and alarm processes provide the ability to monitor tank pressure, annulus leak detection, tank temperature (primary, secondary, concrete), waste temperature, and liquid and sludge waste level in the tank, and annulus. Values for all measurements must be within ranges specified in the HNF-SD-WM-TSR-006 and HNF-IP-1266 (for DSA/TSRs), OSD-T-151-00007 and OSD-T-151-00031 (for DST operational limits), RPP-16922 (for environmental limits) and RPP-11413 (for ventilation limits). See also HNF-1529, Historical Basis for Analog Input Set-points, 241-AY & 241-AZ Tank Farm MICON Automation System. Output displays and data are available for operator review and possible action at the 241-AZ-271 Control Room (MCS). Manual readings (by instrument technicians or Operators) and some local displays can be monitored in the field during power outages or whenever there are communication problems with sending signals to the MCS systems.

4.1.6.2 Control Capability and Locations

Indication and alarms occur both in the 241-AZ-801A and 241-AZ-801A Instrument Buildings and in the 241-AZ-271 Control Room. The annulus CAMs and the leak-detection pit weight-factor systems also alarm at the 241-AZ-271 Control Room (MCS).

4.1.6.3 Automatic and Manual Actions

If automatic actions do not occur as required, manual actions can be taken by an operator at the 241-AZ-271 Control Room, from the 241-AZ-801A and 241-AZ-801A Instrument Buildings, or at specific locations within the tank farm itself such as at the various pit locations (opening/closing valves, manually opening a pit drain, etc.). See Appendix C, Table C-1, for the applicable alarm response procedures. The alarm response procedures describe the step-by-step actions to be taken in response to alarm conditions.
4.1.6.4 Set-points and Ranges

Set-points and ranges, where applicable and/or known, are stated in the alarm response procedures (Appendix C, Table C-1). The alarm response procedures contain instrument set-point information, where applicable.

4.1.6.5 Interlocks, Bypasses, and Permissions

The air lift circulators have a primary tank pressure interlock systems that shut down air to the air lift circulators by closing a solenoid valve on loss of vacuum. See Hanford Site Drawing H-14-020306, Service and Instrument Air System (SA/IA) O&M System P&ID, and H-14–020307, Service and Instrument Air System (SA/IA) O&M System P&ID, for AY and AZ Tank Farms respectively. The procedures are listed in Appendix C

4.2 OPERATIONS

4.2.1 Initial Configuration (Pre-startup)

This section is not applicable for this SDD. This system supports the operational activities of the waste transfer system.

4.2.2 System Startup

This section is not applicable for this SDD. This system supports the operational activities of the waste transfer system.

4.2.3 Normal Operations

Facility operational MODES are not defined for the tank farms TSRs. The operational conditions when the tank farm LCOs and associated SRs are required are specifically stated in the Applicability section of the LCOs see HNF-SD-WM-TSR-006, Section1.6.2. The tank farm ACs applies at all times unless otherwise specifically noted in the ACs. Various activities require certain equipment to be operable. Some activities are not allowed at the same time such as receiving a transfer and a power outage.

Treating stored waste by chemical addition is also a normal operation for the DST system and is covered by RPP-15137, System Design Description for 200 East Area Double-Shell Tank Waste Transfer System

4.2.4 Off-Normal Operations

The AY/AZ Tank Farms use the alarm response procedures listed in Appendix C, Table C-1. The information included in each procedure is detailed and definitive. Each procedure includes a cover sheet and individual procedures for each alarm. Each alarm procedure includes the following breakdown:
• Facility
• Annunciator color and label as it appears on the panel
• Panel location
• Alarm number
• Source
• Set-point value
• Alarm class
• Alarm description
• Operator actions to be taken (step-by-step)
• Possible causes listings
• Reference.

Individual procedures must be consulted for current specific information.

4.2.5 System Shutdown

The air lift circulators and mixer pumps are the only process operational components in this system. Air lift circulator and mixer pump shutdown is performed manually in accordance with the procedures listed in Appendix C (*Information not readily available*). Procedures may no longer be listed on the electronic drive if they are inactive. The mixer pumps are out of service.

4.2.6 Safety Management Programs and Administrative Controls

The following Safety Management Programs and Administrative Controls specified in HNF-SD-WM-TSR-006 may apply to the equipment described in this SDD.

- AC 5.6, “Safety Management Programs”
- AC 5.8, “Specific Administrative Controls”
  - 5.8.1 DST Induced Gas Release Event Evaluation
  - 5.8.2 Flammable Gas Control for Waste-Intruding Equipment
  - 5.8.3 Flammable Gas Controls for Inactive/Miscellaneous Tanks/Facilities
- AC 5.9 “Administrative Control Key Elements”
  - 5.9.1 DST and SST Time to Lower Flammability Limit
  - 5.9.2 Ignition Controls
  - 5.9.4 Waste Characteristics Controls
  - 5.9.5 Nuclear Criticality Safety

4.3 TESTING AND MAINTENANCE

4.3.1 Temporary Configurations

Sometimes instruments are temporarily removed from service to calibrate or functionally test them.
4.3.2 Technical Safety Requirement-Required Surveillances

TSR-required surveillances are described in Section 3.7.2. The specific procedures used to fulfill the requirements of these surveillance activities are listed in Appendix C, Table C-2. NOTE: There are no TSR-required surveillances applicable to the AY and AZ tank farm DST waste storage system.

4.3.3 Non-Technical Safety Requirement Inspections and Testing

Non-TSR-required surveillances are described in Section 3.7.3. The specific procedures used to fulfill the requirements of these surveillance activities are listed in Appendix C, Table C-3.

4.3.4 Maintenance

Most of the subsystems of the AY/AZ Tank Farms DST waste storage system consist of large buried structures that do not require maintenance. Corrosion and deterioration are observed and recorded wherever possible using cameras, ultrasonic thickness testing, and waste-sampling techniques. The exposed and accessible subsystems, including the exposed portions of the pits, instrumentation, and monitor and alarm systems, have established maintenance procedures. In addition, the tank farm has general maintenance procedures that apply to certain components of the tank waste storage system. For the maintainable subsystems and components, the following consistent and proper maintenance activities are required:

- Cleaning or replacing electrodes (cathodic protection for underground piping)
- Checking signal cable integrity/performance
- Exercising associated alarms and annunciators
- Primary tank CAM leak-detection system
- Changing the filter in CAMs
- Regularly calibrating CAMs.

Note: The CAM is calibrated at least every 330 days in accordance with 6-RM-168, *Eberline AMS-4 Continuous Air Monitor Calibration*. The installed CAM is replaced with a CAM that was calibrated in the shop, thus minimizing system downtime. The removed CAM then can be calibrated for future installation.

- Cleaning or replacing gas sampler probes
- Monitoring the primary and annulus tank liquid level
- Checking displacer for residue; periodically cleaning or replacing
- Calibrating Enraf reel/transmitting/leveling unit (for primary tank liquid level and for annulus leak detection Enrafs)
- Calibrating specific-gravity/weight-factor transmitters (No longer calibrated)
- Monitor Air purging all dip tubes (air bubbler pipes)
- Cleaning air filters
- Calibrating pneumatic and electric signal transmitters
- Flushing air lift circulators (Flushing is no longer performed)
• Bumping mixer pumps. (bumping or hand rotating is no longer performed)
• Calibrating pressure monitoring transmitters

All maintenance procedures are included in the Tank Farms Maintenance Procedures. The key maintenance procedures for the AY/AZ Tank Farms DST waste storage system subsystems and components are listed in Appendix C, Table C-4.

4.3.4.1 Post-Maintenance Testing

Post-maintenance testing is addressed in TFC-OPS-MAINT-C-01, Tank Farm Contractor Work Control. Maintenance testing is addressed in TFC-OPS-MAINT-STD-02, section 3.7.6.

4.3.4.2 Post-Modification Testing

Any post modification testing will be fully described within the work documents themselves and will depend on the scope and extent of the modification.

4.4 SUPPLEMENTAL INFORMATION

Waste Feed Delivery Mission

The DST Confinement System consists solely of the structures and components that make up the basic DST structure, and excludes all attachments and insertions. The confinement system performs a passive activity by containing waste. Other systems are attached to or inserted into the DST Confinement System to accomplish the Waste Feed Delivery mission. Requirements for waste feed delivery may or may not be currently met by the AY/AZ DST system. Some of the known requirements are delineated below.

Double-Shell Tank Spare Storage Capacity Constraints from DOE Directives
Requirement: The volume of DST space allocated for tank farm emergencies and emergency returns from the WTP is 1.265 Mgal, as addressed in HNF-3484 *Double–Shell Emergency Pumping Guide*. The *River Protection Project System Plan* (ORP-11242) documents the available and projected emergency space allocation as determined by the Hanford Tank Waste Operations Simulator (HTWOS) computer model.

Basis: The limit of 1.265 million gallons is stipulated by Contract No. DE-AC27-08RV14800, as addressed in ORP-11242 Appendix B, Key Assumptions and Success Criteria. Emergency tank space is planned and tracked through the HTWOS computer model to assure a minimum of 1.265 million gallons of emergency storage capacity is planned to be available prior to any transfer modeled.

**Life of DST System**

Requirement: The DST system shall be capable of accepting and storing waste until all DSTs are closed in 2052.
5.0 REFERENCES

6-RM-168, *Eberline AMS-4 Continuous Air Monitor Calibration*, Radiation Monitoring Group

Regulations*, Part 830.3, as amended.

amended.

ARH-205-1, 1967, *Design Criteria PUREX 241AY Tank Farm*, Atlantic Richfield Hanford
Company, Richland, Washington.

ARH-1437, 1970, *Design Criteria, PUREX AZ Tank Farm*, Atlantic Richfield Hanford
Company, Richland, Washington.

Facilities for 200 East Area*, Atlantic Richfield Hanford Company, Richland,
Washington.

ASME VIII, *ASME Boiler and Pressure Vessel Code*, Section VIII, American Society of
Mechanical Engineers, New York, New York.


Intermediate- and Higher-Temperature Service*, American Society for Testing and
Materials, West Conshohocken, Pennsylvania.

CPS-T-149-00012, *Criticality Prevention Specification for Tank Farm Operations*, RPP Tank
Farms Operating Procedures, Criticality Prevention Specification, CH2M HILL Hanford


DOE Order 5480.22, *Technical Safety Requirements*, U.S. Department of Energy,
Washington, D.C.

Washington, D.C.

Washington, D.C.


Hanford Site Drawings:

- H-2-34965, Sheets 1-7, *Leak Detector Assembly, Typical Details*
- H-2-36382, *Instrumentation Waste Tank, Liquid Level Gauge Installation and Riser Schedule*
- H-2-63796, *241-AY Tank Farm Annulus Pump Pit Arrangement*
- H-2-64301, *Civil Plot Plan & Finish Grading, 241-AY Tank Farm*
- H-2-64306, *Tank Foundation Plan*
- H-2-64307, *Structural Insulating Concrete Plans and Details (AY)*
- H-2-64310, *Concrete Tank Section and Details*
• H-2-64311, Concrete Dome Reinforcement Plan & Details
• H-2-64313, Structural Pump Pits Plans, Section & Details Tank 241-AY-101 & 102
• H-2-64314, Structural Concrete Sluicing Pit, Plans Sections (241-AY)
• H-2-64318, Leak Detection Pit Plan, Sections & Details AY-102
• H-2-64323, sheets 1 & 2, Civil Valves Pits for Water Piping and Condensate Drain
• H-2-64325, Leak Detection Pits Tank AY-101 and Encasement Plan, Sections & Details
• H-2-64365, Sheet 1, 241-AY-801A Instrument Panel Arrangement
• H-2-64366, Instrumentation Temperature, Strain Gauge & Leak Detection Elements, Terminal Box Installation Detail & Connection Schedule
• H-2-64367, Sheets 1-3, Instrumentation, Tube Routing and Transmitter Enclosure Arrangements & Details
• H-2-64368, Instrumentation In-Tank Temperature and Pressure Assemblies Plan & Details
• H-2-64371, Instrumentation Control House Panel Arrangement and Wiring
• H-2-64372, Instrumentation Insulating Concrete Plan & Details
• H-2-64373, Instrumentation Concrete Foundation Tank 101 Plan & Details
• H-2-64374, Instrumentation Concrete Foundation Tank 102 Plan & Details
• H-2-64375, Instrumentation Concrete Dome Plan & Details
• H-2-64341, Electrical Plot Plan & Details UGND Cable Runs
• H-2-64378, Instrumentation, Tube Routing and Leak Detection Pits Arrangements & Details
• H-2-64405, Pipe Plan Tank 101
• H-2-64406, Pipe Plan Tank-102.
• H-2-64419, Tank Riser Details
• H-2-64447, Tank Plan Penetration Schedule
• H-2-64449, Tank Elevation & Details
• H-2-67245, Concrete Tank Section & Haunch Reinforcement
• H-2-67248, Sheet 1, Leak Detection Sump Plan & Details 241-AZ-101 & 102
• H-2-67249, *Structural Concrete Leak Detection Pits Plans, Sections and Details Tank 241-AZ-101*

• H-2-67288, *Ventilation – Ductwork – Upper Level - Plan and Details*

• H-2-67293, *Instrumentation Concrete Foundation Tank 241-AZ 1-1 & 102 Plan & Details*

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• H-2-67314, *Plan Tank 101 Penetration & Schedule 214-AZ Tank Farm*

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• H-2-67317, *Tanks 101 & 102 Section & Details 241-AZ Tank Farm*

• H-2-67349, *Air Lift Circulator and Riser Extension Details*

• H-2-68301, *Civil Plot Plan & Finish Grading, 241-AZ Tank Farm*

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• H-2-68310, *Civil Valve Pits for Steam and Water Piping*

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• H-2-68353, *Pipe Plan Tank-102 241-AY-Tank Farm*

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• H-2-68423, *Tank Riser and Air Lift Circulator Details*

• H-2-92481, Sheet 7, *Annulus Exhaust Sys Connection Diagram AY101-VTA-ENCL-100*

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• H-2-92481, Sheet 11, Annulus Exhaust Sys Instrument Loop Diag CAM 101-AY
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• H-14-010506, Dome Penetration Schedules (WST/WSTA) Tank 241-AY-101 (-102 through -104)
• H-14-010507, Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-101
• H-14-020306, Service and Instrument Air System (SA/IA) O&M System P&ID
• H-14-020307, Service and Instrument Air System (SA/IA) O&M System P&ID
• H-14-020506, Sheets 1 through 3, Waste Storage Tank Annulus System (WSTA) O&M System P&ID
• H-14-020507, Sheets 1through 3, Waste Storage Tank Annulus System (WSTA) O&M System P&ID
• H-14-020606, Sheets 1 and 2, Waste Storage Tank System (WST) O&M System P&ID
• H-14-020607, Sheets 1 through 4, Waste Storage Tank System (WST) O&M System P&ID
• H-14-020806, Waste Transfer System (WT) O&M System P&ID
• H-14-020807, Waste Transfer System WT O&M System P&ID
• H-14-021807, Raw Water System (RW) O&M System P&ID
• H-14-102616, Sheet 1, Drawing List Vicinity Map
- H-14-102666, Sheet 1, Drawing List Vicinity Map
- H-14-100983, Sheets 1 and 2, Instrm. Leak Detector Station, Assy. & Details
- H-14-103266, Piping Floor Drain Seal Assembly Valve Pit 241-AZ-VP
- H-14-107429, DST Pit Floor Drain Seal Assembly AY-01A and AY-02A Pits

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APPENDIX A

SOURCE DOCUMENTS
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APPENDIX A

SOURCE DOCUMENTS

See section 5.0 References, for the referenced documents related to this System Design Description.
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APPENDIX B

SYSTEM DRAWINGS AND DOCUMENTS
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APPENDIX B

SYSTEM DRAWINGS AND DOCUMENTS

The drawings and documents listed in Table B-1, “Essential Drawings” make up the design basis for the system. These drawings and documents must be maintained under configuration control. Any changes to these drawings and documents must be approved by the system engineer responsible for the system.

Table B-1. AY/AZ Essential Drawings

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Table B-2, “Support Drawings and Documents,” lists drawings and documents that comprise the design baseline, excluding the design basis as defined in TFC-PLN-03, for the AY/AZ Tank farms Double-Shell Tank Waste Storage System. It includes support drawings identified in DMCS. These drawings and documents include other systems that supplement the design baseline for this system.

Table B-2. AY/AZ Support Drawings and Documents (6 pages)

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Table B-2. AY/AZ Support Drawings and Documents (6 pages)

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**Documents**

| HNF-4154               | N/A   | Double-Shell Tank Process Waste Sampling Subsystem Specification | WT     |
| HNF-4155               | N/A   | Double-Shell Tank Monitor and Control Subsystem Specification   |        |
| HNF-4157               | N/A   | Double-Shell Tank Utilities Subsystems Specification            | EDS RW IA |
| HNF-4159               | N/A   | Double-Shell Tank Maintenance and Recovery Subsystem Specification |        |
| HNF-4160               | N/A   | Double-Shell Tank Transfer Valving Subsystem Specification       |        |
| HNF-4161               | N/A   | Double-Shell Tank Transfer Piping Subsystem Specification,       |        |
| HNF-4162               | N/A   | Double-Shell Tank Transfer Pump Subsystem Specification          |        |
Table B-2. AY/AZ Support Drawings and Documents (6 pages)

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EAP = Emergency annulus pumping.  
EDS = Electrical distribution system.  
IA = Instrument air.  
RW = Raw water.  
VTA = Ventilation Tank Annulus  
SA = Service air.  
SW = Service water.  
WT = Waste transfer.  
VTP = Ventilation Tank Primary
The documents listed in Table B-3, “Historical Drawings and Documents,” are not active, nor are they maintained under configuration control. The documents are considered to contain information that is relevant and helpful to understanding the system. They should be used with caution, as they may not reflect current field configuration.

Table B-3. AY/AZ Tank Farms Historical Drawings and Documents (2 pages)

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<td>Design Criteria PUREX Tank Farm Expansion</td>
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<td>HWS-7789</td>
<td>Spec For Primary &amp; Secondary Steel Tanks PUREX Tank Farm Expansion, Hanford Engineering Services, Richland Washington, 1968</td>
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<td>Spec For Excavation and Tank Foundations PUREX Tank Farm Expansion, Hanford Engineering Services, Richland Washington, 1968</td>
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<td>HWS-7793</td>
<td>Spec For Thermocouple and Strain Gauge Assemblies PUREX Tank Farm Expansion, Hanford Engineering Services, Richland Washington, 1968</td>
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<td>Specification for Completion of Tank 102 Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm, Vitro Engineering, Richland, Washington, 1972</td>
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<td>Spec For Primary &amp; Secondary Steel Tanks PUREX Tank Farm Expansion, Hanford Engineering Services, Richland Washington, 1970</td>
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<td>Spec For Excavation and Tank Foundations PUREX Tank Farm Expansion, Hanford Engineering Services, Richland Washington, 1970</td>
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Table B-4. AY/AZ Tank Farms Vendor Information

*Information not readily available*
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APPENDIX C
SYSTEM PROCEDURES
APPENDIX C
SYSTEM PROCEDURES

The information listed in Appendix C is provided for information only and may change without notice.

Table C-1. Alarm Response Procedures for the AY/AZ Tank Farm.

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<td>Respond to Monitor Control System Graphic #17 Primary Exhaust Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00018</td>
<td>Respond to Monitor Control System Graphic #18 Primary Vent Stack Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00019</td>
<td>Respond to Monitor Control System Graphic #19 Building Vent Supply Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00020</td>
<td>Respond to Monitor Control System Graphic #20 Building Exhaust Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00021</td>
<td>Respond to Monitor Control System Graphic #21 Building Stack Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00022</td>
<td>Respond to Monitor Control System Graphic #22 Building Temp Control Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00023</td>
<td>Respond to Monitor Control System Graphic #23 Diesel Generator Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00029</td>
<td>Respond to Monitor Control System Power Supply Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00030</td>
<td>Respond to Standby Diesel Generator Local Alarms</td>
</tr>
<tr>
<td>ARP-T-251-00031</td>
<td>Respond to Panel Alarms For AZ301 Condensate Distribution System</td>
</tr>
<tr>
<td>ARP-T-251-00032</td>
<td>Respond to General System Alarms</td>
</tr>
</tbody>
</table>
Table C-2. Procedures for Technical Safety Requirement-Required Surveillances for the AY/AZ Tank Farm (from Section 3.7.2).

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Procedure Title</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No TSR</td>
<td>No TSR-required surveillances are applicable.</td>
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</tr>
</tbody>
</table>

Table C-3. Procedures for Non-technical Safety Requirement Inspections and Testing for the AY/AZ Tank Farm (from Section 3.7.3). (2 Sheets)

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Procedure Title</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-LDD-624</td>
<td>Perform AY/AZ AWF Annulus CAM (AMS-4) Leak Detectors Functional Check</td>
<td>This procedure provides instructions for testing the annulus continuous air monitor leak-detection system for the AY/AZ Tank Farm.</td>
</tr>
<tr>
<td>6-LDD-485</td>
<td>ENRAF Series 854 Annulus Leak Detection Gauges Calibration and Maintenance</td>
<td></td>
</tr>
<tr>
<td>TF-OPS-005¹</td>
<td>Daily CAM and Record Sampler Inspections</td>
<td>This procedure provides instructions for performing daily inspections of continuous air monitors and record air samplers.</td>
</tr>
<tr>
<td>TF-OPS-006</td>
<td>Air Sample Filter Exchange for Record Sampler and Stack CAMs</td>
<td>This procedure provides instructions for performing an air sample filter exchange to meet the requirements for Radioactive Airborne Effluent Sampling (inspection procedure).</td>
</tr>
<tr>
<td>TF-OPS-015</td>
<td>Inspection and Source Checks of AMS-4 CAMs Annulus Leak Detector CAMs</td>
<td>This procedure provides instructions for performing inspections of annulus space continuous air monitors.</td>
</tr>
<tr>
<td>TF-OPS-021</td>
<td>Inspections and Source Checks of Primary Tank Exhauster, Annulus Exhauster AMS-4 CAMs and Effluent Record Samplers</td>
<td>This procedure provides instructions for performing inspections of waste-tank effluent continuous air monitors.</td>
</tr>
<tr>
<td>TF-OR-DR-AZ</td>
<td>AZ Daily Rounds</td>
<td></td>
</tr>
<tr>
<td>TF-OR-QR-AZ</td>
<td>AZ-Quarterly Rounds</td>
<td></td>
</tr>
<tr>
<td>TF-OR-WR-AZ</td>
<td>AZ Weekly Rounds</td>
<td></td>
</tr>
</tbody>
</table>
Table C-3. Procedures for Non-technical Safety Requirement Inspections and Testing for the AY/AZ Tank Farm (from Section 3.7.3). (2 Sheets)

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Procedure Title</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO-020-005</td>
<td>Perform Pit Video Examinations and Leak Checks Using a Remotely Controlled Camera</td>
<td></td>
</tr>
<tr>
<td>TO-020-012</td>
<td>Hot/Cold Water tanker Truck Fill</td>
<td></td>
</tr>
<tr>
<td>TO-020-240</td>
<td>Water Addition to Leak Detection Pits</td>
<td></td>
</tr>
<tr>
<td>TO-020-420</td>
<td>Information not readily available</td>
<td></td>
</tr>
<tr>
<td>TO-020-930</td>
<td>Perform MCCS Survey of Double-Shell Waste Storage Tank/Pits</td>
<td></td>
</tr>
<tr>
<td>TO-040-050</td>
<td>Perform Inspections of Pit Coatings</td>
<td></td>
</tr>
<tr>
<td>TO-040-180</td>
<td>Operate Tank Surface Level Monitoring Devices</td>
<td>This procedure provides operating instructions for tank-level-indicating transmitters and manual tapes.</td>
</tr>
<tr>
<td>TO-040-185</td>
<td>Install/Replace Zipcords for Specified Catch Tanks, Leak Detection Pits and Flush Pits</td>
<td></td>
</tr>
<tr>
<td>TO-040-540</td>
<td>Water Surveillance and Usage</td>
<td></td>
</tr>
<tr>
<td>TO-040-560</td>
<td>200 East/West Tank Farms Sludge Level Readings</td>
<td>This procedure provides instructions for obtaining tank farm sludge-level measurements. Tank farm sludge-level measurements are taken in support of Tank Farm Operations at the request of East/West Tank Farm Engineering.</td>
</tr>
<tr>
<td>TO-040-590</td>
<td>Leak Detection Wells, Annulus Leak Detection Systems</td>
<td></td>
</tr>
<tr>
<td>TO-040-660¹</td>
<td>Obtain/Record Double-Shell Tank Temperature Data</td>
<td>This procedure provides instructions for obtaining and recording waste-tank temperature data from remote thermocouples placed at many locations relative to a single tank.</td>
</tr>
<tr>
<td>TO-200-110</td>
<td>Operate 241-AZ-301 Condensate Distribution System</td>
<td></td>
</tr>
</tbody>
</table>

¹ These procedures will be replaced or modified from their current TSR status to Non-TSR status.
Table C-4. Maintenance Procedures for the AY/AZ Tank Farm.

<table>
<thead>
<tr>
<th>Procedure Number</th>
<th>Title</th>
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</thead>
<tbody>
<tr>
<td><strong>Level Control Indicating Devices Group</strong></td>
<td></td>
</tr>
<tr>
<td>6-CVT-513</td>
<td>Foxboro Differential Pressure Pneumatic Transmitters, Series 13, 13A, 13H and 15</td>
</tr>
<tr>
<td>2-LCD-384</td>
<td>Replace ENRAF Series 854 Wire Drums And/or Displacers</td>
</tr>
<tr>
<td>5-LCD-125</td>
<td>ENRAF Series 854 Initial Installation and Operational Check</td>
</tr>
<tr>
<td>5-LCD-300</td>
<td>ENRAF Series 854 Displacer Weight Check and Calibration Check</td>
</tr>
<tr>
<td>6-LCD-476</td>
<td>Calibrate Omega Model TX-83, A-350 Weight Factor and Specific Gravity Indicators</td>
</tr>
<tr>
<td>6-LDD-485</td>
<td>ENRAF Series 854 Annulus Leak Detection Gauges Calibration and Maintenance</td>
</tr>
<tr>
<td><strong>Leak Detectors and LDE Devices Group</strong></td>
<td></td>
</tr>
<tr>
<td>3-LDD-415</td>
<td>Perform Functional Check of Tracetek Leak Detector</td>
</tr>
<tr>
<td>3-LDD-624</td>
<td>Perform AY/AZ AWF Annulus CAM (AMS-4) Leak Detectors Functional Check</td>
</tr>
<tr>
<td>7-LDD-483</td>
<td>Bench Test Intrinsically Safe Leak Detector Relays B/w 5300 Series</td>
</tr>
<tr>
<td><strong>General Instruments Group</strong></td>
<td></td>
</tr>
<tr>
<td>6-GENI-131</td>
<td>Calibrate Alarm Module</td>
</tr>
<tr>
<td>6-GENI-135</td>
<td>Generic Calibration of Digital Indicators</td>
</tr>
<tr>
<td><strong>Pressure Control/Indicating Devices Group</strong></td>
<td></td>
</tr>
<tr>
<td>3-PCD-426</td>
<td>Functional Testing of Pressure Relief Valves</td>
</tr>
<tr>
<td>6-PCD-132</td>
<td>Zero and Span Adjustable Instruments with Pressure, Current, Voltage, Resistance (Inputs/outputs)</td>
</tr>
<tr>
<td>6-PCD-304</td>
<td>Calibrate Fischer Porter Series 50DP4100 Pressure Transmitter</td>
</tr>
<tr>
<td>6-PCD-508</td>
<td>Calibrate Pressure or Vacuum Switches</td>
</tr>
<tr>
<td>6-PCD-509</td>
<td>Pressure and Vacuum Gauges Calibration</td>
</tr>
<tr>
<td>6-PCD-511</td>
<td>Dwyer Magnehelic Differential Pressure Series 2000 and Capsuhelic Differential Pressure Series 4000</td>
</tr>
<tr>
<td><strong>Radiation Monitoring Group</strong></td>
<td></td>
</tr>
<tr>
<td>5-RM-467</td>
<td>Functional Check for AMS-4 Continuous Air Monitors</td>
</tr>
</tbody>
</table>
APPENDIX D
SYSTEM HISTORY

Information not readily available
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APPENDIX E

DOUBLE-SHELL TANK WASTE STORAGE SYSTEM
MONITORING COMPONENTS
APPENDIX E
DOUBLE-SHELL TANK WASTE STORAGE SYSTEM
MONITORING COMPONENTS

Table E-1 lists the AY/AZ Tank Farm Double-Shell Tank Waste Storage System monitoring components. The information listed in Table E-1 is provided for information only and may change without notice. For current information, see alarm response procedures at RPP TANK FARMS ALARM RESPONSE PROCEDURES at URL: http://aptfpg02/Technical Procedures/TankFarms_Alarmp-221.htm

Table E-1. AY/AZ Tank Farms Double-Shell Tank Waste Storage System Alarm/Annunciation Schedule.

<table>
<thead>
<tr>
<th>Component</th>
<th>Process</th>
<th>Indicating Location</th>
<th>Technical Safety Requirement Reference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>AY101-WST-PI-101</td>
<td>Tank 101 Primary Pressure Indication</td>
<td>241-AZ1101 (Local Indication Riser-062)</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>AY102-WSTA-PI-101</td>
<td>Tank 102 Annulus Pressure Indication</td>
<td>241-AZ-102 (Local Indication Riser-081 )</td>
<td></td>
</tr>
<tr>
<td>AY102-WST-PI-101</td>
<td>Tank 102 Primary Pressure Indication</td>
<td>241-AZ-102 (Local Indication Riser-064 )</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>AY101-WST-LAH-101</td>
<td>Tank 101 Level High Alarm</td>
<td>241-AZ-271 MCS, TMAC</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AY102-WST-LAH-101</td>
<td>Tank 102 Level High Alarm</td>
<td>241-AZ-271 MCS, TMAC</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AY101-WST-LIT-101</td>
<td>Tank 101 Level Indicating Transmitter (ENRAF)</td>
<td>Local, TMACs, MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AY102-WST-LIT-101</td>
<td>Tank 102 Level Indicating Transmitter (ENRAF)</td>
<td>Local, TMACs, MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>PAL-AY101K1-1</td>
<td>Tank 101 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>PAH-AY101K1-1</td>
<td>Tank 101 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>PAL-AY102K1-1</td>
<td>Tank 102 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>PAH-AY102K1-1</td>
<td>Tank 102 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td>SR 3.4.1</td>
</tr>
</tbody>
</table>

NOTE: This is not a comprehensive list of instrumentation for the system. This list includes those components that alarm or indicate system conditions at locations where any necessary actions can be taken to remedy the alarm or off-normal condition. For a complete component list, refer to River Protection Project Master Equipment List.
Table E-1. AY/AZ Tank Farms Double-Shell Tank Waste Storage System Alarm/Annunciation Schedule.

<table>
<thead>
<tr>
<th>Component</th>
<th>Process</th>
<th>Indicating Location</th>
<th>Technical Safety Requirement Reference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAL-AY1K1-1</td>
<td>Tank 101 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271, ABB</td>
<td></td>
</tr>
<tr>
<td>PAH-AY1K1-1</td>
<td>Tank 101 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271, ABB</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>PAL-AY2K1-1</td>
<td>Tank 102 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271, ABB</td>
<td></td>
</tr>
<tr>
<td>PAH-AY2K1-1</td>
<td>Tank 102 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271, ABB</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>AY101-WSTA-LDA-151, -152, -153</td>
<td>Tank 101 Annulus Leak Detection Alarm</td>
<td>Local (Riser-088, -090, -091) TMACs</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AY101-WSTA-PI-101</td>
<td>Tank 101 Annulus Pressure Indication</td>
<td>241-AY-101 (Local Indication Riser-077 )</td>
<td></td>
</tr>
<tr>
<td>AY102-WSTA-LDA-151, -152, -153</td>
<td>Tank 102 Annulus Leak Detection Alarm</td>
<td>Local (Riser-088, -090, -091) TMACs</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AY101-WSTA-WFAH-121</td>
<td>Leak Detection Liquid Level Alarm (High)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AY102-WSTA-WFAH-122</td>
<td>Leak Detection Liquid Level Alarm (Low)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AY102-WSTA-WFAL-122</td>
<td>Leak Detection Liquid Level Alarm (Low)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AY101-WSTA-RAH-101</td>
<td>Tank 101 Annulus High Radiation Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AY101-WSTA-RXA-101</td>
<td>Tank 101 Annulus Failure Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AY102-WSTA-RAH-102</td>
<td>Tank 102 Annulus High Radiation Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AY102-WSTA-RXA-102</td>
<td>Tank 102 Annulus Failure Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
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</table>

**AZ Tank Farm**

<table>
<thead>
<tr>
<th>Component</th>
<th>Process</th>
<th>Indicating Location</th>
<th>Technical Safety Requirement Reference*</th>
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<tbody>
<tr>
<td>AZ101-WSTA-PI-101</td>
<td>Tank 101 Annulus Pressure Indication</td>
<td>-AZ101 (Local Indication Riser-085 )</td>
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</tr>
<tr>
<td>AZ101-WST-PI-101</td>
<td>Tank 101 Primary Pressure Indication</td>
<td>-AZ101 (Local Indication Riser-076 )</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>AZ102-WST-PI-101</td>
<td>Tank 101 Annulus Pressure Indication</td>
<td>-AZ101 (Local Indication Riser-081 )</td>
<td></td>
</tr>
<tr>
<td>AZ102-WST-LAH-101</td>
<td>Tank 101 Level High Alarm</td>
<td>241-AZ-271 MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AZ102-WST-LAH-101</td>
<td>Tank 102 Level High Alarm</td>
<td>241-AZ-271 MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AZ101-WST-LIT-135</td>
<td>Tank 101 Level Indicating Transmitter (ENRAF)</td>
<td>Local, TMACs, MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>AZ102-WST-LIT-101</td>
<td>Tank 102 Level Indicating Transmitter (ENRAF)</td>
<td>Local, TMACs, MCS</td>
<td>AC 5.8.1</td>
</tr>
<tr>
<td>PAL-AZ101K1-1</td>
<td>Tank 101 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
</tbody>
</table>
Table E-1. AY/AZ Tank Farms Double-Shell Tank Waste Storage System Alarm/Annunciation Schedule.

<table>
<thead>
<tr>
<th>Component</th>
<th>Process</th>
<th>Indicating Location</th>
<th>Technical Safety Requirement Reference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAH-AZ101K1-1</td>
<td>Tank 101 Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>PAL-AZ102K1-1</td>
<td>Tank 102 High Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>PAH-AZ102K1-1</td>
<td>Tank 102 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 MCS</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>PAL-AZ1K1-1</td>
<td>Tank 101 Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 ABB</td>
<td></td>
</tr>
<tr>
<td>PAH-AZ1K1-1</td>
<td>Tank 101 Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 ABB</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>PAL-AZ2K1-1</td>
<td>Tank 102 High Pressure Alarm (High Vacuum)</td>
<td>241-AZ-271 ABB</td>
<td></td>
</tr>
<tr>
<td>PAH-AZ2K1-1</td>
<td>Tank 102 High Pressure Alarm (Low Vacuum)</td>
<td>241-AZ-271 ABB</td>
<td>SR 3.4.1</td>
</tr>
<tr>
<td>AZ101-WSTA-LDA-151, -152, -153</td>
<td>Tank 101 Annulus Leak Detection Alarm</td>
<td>Local (Riser-090, -091, -092) TMACs</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ102-WSTA-LDA-151, -152, -153</td>
<td>Tank 102 Annulus Leak Detection Alarm</td>
<td>Local (Riser-089, -091, -092) TMACs</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ101-WSTA-WFAH-121</td>
<td>Leak Detection Liquid Level Alarm (High)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ101-WSTA-WFAL-121</td>
<td>Leak Detection Liquid Level Alarm (Low)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ102-WSTA-WFAH-122</td>
<td>Leak Detection Liquid Level Alarm (High)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ102-WSTA-WFAL-122</td>
<td>Leak Detection Liquid Level Alarm (Low)</td>
<td>241-AZ-271 MCS</td>
<td>LCO 3.5, SR 3.5.1</td>
</tr>
<tr>
<td>AZ101-WSTA-RAH-101</td>
<td>Tank 101 Annulus High Radiation Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AZ101-WSTA-RXA-101</td>
<td>Tank 101 Annulus Failure Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AZ102-WSTA-RAH-102</td>
<td>Tank 102 Annulus High Radiation Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
<tr>
<td>AZ102-WSTA-RXA-102</td>
<td>Tank 102 Annulus Failure Alarm</td>
<td>241-AZ-271 MCS</td>
<td></td>
</tr>
</tbody>
</table>


ANN = Annunciator.
ENCL = Enclosure.
LAH = Level alarm high.
LCO = Limiting condition for operation.
LCS = Limiting control setting.
LDA = Leak-detection alarm.
LIT = Level-indicating transmitter.
PAH = Pressure alarm high.
PAL = Pressure alarm low.
PI = Pressure indicator.
PNL = Panel.
PR = Pressure recorder.
PY = Pressure equipment.
RAH = Radiation alarm high.
TIS = Temperature-indicating switch.
TMACS = Tank Monitor and Control System.
WFA = Weight factor alarm.
WIS = Weight/force indicating switch.
WST = Waste storage tank.
WSTA = Waste storage tank annulus.
APPENDIX F

AY/AZ TANK FARM DOUBLE-SHELL TANK WASTE STORAGE SYSTEM
BOUNDARIES AND INTERFACES
APPENDIX F

AY/AZ TANK FARMS DOUBLE-SHELL TANK WASTE STORAGE SYSTEM BOUNDARIES AND INTERFACES

The following information is included in Appendix F.

- Table F-1, AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundaries – Inclusion/Exclusion.
- Table F-2, AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundaries – Interface Points/Locations
- Figure F-1, Typical AY/AZ Tank Farms Double-Shell Tank Waste Storage Schematic and Site Interface Diagram.

Table F-1. AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundaries – Inclusion/Exclusion.

<table>
<thead>
<tr>
<th>Included in AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundary</th>
<th>Not Included in AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Waste Storage Tank</strong></td>
<td></td>
</tr>
<tr>
<td>Typical for four tanks</td>
<td></td>
</tr>
<tr>
<td>- Steel primary and secondary tank</td>
<td>- Ventilation tank annulus systems (4 total)</td>
</tr>
<tr>
<td>- Tank risers</td>
<td>- Ventilation tank primary systems (4 total)</td>
</tr>
<tr>
<td>- Concrete shell</td>
<td>- Buried supernate, slurry, drain, potable water, raw water, and process air piping; electrical distribution system services; area lighting; and security</td>
</tr>
<tr>
<td>- Concrete foundation</td>
<td></td>
</tr>
<tr>
<td>- Foundation drainage piping</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pits</strong></td>
<td></td>
</tr>
<tr>
<td>Central pump pits (4 total)</td>
<td></td>
</tr>
<tr>
<td>- Includes pit, cover block, air-lift circulators, air-line jumpers, signal cable, and embedded pit spray system</td>
<td>- Waste transfer pump, jumpers, motor controller, and power cable</td>
</tr>
<tr>
<td></td>
<td>- Electrical distribution cable, conduit, and components serving motor controller</td>
</tr>
<tr>
<td></td>
<td>- Electrical welding receptacles</td>
</tr>
<tr>
<td></td>
<td>- Pipe encasement leak-detection valves and piping in pit</td>
</tr>
<tr>
<td></td>
<td>- Pit leak detection system</td>
</tr>
<tr>
<td><strong>Annulus pump pits (4 total)</strong></td>
<td></td>
</tr>
<tr>
<td>- Includes pit, cover block, signal cable and connectors, and embedded pit spray system</td>
<td>- Emergency annulus pumping system: Includes all associated items</td>
</tr>
<tr>
<td></td>
<td>- Existing motor controller and connecting electrical distribution cable, conduit, and components</td>
</tr>
<tr>
<td></td>
<td>- Pipe encasement leak-detection piping in pit</td>
</tr>
<tr>
<td></td>
<td>- Pit leak detection system</td>
</tr>
<tr>
<td><strong>Leak-detection pits (4 total)</strong></td>
<td></td>
</tr>
<tr>
<td>- Includes pit, cover block, wells, pit leak detector, transmitter station, signal cable, connectors, and embedded pit spray system</td>
<td>- Potable water transfer pump, jumpers, motor controller, and power cable</td>
</tr>
<tr>
<td>- Pit leak detection system</td>
<td>- Electrical distribution cable, conduit, and components serving motor controller</td>
</tr>
<tr>
<td></td>
<td>- Electrical welding receptacles</td>
</tr>
<tr>
<td></td>
<td>- Pipe encasement leak-detection piping in pit</td>
</tr>
</tbody>
</table>
Table F-1. AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundaries – Inclusion/Exclusion.

<table>
<thead>
<tr>
<th>Included in AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundary</th>
<th>Not Included in AY/AZ Tank Farms Double-Shell Tank Waste Storage System Boundary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sluice pits (12 total)</td>
<td>• All drain piping and waste transfer jumpers in pit</td>
</tr>
<tr>
<td>• Includes pit, cover block, signal cable, and connectors</td>
<td>• Waste transfer pump, motor controller, and power cable</td>
</tr>
<tr>
<td></td>
<td>• Electrical distribution cable, conduit, and components serving motor controller</td>
</tr>
<tr>
<td></td>
<td>• Pit leak detection system</td>
</tr>
<tr>
<td>Annulus exhaust continuous air monitor (CAM) stations (4 total)</td>
<td>• Electrical distribution cable, conduit, and components up to transmitter station at pit</td>
</tr>
<tr>
<td>• Includes pit, cover block, sampling probes, sampling tubing, annulus CAMs, transmitter station, signal cable, and connectors</td>
<td>• Annulus exhausting piping/duct and fittings</td>
</tr>
<tr>
<td></td>
<td>• Valve pits (waste transfer)</td>
</tr>
<tr>
<td></td>
<td>• Flush pit (Tank 241-AY-102 only) (waste transfer)</td>
</tr>
</tbody>
</table>

**Monitoring and Alarm Systems**

<p>| Enraf level gauge station (4 total)                                       | TMACs equipment                                                                 |
|• All items up to connection terminals in Tank Monitor and Control System (TMACs) terminal box | • Includes the TMACs terminal box and cables provided to serve the Enraf level gauge |
| <strong>Temperature profile trees (16 total)</strong>                                  | TMACs equipment                                                                 |
|• Includes all items up to connection terminals in TMACs terminal box       | • Includes the TMACs modems, terminal box, and cables provided to serve the thermocouple trees |
| <strong>Tank temperature monitoring system</strong>                                     | TMACs equipment                                                                 |
|• Includes all thermocouples, terminal boxes, signal cable, wells, and conduit from all four tanks up to the instrument panel in the 241-AY(&amp; AZ)-801A Instrument Control Buildings | • Includes the TMACs modem, terminal box, and cables connecting to the thermocouple TBX boxes at the tanks |
| <strong>Instrument panels (241-AY(&amp; AZ)-801A Instrument Control Buildings)</strong>    | TMACs equipment                                                                 |
|• Includes enclosure and all components in the instrument panel (cable, tubing, selector switches, transducers, relays, annunciating equipment, pneumatic signal circuitry, alarms systems, etc.) | • Includes TMACs, Westronics, and Acromag systems, and connecting cables to the instrumentation panel |
| Instrument air/plant air supply                                            | Instrument air/plant air supply                                                |
| • Includes air compressor, manifolds, valves, piping, switches, and gauges on South wall of the Instrument Control Building that are on the air supply side of the pneumatic control systems serving the instrumentation panel and transmitter enclosures | Instrument air/plant air supply                                                |
| EAP = Emergency annulus pumping.                                           | SA = Service air.                                                              |
| EDS = Electrical distribution system.                                      | SW = Service water.                                                           |
| IA = Instrument air.                                                       | WT = Waste transfer.                                                          |
| RW = Raw water.                                                            | VTA = Ventilation Tank Annulus                                                |
| TMACs = Tank Monitor and Control System                                    | VTP = Ventilation Tank Primary                                                |</p>
<table>
<thead>
<tr>
<th>Subsystem/Component</th>
<th>Inter-facing System</th>
<th>Interface Point/Location</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Tank Risers (WST) (# per tank)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Primary ventilation air intake (1)</td>
<td>VTP</td>
<td>Face of first flange on riser above tank</td>
</tr>
<tr>
<td>• Primary ventilation air outlet (1)</td>
<td>VTP</td>
<td>Face of first flange on riser above tank</td>
</tr>
<tr>
<td>• Temperature profile tree (4)</td>
<td>TMACS</td>
<td>Signal cable terminals in TMACS enclosure</td>
</tr>
<tr>
<td><strong>Annulus Risers (WSTA) (# per tank)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Annulus ventilation air intake (8)</td>
<td>TMACS</td>
<td>Signal cable terminals in TMACS enclosure</td>
</tr>
<tr>
<td>• Annulus ventilation air outlet (4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Note: See Tank Plan Views for riser location and number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Air-lift circulators</td>
<td>VTA</td>
<td>Face of first flange on riser above tank</td>
</tr>
<tr>
<td></td>
<td>VTA</td>
<td>Face of first flange on riser above tank</td>
</tr>
<tr>
<td></td>
<td>IA/SA</td>
<td>First valve in small casings in the farm</td>
</tr>
<tr>
<td><strong>Central Pump Pit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Waste Transfer Pump (WT item)</td>
<td>WT</td>
<td>Pump adaptor flange face on riser</td>
</tr>
<tr>
<td>• Embedded pit spray and spray ring systems</td>
<td>RW</td>
<td>Outside face of pit wall</td>
</tr>
<tr>
<td>• Pit leak detectors</td>
<td>WT</td>
<td>Pit floor surface and cable slot surfaces</td>
</tr>
<tr>
<td><strong>Annulus Pump Pit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Emergency annulus pump Assembly (WT item)</td>
<td>WT</td>
<td>Top face of pump adaptor flange on riser</td>
</tr>
<tr>
<td>• Embedded pit spray and spray ring systems</td>
<td>RW</td>
<td>Outside face of pit wall</td>
</tr>
<tr>
<td>• Pit leak detectors</td>
<td>WT</td>
<td>Pit floor surface and cable slot surfaces</td>
</tr>
<tr>
<td><strong>Leak Detection Pit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• PW transfer pump (WT item)</td>
<td>WT</td>
<td>Top face of pump adaptor flange on riser</td>
</tr>
<tr>
<td>• Embedded pit spray and spray ring systems</td>
<td>RW</td>
<td>Outside face of pit wall</td>
</tr>
<tr>
<td>• Pit leak detector transmitter enclosure</td>
<td>EDS</td>
<td>Line side of disconnect switch serving the component</td>
</tr>
<tr>
<td><strong>Sluice Pit</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Drain pipes in pit (WT items)</td>
<td>WT</td>
<td>Top face of pump adaptor flange on riser</td>
</tr>
<tr>
<td>• Embedded pit spray and spray ring systems</td>
<td>RW</td>
<td>Outside face of pit wall</td>
</tr>
<tr>
<td>Subsystem/Component</td>
<td>Interfacing System</td>
<td>Interface Point/Location</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>--------------------</td>
<td>-----------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Ventilation Instrument CAM Station</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Air sample and return probes</td>
<td>VTA</td>
<td>Sampling port flange or pipe tap connection on 12-inch annulus exhaust ducts</td>
</tr>
<tr>
<td>• Exhaust radiation monitor enclosure</td>
<td>EDS</td>
<td>Power cable terminals in monitor enclosure for electric power connection</td>
</tr>
<tr>
<td>Enraf Level Gauge</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Enraf level gauge</td>
<td>TMACS</td>
<td>Signal cable terminals in TMACS enclosure adjacent to Enraf gauge</td>
</tr>
<tr>
<td>• Enraf level gauge</td>
<td>EDS</td>
<td>Power cable terminals in Enraf level gauge for electric power connection</td>
</tr>
<tr>
<td>Leak Detection Pit Transmitter Enclosure</td>
<td>IA/PA</td>
<td>Air service isolation valve at enclosure</td>
</tr>
<tr>
<td>• Leak detection pit transmitter enclosure</td>
<td>EDS</td>
<td>Power cable terminals at disconnect serving the enclosure.</td>
</tr>
<tr>
<td>Instrumentation Panel (in 241-AY(&amp;AZ)-801)</td>
<td></td>
<td>Nearest air supply isolation valve to the instrumentation panel</td>
</tr>
<tr>
<td>• Air supply for pneumatic systems</td>
<td>IA/SA</td>
<td>Power cable terminals at disconnect serving the instrumentation panel.</td>
</tr>
<tr>
<td>• Panel power supply</td>
<td>EDS</td>
<td></td>
</tr>
</tbody>
</table>

EAP = Emergency annulus pumping.
EDS = Electrical distribution system.
IA = Instrument air.
PA = Process air.
RW = Raw water.
SA = Service air.

SW = Service water.
TMACS = Tank Monitor and Control System
WT = Waste transfer.
VTA = Ventilation Tank Annulus
VTP = Ventilation Tank Primary

Figure F-1. Schematic and Boundaries Diagram for Typical AY and AZ Double-Shell Tank Waste Storage System
SCHEMATIC & BOUNDARIES DIAGRAM FOR
TYPICAL AY & AZ DOUBLE-SHELL TANK WASTE STORAGE SYSTEMS
NOT TO SCALE

ABBREVIATIONS

ALC  AERIAL CIRCUIT  RW  RAW WATER
ALD  ANNULUS LEAK DETECTOR (PRIMARY TANK LEAKAGE)  SA  SERVICE AIR
APP  ANNULUS PUMP PIT  SL  SLURRY
CAM  CONTINUOUS AIR MONITOR  SLP  SLUDGE PIT
CE  CONDUCTIVITY LEAK DETECTOR  SN  SUPERNATE
CNDS  CONDENSATE  SCT  SPECIFIC GRAVITY
CPP  CENTRAL PUMP PIT  STM  STEAM
EAP  EMERGENCY ANNUlus PUMPING SYSTEM  TE  TEMPERATURE ELEMENT
ENCLOSURE  TEMPERATURE TRANSMITTER  TTR  THERMOCOUPLE TREE (1 TE & 3 TE TYPE)
EDS  ELECTRICAL DISTRIBUTION SYSTEM  VTA  VENTILATION TANK ANNULUS
EMLF  EMERGENCY LEVEL GAUGE  VTP  VENTILATION TANK PRIMARY
ES  ELECTRONIC SIGNAL  WST  WASTE STORAGE TANK SYSTEM
IA  INSTRUMENT AIR SYSTEM  WSTA  WASTE STORAGE TANK ANNULUS
INSTR  INSTRUMENT  WLF  WASTE FACTOR TRANSMITTER
LDF  LEAK DETECTION PIT  WT  WASTE TRANSFER SYSTEM
LDP  LEAK DETECTION PIT  VFD  VARIABLE FREQUENCY DRIVE
MC  MOTOR CONTROLLER  TRAC  TANK MONITOR AND CONTROL SYSTEM
NITF  MULTIFUNCTION INSTRUMENT TREE  VFP  VENTILATION AIR PIPING (VENTILATION SYSTEMS)
NDT  LEAK DETECTOR TRANSCEIVER  VLP  VENTILATION AIR PIPING (DST WASTE STORAGE SYSTEMS)
PWN  PROCESS SLURRY WATER  INSTRUMENTATION & CONTROL CIRCUITRY
PW  PROCESS WATER  SYSTEM BOUNDARY

LEGEND

2. THE ONLY DST WITHOUT A TRANSFER PUMP IS AZ-191. AZ-191 HAS A FALSE PUMP HEAD THAT WILL BE REPLACED WITH A NEW TRANSFER PUMP IN THE FUTURE.

NOTES

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