**Design Demonstrations for the Remaining 19 Category B
Tank Systems at Oak Ridge National Laboratory,
Oak Ridge, Tennessee**

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Prepared by

EBASCO

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ACRONYMS

ACI	American Concrete Institute
ACGIH	American Conference of Governmental Industrial Hygienists
ACPA	American Concrete Pipe Association
AEC	Atomic Energy Commission
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
ASA	American Standards Association
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CFM	cubic foot per minute
CRSI	Concrete Reinforcing Steel Institute
DOE	United States Department of Energy
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
ftm	foot per minute
HEPA	High Efficiency Particulate Air
HFIR	High Flux Isotope Reactor
HOG	Hot Offgas
HVAC	heating, ventilation, and air conditioning
ISA	Instrument Society of America
LLLW	liquid low-level waste
NFPA	National Fire Protection Association
NHF	New Hydrofracture Facility
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Office
OSHA	Occupational Safety and Health Administration
psi	pound per square inch
psig	pound per square inch, gauge
PVC	polyvinyl chloride
PWTP	Process Waste Treatment Plant
RDF	Radiochemical Development Facility
REDC	Radiochemical Engineering Development Center
RHD	Radioactive Hot Drain
RHD-HOG	Radioactive Hot Drain-Hot Offgas
RHDR	Radioactive Hot Drain Recoverable
RPP	Radiochemical Processing Plant
SMACNA	Sheet Metal and Air Conditioning Contractors National Association

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**ACRONYMS
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SS	stainless steel
TDEC	Tennessee Department of Environment and Conservation
UCC-ND	Union Carbide Corporation-Nuclear Division
wg	water gauge

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1.0 INTRODUCTION

This document presents design demonstrations conducted of liquid low-level waste (LLLW) storage tank systems located at the Oak Ridge National Laboratory (ORNL). ORNL is part of the United States Department of Energy's (DOE) Oak Ridge Reservation located southwest of the city of Oak Ridge, Tennessee. The laboratory has conducted research in energy related fields since 1943. The facilities used to conduct the research include nuclear reactors, chemical pilot plants, research laboratories, radioisotope production laboratories, and support facilities. These facilities have produced a variety of radioactive and/or hazardous wastes that have been transported and stored through an extensive network of piping and tankage.

Demonstration of the design of these tank systems has been stipulated by the Federal Facility Agreement (FFA) between the EPA (United States Environmental Protection Agency)—Region IV; the Tennessee Department of Environment and Conservation (TDEC); and the DOE. The FFA establishes four categories of tank systems:

- Category A—New or Replacement Tank Systems with Secondary Containment
- Category B—Existing Tank Systems with Secondary Containment
- Category C—Existing Tank Systems Without Secondary Containment, and
- Category D—Existing Tank Systems Without Secondary Containment That are Removed from Service

This document provides a design demonstration of the secondary containment and ancillary equipment of 19 tank systems listed in the FFA as Category B. The design demonstration for each tank is presented in Section 2. The design demonstrations were developed using information obtained from the design drawings (as-built when available), construction specifications, and interviews with facility operators. The assessments assume that each tank system was constructed in accordance with the design drawings and construction specifications for that system unless specified otherwise. Each design demonstration addresses system conformance to the requirements of the FFA (Appendix F, Section C).

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2.0 SUMMARY ASSESSMENT

Individual design demonstrations of the secondary containment systems of 19 FFA Category B tank systems are included in Sections 2.1 through 2.19. As additional information is identified for a specific tank system, the section containing the assessment of that tank containment system may be revised and reissued.

The objective of each assessment is to demonstrate that the design of the secondary containment system meets the requirements of Appendix F, Section C of the FFA. Tank System T-13 meets the requirements of the FFA. Fourteen Tank Systems (N-71, P-3, P-4, C-1, C-2, L-11, B-2-T, B-3-T, C-6-T, F-111, F-126, S-223, S-324, and S-523) have minor deficiencies for which there are one or more mitigating design features that adequately resolve the deficiency. Four Tank Systems (WC-20, F-201, F-501, and LA-104) have deficiencies which do not fully meet the secondary containment requirements. Tank System WC-20 will be replaced through the Melton Valley LLLW Collection and Transfer System Upgrade, which is a line item project scheduled to be completed in FY 1997. Tank Systems F-201 and F-501 will be removed from service upon completion of the Bethel Valley LLLW Collection and Transfer System Upgrade Project in FY 1997.

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2.1 Tank N-71

2.1.1 Tank Summary

Tank N-71 is a nominal, 325-gal, vertical tank installed in 1954 in the Radiochemical Development Facility (RDF) (Building 3019) at the main Bethel Valley Complex (Figures 2.1-1 and 2.1-2). The tank is in Cell 7, one of several cells in an underground concrete vault at the lowest level of the building. The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an SS-lined, reinforced concrete vault. Tank N-71 is used as a collection tank in the radioactive liquid low-level waste (LLLW) system of Building 3019 and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.1.2 Standards for Design Demonstration

2.1.2.1 Tank Description and Design Standards

Tank Description

Tank N-71 is located in the southwest corner of the lower level of Cell 7 in Building 3019. The tank is used and managed by the Oak Ridge National Laboratory (ORNL) Chemical Technology Division and is part of the Bethel Valley LLLW System.

Tank N-71 is a vertically oriented SS tank with a nominal capacity of 325 gal. The tank measures 3'6" in outside diameter and 4'6" in overall height.

Design Standards

The applicable codes and standards used for Tank System N-71 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM);

American Concrete Institute (ACI);

Atomic Energy Commission (AEC) General Design Criteria;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Underwriters' Laboratories, Inc.;

American Society of Mechanical Engineers (ASME);

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National Fire Protection Association (NFPA);

National Plumbing Code; and

Instrument Society of America (ISA).

2.1.2.2 Generic Description of Tank Contents

Tank N-71 is designed to serve as a radioactive LLLW laboratory collection tank for the Building 3019 west drain header. LLLW includes raffinates from extraction processes; overheads from evaporation processes; and liquids left after analyses, decontamination solutions, and bench-scale experimental processes (Figure 2.1-3). The wastes may also include a variety of laboratory-generated acids and bases, typically nitric and caustic.

The analytical data (Figure 2.1-9) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank N-71.

2.1.2.3 Corrosion Protection Measures

Tank N-71 is located in the lower level of Building 3019 in a 304L SS-lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.1.2.4 Documented Age

Tank N-71 was placed in operation in 1954.

2.1.3 Standards for Containment/Release Detection

2.1.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness to Prevent Failure

Tank N-71 is constructed of type 304L SS. The vault bottom is lined with 11-gauge (1/8"), 304L SS with sidewalls that project 4" up the vault (Figure 2.1-4).

The assessment concludes that the SS vault lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete.

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2.1.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank N-71 is located in an underground, 304L SS-lined, reinforced concrete vault (Figure 2.1-5). The floor of the vault is an 18" thick, reinforced concrete base slab which was designed with a minimum allowable 28-day compressive strength of 3000 psi. The vault floor elevation is 830'4", which is 9'8" below grade.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.1.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank N-71 is provided with a tank level monitor and is located in a 304L SS-lined vault. Any leakage from Tank N-71 is gravity fed to a floor drain which is routed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 3019.

The assessment concludes that Tank System N-71 is provided with a leak detection system.

2.1.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank N-71 vault floor is sloped to a floor drain which is routed to a 304L SS-lined sump. The sump provides a low point to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

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2.1.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank N-71 is located in an SS-lined, reinforced concrete vault. The following items address specific components of the vault system.

Containment

Tank N-71 is located in a vault with a 304L SS liner designed to be leaktight. The vault includes five process areas that have one continuous SS liner. Each process area has a 1-1/2", schedule 40, 304L SS floor drain embedded in the concrete floor and welded to the SS liner. The drain lines are routed to a common 304L SS-lined, instrumented sump. The lined portion of the vault provides containment for 900 gal of liquid compared with a nominal full tank content of 325 gal for Tank N-71.

The assessment concludes that the SS-lined portion of the vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of Building 3019, which contains Tank N-71, provides for surface water runoff to prevent any buildup of surface water during rainfall. Building 3019 is located near the crest of a hill with site grades sloping away from the building conveying rainwater to storm drain catch basin inlets (Figure 2.1-6). The tank vault finished floor elevation is 830'4", which is 9'8" below grade. Three of the four tank vault walls have no direct contact with the soil or water. The remaining tank vault wall is in direct contact with the soil and water. The use of an external waterproofing system to minimize the potential for infiltration of groundwater is not included in the design drawings or construction specifications. However, the site drainage system is designed to minimize the potential for infiltration of groundwater; and in the unlikely event that any infiltration occurs, it will be contained and removed by the secondary containment system.

The assessment concludes that the vault is designed to minimize the potential for infiltration.

Water Stops

The use of water stops in the secondary containment structure is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the below-grade construction joints because the vault utilizes an external site drainage system and is internally lined and provided with an alarmed leak detection

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and removal system. Therefore, the lack of water stops in the below-grade construction joints is not considered significant.

Vapor Protection, Vessel Vent System

Tank N-71 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

Tank N-71 is vented through an offgas system that scrubs and HEPA-filters the offgas and keeps the tank under negative pressure relative to the vault pressure. The vault structure is ventilated with a cell exhaust ventilation system that generates a sweep flow rate of approximately 2500 CFM through Cells 6 and 7. This exhaust system was designed to keep the cell at -1" to -3" of water gauge (wg) pressure (Figures 2.1-7 and 2.1-8).

The assessment concludes that Tank System N-71 is provided with a means to protect against the formation and ignition of vapors.

2.1.4 Supplemental Information

2.1.4.1 Ancillary Equipment

The material of construction for the inlet and discharge piping is 304L SS, which is the same material as that used in Tank N-71. The transfer piping and support equipment are exposed to the same liquids as Tank N-71. The piping within the confines of the vault has secondary containment.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.1.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank N-71.

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Energy Systems Drawing D-14169, Cell 6 and 7 Sections and Details, Revision 1.

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Technical drawing of a mechanical assembly, likely a pump or motor housing, showing various components and dimensions. The drawing is oriented vertically on the page.

Key Components and Dimensions:

- Top Section:**
 - Large circular feature labeled **T-10** with a diameter of $3'-6"$ and a radius of $3'-1"$.
 - Small circular feature labeled **R-5** with a diameter of $3'-0"$ and a radius of $9"$.
 - Component **R-1-M** is located near the top left.
 - Component **R-11** is located near the top center.
 - Component **X-12** is located near the top right.
 - Component **X-13** is located near the top right.
 - Component **X-14** is located near the top right.
 - Component **X-15-A** is located near the top right.
 - Component **X-15-B** is located near the top right.
 - Component **X-15-C** is located near the top right.
 - Component **X-15-D** is located near the top right.
 - Component **X-15-E** is located near the top right.
 - Component **X-15-F** is located near the top right.
 - Component **X-15-G** is located near the top right.
 - Component **X-15-H** is located near the top right.
 - Component **X-15-I** is located near the top right.
 - Component **X-15-J** is located near the top right.
 - Component **X-15-K** is located near the top right.
 - Component **X-15-L** is located near the top right.
 - Component **X-15-M** is located near the top right.
 - Component **X-15-N** is located near the top right.
 - Component **X-15-O** is located near the top right.
 - Component **X-15-P** is located near the top right.
 - Component **X-15-Q** is located near the top right.
 - Component **X-15-R** is located near the top right.
 - Component **X-15-S** is located near the top right.
 - Component **X-15-T** is located near the top right.
 - Component **X-15-U** is located near the top right.
 - Component **X-15-V** is located near the top right.
 - Component **X-15-W** is located near the top right.
 - Component **X-15-X** is located near the top right.
 - Component **X-15-Y** is located near the top right.
 - Component **X-15-Z** is located near the top right.
- Middle Section:**
 - Component **T-1** is located in the middle left.
 - Component **R-3-P** is located in the middle center.
 - Component **P-67** is located in the middle right.
- Bottom Section:**
 - Large circular feature labeled **R-2** with a diameter of $6'-0"$ and a radius of $2'-2\frac{1}{2}"$.
 - Component **P-55** is located near the bottom left.
 - Component **R-3** is located near the bottom center.
 - Component **P-50-A** is located near the bottom right.
 - Component **P-50-B** is located near the bottom right.
 - Component **N-71** is located near the bottom right.
 - Component **P-60** is located near the bottom right.
 - Component **P-66** is located near the bottom right.
 - Component **P-59** is located near the bottom right.

Dimensions:

- $3'-6"$ (Diameter of T-10)
- $3'-1"$ (Radius of T-10)
- $3'-0"$ (Diameter of R-5)
- $9"$ (Radius of R-5)
- $6'-0"$ (Diameter of R-2)
- $2'-2\frac{1}{2}"$ (Radius of R-2)
- $2'-10"$ (Distance between R-3-P and P-67)
- $2'-2"$ (Distance between R-3 and P-55)
- $1'-9"$ (Distance between P-55 and P-50-A)
- $3'-1\frac{1}{2}"$ (Distance between P-50-A and P-50-B)
- $1'-6"$ (Distance between P-50-B and N-71)
- $3'-1\frac{1}{2}"$ (Distance between N-71 and P-60)
- $1'-6"$ (Distance between P-60 and P-66)
- $6'-0"$ (Total width of the bottom section)

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Figure 2.1-3 Schematic of the Liquid Low-Level Waste System

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Figure 2.1-4 Tank N-71 Vault and Liner

FLOOR PLAN
CELL No. 7

REF. DWG. D14165

REV. 0 12-04-92

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Figure 2.1-5 Tank N-71 Vault and Liner

$$\begin{array}{r} 510710 \text{ N. } 5.5 \\ \hline 311 \cdot 110 \end{array}$$

REF. DWG. D14161, D14167, D14169

REV. 0 12-04-92

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Figure 2.1-6 Building 3019 Grading Plan

REF. DWG. D10615

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Figure 2.1-7
Tank N-71 H&V Diagram (Cell 7)

RPP Ventilation system.

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Figure 2.1-8
Tank N-71 H&V Diagram (Cell 7)

Schematic diagram of VOG system.

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Figure 2.1-9
Analytical Data For Liquid

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	<u>Sr-90</u>	(b) Quantities	<u>Trace</u>
	<u>Cs-137</u>		<u>Trace</u>
	<u>U-235</u>		<u>0.4 g/year</u>
	<u>U-238</u>		<u>50.0 g/year</u>
	<u>U-233</u>		<u>1.0 g/year</u>
	<u>Th-232</u>		<u>100.0 g/year</u>
 (b) Others (i.e. acids, bases, organics, cleaners, etc.)			
	<u>nitric acid</u>		<u>4.7 Kg/year</u>

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2.2 Tank P-3

2.2.1 Tank Summary

Tank P-3 is a nominal, 200-gal, vertical tank installed in 1954 in the Radiochemical Development Facility (RDF) (Building 3019) at the main Bethel Valley Complex (Figures 2.2-1 and 2.2-2). The tank is in Cell 6, one of several cells in an underground concrete vault at the lowest level of the building. The tank is constructed of ASME SA-240, type 347 stainless steel (SS) and is located in an SS-lined, reinforced concrete vault. Tank P-3 is used as a process collection tank in the radioactive liquid low-level waste (LLLW) system of Building 3019 and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.2.2 Standards for Design Demonstration

2.2.2.1 Tank Description and Design Standards

Tank Description

Tank P-3 is located in the southeast corner of the lower level of Cell 6 in Building 3019. The tank is used and managed by Oak Ridge National Laboratory (ORNL) Chemical Technology Division and is part of the Bethel Valley LLLW System.

Tank P-3 is a vertically oriented SS tank with a nominal capacity of 200 gal. The tank measures 3'0" in outside diameter and 4'0" in overall height and is constructed of 3/16" thick, type 347 SS.

Design Standards

The applicable codes and standards used for Tank System P-3 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM);

American Concrete Institute (ACI);

Concrete Reinforcing Steel Institute (CRSI);

American Welding Society (AWS);

Atomic Energy Commission (AEC) General Design Criteria;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

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Underwriters' Laboratories, Inc.;

American Society of Mechanical Engineers (ASME);

National Fire Protection Association (NFPA);

National Plumbing Code; and

Instrument Society of America (ISA).

2.2.2.2 Generic Description of Tank Contents

Tank P-3 is designed to serve as a radioactive LLLW process collection tank for the Building 3019 east drain header. LLLW includes raffinates from extraction processes, overheads from evaporation processes, and liquids left after analyses and bench-scale experimental processes (Figure 2.2-3). The wastes may also include a variety of laboratory-generated acids and bases, typically nitric and caustic.

The analytical data (Figure 2.2-9) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank P-3.

2.2.2.3 Corrosion Protection Measures

Tank P-3 is located in the lower level of Building 3019 in a 304L SS-lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.2.2.4 Documented Age

Tank P-3 was placed in operation in 1954.

2.2.3 Standards for Containment/Release Detection

2.2.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank P-3 is constructed of type 347 SS. The vault bottom is lined with 11-gauge (1/8"), 304L SS with sidewalls that project 4" up the vault (Figure 2.2-4).

The assessment concludes that the SS vault lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete.

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2.2.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank P-3 is located in an underground, 304L SS-lined, reinforced concrete vault (Figure 2.2-5). The floor of the vault is an 18" thick, reinforced concrete base slab which was designed with a minimum allowable 28-day compressive strength of 3000 psi. The vault floor elevation is 830'4", which is 9'8" below grade.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.2.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank P-3 is provided with a tank level monitor and is located in a 304L SS-lined vault. Any leakage from Tank P-3 is gravity fed to a floor drain which is routed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 3019.

The assessment concludes that Tank System P-3 is provided with a leak detection system.

2.2.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank P-3 vault floor is sloped to a floor drain which is routed to a 304L SS-lined sump. The sump provides a low point to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.2.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank P-3 is located in an SS-lined, reinforced concrete vault. The following items address specific components of the vault system.

Containment

Tank P-3 is located in a vault with a 304L SS liner designed to be leaktight. The vault includes six process areas that have one continuous SS liner. Each process area has a 1-1/2", schedule 40,

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304L SS floor drain embedded in the concrete floor and welded to the SS liner. The drain lines are routed to a common 304L SS-lined, instrumented sump. The lined portion of the vault provides containment for 800 gal of liquid compared with a nominal full tank content of 200 gal for Tank P-3.

The assessment concludes that the SS-lined portion of the vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of Building 3019, which contains Tank P-3, provides for surface water runoff to prevent any buildup of surface water during rainfall. Building 3019 is located near the crest of a hill with site grades sloping away from the building conveying rainwater to storm drain catch basin inlets (Figure 2.2-6). The tank vault finished floor elevation is 830'4", which is 9'8" below grade. Three of the four tank vault walls have no direct contact with the soil or water. The remaining tank vault wall is in direct contact with the soil and water. The use of an external waterproofing system to minimize the potential for infiltration of groundwater is not included in the design drawings or construction specifications. However, the site drainage system is designed to minimize the potential for infiltration of groundwater; and in the unlikely event that any infiltration occurs it will be contained and removed by the secondary containment system.

The assessment concludes that the vault is designed to minimize the potential for infiltration.

Water Stops

The use of water stops in the secondary containment structure is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the below-grade construction joints because the vault utilizes an external site drainage system and is internally lined and provided with an alarmed leak detection and removal system. Therefore, the lack of water stops in the below-grade construction joints is not considered significant.

Vapor Protection, Vessel Vent System

Tank P-3 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

Tank P-3 is vented through an offgas system that scrubs and HEPA-filters the offgas and keeps the tank under negative pressure relative to the vault pressure. The vault structure is ventilated with a cell exhaust ventilation system that generates a sweep flow rate of approximately 2500 CFM through Cells 6 and 7. This exhaust system was designed to keep the cell at -1" to -3" of water gauge (wg) pressure (Figures 2.2-7 and 2.2-8).

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The assessment concludes that Tank System P-3 is provided with a means to protect against the formation and ignition of vapors.

2.2.4 Supplemental Information

2.2.4.1 Ancillary Equipment

The material of construction for the inlet and discharge piping is 347 SS, which is the same material as that used in Tank P-3. The transfer piping and support equipment are exposed to the same liquids as Tank P-3. The piping within the confines of the vault has secondary containment.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.2.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank P-3.

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2.2.5 References

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Energy Systems Drawing D-14161, Cell 5 Plan and Details, Dated 7/2/53 (No Revision No.).

Energy Systems Drawing D-14165, Cell 6 and 7 Plan and Details, Revision 2.

Energy Systems Drawing D-14167, Cell 6 and 7 Sections and Details, Revision 2.

Energy Systems Drawing D-14168, Cell 6 and 7 Sections and Details, Revision 1.

Energy Systems Drawing D-14169, Cell 6 and 7 Sections and Details, Revision 1.

Energy Systems Drawing E-11731, Cell 7 Piping Flowsheet Sheet 2, Revision 2.

Energy Systems Drawing D-17188, Drain Piping for Cell 6 and 7, Revision 1.

Energy Systems Drawing D-14534, Equipment Layout Make-Up Area Plan, Revision 3.

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Energy Systems Drawing D-10615, Plot Plan, Revision E.

Energy Systems Drawing D-10667, Site Plan and Details, Revision B.

Energy Systems Drawing D-14185, Tank Supports Plan and Details, Revision 1.

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LLLW Generator Survey 1990 for Building 3019.

Oak Ridge National Laboratory. 1984. *Final Safety Analysis Report for the Radiochemical Processing Plant (RPP)*. ORNL/CF-81/37. Oak Ridge National Laboratory.

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Peretz, F. J., et al. 1986. *Characterization of Low Level Liquid Wastes at the Oak Ridge National Laboratory*. ORNL/TM-10218. Oak Ridge National Laboratory.

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Streets:

- Hilltop Circle
- Reactor Drive
- Hillside Avenue
- Central Avenue
- First Street
- Third Street
- White Oak Ave.
- Fifth Street

Addresses:

- 2000, 2001, 2004, 2008, 2013, 2019, 2024, 2026, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 26

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FLOOR PLAN

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REV. 0 12-04-92

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Figure 2.2-3 Schematic of the Liquid Low-Level Waste System

REV. 0 12-04-92

REF. DWG. D14165

FLOOD PLAN
CELL No. 6

REV. 0 12-04-92

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Figure 2.2-5 Tanks P-3 and P-4 Vault and Liner

$$\begin{array}{r} 51.6710 \text{ N. } 5.5 \\ \hline 311.10' \\ \hline \end{array}$$

Diagram of a pump structure with the following labels:

- Top left: $\frac{1}{2}$ in. or 1 in.
- Top right: $\frac{1}{2}$ in. or 1 in.
- Bottom left: $\frac{1}{2}$ in. or 1 in.
- Bottom right: $\frac{1}{2}$ in. or 1 in.
- Center: $\frac{1}{2}$ in. or 1 in.
- Right side: $\frac{1}{2}$ in. or 1 in.
- Far right: $\frac{1}{2}$ in. or 1 in.

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Figure 2.2-6 Building 3019 Grading Plan

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Figure 2.2-7
Tanks P-3 and P-4 H&V Diagram (Cell 6)

RPP Ventilation system.

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**Figure 2.2-8
Tanks P-3 and P-4 H&V Diagram (Cell 6)**

Schematic diagram of VOG system.

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**Figure 2.2-9
Analytical Data For Liquid**

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	Sr-90	(b) Quantities	Trace
	Cs-137		Trace
	U-235		0.4 g/year
	U-238		50.0 g/year
	U-233		1.0 g/year
	Th-232		100.0 g/year
(b) Others (i.e. acids, bases, organics, cleaners, etc.)			
	nitric acid		4.7 Kg/year

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2.3 Tank P-4

2.3.1 Tank Summary

Tank P-4 is a nominal, 200-gal, vertical tank installed in 1954 in the Radiochemical Development Facility (RDF) (Building 3019) at the main Bethel Valley Complex (Figures 2.3-1 and 2.3-2). The tank is in Cell 6, one of several cells in an underground concrete vault at the lowest level of the building. The tank is constructed of ASME SA-240, type 347 stainless steel (SS) and is located in an SS-lined, reinforced concrete vault. Tank P-4 is used as a process collection tank in the radioactive liquid low-level waste (LLLW) system of Building 3019 and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.3.2 Standards for Design Demonstration

2.3.2.1 Tank Description and Design Standards

Tank Description

Tank P-4 is located along the south wall of the lower level of Cell 6 in Building 3019. The tank is used and managed by the Oak Ridge National Laboratory (ORNL) Chemical Technology Division and is part of the Bethel Valley LLLW System.

Tank P-4 is a vertically oriented SS tank with a nominal capacity of 200 gal. The tank measures 3'0" in outside diameter and 4'0" in overall height. The tank is constructed of 3/16" thick, type 347 SS.

Design Standards

The applicable codes and standards used for Tank System P-4 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM);

American Concrete Institute (ACI);

Concrete Reinforcing Steel Institute (CRSI);

American Welding Society (AWS);

Atomic Energy Commission (AEC) General Design Criteria;

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Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Underwriters' Laboratories, Inc.;

American Society of Mechanical Engineers (ASME);

National Fire Protection Association (NFPA);

National Plumbing Code; and

Instrument Society of America (ISA).

2.3.2.2 Generic Description of Tank Contents

Tank P-4 is designed to serve as a radioactive LLLW process collection tank for the Building 3019 east drain header. LLLW includes raffinates from extraction processes, overheads from evaporation processes, and liquids left after analyses and bench-scale experimental processes (Figure 2.3-3). The wastes may also include a variety of laboratory-generated acids and bases, typically nitric and caustic.

The analytical data (Figure 2.3-9) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank P-4.

2.3.2.3 Corrosion Protection Measures

Tank P-4 is located in the lower level of Building 3019 in a 304L SS-lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.3.2.4 Documented Age

Tank P-4 was placed in operation in 1954.

2.3.3 Standards for Containment/Release Detection

2.3.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank P-4 is constructed of type 304 SS. The vault bottom is lined with 11-gauge (1/8"), 304L SS with sidewalls that project 4" up the vault (Figure 2.3-4).

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The assessment concludes that the SS vault lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.3.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank P-4 is located in an underground, 304L SS-lined, reinforced concrete vault (Figure 2.3-5). The floor of the vault is an 18" thick, reinforced concrete base slab which was designed with a minimum allowable 28-day compressive strength of 3000 psi. The vault floor elevation is 830'4", which is 9'8" below grade.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.3.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank P-4 is provided with a tank level monitor and is located in a 304L SS-lined vault. Any leakage from Tank P-4 is gravity fed to a floor drain which is routed to a sump where any accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 3019.

The assessment concludes that Tank System P-4 is provided with a leak detection system.

2.3.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank P-4 vault floor is sloped to a floor drain which is routed to a 304L SS-lined sump. The sump provides a low point to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.3.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank P-4 is located in an SS-lined, reinforced concrete vault. The following items address specific components of the vault system.

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Containment

Tank P-4 is located in a vault with a 304L SS liner designed to be leaktight. The vault includes six process areas that have one continuous SS liner. Each process area has a 1-1/2", schedule 40, 304L SS floor drain embedded in the concrete floor and welded to the SS liner. The drain lines are routed to a common 304L SS-lined, instrumented sump. The lined portion of the vault provides containment for 800 gal of liquid compared with a nominal full tank content of 200 gal for Tank P-4.

The assessment concludes that the SS-lined portion of the vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of Building 3019, which contains Tank P-4, provides for surface water runoff to prevent any buildup of surface water during rainfall. Building 3019 is located near the crest of a hill with site grades sloping away from the building conveying rainwater to storm drain catch basin inlets (Figure 2.3-6). The tank vault finished floor elevation is 830'4", which is 9'8" below grade. Three of the four tank vault walls have no direct contact with the soil or water. The remaining tank vault wall is in direct contact with the soil and water. The use of an external waterproofing system to minimize the potential for infiltration of groundwater is not included in the design drawings or construction specifications. However, the site drainage system is designed to minimize the potential for infiltration of groundwater; and in the unlikely event that any infiltration occurs, it will be contained and removed by the secondary containment system.

The assessment concludes that the vault is designed to minimize the potential for infiltration.

Water Stops

The use of water stops in the secondary containment structure is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the below-grade construction joints because the vault utilizes an external site drainage system and is internally lined and provided with an alarmed leak detection and removal system. Therefore, the lack of water stops in the below-grade construction joints is not considered significant.

Vapor Protection, Vessel Vent System

Tank P-4 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

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Tank P-4 is vented through an offgas system that scrubs and HEPA-filters the offgas and keeps the tank under negative pressure relative to the vault pressure. The vault is ventilated with a cell exhaust ventilation system that generates a sweep flow rate of approximately 2500 CFM through Cells 6 and 7. This exhaust system was designed to keep the cell at -1" to -3" of water gauge (wg) pressure (Figures 2.3-7 and 2.3-8).

The assessment concludes that Tank System P-4 is provided with a means to protect against the formation and ignition of vapors.

2.3.4 Supplemental Information

2.3.4.1 Ancillary Equipment

The material of construction for the inlet and discharge piping is 347 SS, which is the same material as that used in Tank P-4. The transfer piping and support equipment are exposed to the same liquids as Tank P-4. The piping within the confines of the vault has secondary containment.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.3.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank P-4.

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Energy Systems Drawing D-14168, Cell 6 and 7 Sections and Details, Revision 1.

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Energy Systems Drawing D-10615, Plot Plan, Revision E.

Energy Systems Drawing D-10667, Site Plan and Details, Revision B.

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Figure 2.3-1 Location of Building 3019

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Figure 2.3-2 Layout of Tanks P-3 and P-4 in Cell 6

FLOOR PLAN

REF. DWG. M-12229-CP-047-D

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Figure 2.3-3 Schematic of the Liquid Low-Level Waste System

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Figure 2.3-4 Tanks P-3 and P-4 Vault and Liner

OF 6" HOLLOW
CONCRETE WALL

REF. DWG. D14165

FLOOR PLAN
CELL No. 6

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Architectural floor plan of a building. The plan includes the following dimensions and features:

- Overall Dimensions:**
 - Top: 10' 0"
 - Right: 10' 0"
 - Bottom: 10' 0"
 - Left: 10' 0"
- Rooms and Dimensions:**
 - Top Left: 10' 0" x 10' 0"
 - Top Right: 10' 0" x 10' 0"
 - Bottom Left: 10' 0" x 10' 0"
 - Bottom Right: 10' 0" x 10' 0"
 - Central Hall: 10' 0" x 10' 0"
 - Staircase: 10' 0" x 10' 0"
 - Bathroom: 10' 0" x 10' 0"
 - Bedroom: 10' 0" x 10' 0"
 - Kitchen: 10' 0" x 10' 0"
 - Dining Room: 10' 0" x 10' 0"
 - Living Room: 10' 0" x 10' 0"
- Other Features:**
 - Entrance: 10' 0" x 10' 0"
 - Corridor: 10' 0" x 10' 0"
 - Window: 10' 0" x 10' 0"
 - Door: 10' 0" x 10' 0"

[illegible]

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Figure 2.3-6 Building 3019 Grading Plan

REF. DWG. D10615

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Figure 2.3-7
Tanks P-3 and P-4 H&V Diagram (Cell 6)

RPP Ventilation system.

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Figure 2.3-8
Tanks P-3 and P-4 H&V Diagram (Cell 6)

Schematic diagram of VOG system.

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**Figure 2.3-9
Analytical Data For Liquid**

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	Sr-90	(b) Quantities	Trace
	Cs-137		Trace
	U-235		0.4 g/year
	U-238		50.0 g/year
	U-233		1.0 g/year
	Th-232		100.0 g/year
(b) Others	(i.e. acids, bases, organics, cleaners, etc.)		
	nitric acid		4.7 Kg/year

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2.4 Tank C-1

2.4.1 Tank Summary

Tank C-1 is a nominal 50,000-gal, horizontal tank installed in 1964 near the liquid low-level waste (LLLW) Evaporator (Building 2531) and near the center of the main Bethel Valley Complex (Figures 2.4-1 and 2.4-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank C-1 is used as a concentrate collection tank for the LLLW Evaporator and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.4.2 Standards for Design Demonstration

2.4.2.1 Tank Description and Design Standards

Tank Description

Tank C-1 is located north of Evaporator Building 2531 in a reinforced concrete vault with Tank C-2. The tank is used and managed by the Waste Management and Remedial Actions Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank C-1 center lines are E 30600 and N 21850.

Tank C-1 is a nominal 50,000-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 12'0" with ASME flanged and dished heads and an overall length of 61'0". The shell and heads have a nominal thickness of 1/2". The tank operates at slightly less than atmospheric pressure.

Design Standards

The applicable codes and standards used for Tank System C-1 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

Specifications for The Construction of Improvements to Radioactive Liquid Waste System Phase II, Building 2531, Specification No. 10851-E-206-S;

American Society for Testing and Materials (ASTM) A15, A53, A120, A167, A181, A182, A185, A200, A213, A214, A234, A240, A245, A269, A276, A312, A371, A376, A403, B68, C94, C175, E94, E142, and E165;

National Electric Code;

Atomic Energy Commission (AEC) Safety Code;

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Underwriters' Laboratories, Inc.; and

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels (1962 edition).

2.4.2.2 Generic Description of Tank Contents

Tank C-1 was designed to collect high-level waste generated at ORNL. However, because no significant quantities of high-level waste were ever generated, this tank was repiped to serve as an LLLW concentrate storage tank (Figure 2.4-3). LLLW is generated from a variety of facilities at ORNL including reactors, radioactive fuel processing areas, radioisotope processing areas, decontamination operations, hot cells, and radiochemical laboratories. The waste generators collect the waste, which is then transferred to the LLLW Evaporator Feed Tank W-22. Any waste found to be acidic is adjusted to basic with sodium hydroxide in the generator collection tanks or in the evaporator feed tank. This pH adjustment causes most of the transuranic waste components and heavy metals to precipitate out of solution. The waste is then processed through the evaporator; and the concentrate is transferred to Tanks C-1, C-2, W-21, and W-23 before it is sent to the Melton Valley Storage Tanks.

Due to the lack of a convenient access point, Tank C-1 has not been sampled. However, Tank W-23, which is also used to store LLLW concentrate, has been sampled. Because both Tank W-23 and Tank C-1 are used to collect LLLW concentrate from the evaporator, it is logical to assume that the characteristics of the waste stored in Tank W-23 should be similar to the waste stored in Tank C-1.

The liquid waste supernate sampled in Tank W-23 ranges in color from pale to deep yellow with high pH (11–13) sodium/potassium nitrate salt solutions and should be similar to the waste concentrate expected to be found in Tank C-1 (Figure 2.4-8). Based on radiation levels found in Tank W-23 and the historical use of Tank C-1 as an evaporator feed tank, Tank C-1 may contain radioactive materials (Figure 2.4-9).

2.4.2.3 Corrosion Protection Measures

Tank C-1 is located in an underground, epoxy-coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.4.2.4 Documented Age

Tank C-1 was installed in 1964.

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2.4.3 Standards for Containment/Release Detection

2.4.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank C-1 is constructed of type 304L SS. The interior of the tank vault (floor and walls) is provided with a three-coat system of Amercoat 74S epoxy (Figure 2.4-4).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy coating is compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.4.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank C-1 is located in an underground, reinforced concrete vault (Figure 2.4-5). Tank C-1 shares the vault with Tank C-2. The tank vault foundation is a 30'2" x 67'4" x 2'0" thick, reinforced concrete base slab that rests on limestone.

The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

2.4.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank C-1 is provided with a tank level monitor and is situated within an epoxy-coated, concrete vault. The floor of the vault is sloped to a sump where accumulation of liquid will be detected by a level sensor that will activate an alarm in the Waste Operations Control Center (Building 3130).

The assessment concludes that Tank System C-1 is provided with a leak detection system.

2.4.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank C-1 vault floor slopes to a 2'6" x 2'6" x 1'6" deep, epoxy-coated sump with a containment capacity of 70 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

Tank C-1 has a nominal capacity of 50,000 gal with tank inlet and outlet nozzles located on the top of the tank preventing accidental tank leakage from piping attachment failure. The secondary containment is designed to minimize the potential for rainwater inleakage; however, the vault is

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known to leak occasionally. This inleakage is contained and subsequently removed from the secondary containment system.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.4.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank C-1 is located in a below-grade, epoxy-coated, reinforced concrete vault. The following items address specific components of the vault system.

Containment

Tank C-1 is located in a below-grade, epoxy-coated, reinforced concrete vault designed to be leaktight. The epoxy-coated portion of the vault measures 28'2" x 65'4" x 14'6" high, which represents a total volume of 199,580 gal. Of that total volume, 50,000 gal are occupied by Tank C-2, leaving an available containment volume of 149,580 gal. The nominal full tank content of Tank C-1 is 50,000 gal.

The assessment concludes that the epoxy-coated portion of the vault is sufficient to contain the full tank volume along with the occasional roof plug inleakage.

Infiltration

Site and storm drainage design around the perimeter of the vault provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Tank C-1 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the tank vault are maintained at a minimum of 6" below perimeter walls to prevent run-on (Figure 2.4-6). The 14", reinforced concrete tank vault walls have an external asphalt or coal tar type felt membrane forming a waterproofing system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 793'6", which is 10'0" below grade. The highest water table elevation at the Tank C-1 vault is 802.88' per Well No. 563 measurements.

The tank vault is designed with a 6" pipe located around the foundation base to provide a foundation drain system. The pipe header is routed to the storm sewer system.

The vault roof consists of reinforced concrete shielding plugs covered by a layer of polyethylene and a 6" concrete slab. The vault is also provided with an access hatch that is sealed with a continuous 1/2" thick by 6" wide neoprene gasket to minimize the potential for inleakage.

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The assessment concludes that the vault is designed to minimize the potential for infiltration.

Water Stops

The Tank C-1 secondary containment structure is constructed with 16-oz, cold-rolled copper water stops and 2" x 4" keyways in all below-grade construction joints, but the water stops are not chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank C-1 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system). The primary system consists of six gas-lift circulators. Routinely, a small flow of approximately 1 CFM is put through two circulators in each tank, which serve to dilute and sweep out any radiolytic gas that may be present. Circulator air is vented through the tank offgas connection (Figure 2.4-7).

The tank vault is maintained at a pressure of -1" to -4" of water gauge (wg) with a flow of 1400 CFM.

Exhaust gas from both the tank and vault is disposed of through the Central Laboratory Gaseous Waste Disposal System. Prior to discharge into this system, gaseous streams are filtered to reduce the level of particulate activity to a minimum. The filter system consists of a HEPA filter preceded by a 95% efficiency prefilter. The filter system is designed to provide an efficiency of 99.95% for 0.3 micron particles at a velocity of 250 fpm.

The assessment concludes that Tank System C-1 is provided with a means to protect against the formation and ignition of vapors.

2.4.4 Supplemental Information

2.4.4.1 Ancillary Equipment

Single-wall piping associated with Tank C-1 is located within the confines of the vault system that provides secondary containment. The piping is fabricated from type 304L SS, which is the same material as that used in Tank C-1. The transfer piping is exposed to the same liquids as Tank C-1; therefore, 304L SS is an acceptable material for the support equipment.

The assessment concludes that the ancillary equipment is properly designed for leak detection and secondary containment.

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2.4.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank C-1.

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Figure 2.4-1
Location of Tank C-1

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Figure 2.4-2
Layout of Tank C-1

Figure 2.4-3 Schematic of the Liquid Low-Level Waste System

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Figure 2.4-5 Tank C-1 Vault

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Figure 2.4-6 Tank Vault Grading Plan

REF. DWG. C-20237-EA-001-D

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Figure 2.4-7 Tank C-1 H&V Diagram

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Figure 2.4-8
Analytical Data For Liquid and Sludge Samples

**ANALYTICAL DATA FOR
LIQUID SAMPLE**

**ANALYTICAL DATA FOR
SLUDGE SAMPLE**

Characteristic	JAN, 1990	* WZ-1	REPRESENTATIVE SAMPLE	Characteristic	JAN, 1990	* WZ-3	REPRESENTATIVE SAMPLE
<u>Physical properties and microchemical data</u>				<u>Physical properties and microchemical data</u>			
TDS (mg/mL)	381			TS (mg/g)	544		
TS (mg/mL)	383			Density (g/mL)	1.34		
Density (g/mL)	1.3423			IC (mg/g)	18100		
IC (mg/L)	8340			TC (mg/g)	22200		
TC (mg/L)	9500			TOC (mg/g)	4120		
TOC (mg/L)	1160						
<u>RCRA metals</u>				<u>RCRA metals</u>			
Ag (mg/L)	<0.44			Ag (mg/g)	(28)		
As (mg/L)	<3.8			As (mg/g)	(<30)		
Ba (mg/L)	<0.19			Ba (mg/g)	63		
Cd (mg/L)	1.7			Cd (mg/g)	32		
Cr (mg/L)	0.42			Cr (mg/g)	190		
Hg (mg/L)	0.07			Hg (mg/g)	19		
Ni (mg/L)	3.8			Ni (mg/g)	110		
Pb (mg/L)	2.7			Pb (mg/g)	(450)		
Se (mg/L)	<2.3			Se (mg/g)	<39		
Ti (mg/L)	<0.94			Ti (mg/g)	<16		
<u>Trace metals</u>				<u>Trace metals</u>			
Al (mg/L)	1.8			Al (mg/g)	2800		
B (mg/L)	10			B (mg/g)	<10		
Ca (mg/L)	18			Ca (mg/g)	15000		
Co (mg/L)	.			Co (mg/g)			
Fe (mg/L)	0.70			Fe (mg/g)	1900		
K (mg/L)	78000			K (mg/g)	18000		
Mg (mg/L)	3.4			Mg (mg/g)	16000		
Na (mg/L)	82000			Na (mg/g)	82000		
Si (mg/L)	<1			Si (mg/g)	290		
Sr (mg/L)	0.40			Sr (mg/g)	12000		
Th (mg/L)	15.8			Th (mg/g)	17000		
U (mg/L)	17			U (mg/g)			
<u>Anions</u>				<u>Radionuclide emitters</u>			
Chloride (M)	0.10			Gross alpha (Bq/L)	2.22e+05		
Fluoride (M)	<0.053			Gross beta (Bq/L)	6.67e+06		
Nitrate (M)	3.23			¹⁴ C (Bq/L)	3.65e+02		
Phosphate (M)	<0.053			¹⁴ C ₂ (Bq/L)	<2.7e+04		
Sulfate (M)	0.081			⁶⁰ Co (Bq/L)	2.52e+05		
<u>Alkalinity</u>				¹³⁴ Cs (Bq/L)	<6.5e+03		
pH	12.8			¹³⁷ Cs (Bq/L)	4.95e+05		
H ⁺ (M)	.			¹³² Eu (Bq/L)	7.22e+05		
OH ⁻ (M)	0.15			¹⁵⁴ Eu (Bq/L)	5.14e+05		
CO ₃ ²⁻ (M)	0.70			¹⁵² Eu (Bq/L)	1.21e+05		
HCO ₃ ⁻ (M)				⁹⁰ Sr (Bq/L)	<7.0e+03		
<u>Radionuclide emitters</u>				¹⁰⁶ Ru (Bq/L)	<6.2e+04		
Gross alpha (Bq/mL)	8.20e+01			⁹⁰ Sr (Bq/L)	2.28e+06		
Gross beta (Bq/mL)	4.62e+05			⁶⁵ Zn (Bq/L)	<4.5e+04		
¹⁴ C (Bq/mL)	6.35e+01						
¹⁴⁴ Ce (Bq/mL)	<1.6e+03			<u>Alpha emitters</u>			
⁶⁰ Co (Bq/mL)	6.21e+02			²³⁸ U (Bq/L)	1.18e+04		
¹³⁴ Cs (Bq/mL)	4.63e+03			²³⁵ U (Bq/L)	<2.8e+04		
¹³⁷ Cs (Bq/mL)	4.36e+05			²³⁸ U (Bq/L)	1.18e+04		
¹⁵² Eu (Bq/mL)	<2.1e+02			²³⁹ Pa/ ²⁴¹ Am (Bq/L)	3.21e+04		
¹⁵⁴ Eu (Bq/mL)	<1.6e+02			²⁴⁰ Am (Bq/L)	<2.6e+04		
¹⁵² Eu (Bq/mL)	<8.5e+02			²⁴¹ Am (Bq/L)	1.67e+05		
²³⁸ U (Bq/mL)	1.19e+02						
²³⁵ U (Bq/mL)	<1.0e+02						
²³⁹ Pa (Bq/mL)	3.78e+03						
²⁴¹ Am (Bq/mL)	4.12e+02						
²⁴⁰ Am (Bq/mL)	<1.0e+02						
<u>Alpha emitters</u>							
²³⁸ U (Bq/mL)	4.00e+00						
²³⁵ U (Bq/mL)	6.00e+00						
²³⁹ Pa/ ²⁴¹ Am (Bq/mL)	6.00e+00						
²⁴⁰ Am/ ²⁴¹ Am (Bq/mL)	3.90e+01						
²⁴¹ Am (Bq/mL)	4.00e+00						

* NO DATA FOR TANK C-1, TANK WZ3 SHOWN AS A REP. SAMPLE

LEGEND:

TSD - TOTAL DISSOLVED SOLIDS
TS - TOTAL SOLIDS
IC - INORGANIC CARBON
TC - TOTAL CARBON
TOC - TOTAL ORGANIC CARBON

Figure 2.4-9 Radiochemical Analyses In the Evaporator Service Tanks

Radiochemical analyses of beta emitters in the Evaporator Service Tanks^a

Tank	Sample date	Sample location	Gross beta TRU ^b	Gross beta RMAL ^c	Gross Gamma (c/min-ml)	Sr-90	Cs-137	Co-60	Eu-152	Eu-154	Eu-155	Zr-95	Nb-95
W-21	Nov. 85	Solids ^d	84,900	68,300	1.49E+07	16,400	6,760	1,060	11,600	5,840	2,400	2,660	200
W-22	Nov. 85	Solids ^d	56,500	53,700	1.18E+07	10,200	5,050	740	10,900	5,350	2,060	2,920	330
W-23	Nov. 85	Liquid ^e	66,800	49,800	1.25E+07	9,400	2,040	760	13,000	f	2,250		200
	Nov. 85	Solids ^d	237,000	205,000	1.35E+07	73,700	6,510	880	12,100	8,220	2,550	3,400	

* REPRESENTATIVE SAMPLE

^aAll data from the TRU laboratory except RMAL gross beta and Sr-90.

^bTRU data: Request No. 45764, received 1/30/86, completed 2/6/86.

^cRMAL data: Request No. 34529, received 11/12/85, completed 11/22/85.

^dnCi/g for solid samples.

^enCi/mL for liquid samples.

^fA blank space means no data available.

Radiochemical analyses of alpha emitters in the Evaporator Service Tanks^a

Tank	Sample date	Sample location	Gross alpha TRU ^b	Gross alpha RMAL ^c	Am-241	Om-244	Pu-239 & Pu-240	Pu-238	U-233
W-21	Nov. 85	Solids ^d	5110	1980	810	70	380	830	50
W-22	Nov. 85	Solids ^d	3510	2260	1100	100	190	280	58
W-23	Nov. 85	Liquid ^e	870	710	280	50	50	90	38
	Nov. 85	Solids ^d	6970	3190	2190	<30	580	500	130

^aAll data from the TRU laboratory except RMAL gross alpha.

^bTRU data: Request No. 45764, received 1/30/86, completed 2/6/86.

^cRMAL data: Request No. 34529, received 11/12/85, completed 11/22/85.

^dnCi/g for solid samples.

^enCi/mL for liquid samples.

* = NO DATA FOR TANK C-1, TANK W23 SHOWN AS REPRESENTATIVE SAMPLE

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2.5 Tank C-2

2.5.1 Tank Summary

Tank C-2 is a nominal 50,000-gal, horizontal tank installed in 1964 near the liquid low-level waste (LLLW) Evaporator (Building 2531) and near the center of the main Bethel Valley Complex (Figures 2.5-1 and 2.5-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank C-2 is used as a concentrate collection tank for the LLLW Evaporator and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.5.2 Standards for Design Demonstration

2.5.2.1 Tank Description and Design Standards

Tank Description

Tank C-2 is located north of Evaporator Building 2531 in a reinforced concrete vault with Tank C-1. The tank is used and managed by the Waste Management and Remedial Actions Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank C-2 centerlines are E 30600 and N 21863.58.

Tank C-2 is a nominal 50,000-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 12'0" with ASME flanged and dished heads and an overall length of 61'0". The shell and heads have a nominal thickness of 1/2". The tank operates at slightly less than atmospheric pressure.

Design Standards

The applicable codes and standards used for Tank System C-2 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

Specifications for The Construction of Improvements to Radioactive Liquid Waste System Phase II, Building 2531, Specification No. 10851-E-206-S;

American Society for Testing and Materials (ASTM) A15, A53, A120, A167, A181, A182, A185, A200, A213, A214, A234, A240, A245, A269, A276, A312, A371, A376, A403, B68, C94, C175, E94, E142, and E165;

National Electric Code;

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Atomic Energy Commission (AEC) Safety Code;

Underwriters' Laboratories, Inc.; and

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels, (1962 edition).

2.5.2.2 Generic Description of Tank Contents

Tank C-2 was designed to collect high-level waste generated at ORNL. However, because no significant quantities of high-level waste were ever generated, this tank was repiped to serve as an LLLW concentrate storage tank (Figure 2.5-3). LLLW is generated from a variety of facilities at ORNL including reactors, radioactive fuel processing areas, radioisotope processing areas, decontamination operations, hot cells, and radiochemical laboratories. The waste generators collect the waste, which is then transferred to the LLLW Evaporator Feed Tank W-22. Any waste found to be acidic is adjusted to basic with sodium hydroxide in the generator collection tanks or in the evaporator feed tank. This pH adjustment causes most of the transuranic waste components and heavy metals to precipitate out of solution. The waste is then processed through the evaporator; and the concentrate is transferred to Tanks C-1, C-2, W-21, and W-23 before it is sent to the Melton Valley Storage Tanks.

Due to the lack of a convenient access point, Tank C-2 has not been sampled. However, Tank W-23, which is also used to store LLLW concentrate, has been sampled. Because both Tank W-23 and Tank C-2 are used to collect LLLW concentrate from the evaporator, it is logical to assume that the characteristics of the waste stored in Tank W-23 should be similar to those of the waste stored in Tank C-2.

The liquid waste supernate sampled in Tank W-23 ranges in color from pale to deep yellow with high pH (11–13) sodium/potassium nitrate salt solutions and should be similar to the waste concentrate expected to be found in Tank C-2 (Figure 2.5-8). Based on radiation levels found in Tank W-23 and the historical use of the Tank C-2 as an evaporator feed tank, Tank C-2 may contain radioactive materials (Figure 2.5-9).

2.5.2.3 Corrosion Protection Measures

Tank C-2 is located in an underground, epoxy-coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.5.2.4 Documented Age

Tank C-2 was installed in 1964.

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2.5.3 Standards for Containment/Release Detection

2.5.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank C-2 is constructed of type 304L SS. The interior of the tank vault (floor and walls) is provided with a three-coat system of Amercoat 74S epoxy (Figure 2.5-4).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy coating is compatible with the stored waste and designed to prevent migration of waste in the concrete.

2.5.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank C-2 is located in an underground, reinforced concrete vault (Figure 2.5-5). Tank C-2 shares the vault with Tank C-1. The tank vault foundation is a 30'2" x 67'4" x 2'0" thick, reinforced concrete base slab that rests on limestone.

The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

2.5.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank C-2 is provided with a tank level monitor and is situated within an epoxy-coated, concrete vault. The floor of the vault is sloped to a sump where accumulation of liquid will be detected by a level sensor that will activate an alarm in the Waste Operations Control Center (Building 3130).

The assessment concludes that Tank System C-2 is provided with a leak detection system.

2.5.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank C-2 vault floor slopes to a 2'6" x 2'6" x 1'6" deep, epoxy-coated sump with a containment capacity of 70 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

Tank C-2 has a nominal capacity of 50,000 gal with tank inlet and outlet nozzles located on the top of the tank preventing accidental tank leakage from piping attachment failure. The secondary containment is designed to minimize the potential for rainwater inleakage; however, the vault is

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known to leak occasionally. This inleakage is contained and subsequently removed from the secondary containment system.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.5.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank C-2 is located in a below-grade, epoxy-coated, reinforced concrete vault. The following items address specific components of the vault system.

Containment

Tank C-2 is located in a below-grade, epoxy-coated, reinforced concrete vault designed to be leaktight. The epoxy-coated portion of the vault measures 28'2" x 65'4" x 14'6" high, which represents a total volume of 199,580 gal. Of that total volume, 50,000 gal are occupied by Tank C-1, leaving an available containment volume of 149,580 gal. The nominal full tank content of Tank C-2 is 50,000 gal.

The assessment concludes that the epoxy-coated portion of the vault is sufficient to contain the full tank volume along with the occasional roof plug inleakage.

Infiltration

Site and storm drainage design around the perimeter of the vault provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Tank C-2 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the tank vault are maintained at a minimum of 6" below perimeter walls to prevent run-on (Figure 2.5-6). The 14", reinforced concrete tank vault walls have an external asphalt or coal tar type felt membrane forming a waterproofing system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 793'6", which is 10'0" below grade. The highest water table elevation at the Tank C-2 vault is 802.88' per Well No. 563 measurements.

The tank vault is designed with a 6" pipe located around the foundation base to provide a foundation drain system. The pipe header is routed to the storm sewer system.

The vault roof consists of reinforced concrete shielding plugs covered by a layer of polyethylene and a 6" concrete slab. The vault is also provided with an access hatch that is sealed with a continuous 1/2" thick by 6" wide neoprene gasket to minimize the potential for inleakage.

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The assessment concludes that the vault is designed to minimize the potential for infiltration.

Water Stops

The Tank C-2 secondary containment structure is constructed with 16-oz cold-rolled copper water stops and 2" x 4" keyways in all below-grade construction joints, but the water stops are not chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank C-2 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system). The primary system consists of six gas-lift circulators. Routinely, a small flow of approximately 1 CFM is put through two circulators in each tank, which serve to dilute and sweep out any radiolytic gas that may be present. Circulator air is vented through the tank offgas connection (Figure 2.5-7).

The tank vault is maintained at a pressure of -1" to -4" of water gauge (wg) with a flow of 1400 CFM.

Exhaust gas from both the tank and vault is disposed of through the Central Laboratory Gaseous Waste Disposal System. Prior to discharge into this system, gaseous streams are filtered to reduce the level of particulate activity to a minimum. The filter system consists of a HEPA filter preceded by 95% efficiency prefilter. The filter system is designed to provide an efficiency of 99.95% for 0.3 micron particles at a velocity of 250 fpm.

The assessment concludes that Tank System C-2 is provided with a means to protect against the formation and ignition of vapors.

2.5.4 Supplemental Information

2.5.4.1 Ancillary Equipment

Single-wall piping associated with Tank C-2 is located within the confines of the vault system that provides secondary containment. The piping is fabricated from type 304L SS, which is the same material as that used in Tank C-2. The transfer piping is exposed to the same liquids as Tank C-2; therefore, 304L SS is an acceptable material for the support equipment.

The assessment concludes that the ancillary equipment is properly designed for leak detection and secondary containment.

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2.5.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank C-2.

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2.5.5 References

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Technical Specifications for the Construction of Improvements to Radioactive Liquid Waste System, Phase I, Building 2531.

Figure 2.5-1
Location of Tank C-2

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Figure 2.5-2
Layout of Tank C-2

REF. DWG. E-S-52712

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Figure 2 5.3 Schematic of the Liquid Low-Level Waste System

Figure 2.5-4 Tank C-2 Vault

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Figure 2.5-5 Tank C-2 Vault

REF DWG. S3E-20237-B013

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This is a detailed site plan for a facility, likely a water treatment plant. The central feature is a large rectangular structure labeled "TANK C-2". To its right is a smaller rectangular building labeled "NEW SAMPLING ROOM - SEE DWG. D-32730". Above the tank, there are two circular structures, each labeled "OUTLINE OF CONCRETE". To the right of the sampling room is a larger rectangular building labeled "2531" with "FLOOR EL. 808.0 (EXISTING)". The plan includes numerous contour lines with elevation values such as 805.0, 806.0, 807.0, 808.0, 809.0, 810.0, 810.5, 811.0, 812.0, 813.0, 814.0, 815.0, 816.0, 817.0, 818.0, 819.0, 820.0, 821.0, 822.0, 823.0, 824.0, 825.0, 826.0, 827.0, 828.0, 829.0, 830.0, 831.0, 832.0, 833.0, 834.0, 835.0, 836.0, 837.0, 838.0, 839.0, 840.0, 841.0, 842.0, 843.0, 844.0, 845.0, 846.0, 847.0, 848.0, 849.0, 850.0, 851.0, 852.0, 853.0, 854.0, 855.0, 856.0, 857.0, 858.0, 859.0, 860.0, 861.0, 862.0, 863.0, 864.0, 865.0, 866.0, 867.0, 868.0, 869.0, 870.0, 871.0, 872.0, 873.0, 874.0, 875.0, 876.0, 877.0, 878.0, 879.0, 880.0, 881.0, 882.0, 883.0, 884.0, 885.0, 886.0, 887.0, 888.0, 889.0, 890.0, 891.0, 892.0, 893.0, 894.0, 895.0, 896.0, 897.0, 898.0, 899.0, 900.0, 901.0, 902.0, 903.0, 904.0, 905.0, 906.0, 907.0, 908.0, 909.0, 910.0, 911.0, 912.0, 913.0, 914.0, 915.0, 916.0, 917.0, 918.0, 919.0, 920.0, 921.0, 922.0, 923.0, 924.0, 925.0, 926.0, 927.0, 928.0, 929.0, 930.0, 931.0, 932.0, 933.0, 934.0, 935.0, 936.0, 937.0, 938.0, 939.0, 940.0, 941.0, 942.0, 943.0, 944.0, 945.0, 946.0, 947.0, 948.0, 949.0, 950.0, 951.0, 952.0, 953.0, 954.0, 955.0, 956.0, 957.0, 958.0, 959.0, 960.0, 961.0, 962.0, 963.0, 964.0, 965.0, 966.0, 967.0, 968.0, 969.0, 970.0, 971.0, 972.0, 973.0, 974.0, 975.0, 976.0, 977.0, 978.0, 979.0, 980.0, 981.0, 982.0, 983.0, 984.0, 985.0, 986.0, 987.0, 988.0, 989.0, 990.0, 991.0, 992.0, 993.0, 994.0, 995.0, 996.0, 997.0, 998.0, 999.0, 1000.0. The plan also shows a "NEW HWY. STATION HOUSE - SEE DWG. D-32730" and a "NEW CURB & GUTTER TO BLEND WITH EXIST." The drawing is oriented with North at the top.

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Figure 2.5-7 Tank C-2 H&V Diagram

Figure 2.5-8
Analytical Data For Liquid and Sludge Samples

**ANALYTICAL DATA FOR
LIQUID SAMPLE**

**ANALYTICAL DATA FOR
SLUDGE SAMPLE**

Characteristic JAN. 1990 * W23-L1 REPRESENTATIVE SAMPLE			Characteristic JAN. 1990 * W23-S REPRESENTATIVE SAMPLE		
<u>Physical properties and miscellaneous data</u>			<u>Physical properties and miscellaneous data</u>		
TDS (mg/mL)		381	TS (mg/g)		544
TS (mg/mL)		383	Density (g/mL)		1.34
Density (g/mL)		1.2423	IC (mg/kg)		18100
IC (mg/L)		8340	TC (mg/kg)		22200
TC (mg/L)		9300	TOC (mg/kg)		4120
TOC (mg/L)		1160	<u>RCRA metals</u>		
<u>RCRA metals</u>			<u>RCRA metals</u>		
Ag (mg/L)		<0.44	Ag (mg/kg)		(28)
As (mg/L)		<3.0	As (mg/kg)		(<50)
Ba (mg/L)		<0.19	Ba (mg/kg)		63
Cd (mg/L)		1.7	Cd (mg/kg)		32
Cr (mg/L)		0.42	Cr (mg/kg)		190
Hg (mg/L)		0.07	Hg (mg/kg)		19
Ni (mg/L)		3.0	Ni (mg/kg)		110
Pb (mg/L)		2.7	Pb (mg/kg)		(450)
Se (mg/L)		<2.3	Se (mg/kg)		<39
Tl (mg/L)		<0.94	Tl (mg/kg)		<16
<u>Process metals</u>			<u>Process metals</u>		
Al (mg/L)		1.8	Al (mg/kg)		2800
B (mg/L)		10	B (mg/kg)		<10
Ca (mg/L)		18	Ca (mg/kg)		15000
Co (mg/L)		.	Co (mg/kg)		
Fe (mg/L)		0.70	Co (mg/kg)		1900
K (mg/L)		78000	Fe (mg/kg)		18000
Mg (mg/L)		3.4	K (mg/kg)		16000
Na (mg/L)		82000	Mg (mg/kg)		83000
Si (mg/L)		<1	Na (mg/kg)		290
Sr (mg/L)		0.40	Sr (mg/kg)		13000
Th (mg/L)		15.8	Th (mg/kg)		17000
U (mg/L)		17	U (mg/kg)		
<u>Anions</u>			<u>Radionuclide emitters</u>		
Chloride (M)		0.10	Gross alpha (Bq/g)		2.23e+05
Fluoride (M)		<0.053	Gross beta (Bq/g)		6.67e+06
Nitrate (M)		3.23	¹⁴ C (Bq/g)		3.65e+02
Phosphate (M)		<0.053	¹⁴ Ce (Bq/g)		<2.7e+04
Sulfate (M)		0.081	⁶⁰ Co (Bq/g)		2.52e+03
<u>Alkalinity</u>			¹³⁷ Cs (Bq/g)		<6.5e+03
pH		12.8	¹³⁷ Cs (Bq/g)		4.95e+03
H ⁺ (M)		.	¹⁵² Eu (Bq/g)		7.22e+03
OH ⁻ (M)		0.15	¹⁵² Eu (Bq/g)		5.14e+05
CO ₃ ²⁻ (M)		0.70	¹⁵⁴ Eu (Bq/g)		1.21e+05
HCO ₃ ⁻ (M)			¹⁵⁴ Eu (Bq/g)		<7.0e+03
<u>Radionuclide emitters</u>			⁹⁰ Nb (Bq/g)		<6.2e+04
Gross alpha (Bq/mL)		8.20e+01	⁹⁰ Ru (Bq/g)		2.28e+06
Gross beta (Bq/mL)		4.62e+05	⁹⁰ Sr (Bq/g)		<4.5e+04
Gross beta (Bq/mL)		6.35e+01	⁹⁰ Zr (Bq/g)		
¹⁴ C (Bq/mL)		<1.6e+03	<u>Alpha emitters</u>		
¹⁴ Ce (Bq/mL)		6.21e+02	²³⁸ U (Bq/g)		1.18e+04
⁶⁰ Co (Bq/mL)		4.63e+03	²³⁵ U (Bq/g)		<2.5e+04
¹³⁷ Cs (Bq/mL)		4.36e+05	²³⁸ U (Bq/g)		1.18e+04
¹³⁷ Cs (Bq/mL)		<2.1e+02	²³⁸ Pu/ ²³⁹ Pu (Bq/g)		3.21e+04
¹⁵² Eu (Bq/mL)		<1.6e+02	²³⁸ Pu/ ²³⁹ Pu/ ²⁴¹ Am (Bq/g)		<2.6e+04
¹⁵² Eu (Bq/mL)		<8.5e+02	²⁴⁰ Cm (Bq/g)		1.67e+05
¹⁵² Eu (Bq/mL)		1.19e+02			
⁹⁰ Nb (Bq/mL)		<1.0e+02			
⁹⁰ Ru (Bq/mL)		3.78e+03			
⁹⁰ Sr (Bq/mL)		4.12e+02			
⁹⁰ Zr (Bq/mL)		<1.0e+02			
<u>Alpha emitters</u>					
²³⁸ U (Bq/mL)		4.00e+00			
²³⁵ U (Bq/mL)		6.00e+00			
²³⁸ Pu/ ²³⁹ Pu (Bq/mL)		6.00e+00			
²³⁸ Pu/ ²³⁹ Pu/ ²⁴¹ Am (Bq/mL)		3.90e+01			
²⁴⁰ Cm (Bq/mL)		4.00e+00			

* NO DATA FOR TANK C-2, TANK W23 SHOWN AS A REP. SAMPLE

LEGEND:
TSD - TOTAL DISSOLVED SOLIDS
TS - TOTAL SOLIDS
IC - INORGANIC CARBON
TC - TOTAL CARBON
TOC - TOTAL ORGANIC CARBON

Figure 2.5-9 Radiochemical Analyses In the Evaporator Service Tanks

Radiochemical analyses of beta emitters in the Evaporator Service Tanks^a

Tank	Sample date	Sample location	Gross beta TRU ^b	Gross beta RHAL ^c	Gross Gamma (c/min-mL)	Sr-90	Cs-137	Co-60	Eu-152	Eu-154	Eu-155	Zr-95	Nb-95
W-21	Nov. 85	Solids ^d	84,900	68,300	1.49E+07	16,400	6,760	1,060	11,600	5,840	2,400	2,660	200
W-22	Nov. 85	Solids ^d	56,500	53,700	1.18E+07	10,200	5,050	740	10,900	5,350	2,060	2,920	330
W-23	Nov. 85	Liquid ^e	66,800	49,800	1.25E+07	9,400	2,040	760	13,000	^f	2,250		200
	Nov. 85	Solids ^d	237,000	203,000	1.35E+07	73,700	6,510	880	12,100	8,220	2,550	3,400	

* REPRESENTATIVE SAMPLE

^a All data from the TRU laboratory except RHAL gross beta and Sr-90.

^b TRU data: Request No. 45764, received 1/30/86, completed 2/6/86.

^c RHAL data: Request No. 34529, received 11/12/85, completed 11/22/85.

^d nCi/g for solid samples.

^e nCi/mL for liquid samples.

^f A blank space means no data available.

Radiochemical analyses of alpha emitters
in the Evaporator Service Tanks^a

Tank	Sample date	Sample location	Gross alpha TRU ^b	Gross alpha RHAL ^c	Am-244	Am-241	Pu-239 & Pu-240	Pu-238	U-233
W-21	Nov. 85	Solids ^d	5110	1980	810	70	380	830	50
W-22	Nov. 85	Solids ^d	3510	2260	1100	100	190	280	58
W-23	Nov. 85	Liquid ^e	870	710	280	50	50	90	38
	Nov. 85	Solids ^d	6970	3190	2190	<30	580	500	130

^a All data from the TRU laboratory except RHAL gross alpha.

^b TRU data: Request No. 45764, received 1/30/86, completed 2/6/86.

^c RHAL data: Request No. 34529, received 11/12/85, completed 11/22/85.

^d nCi/g for solid samples.

^e nCi/mL for liquid samples.

* = NO DATA FOR TANK C-2, TANK W23
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2.6 Tank L-11

2.6.1 Tank Summary

Tank L-11 is a nominal, 500-gal, vertical tank installed in 1974 in the Process Waste Treatment Plant (PWTP) (Building 3544) and is part of the main Bethel Valley Complex (Figures 2.6-1 and 2.6-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an aboveground, reinforced concrete vault. Tank L-11 is used as a liquid low-level waste (LLLW) collection tank for the evaporation bottoms from the L-10 PWTP Evaporator and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.6.2 Standards for Design Demonstration

2.6.2.1 Tank Description and Design Standards

Tank Description

Tank L-11 is located at the south wall of Building 3544 in the Ion Exchange and Evaporator Room. The tank is used and managed by the Waste Management and Remedial Actions Division and is part of the Bethel Valley LLLW System. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank L-11 centerlines are N 21280 and E 30830.

Tank L-11 is a vertically oriented SS tank with a nominal capacity of 500 gal. The tank has an outside diameter of 4'0" and an overall height of 6'0".

Design Standards

The applicable codes and standards used for Tank System L-11 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) C39, C78, C138, C143, and D1752;

American Standards Association (ASA) Safety Code for Building Construction;

American Concrete Institute (ACI);

American Concrete Pipe Association (ACPA);

Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

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Occupational Safety and Health Administration (OSHA);

American Society of Mechanical Engineers (ASME);

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation;

American National Standards Institute (ANSI); and

Instrument Society of America (ISA).

2.6.2.2 Generic Description of Tank Contents

Tank L-11 is designed to serve as an LLLW process collection tank for the Building 3544 Evaporator. The tank collects evaporator bottoms from the L-10 PWTP Evaporator (Figure 2.6-3). These wastes may include a variety of dilute acids, bases, and organics. The residence time for acids is low. After each waste transfer, Tank L-11 is neutralized with a high pH solution and flushed with water. The tank may contain radioactive materials from Building 3544.

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The analytical data (Figure 2.6-8) of waste stream contaminants from the generators are representative of the waste transferred to and from Tank L-11.

2.6.2.3 Corrosion Protection Measures

Tank L-11 is located at the south wall of Building 3544 in an aboveground, coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.6.2.4 Documented Age

Tank L-11 was constructed in 1974.

2.6.3 Standards for Containment/Release Detection

2.6.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank L-11 is constructed of type 304L SS. The floor of the tank vault is provided with a 40-mil-thick system of Quantum Polymorphic Resin. The walls of the vault are provided with a three-coat system of Amercoat 66 epoxy. According to manufacturer's specifications, the vault floor resin coating and the vault walls epoxy coating are compatible with the waste and designed to prevent migration of waste into the concrete. The sump to which Tank Vault L-11 drains is lined with type 304L SS (Figure 2.6-4).

The assessment concludes that the secondary containment system coatings and linings are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.6.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System.

Tank L-11 is located in an aboveground, coated, reinforced concrete vault (Figure 2.6-5). The floor of the vault is an 8" thick, reinforced concrete base slab which was designed with a 28-day compressive strength of 4000 psi.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

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2.6.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank L-11 is provided with a tank level monitor and is located in a coated vault. Any leakage from Tank L-11 is gravity fed to a floor drain which is routed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 3544.

The assessment concludes that Tank System L-11 is provided with a leak detection system.

2.6.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank L-11 vault floor is sloped to a floor drain which is routed to a 304L SS-lined sump. The sump provides a low point to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.6.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank L-11 is located in a coated, reinforced concrete vault. The following items address specific components of the vault system.

Containment

Tank L-11 is located in an aboveground vault designed to be leaktight. The vault includes one process area that has two, 4", PVC floor drains embedded in the concrete floor. The drain lines are routed to a common 304L SS-lined instrumented sump. The 304L SS-lined portion of the sump provides containment for 1150 gal of liquid compared with a nominal full tank content of 500 gal for Tank L-11. *The Effects of Nuclear Radiations on Elastomers and Plastic Components and Materials* dated 1964 qualifies the 4", PVC drain lines as appropriate for this application.

The assessment concludes that the SS-lined portion of the sump is sufficient to contain the full tank volume.

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Infiltration

Site and storm drainage design around the perimeter of Building 3544, which contains Tank L-11, provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades slope away from the building conveying rainwater to storm drain catch basin inlets (Figure 2.6-6). The tank vault finished floor elevation is 782'6", which is 6" above ground elevation and includes a foundation drain system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank L-11 secondary containment structure is constructed with 2" x 4" keyways with continuous water stops in all below-grade construction joints, but the design drawings and construction specifications do not indicate that the water stops are chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank L-11 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

Tank L-11 is vented through a HEPA-filtered tank offgas system that keeps the tank under negative pressure relative to the vault pressure. The vault is ventilated with a HEPA-filtered vault exhaust ventilation system that generates a sweep flow rate of approximately 1700 CFM through the vault. This exhaust system was designed to maintain the vault at a negative pressure (Figure 2.6-7).

The assessment concludes that Tank System L-11 is provided with a means to protect against the formation and ignition of vapors.

2.6.4 Supplemental Information

2.6.4.1 Ancillary Equipment

Piping associated with Tank L-11 is single wall. Piping and related equipment such as jet ejectors, pumps, and valves are fabricated from 304L SS, which is the same material as that used in Tank L-11. The transfer piping and associated equipment are exposed to the same liquids as Tank L-11; therefore, 304L SS is acceptable for the support equipment. Within the confines of the

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vault system, any piping and related equipment is provided secondary containment by the coated vault and 304L SS-lined sump.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.6.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank L-11.

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2.6.5 References

- Energy Systems Drawing S-21246-EB-014D, Concrete Sections Sheet 2, Revision A.
- Energy Systems Drawing S-21246-EB0-15D, Concrete Sections Sheet 3, Revision 0.
- Energy Systems Drawing A-21246-EB0-18D, General Structural Notes, Revision 0.
- Energy Systems Drawing H-21246-EG-003D, Heating and Ventilating Flow and Control Diagram, Revision 0.
- Energy Systems Drawing I-21246-EI-015D, Instrumentation Systems, Revision C.
- Energy Systems Drawing P-21246-EE-032D, Ion Exchange Room Process Piping Elevation G-G and H-H, Revision 3.
- Energy Systems Drawing M-21246-EE-028D, Process Equipment Layout Plan, Revision 0.
- King, R. W., N. J. Broadway, and S. Palinchak. *The Effect of Nuclear Radiations on Elastomers and Plastic Components and Materials*. USAEC REIC Report 21, 1961. N. J. Broadway and S. Palinchak, (same title), REIC Report 21 (Add.), 1964.
- LLLW Generator Survey 1990 for Building 3544.
- Oak Ridge National Laboratory. *Specification for the Construction of Process Waste Treatment Plant Building 3544*. Invitation No. 401-74-13A.
- Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.
- Peretz, F. J., et al. 1986. *Characterization of Low Level Liquid Wastes at the Oak Ridge National Laboratory*. ORNL/TM-10218. Oak Ridge National Laboratory.

Figure 2.6-2 Layout of Tank L-11

94'-7 1/2"

FLOOR PLAN

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REF. DRAWING: EE-028-D

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Figure 2.6-3
Schematic of the Liquid Low-Level Waste System

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BASCO/MAIN

REF. DWG. M-011-6-EE-029-D
S-21246-EB-014-D

SECTION A-A
PLAN EE-028-D

REV. 0 12-04-92

PLAN EE-028 - D

REV. 0 12-04-92

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Figure 2.6-6
Building 3544 Grading Plan

Figure 2.6-7 H&V Diagram

FLOW DIAGRAM
NO SCALE

Figure 2.6-8
Analytical Data For Liquid

9. WASTE STREAM CONTAMINANTS:

(a) Isotopes: all Quantities: Trace

(b) Others (i.e. acids, bases, organics, cleaners, etc.)

nitric acid (3N) 2000.0 gal/year

sodium hydroxide (50%) 440.0 gal/year

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2.7 Tank B-2-T

2.7.1 Tank Summary

Tank B-2-T is a nominal, 1870-gal, vertical tank installed in 1965 near the Radiochemical Engineering Development Center (REDC) (Building 7930) in the Melton Valley High Flux Isotope Reactor (HFIR) Complex (Figures 2.7-1 and 2.7-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank B-2-T is used as a process collection tank for the Radioactive Hot Drain-Hot Offgas (RHD-HOG) System and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.7.2 Standards for Design Demonstration

2.7.2.1 Tank Description and Design Standards

Tank Description

Tank B-2-T is located near the southwest corner of Building 7930 in an underground vault with Tanks B-3-T and C-6-T. The tank is under the control of the REDC and operated by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank B-2-T centerlines are N 17697.33 and E 32577.0.

Tank B-2-T is a nominal, 1870-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 7'0" and an overall height of 8'10-7/8". The shell and the heads have a nominal thickness of 3/8" and 5/16", respectively. The tank operates under a pressure of approximately -15" of water gauge (wg).

Design Standards

The applicable codes and standards used for Tank System B-2-T and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A93, A244, A307, C39, C78, C138, C143, and D1752;

American Standards Association (ASA) Safety Code for Building Construction;

American Concrete Institute (ACI);

American Concrete Pipe Association (ACPA);

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Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

American Society of Mechanical Engineers (ASME), Sections II, IV, VIII, and IX;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation;

American National Standards Institute (ANSI); and

Instrument Society of America (ISA).

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2.7.2.2 Generic Description of Tank Contents

Tank B-2-T is designed to serve as an LLLW collection tank for the Building 7930 RHD-HOG System. The primary source of LLLW in the building is from Cell G (Figure 2.7-3). These wastes may include a variety of dilute acids, bases, and organics. The tank may contain radioactive materials from the REDC.

The analytical data (Figure 2.7-8) of waste stream contaminants from the generators are representative of wastes transferred to and stored in Tank B-2-T.

2.7.2.3 Corrosion Protection Measures

Tank B-2-T is located near the southwest corner of Building 7930 in an underground, coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.7.2.4 Documented Age

Tank B-2-T was installed in 1965.

2.7.3 Standards for Containment/Release Detection

2.7.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank B-2-T is constructed of type 304L SS. The tank vault floor is provided with a 30-mil-thick system of Amercoat 66 epoxy, and the tank vault walls are provided with a 5-mil-thick system of Amercoat 99 vinyl emulsion (Figure 2.7-4).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy-coated floor and vinyl-emulsion-coated walls are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.7.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank B-2-T is located in an underground, reinforced concrete vault (Figure 2.7-5). Tank B-2-T shares the vault with Tanks B-3-T and C-6-T. The vault inside dimensions are 10'0" x 25'6" x 19'3" high. The floor slab and three walls are 2'0" thick, and the east wall is 3'0" thick, reinforced concrete. The roof is constructed of three, removable, reinforced concrete plugs that are 4'6" thick. The vault floor elevation is 825'0", which is 23'0" below grade (EL. 848'0").

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The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.7.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank B-2-T is provided with a tank level monitor and is located in a coated vault. Any leakage from Tank B-2-T is gravity fed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 7930.

The assessment concludes that Tank System B-2-T is provided with a leak detection system.

2.7.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank B-2-T vault bottom slopes to a 1'0" x 1'0" x 1'0" deep, epoxy-coated sump with a capacity of 7.5 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The secondary containment is designed to minimize the potential for rainwater leakage; however, the removable plugs located on the containment roof are known to leak occasionally. This leakage is contained and subsequently removed from the secondary containment system.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.7.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank B-2-T is located in a coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank B-2-T is located in a below-grade vault with coatings designed to be leaktight. The epoxy-coated portion of the vault measures 10'0" x 25'6" x 19'3" high, which represents a total volume of 36,700 gal. Of that total volume, 1870 gal are occupied by Tank B-3-T; and 375 gal are occupied by Tank C-6-T, leaving an available containment volume of 34,455 gal. The nominal full tank content of Tank B-2-T is 1870 gal.

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The assessment concludes that the coated vault is sufficient to contain the full tank volume along with the occasional roof plug inleakage.

Infiltration

Site and storm drainage design around the perimeter of the vault containing Tank B-2-T provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the vault containing Tank B-2-T slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault containing Tank B-2-T are maintained at a minimum of 8" below perimeter walls to prevent water run-on. The 2'0" thick, reinforced concrete tank vault walls have an external, three-ply application of coal tar pitch type membrane coating; and the floor slab has a 6-mil-thick, polyethylene membrane, which comprise the waterproofing system. The pipe penetrations through the walls were sealed to the waterproof membrane, and the roof plug joints are caulked with resilient type sealer. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 825'0", which is 23'0" below grade (EL. 848'0") (Figure 2.7-6).

The tank vault is designed with a 6" diameter, 16-gauge, galvanized, perforated pipe located around the foundation base to provide a foundation drain system. The pipe header is routed to the storm water sewer.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank B-2-T secondary containment structure is constructed with 16-oz, cold-rolled copper water stops and 2" x 6" keyways in all below-grade construction joints, but the water stops are not chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank B-2-T is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system). Both the tank and the vault are vented to the atmosphere via a HEPA-filtered exhaust system and the 7911 Stack. The tank ventilation flow rate is approximately 40 CFM, and the vault ventilation flow rate is approximately 100 CFM. The ventilation system is designed to maintain the tank at a more negative pressure than the vault, which is at a negative pressure relative to the atmosphere (Figure 2.7-7).

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The assessment concludes that Tank System B-2-T is provided with a means to protect against the formation and ignition of vapors.

2.7.4 Supplemental Information

2.7.4.1 Ancillary Equipment

Piping associated with Tank B-2-T is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used in Tank B-2-T. The transfer piping and associated equipment are exposed to the same liquids as Tank B-2-T; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system is provided secondary containment by the coated vault.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.7.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank B-2-T.

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- Energy Systems Drawing, H-20998-Y-325-E, Cell Exhaust and HOG Filter Pit Plan and Details, Revision 1.
- Energy Systems Drawing C-20998-Y-012-E, Civil Site Plan Details, Sheet 1, Revision 2.
- Energy Systems Drawing C-20998-Y-015-E, Civil Utility Details, Sheet 1, Revision 1.
- Energy Systems Drawing H-20998-Y-304-E, Control Diagram Exhaust System, Revision A.
- Energy Systems Drawing H-20998-Y-305-E, Control Diagram Hot Offgas Exhaust System, Revision A.
- Energy Systems Drawing 20999-U-X02-E, Details Waste Pit Tanks, Revision 1.
- Energy Systems Drawing H-20998-Y-302-E, Flow Diagram HVAC, Revision A.
- Energy Systems Drawing P-20998-Y-404-E, Flow Diagram RHD, RHDR, and PWD Systems, Sheet 2, Revision 1.
- Energy Systems Drawing S-20998-Y-223E, Radioactive Waste and Filter Pits, Sheet 1, Dated 1/15/65 (No Revision No.).
- Energy Systems Drawing P-20998-Y-428-E, Waste Pit Piping Details, Sheet 1, Revision 1.
- Energy Systems Drawing P-20998-Y-430-E, Waste Pit Piping Details, Sheet 3, Revision 1.
- Energy Systems Drawing 20999-U-X01-E, Waste Pit Tanks, Revision 2.
- King, Notz, and Bigelow. 1987. *Safety Analysis: TURF, Building 7930*. ORNL/TM-9505. Oak Ridge National Laboratory.
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R. M. Parson Co. 1977. *Natural Disturbance Analysis of Buildings 7930 and 3019*. Document No. X-OE-23.

Figure 2.7-1 Location of Radiochemical Engineering Development Center

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Figure 2.7-2
Layout of the Waste Pit Tanks

Figure 2.7-3 Schematic of the Liquid Low-Level Waste System

Figure 2.7-4 Tanks B-2-T, B-3-T and C-6-T Vault

FOUNDATION PLAN

SCALE 1/4" = 1'-0"

NOTE: ROOM NUMBER SHOWN THIS REF. TO FINISH SCHEDULE ON DWG. A-1.

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Figure 2.7-5 Tanks B-2-T, B-3-T and C-6-T Vault

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Figure 2.7-6
Filter and Waste Pit (Building 7930) Grading Plan

Figure 2.7-7 Tanks B-2-T, B-3-T and C-6-T H&V Diagram

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Figure 2.7-8
Analytical Data For Liquid

WASTE STREAM CONTAMINANTS:

(a) Isotopes: Cf-252 (b) Quantities 0.5 mg/year
Other Cf Trace

(b) Others (i.e. acids, bases, organics, cleaners, etc.)

<u>acidified butyrates</u>	<u>824.9 g/year</u>
<u>nitric acid (dilute)</u>	<u>Trace</u>
<u>palladium tetrammine di-hydrate</u>	<u>Trace</u>
<u>hydrazine decomposition products</u>	<u>Trace</u>

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2.8 Tank B-3-T

2.8.1 Tank Summary

Tank B-3-T is a nominal, 1870-gal, vertical tank installed in 1965 near the Radiochemical Engineering Development Center (REDC) (Building 7930) in the Melton Valley High Flux Isotope Reactor (HFIR) Complex (Figures 2.8-1 and 2.8-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank B-3-T is used as a process collection tank for the Radioactive Hot Drain-Hot Offgas (RHD-HOG) System and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.8.2 Standards for Design Demonstration

2.8.2.1 Tank Description and Design Standards

Tank Description

Tank B-3-T is located near the southwest corner of Building 7930 in an underground vault with Tanks B-2-T and C-6-T. The tank is under the control of the REDC and operated by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank B-3-T centerlines are N 17697.33 and E 32568.5.

Tank B-3-T is a nominal, 1870-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 7'0" and an overall height of 8'10-7/8". The shell and the heads have a nominal thickness of 3/8" and 5/16", respectively. The tank operates under a pressure of approximately -15" of water gauge (wg).

Design Standards

The applicable codes and standards used for Tank System B-3-T and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A93, A244, A307, C39, C78, C138, C143, and D1752;

American Standards Association (ASA) Safety Code for Building Construction;

American Concrete Institute (ACI);

American Concrete Pipe Association (ACPA);

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Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirement, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

American Society of Mechanical Engineers (ASME), Sections II, IV, VIII, and IX;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation;

American National Standards Institute (ANSI); and

Instrument Society of America (ISA).

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2.8.2.2 Generic Description of Tank Contents

Tank B-3-T is designed to serve as an LLLW overflow tank for Tank B-2-T. The primary source of LLLW in the building is from Cell G (Figure 2.8-3). These wastes may include a variety of dilute acids, bases, and organics. The tank may contain radioactive materials from the REDC.

The analytical data (Figure 2.8-8) of waste stream contaminants from the generators are representative of waste that may be transferred to and stored in Tank B-3-T.

2.8.2.3 Corrosion Protection Measures

Tank B-3-T is located near the southwest corner of Building 7930 in an underground, coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.8.2.4 Documented Age

Tank B-3-T was installed in 1965.

2.8.3 Standards for Containment/Release Detection

2.8.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank B-3-T is constructed of type 304L SS. The tank vault floor is provided with a 30-mil-thick system of Amercoat 66 epoxy, and the tank vault walls are provided with a 5-mil-thick system of Amercoat 99 vinyl emulsion (Figure 2.8-4).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy-coated floor and vinyl-emulsion-coated walls are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.8.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank B-3-T is located in an underground, reinforced concrete vault (Figure 2.8-5). Tank B-3-T shares the vault with Tanks B-2-T and C-6-T. The vault inside dimensions are 10'0" x 25'6" x 19'3" high. The floor slab and three walls are 2'0" thick; and the east wall is 3'0" thick, reinforced concrete. The roof is constructed of three, removable, reinforced concrete plugs that are 4'6" thick. The vault floor elevation is 825'0", which is 23'0" below grade (EL. 848'0").

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The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.8.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank B-3-T is provided with a tank level monitor and is located in a coated vault. Any leakage from Tank B-3-T is gravity fed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 7930.

The assessment concludes that Tank System B-3-T is provided with a leak detection system.

2.8.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank B-3-T vault bottom slopes to a 1'0" x 1'0" x 1'0" deep, epoxy-coated sump with a capacity of 7.5 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pump system is provided to remove liquids that accumulate in the sump.

The secondary containment is designed to minimize the potential for rainwater leakage; however, the removable plugs located on the containment roof are known to leak occasionally. This leakage is contained and subsequently removed from the secondary containment system.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.8.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank B-3-T is located in a coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank B-3-T is located in a below-grade vault with coatings designed to be leaktight. The epoxy-coated portion of the vault measures 10'0" x 25'6" x 19'3" high, which represents a total volume of 36,700 gal. Of that total volume, 1870 gal are occupied by Tank B-2-T; and 375 gal are occupied by Tank C-6-T, leaving an available containment volume of 34,455 gal. The nominal full tank content of Tank B-3-T is 1870 gal.

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The assessment concludes that the coated vault is along with the occasional roof plug inleakage sufficient to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of the vault containing Tank B-3-T provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the vault containing Tank B-3-T slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault containing Tank B-3-T are maintained at a minimum of 8" below perimeter walls to prevent water run-on. The 2'0" thick, reinforced concrete tank vault walls have an external, three-ply application of coal tar pitch type membrane coating; and the floor slab has a 6-mil-thick, polyethylene membrane, which comprise the waterproofing system. The pipe penetrations through the walls were sealed to the waterproof membrane; and the roof plug joints are caulked with resilient type sealer. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 825'0", which is 23'0" below grade (EL. 848'0") (Figure 2.8-6).

The tank vault is designed with a 6" diameter, 16-gauge, galvanized, perforated pipe located around the foundation base to provide a foundation drain system. The pipe header is routed to the storm water sewer.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank B-3-T secondary containment structure is constructed with 16-oz, cold-rolled copper water stops and 2" x 6" keyways in all below-grade construction joints, but the water stops are not chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank B-3-T is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system). Both the tank and the vault are vented to the atmosphere via a HEPA-filtered exhaust system and the 7911 Stack. The tank ventilation flow rate is approximately 40 CFM, and the vault ventilation flow rate is approximately 100 CFM. The ventilation system is designed to maintain the tank at a more negative pressure than the vault, which is at a negative pressure relative to the atmosphere (Figure 2.8-7).

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The assessment concludes that Tank System B-3-T is provided with a means to protect against the formation and ignition of vapors.

2.8.4 Supplemental Information

2.8.4.1 Ancillary Equipment

Piping associated with Tank B-3-T is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used in Tank B-3-T. The transfer piping and associated equipment are exposed to the same liquids as Tank B-3-T; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system is provided secondary containment by the coated vault.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.8.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank B-3-T.

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2.8.5 References

Binford, F. T., and S. D. Orfi. 1979. *The Intermediate Level Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis*. ORNL/TM-6959. Oak Ridge National Laboratory.

Energy Systems Drawing H-20998-Y-325-E, Cell Exhaust and HOG Filter Pit Plan and Details, Revision 1.

Energy Systems Drawing C-20998-Y-012-E, Civil Site Plan Details, Sheet 1, Revision 2.

Energy Systems Drawing C-20998-Y-015-E, Civil Utility Details, Sheet 1, Revision 1.

Energy Systems Drawing H-20998-Y-304-E, Control Diagram Exhaust System, Revision A.

Energy Systems Drawing H-20998-Y-305-E, Control Diagram Hot Offgas Exhaust System, Revision A.

Energy Systems Drawing 20999-U-X02-E, Details Waste Pit Tanks, Revision 1.

Energy Systems Drawing H-20998-Y-302-E, Flow Diagram HVAC, Revision A.

Energy Systems Drawing P-20998-Y-404-E, Flow Diagram RHD, RHDR, and PWD Systems, Sheet 2, Revision 1.

Energy Systems Drawing S-20998-Y-223E, Radioactive Waste and Filter Pits, Sheet 1, Dated 1/15/65 (No Revision No.).

Energy Systems Drawing P-20998-Y-428-E, Waste Pit Piping Details, Sheet 1, Revision 1.

Energy Systems Drawing P-20998-Y-430-E, Waste Pit Piping Details, Sheet 3, Revision 1.

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Oak Ridge National Laboratory. *Specification for the Construction of Thorium-Uranium Fuel Cycle Development Facility Building 7930*. Invitation No. 401-65-4A.

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R. M. Parson Co. 1977. *Natural Disturbance Analysis of Buildings 7930 and 3019*. Document No. X-OE-23.

Figure 2.8-1 Location of Radiochemical Engineering Development Center

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Figure 2.8-2
Layout of the Waste Pit Tanks

Figure 2.8-3 Schematic of the Liquid Low-Level Waste System

Figure 2.8-4 Tanks B-2-T, B-3-T and C-6-T Vault

FOUNDATION PLAN
SCALE 1/4" = 1'-0"

NOTE: NUMBER SHOWN THIS
REFER TO FINISH SCHEDULE
ON DWG. A-1.

Figure 2.8-5 Tanks B-2-T, B-3-T and C-6-T Vault

SECTION B-B

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Filter and Waste Pit (Building 7930) Grading Plan

Figure 2.8-7 Tanks B-2-T, B-3-T and C-6-T H&V Diagram

Figure 2.8-8
Analytical Data For Liquid

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	<u>Cf-252</u>	(b) Quantities	<u>0.5 mg/year</u>
	<u>Other Cf</u>		<u>Trace</u>
	<u> </u>		<u> </u>
(b) Others (i.e. acids, bases, organics, cleaners, etc.)			
	<u>acidified butyrates</u>		<u>824.9 g/year</u>
	<u>nitric acid (dilute)</u>		<u>Trace</u>
	<u>palladium tetrammine di-hydrate</u>		<u>Trace</u>
	<u>hydrazine decomposition products</u>		<u>Trace</u>
	<u> </u>		<u> </u>

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2.9 Tank C-6-T

2.9.1 Tank Summary

Tank C-6-T is a nominal, 710-gal (375 gal usable), vertical tank installed in 1965 near the Radiochemical Engineering Development Center (REDC) (Building 7930) in the Melton Valley High Flux Isotope Reactor (HFIR) Complex (Figures 2.9-1 and 2.9-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank C-6-T is used as a process collection tank for the Radioactive Hot Drain Recoverable (RHDR) System and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.9.2 Standards for Design Demonstration

2.9.2.1 Tank Description and Design Standards

Tank Description

Tank C-6-T is located near the southwest corner of Building 7930 in an underground vault with Tanks B-2-T and B-3-T. The tank is under the control of the REDC and operated by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank C-6-T centerlines are N 17697.33 and E 32561.5.

Tank C-6-T is a nominal, 710-gal (375 gal usable), vertical tank constructed of type 304L SS. The tank has an outside diameter of 4'0" and an overall height of 8'10-7/8". The shell and the heads have a nominal thickness of 5/16". The tank operates under a pressure of about -15" of water gauge (wg).

Design Standards

The applicable codes and standards used for Tank System C-6-T and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A93, A244, A307, C39, C78, C138, C143, and D1752;

American Standards Association (ASA) Safety Code for Building Construction;

American Concrete Institute (ACI);

American Concrete Pipe Association (ACPA);

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Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

American Society of Mechanical Engineers (ASME), Sections II, IV, VIII, and IX;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation;

American National Standards Institute (ANSI); and

Instrument Society of America (ISA).

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2.9.2.2 Generic Description of Tank Contents

Tank C-6-T is designed to serve as an LLLW collection tank for the Building 7930 RHDR System. The primary source of LLLW in the building is from Cell G (Figure 2.9-3). These wastes may include a variety of dilute acids, bases, and organics. The tank may contain radioactive materials from the REDC.

The analytical data (Figure 2.9-8) of waste stream contaminants from the generators are representative of wastes transferred to and stored in Tank C-6-T.

2.9.2.3 Corrosion Protection Measures

Tank C-6-T is located near the southwest corner of Building 7930 in an underground, coated, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.9.2.4 Documented Age

Tank C-6-T was installed in 1965.

2.9.3 Standards for Containment/Release Detection

2.9.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank C-6-T is constructed of type 304L SS. The tank vault floor is provided with a 30-mil-thick system of Amercoat 66 epoxy, and the tank vault walls are provided with a 5-mil-thick system of Amercoat 99 vinyl emulsion (Figure 2.9-4).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy-coated floor and vinyl-emulsion-coated walls are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.9.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank C-6-T is located in an underground, reinforced concrete vault (Figure 2.9-5). Tank C-6-T shares the vault with Tanks B-3-T and B-2-T. The vault inside dimensions are 10'0" x 25'6" x 19'3" high. The floor slab and three walls are 2'0" thick; and the east wall is 3'0" thick, reinforced concrete. The roof is constructed of three, removable, reinforced concrete plugs which are 4'6" thick. The vault floor elevation is 825'0", which is 23'0" below grade (EL. 848'0").

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The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.9.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank C-6-T is provided with a tank level monitor and is located in a coated vault. Any leakage from Tank C-6-T is gravity fed to a sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of Building 7930.

The assessment concludes that Tank System C-6-T is provided with a leak detection system.

2.9.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank C-6-T vault bottom slopes to a 1'0" x 1'0" x 1'0" deep, epoxy-coated sump with a capacity of 7.5 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The secondary containment is designed minimize the potential for rainwater inleakage; however, the removable plugs located on the containment roof are known to leak occasionally. This inleakage is contained and subsequently removed from the secondary containment system.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.9.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank C-6-T is located in a coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank C-6-T is located in a below-grade vault with coatings designed to be leaktight. The epoxy-coated portion of the vault measures 10'0" x 25'6" x 19'3" high, which represents a total volume of 36,700 gal. Of that total volume, 1870 gal are occupied by Tank B-2-T; and 1870 gal are occupied by Tank B-3-T, leaving an available containment volume of 32,960 gal. The nominal full tank content of Tank C-6-T is 710 gal (375 gal usable).

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The assessment concludes that the coated vault is sufficient to contain the full tank volume along with the occasional roof plug inleakage .

Infiltration

Site and storm drainage design around the perimeter of the vault containing Tank C-6-T provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the vault containing Tank C-6-T slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault containing Tank C-6-T are maintained at a minimum of 8" below perimeter walls to prevent water run-on. The 2'0" thick, reinforced concrete tank vault walls have an external, three-ply application of coal tar pitch type membrane coating; and the floor slab has a 6-mil-thick, polyethylene membrane, which comprise the waterproofing system. The pipe penetrations through the walls were sealed to the waterproof membrane and the roof plug joints are caulked with resilient type sealer. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 825'0", which is 23'0" below grade (EL. 848'0") (Figure 2.9-6).

The tank vault is designed with a 6" diameter, 16-gauge, galvanized, perforated pipe located around the foundation base to provide a foundation drain system. The pipe header is routed to the storm water sewer.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank C-6-T secondary containment structure is constructed with 16-oz, cold-rolled copper water stops and 2" x 6" keyways in all below-grade construction joints, but the water stops are not chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank C-6-T is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system). Both the tank and the vault are vented to the atmosphere via a HEPA-filtered exhaust system and the 7911 Stack. The tank ventilation flow rate is approximately 40 CFM, and the vault ventilation flow rate is approximately 100 CFM. The ventilation system is designed to maintain the tank at a more negative pressure than the vault, which is at a negative pressure relative to the atmosphere (Figure 2.9-7).

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The assessment concludes that Tank System C-6-T is provided with a means to protect against the formation and ignition of vapors.

2.9.4 Supplemental Information

2.9.4.1 Ancillary Equipment

Piping associated with Tank C-6-T is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used in Tank C-6-T. The transfer piping and associated equipment are exposed to the same liquids as Tank C-6-T; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system is provided secondary containment by the coated vault.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.9.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank C-6-T.

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Figure 2.9-1 Location of Radiochemical Engineering Development Center

Figure 2.9-2
Layout of the Waste Pit Tanks

Figure 2.9-3 Schematic of the Liquid Low-Level Waste System

Figure 2.9-4 Tanks B-2-T, B-3-T and C-6-T Vault

FOUNDATION PLAN
SCALE 1/4"=1'-0"

NOTE 1:
ROOM NUMBERS SHOWN THRU.
REFER TO FORMER SCHEDULE
ON DWG. A-1.

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Figure 2.9-5 Tanks B-2-T, B-3-T and C-6-T Vault

SECTION B-B

REF. DWG. S-20998-Y-223-E

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Figure 2.9-6
Filter and Waste Pit (Building 7930) Grading Plan

Figure 2.9-7 Tanks B-2-T, B-3-T and C-6-T H&V Diagram

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Figure 2.9-8
Analytical Data For Liquid

WASTE STREAM CONTAMINANTS:

(a)	Isotopes:	<u>Cf-252</u>	(b)	Quantities	<u>0.5 mg/year</u>
		<u>Other Cf</u>			<u>Trace</u>
		<u> </u>			<u> </u>
(b)	Others (i.e. acids, bases, organics, cleaners, etc.)				
		<u>acidified butyrates</u>			<u>824.9 g/year</u>
		<u>nitric acid (dilute)</u>			<u>Trace</u>
		<u>palladium tetrammine di-hydrate</u>			<u>Trace</u>
		<u>hydrazine decomposition products</u>			<u>Trace</u>
		<u> </u>			<u> </u>

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2.10 Tank F-111

2.10.1 Tank Summary

Tank F-111 is a nominal, 125-gal, vertical tank installed in 1966 in the Transuranium Processing Plant (Building 7920) at the Melton Valley High Flux Isotope Reactor (HFIR) Complex (Figures 2.10-1 and 2.10-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, Hastelloy "C" lined, reinforced concrete vault. Tank F-111 is used to collect liquid low-level waste (LLLW) from Building 7920 and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.10.2 Standards for Design Demonstration

2.10.2.1 Tank Description and Design Standards

Tank Description

Tank F-111 is located in the lower level of Building 7920 with Tanks F-115 and F-126. The tank is under the control of the Radiochemical Engineering Development Center (REDC) and operated by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank F-111 centerlines are N 17464.75 and E 32608.09.

Tank F-111 is a nominal, 125-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 2'3", a vertical straight sidewall length of 4'0" with ASME flanged and dished heads, and an overall length of 5'1". The shell and the heads have a nominal thickness of 5/16". The tank has an integral external water-cooled jacket. The tank is designed for full vacuum, with atmospheric pressure in the jacket at 200°F and atmospheric pressure with 55 psig in the jacket at 200°F, and operates at a pressure of -4" to -12" of water gauge (wg).

Design Standards

The applicable codes and standards used for Tank System F-111 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A93, A245, A307, C39, C144, D1190, and D1751;

American Concrete Institute (ACI) 318-56, 604-56, and 613-54;

American Concrete Pipe Association (ACPA);

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Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;
Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);
Occupational Safety and Health Administration (OSHA);
American Society of Mechanical Engineers (ASME), Sections II, V, IV, VIII, and IX;
American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;
ASHRAE Guide and Data Book—Applications;
ASHRAE Guide and Data Book—Equipment;
ASHRAE Handbook—Systems;
American Conference of Governmental Industrial Hygienists (ACGIH);
Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;
AMCA Fans and Systems—Publication 201;
AMCA Directory—Publication 261;
National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;
NFPA No. 91—Blower and Exhaust Systems;
National Electric Code;
Underwriters' Laboratories, Inc.;
Factory Mutual Engineering Corporation;
American National Standards Institute (ANSI); and
Instrument Society of America (ISA).

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2.10.2.2 Generic Description of Tank Contents

Tank F-111 is designed to serve as an LLLW process collection tank for Building 7920. The primary source of LLLW is from water used in equipment flushing procedures, condensate transferred from Tank T-34, and high pH de jacketing waste solutions transferred from Tank T-70 (Figure 2.10-3). These wastes may include a variety of dilute acids, bases, and organics. The tank may contain radioactive materials from Building 7920.

The analytical data (Figure 2.10-8) of waste stream contaminants from the generators are representative of the wastes transferred to and stored in Tank F-111.

2.10.2.3 Corrosion Protection Measures

Tank F-111 is located in the lower level of Building 7920 in a Hastelloy "C" lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.10.2.4 Documented Age

Tank F-111 was installed in 1966.

2.10.3 Standards for Containment/Release Detection

2.10.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank F-111 is constructed of type 304L SS. The vault bottom is lined with 1/4", Hastelloy "C" plate with sidewalls lined with 1/8", Hastelloy "C" plate (Figure 2.10-4). The vault walls above the Hastelloy "C" liner are coated with a 30-mil-thick system of Amercoat 66 epoxy.

The assessment concludes that the Hastelloy "C" lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete. The assessment also concludes that, according to manufacturer's specifications, the vault's epoxy-coated walls are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.10.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank F-111 is located in the lower level of Building 7920 in a Hastelloy "C" lined, reinforced concrete vault (Figure 2.10-5). Tank F-111 shares the vault with Tanks F-115 and F-126. The tank vault foundation is a 17'6" x 22'8" x 2'6" thick, reinforced concrete base slab which supports

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Tanks F-111, F-115, and F-126. The tank vault floor elevation is 835'6", which is 11'6" below finished grade (EL. 847'0").

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.10.3.3 Provide with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents.

Tank F-111 is provided with a tank level monitor and is located in a Hastelloy "C" lined vault. Any leakage from Tank F-111 is gravity fed to a Hastelloy "C" lined sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of the Transuranium Processing Plant (Building 7920).

The assessment concludes that Tank System F-111 is provided with a leak detection system.

2.10.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank F-111 vault bottom slopes to a 6" diameter by 1'0" deep, Hastelloy "C," schedule 10S lined sump. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The Tank F-111 inlet and outlet nozzles are located on the top head of the tank preventing accidental tank leakage from piping attachment failure.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.10.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency.

Tank F-111 is located in a Hastelloy "C" lined, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank F-111 is located in a below-grade vault with a Hastelloy "C" liner designed to be leaktight. The 8'6" x 15'8" x 6" high (from finished vault floor) vault liner provides containment for 600 gal of liquid compared with a nominal full tank content of 125 gal for Tank F-111.

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The assessment concludes that the Hastelloy "C" lined vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage around the perimeter of Building 7920 provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the building containing Tank F-111 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault containing Tank F-111 are maintained at 3'6" below perimeter walls preventing water run-on (Figure 2.10-6). The 4'0" thick, reinforced concrete tank vault walls have an external, five-ply asphalt or tar-type vapor-barrier membrane forming a waterproofing system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 835'6", which is 11'6" below finished grade (EL. 847'0").

The building is designed with subsurface drainage around the foundation base to provide a foundation drain system. The perforated vitrified clay pipe discharges to the storm water sewer.

The maintenance access plugs located in the vault ceiling are caulked with resilient type sealer to minimize the potential for water leakage.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank F-111 secondary containment structure is constructed with 6" water stops in all below-grade construction joints; but, neither the design drawings nor the construction specifications indicate that they are chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally lined, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank F-111 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

Tank F-111 is vented through a HEPA-filtered offgas system that keeps the tank under a negative pressure relative to the vault pressure. The vault is ventilated with a cell exhaust ventilation system that generates a sweep flow rate of approximately 400 CFM through the vault. The cell exhaust system was designed to keep the vault at a negative pressure and is HEPA filtered (Figure 2.10-7).

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The assessment concludes that Tank System F-111 is provided with a means to protect against the formation and ignition of vapors.

2.10.4 Supplemental Information

2.10.4.1 Ancillary Equipment

Piping associated with Tank F-111 is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from type 304L SS or Hastelloy "C." Tank F-111 is constructed of type 304L SS and the tank vault is lined with Hastelloy "C." The transfer piping and associated equipment are exposed to the same liquids as Tank F-111. Therefore, type 304L SS and Hastelloy "C" are acceptable for the support equipment. Within the confines of the vault system, the vault provides secondary containment; and any leakage from piping and related equipment collects in the Hastelloy "C" lined sump.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.10.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank F-111.

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Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.

Figure 2.10-2 Layout of the Waste Pit Tanks

Figure 2.10-3
Schematic of the Liquid Low-Level Waste System

REF. DWG. E-58088

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Figure 2.10-4
Tank Vault Hastelloy "C" Liner

PLAN OF WASTE PIT FLOOR PAN

REF. DWG. 2397-V-225

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Figure 2.10-5
Tank Vault Hastelloy "C" Liner

REF. DWG. 2397-V-248

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Figure 2.10-7 Tanks F-111 and F-126 H&V Diagram

REF. DWG 2397-V-03

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Figure 2.10-8
Analytical Data For Liquid

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	Quantities:
<u>Cm-244</u>	<u>Trace</u>
<u>Cf-252</u>	<u>Trace</u>
<u>Sr-90</u>	<u>Trace</u>
<u>Tc-99</u>	<u>Trace</u>
<u>Cs-137</u>	<u>Trace</u>
<u>Am-241</u>	<u>Trace</u>
<u>Am-243</u>	<u>Trace</u>
<u> </u>	<u> </u>

(b) Others (i.e. acids, bases, organics, cleaners, etc.)

<u>sodium nitrate</u>	<u>Trace</u>
<u>nitric acid</u>	<u>Trace</u>
<u>sodium hydroxide</u>	<u>Trace</u>
<u>potassium iodide</u>	<u>Trace</u>
<u>ferrous chloride</u>	<u>Trace</u>
<u>ferrous sulfate</u>	<u>Trace</u>
<u>thenoyltrifluoroacetone (TTA)</u>	<u>Trace</u>
<u> </u>	<u> </u>

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2.11 Tank F-126

2.11.1 Tank Summary

Tank F-126 is a nominal, 1200-gal, vertical tank installed in 1966 in the Transuranium Processing Plant (Building 7920) at the Melton Valley High Flux Isotope Reactor (HFIR) Complex (Figures 2.11-1 and 2.11-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, Hastelloy "C" lined, reinforced concrete vault. Tank F-126 is used to collect liquid low-level waste (LLLW) from Building 7920 and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.11.2 Standards for Design Demonstration

2.11.2.1 Tank Description and Design Standards

Tank Description

Tank F-126 is located in the lower level of Building 7920 with Tanks F-111 and F-115. The tank is under the control of the Radiochemical Engineering Development Center (REDC) and operated by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank F-126 centerlines are N 17466.34 and E 32612.84.

Tank F-126 is a nominal, 1200-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 5'6", a vertical straight sidewall length of 5'5-1/2" with ASME flanged and dished heads, and an overall length of 7'8-1/2". The shell and the heads have a nominal thickness of 5/16". The tank has an integral external water-cooled jacket. The tank is designed for full vacuum, with atmospheric pressure in the jacket at 200°F and atmospheric pressure with 55 psig in the jacket at 200°F, and operates at a pressure of -4" to -12" of water gauge (wg).

Design Standards

The applicable codes and standards used for Tank System F-126 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A93, A245, A307, C39, C144, D1190, and D1751;

American National Standards Institute (ANSI);

American Concrete Institute (ACI) 318-56, 604-56, and 613-54;

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American Concrete Pipe Association (ACPA);

Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

American Society of Mechanical Engineers (ASME), Sections II, IV, V, VIII, and IX;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation; and

Instrument Society of America (ISA).

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2.11.2.2 Generic Description of Tank Contents

Tank F-126 is designed to serve as an LLLW process collection tank for Building 7920. The primary source of LLLW is spent caustic from the scrubber, aqueous acidic wastes from Tank F-115, and neutralized organic wastes (Figure 2.11-3). These wastes may include a variety of dilute acids, bases, and organics. The tank may contain radioactive materials from Building 7920.

The analytical data (Figure 2.11-8) of waste stream contaminants from the generators are representative of the waste that may be transferred to and stored in Tank F-126.

2.11.2.3 Corrosion Protection Measures

Tank F-126 is located in the lower level of Building 7920 in a Hastelloy "C" lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.11.2.4 Documented Age

Tank F-126 was installed in 1966.

2.11.3 Standards for Containment/Release Detection

2.11.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank F-126 is constructed of type 304L SS. The vault bottom is lined with 1/4", Hastelloy "C" plate with sidewalls lined with 1/8", Hastelloy "C" plate (Figure 2.11-4). The vault walls above the Hastelloy "C" liner are coated with a 30-mil-thick system of Amercoat 66 epoxy.

The assessment concludes that the Hastelloy "C" lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete. The assessment also concludes that, according to manufacturer's specifications, the vault's epoxy-coated walls are compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.11.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank F-126 is located in the lower level of Building 7920 in a Hastelloy "C" lined, reinforced concrete vault (Figure 2.11-5). Tank F-126 shares the vault with Tanks F-111 and F-115. The tank vault foundation is a 17'6" x 22'8" x 2'6" thick, reinforced concrete base slab which supports

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Tanks F-111, F-115, and F-126. The tank vault floor elevation is 835'6", which is 11'6" below finished grade (EL. 847'0").

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.11.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents.

Tank F-126 is provided with a tank level monitor and is located in a Hastelloy "C" lined vault. Any leakage from Tank F-126 is gravity fed to a Hastelloy "C" lined sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in the operating area of the Transuranium Processing Plant (Building 7920).

The assessment concludes that Tank System F-126 is provided with a leak detection system.

2.11.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank F-126 vault bottom slopes to a 6" diameter by 1'0" deep, Hastelloy "C," schedule 10S, lined sump. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The Tank F-126 inlet and outlet nozzles are located on the top head of the tank preventing accidental tank leakage from piping attachment failure.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.11.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency.

Tank F-126 is located in a Hastelloy "C" lined, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank F-126 is located in a below-grade vault with a Hastelloy "C" liner and epoxy-coated walls designed to be leaktight. The 8'6" x 15'8" x 6" high (from finished vault floor) vault liner provides containment for 600 gal of liquid in the liner. The vault walls above the liner are coated with a

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30-mil-thick system of Amercoat 66 epoxy. This coating allows for an additional liquid holding capacity of 10,400 gal. Tank F-126 has a nominal tank content of 1200 gal.

The assessment concludes that the Hastelloy "C" lined vault along with the epoxy-coated walls is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage around the perimeter of Building 7920 provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the building containing Tank F-126 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault containing Tank F-126 are maintained at 3'6" below perimeter walls preventing water run-on (Figure 2.11-6). The 4'0" thick, reinforced concrete tank vault walls have an external, five-ply asphalt or tar-type vapor-barrier membrane forming a waterproofing system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 835'6", which is 11'6" below finished grade (EL. 847'0").

The building is designed with subsurface drainage around the foundation base to provide a foundation drain system. The perforated vitrified clay pipe discharges to the storm water sewer.

The maintenance access plugs located in the vault ceiling are caulked with resilient type sealer to minimize the potential for water inleakage.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank F-126 secondary containment structure is constructed with 6" water stops in all below-grade construction joints; but neither the design drawings nor the construction specifications indicate that they are chemical resistant. However, it is unlikely that water from outside the system or LLLW from inside the system will come in contact with the water stops because the vault is externally waterproofed, internally lined, and provided with an alarmed leak detection and removal system. Therefore, the lack of chemical resistance is not considered significant.

Vapor Protection, Vessel Vent System

Tank F-126 is provided with a tank offgas system (primary system) and a vault space ventilation system (secondary system).

Tank F-126 is vented through a HEPA-filtered offgas system that keeps the tank under a negative pressure relative to the vault pressure. The vault is ventilated with a cell exhaust ventilation system

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that generates a sweep flow rate of approximately 400 CFM through the vault. The cell exhaust system was designed to keep the vault at a negative pressure and is HEPA filtered (Figure 2.11-7).

The assessment concludes that Tank System F-126 is provided with a means to protect against the formation and ignition of vapors.

2.11.4 Supplemental Information

2.11.4.1 Ancillary Equipment

Piping associated with Tank F-126 is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from type 304L SS or Hastelloy "C." Tank F-126 is constructed of type 304L SS and the tank vault is lined with Hastelloy "C." The transfer piping and associated equipment are exposed to the same liquids as Tank F-126. Therefore, type 304L SS and Hastelloy "C" are acceptable for the support equipment. Within the confines of the vault system, the vault provides secondary containment; and any leakage from piping and related equipment collects in the Hastelloy "C" lined sump.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.11.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank F-126.

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2.11.5 References

Binford, F. T., and S. D. Orfi. 1979. *The Intermediate Level Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis*. ORNL/TM-6959. Oak Ridge National Laboratory.

Catalytic Construction Company. *Specification for the Construction of Transuranium Processing Plant Building 7920*. Oak Ridge National Laboratory. Invitation No. 401-63-11A.

Chemical Technology Division. 1978. Quality Assurance Procedure Manual.

Energy Systems Drawing 2397-V-246, Concrete, Cell Plan and Elevation, Revision 4.

Energy Systems Drawing 2397-V-247, Concrete, Cell Elevation and Sections, Revision 7.

Energy Systems Drawing 2397-V-248, Concrete, Cell Sections and Details, Revision 4.

Energy Systems Drawing 2397-V-303, Equipment Arrangement, Plan and Section, Revision 2.

Energy Systems Drawing 2397-V-225, Floor Plan, Waste System Pit, Revision 3.

Energy Systems Drawing 2397-V-52, Grading and Paving Plan, Revision 3.

Energy Systems Drawing 2397-V-801, Instrument Flow Diagram, Process Waste System, Revision 1.

Energy Systems Drawing 2397-V-305, Piping, Plan, and Sections, Revision 5.

Energy Systems Drawing 2397-V-306, Piping, Plan, and Sections, Revision 3.

Energy Systems Drawing 2397-V-03, Vessel Offgas and Cell Cubicle Vents, Revision 5.

Energy Systems Drawing 2397-V-08, Waste Disposal System, Flow Diagram, Sheet 3, Revision 4.

Energy Systems Drawing E52178, Waste Pit Process Piping Plan, Revision 9.

Energy Systems Drawing E52179, Waste Pit Process Piping Sections, Revision 6.

King, et al. 1984. *Safety Analysis: Transuranium Processing Plant, Building 7920*. ORNL/TM-7688. Oak Ridge National Laboratory.

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Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.

Peretz, F. J., et al. 1986. *Characterization of Low Level Liquid Wastes at the Oak Ridge National Laboratory*. ORNL/TM-10218. Oak Ridge National Laboratory.

Figure 2.11-1 Location of Transuranium Processing Plant (Building 7920) at ORNL

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Figure 2.11-2 Layout of the Waste Pit Tanks

Figure 2.11-3
Schematic of the Liquid Low-Level Waste System

Figure 2.11-4
Tank Vault Hastelloy "C" Liner

PLAN OF WASTE PIT FLOOR PAN
SCALE: 3/4" = 1'-0"

REF. DWG. 2397-V-225

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Figure 2.11-5
Tank Vault Hastelloy "C" Liner

REF. DWG. 2397-V-248

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REF. DWG. 2397-V-52

Figure 2.11-7 Tanks F-111 and F-126 H&V Diagram

REF. DWG. 2397-V-03

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**Figure 2.11-8
Analytical Data For Liquid**

WASTE STREAM CONTAMINANTS:

(a)	Isotopes: <u>Cm-244,245,246,247</u>	(b)	Quantities	<u>Trace</u>
	<u>Cf-250,251,252</u>			<u>Trace</u>
	<u>Sr-90</u>			<u>Trace</u>
	<u>Tc-99</u>			<u>Trace</u>
	<u>Cs-137</u>			<u>Trace</u>
	<u>Am-241,242,243</u>			<u>Trace</u>
	<u> </u>			<u> </u>
(b)	Others (i.e. acids, bases, organics, cleaners, etc.)			
	<u>sodium nitrate</u>			<u>Trace</u>
	<u>nitric acid</u>			<u>Trace</u>
	<u>sodium hydroxide</u>			<u>Trace</u>
	<u>potassium iodide</u>			<u>Trace</u>
	<u>ferrous chloride</u>			<u>Trace</u>
	<u>ferrous sulfate</u>			<u>Trace</u>
	<u>thenoyltrifluoroacetone (TTA)</u>			<u>Trace</u>

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2.12 Tank WC-20

2.12.1 Tank Summary

Tank WC-20 is a nominal, 10,000-gal, horizontal tank installed in 1976 near the Melton Valley Storage Tank Facility Building 7569 (Figures 2.12-1 and 2.12-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, SS-lined, reinforced concrete vault. Tank WC-20 is used as a collection tank for liquid low-level waste (LLLW) generated from Buildings 7920 and 7930 and is classified as a Federal Facility Agreement (FFA) Category B tank. Tank System WC-20 will be replaced through the Melton Valley LLLW Collection and Transfer System Upgrade, which is a line item project scheduled to be completed in FY 1997.

2.12.2 Standards for Design Demonstration

2.12.2.1 Tank Description and Design Standards

Tank Description

Tank WC-20 is located adjacent to the Building 7569 Control House and is used and managed by the Waste Management and Remedial Actions Division. The tank is a part of the Melton Valley LLLW System. The Oak Ridge National Laboratory (ORNL) coordinates for the Tank WC-20 centerlines are N 18997.7 and E 32600.5.

Tank WC-20 is a nominal, 10,000-gal, horizontal tank constructed of type 304L SS with dished heads. The shell and heads have a nominal thickness of 3/8". The tank has an outside diameter of 10'0", a straight sidewall length of 15'7-7/8", and an overall length of 19'5-5/8". The tank is stamped as an ASME Section VIII pressure vessel to 15 psig with a design temperature of 150°F and operates at slightly negative pressure relative to the vault.

Design Standards

The applicable codes and standards used for Tank System WC-20 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A48, A262-70, C91, C139, C144, and D1751;

Union Carbide Corporation-Nuclear Division (UCC-ND) Standards, Sections 303, 401, 411, 702, and 914.04;

UCC-ND Engineering Standard Y-EF-538;

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American Concrete Institute (ACI), 301-72;

American Concrete Pipe Association (ACPA);

Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

UCC-ND Technical Specifications;

UCC-ND General Design Criteria, Y-EF-53;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99;

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

Sheet Metal and Air Conditioning Contractors National Association (SMACNA) High Velocity Duct Construction Standards and Low Velocity Standards;

SMACNA Ducted Electric Heat Guide for Air Handling Systems;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems

National Electric Code;

Design, Construction, and Testing of High Efficiency Air Filtration Systems for Nuclear Applications—Nuclear Safety Information Center 65;

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Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation; and

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes, Sections II, V, VIII, and IX.

2.12.2.2 Generic Description of Tank Contents

Tank WC-20 is designed to serve as an LLLW collection tank for Buildings 7920 and 7930. LLLW is produced from radiochemical operations designed to recover isotopes produced from irradiated HFIR targets and other sources. These wastes may include a variety of dilute acids, bases, and organics. The pH of Tank WC-20 is maintained at alkaline levels. The tank may contain radioactive materials from the Radiochemical Engineering Development Center, which is the main contributor of transuranic radionuclides in the LLLW System (Figure 2.12-3).

The analytical data (Figure 2.12-8) of waste stream contaminants from the generators are representative of waste that may be transferred to and stored in Tank WC-20.

2.12.2.3 Corrosion Protection Measures

Tank WC-20 is located in an underground, 304L SS-lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.12.2.4 Documented Age

Tank WC-20 was installed in 1976.

2.12.3 Standards for Containment/Release Detection

2.12.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank WC-20 is constructed of 304L SS. The vault bottom is lined with 11-gauge (1/8"), 304L SS with sidewalls of 16-gauge (1/16"), 304L SS (Figures 2.12-4 and 2.12-5).

The assessment concludes that the SS lining material is compatible with the stored waste and designed to prevent migration of waste into the concrete.

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2.12.3.2 Placed on a Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank WC-20 is located in an underground 304L SS-lined, reinforced concrete vault adjacent to the Control House (Building 7569). The tank vault measures 18'0" x 25'0" with 2'0" thick, reinforced concrete base slab and walls. The tank vault floor elevation is 845'6", which is 17'9" below finished grade (EL. 863'3"). The base slab for the vault is set on the rock line with approximately 6" of stabilizing aggregate for leveling purposes.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.12.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank WC-20 is provided with a tank level monitor and is located in a 304L SS-lined vault. Any leakage from Tank WC-20 is gravity fed to the sump where accumulation of liquid will be detected by a pneumatic level indicator, and an alarm will sound in Building 7569. The alarm is also telemetered to the Waste Operations Control Center (Building 3130).

The assessment concludes that Tank System WC-20 is provided with a leak detection system.

2.12.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank WC-20 vault bottom slopes to a 2'0" x 2'0" x 2'0" deep, 304L SS-lined sump with a capacity of 60 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.12.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank WC-20 is located in an SS-lined, reinforced concrete vault. The following sections address specific components of the vault system.

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Containment

Tank WC-20 is located in a below-grade vault with a 304L SS liner designed to be leaktight. The 14'0" x 21'0" x 5'0" high (from finished vault floor) vault liner provides containment for 10,995 gal of liquid compared with a nominal full tank content of 10,000 gal for Tank WC-20.

The assessment concludes that the SS-lined vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of the Tank WC-20 vault provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the Tank WC-20 vault slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the Tank WC-20 vault are maintained at a minimum of 6" below perimeter walls to prevent water run-on. The 2'0" thick, reinforced concrete tank vault walls have an external vapor barrier membrane with an asphalt composition of oxidized asphalt and mineral aggregate forming a waterproofing system. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 845'6", which is 17'9" below finished grade (Figure 2.12-6). The maximum water table elevation at the Tank WC-20 vault is 847'4" per groundwater measurements.

The tank vault is designed with a 6", polyvinyl chloride (PVC) pipe located around the foundation base to provide a foundation drain system. The PVC pipe header is routed to the storm water sewer. The 3'0" thick, reinforced concrete vault roof slab is sloped to channel water to a drainage collection system minimizing water buildup. A maintenance access plug is normally sealed in place to minimize the potential for inleakage to the vault containment.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank WC-20 secondary containment structure is constructed with chemical-resistant PVC water stops in all below-grade construction joints.

The assessment concludes that the secondary containment structure is constructed with chemical-resistant water stops.

Vapor Protection, Vessel Vent System

Tank WC-20 is provided with a tank offgas system (primary system); however, a vault space ventilation system (secondary system) is not provided.

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Tank WC-20 is vented through a HEPA-filtered tank offgas system with an air flow of 100 CFM, which maintains the tank at a negative pressure relative to the vault pressure (Figure 2.12-7). The tank offgas system has an explosive gas analyzer that is checked daily and also has an alarm which is telemetered to the Waste Operations Control Center (Building 3130)

The assessment concludes that Tank WC-20 is provided with a means to protect against the formation and ignition of vapors; however, a vault space ventilation system is not provided.

2.12.4 Supplemental Information

2.12.4.1 Ancillary Equipment

Piping associated with Tank WC-20 is constructed of type 304L SS. Tank WC-20 is constructed of type 304L SS. The transfer piping is exposed to the same liquids as Tank WC-20; therefore, type 304L SS is acceptable for the support equipment. Within the confines of the vault system, the vault provides secondary containment; and any leakage from the piping is collected in the SS-lined sump.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.12.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank WC-20.

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2.12.5 References

Energy Systems Drawing C-20854-YA-002E, Melton Valley Collection Tank Excavation and Sections, Revision D.

Energy Systems Drawing I-20854-YE-001-E, Melton Valley Collection Tank, Instrument Flow Diagram Process, Revision G.

Energy Systems Drawing I-20854-YE-001-E, Melton Valley Collection Tank, Instrument Flow Diagram Ventilation, Revision G.

Energy Systems Drawing S-20854-YB-002E, Melton Valley Collection Tank, Sections of Concrete Vault and Valve Pit, Revision E.

Energy Systems Drawing C-20854-YA-001E, Melton Valley Collection Tank Site and Grading Plan, Revision F.

Energy Systems Drawing S-20854-YB-006E, Melton Valley Collection Tank, Tank Plan, Section and Detail, Revision 3.

Energy Systems Drawing P-20854-YC-001-E, Melton Valley Collection Tank, Tank WC-20 Control Room and Valve Pit Tank Piping Plan and Sections, Revision C.

Energy Systems Drawing C-20854-EA-003-D, Site Plan Auger Hole, Location TRU-Turf Collection Tank WC-20, Revision O.

Energy Systems Drawing X-20854 EE 001-D, TRU and TURF 10,000 Gal Tank Flow Sheet, Dated 2/5/73 (No Revision No.).

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.

Peretz, F. J., et al. 1986. *Characterization of Low Level Liquid Wastes at the Oak Ridge National Laboratory*. ORNL/TM-10218. Oak Ridge National Laboratory.

Samborn, Steketee, Otis, and Evans, Inc. 1975. *Intermediate Level Waste Management Facilities Title I Report (Book 1 and 2), Holifield National Laboratory, Oak Ridge, Tennessee*. Oak Ridge National Laboratory.

Waste Generator Survey for Buildings 7920 and 7930.

Figure 2.12-1
Location of Tank WC-20

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Figure 2.12-2
Layout of Tank WC-20

Figure 2.12-3
Schematic of the Liquid Low-Level Waste System

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Figure 2.12-4 Tank WC-20 Vault and Liner

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Figure 2.12-5 Tank WC-20 Vault and Liner

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Figure 2.12-7 Tank WC-20 H&V Diagram

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**Figure 2.12-8
Analytical Data For Liquid**

WASTE STREAM CONTAMINANTS:

(a)	Isotopes: <u>Cm-244,245,246,247</u>	(b)	Quantities <u>Trace</u>
	<u>Cf-250,251,252</u>		<u>Trace</u>
	<u>Sr-90</u>		<u>Trace</u>
	<u>Tc-99</u>		<u>Trace</u>
	<u>Cs-137</u>		<u>Trace</u>
	<u>Am-241,242,243</u>		<u>Trace</u>
	<u> </u>		<u> </u>
(b)	Others (i.e. acids, bases, organics, cleaners, etc.)		
	<u>sodium nitrate</u>		<u>Trace</u>
	<u>nitric acid</u>		<u>Trace</u>
	<u>sodium hydroxide</u>		<u>Trace</u>
	<u>potassium iodide</u>		<u>Trace</u>
	<u>ferrous chloride</u>		<u>Trace</u>
	<u>ferrous sulfate</u>		<u>Trace</u>
	<u>thenoyltrifluoroacetone (TTA)</u>		<u>Trace</u>

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2.13 Tank F-201

2.13.1 Tank Summary

Tank F-201 is a nominal, 50-gal, vertical tank installed in 1962 near the High Radiation Level Examination Laboratory (Building 3525) at the main Bethel Valley Complex (Figures 2.13-1 and 2.13-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank F-201 is used as a storage well drain transfer tank for the liquid low-level waste (LLLW) system drains from the charging area of Building 3525 and is classified as a Federal Facility Agreement (FFA) Category B tank. Tank System F-201 will be removed from service upon completion of the Bethel Valley LLLW Collection and Transfer System Upgrade project in FY 1997.

2.13.2 Standards for Design Demonstration

2.13.2.1 Tank Description and Design Standards

Tank Description

Tank F-201 is located near Building 3525 in an underground vault. The tank is used and managed by the Oak Ridge National Laboratory (ORNL) Chemical Technology Division and is part of the Bethel Valley LLLW System. The ORNL coordinates for the Tank F-201 centerlines are N 21925 and E 31238.

Tank F-201 is a nominal, 50-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 1'6" with ASME flanged and dished heads and a length of 3'0".

Design Standards

The applicable codes and standards used for Tank System F-201 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A240, A403, A298, A106, A234, A217, A181, A53, A120, A338, B75, A74, A40.1, A182, A193, A312, C76, C33, D155, A15, A185, C94, C31, C192, and C39;

American Concrete Institute (ACI) 318, 315, and 604;

Federal Specifications HHF191, SSC192, UUP264, HHF341, SSS164, QQS632, and SSA281;

American Society of Mechanical Engineers (ASME) Section VIII; and

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National Fire Prevention Association.

2.13.2.2 Generic Description of Tank Contents

Tank F-201 is designed to serve as a storage well drain transfer tank for the LLLW system drains from the charging area of Building 3525. LLLW is produced from the decontamination and cleanup of the hot cells used in the disassembly and examination process (Figure 2.13-3). The tank may contain radioactive materials from Building 3525.

The analytical data (Figure 2.13-6) of the waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank F-201.

2.13.2.3 Corrosion Protection Measures

Tank F-201 is located in an underground concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.13.2.4 Documented Age

Tank F-201 was installed in 1962.

2.13.3 Standards for Containment/Release Detection

2.13.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank F-201 is constructed of type 304L SS. The vault containing Tank F-201 is constructed of reinforced concrete but is not provided with a liner, nor does it have a protective coating on the concrete.

The assessment concludes that the vault containing Tank F-201 is not constructed of or lined with materials that are compatible with the stored waste.

2.13.3.2 Placed on a Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank F-201 is located in an underground, reinforced concrete vault (Figure 2.13-4). The tank vault foundation is a 7'0" x 8'9" x 1'0" thick, reinforced concrete base slab. The tank vault floor elevation is 788'1", which is 12'5" below finished grade (EL. 800'6"). The concrete base slab is designed with a minimum allowable 28-day compressive strength of 3000 psi.

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The assessment concludes that the vault foundation supporting the secondary containment system is properly designed.

2.13.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank F-201 is provided with a tank level monitor and is located in an underground vault. Any leakage from Tank F-201 is gravity fed to a 1'0" x 1'0" x 1'0" deep sump. The sump is not provided with a leak detection system.

The assessment concludes that Tank F-201 is provided with a tank level monitor; however, the tank vault is not provided with a leak detection system.

2.13.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank F-201 vault bottom slopes to a 1'0" x 1'0" x 1'0" deep sump. The sump provides a low point within the tank vault to drain liquids. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment system is designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.13.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank F-201 is located in a reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank F-201 is located in a below-grade vault with dimensions of 4'0" x 5'9" x 13'5" high (from finished vault floor) and provides containment for 2300 gal of liquid compared with a nominal full tank content of 50 gal for Tank F-201. A 1" drain line, however, connects the vault containing Tank F-201 with an adjacent vault that contains Tank F-202 and provides an additional 1800 gal of capacity.

The assessment concludes that the vault is sufficient to contain the full tank volume.

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Infiltration

Site and storm drainage around the perimeter of the vault containing Tank F-201 provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around the vault containing Tank F-201 slope away from the vault conveying rainwater to storm drain catch basin inlets (Figure 2.13-5). Finished grades around the vault are maintained at a minimum of 2'0" below perimeter walls to prevent water run-on. The 1'0" thick, reinforced concrete tank vault walls have an external waterproofing membrane and the roof plug joints are caulked with a resilient type sealer. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 788'1", which is approximately 12'5" below grade (EL. 800'6").

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank F-201 secondary containment structure is constructed with 2" x 4" keyways and chemical-resistant, polyvinyl chloride (PVC) water stops in all below-grade construction joints.

The assessment concludes that the secondary containment structure is constructed with chemical-resistant water stops.

Vapor Protection, Vessel Vent System

Tank F-201 is provided with a tank offgas system (primary system); however, a vault space ventilation system (secondary system) is not provided.

Tank F-201 is vented through a HEPA-filtered tank offgas system with an airflow of 100 CFM, which maintains the tank at a negative pressure relative to the vault pressure (Figure 2.13-3).

The assessment concludes that Tank F-201 is provided with a means to protect against the formation and ignition of vapors; however, a vault space ventilation system is not provided.

2.13.4 Supplemental Information

2.13.4.1 Ancillary Equipment

Single-wall piping and transfer equipment associated with Tank F-201 are located inside the vault, which provides secondary containment. Piping and support equipment are fabricated from 304L SS, which is the same material as that used in Tank F-201. The transfer piping and support equipment are exposed to the same liquids as Tank F-201; therefore, 304L SS is an acceptable material for the support equipment.

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The assessment concludes that the ancillary equipment is properly designed for secondary containment.

2.13.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank F-201.

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2.13.5 References

Binford, F. T., and S. D. Orfi. 1979. *The Intermediate Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis*. ORNL/TM-6959. Oak Ridge National Laboratory.

Energy Systems Drawing S-20566-Y-108-E, Concrete Sections and Details, Dated 3/24/60 (No Revision No.).

Energy Systems Drawing H-20566-Y-203-E, Flow Diagram Cell Exhaust System and Radioactive Offgas System, Revision 1.

Energy Systems Drawing H-20566-Y-202-E, Flow Diagram, Cells, Hot Equipment, Storage Area, Decontamination Area, and Maintenance Room, Revision 1.

Energy Systems Drawing S-20566-Y-103-E, Foundation-Basement Plan and Details, Revision 2.

Energy Systems Drawing H-20566-Y-218-E, Radioactive Offgas Pit and RHD Pit, Revision 2.

Energy Systems Drawing A-20566-Y-002-E, Plan-Basement, Revision 1.

Energy Systems Drawing H-20566-Y-225-E, Radioactive Off-Gas System, Revision 2.

Energy Systems Drawing S-20566-Y-101-E, Plot Plan and Boring Data, Revision 2.

LLLW Generator Survey 1990 for Building 3525.

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.

Figure 2.13-1 Location of Building 3525

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Figure 2.13-3 Schematic of the Liquid Low-Level Waste System

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Figure 2.13-4 Tank F-201 Vault

Figure 2.13-5
Grading Plan

**Figure 2.13-6
Analytical Data**

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	<u>U-233</u>	(b) Quantities	<u>Trace</u>
	<u>U-235</u>		<u>Trace</u>
	<u>U-238</u>		<u>Trace</u>
	<u>Pu-239</u>		<u>Trace</u>
	<u>Th-232</u>		<u>Trace</u>
	<u>Kr-85</u>		<u>Trace</u>
	<u>Cs-137</u>		<u>50.00 Ci/year</u>
	<u> </u>		<u> </u>

(b) Others (i.e. acids, bases, organics, cleaners, etc.)

<u>nitric acid</u>	<u>5.0 gal/year</u>
<u>sodium hydroxide</u>	<u>5.0 gal/year</u>
<u>Mr. Clean</u>	<u>5.0 gal/year</u>
<u>sodium bisulfate</u>	<u>200.0 gal/year</u>

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2.14 Tank F-501

2.14.1 Tank Summary

Tank F-501 is a nominal, 400-gal, vertical tank installed in 1964 near the High Radiation Level Examination Laboratory (Building 3525) at the main Bethel Valley Complex (Figures 2.14-1 and 2.14-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank F-501 is used as a storage tank for the liquid low-level waste (LLLW) system of Building 3525 and is classified as a Federal Facility Agreement (FFA) Category B tank. Tank System F-501 will be removed from service upon completion of the Bethel Valley LLLW Collection and Transfer System Upgrade Project in FY 1997.

2.14.2 Standards for Design Demonstration

2.14.2.1 Tank Description and Design Standards

Tank Description

Tank F-501 is located near Building 3525 in an underground vault. The tank is used and managed by the Oak Ridge National Laboratory (ORNL) Metals and Ceramics Division and is part of the Bethel Valley LLLW System. The ORNL coordinates for the Tank F-501 centerlines are N 21890 and E 31246.

Tank F-501 is a nominal, 400-gal, vertical tank constructed of type 304L SS. The tank has an outside diameter of 4'0" and a length of 3'10".

Design Standards

The applicable codes and standards used for Tank System F-501 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A15, A40.1, A53, A74, A106, A107, A120, A181, A182, A185, A193, A217, A234, A240, A298, A312, A338, A403, B75, C31, C33, C39, C76, C94, C192, and D155;

American Concrete Institute (ACI) 315, 318, and 604;

Federal Specifications HHF191, SSC192, UUP264, HHF341, SSS164, QQS632, and SSA281;

American Society of Mechanical Engineers (ASME), Section VIII; and

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2.14.2.2 Generic Description of Tank Contents

Tank F-501 is designed to serve as a storage tank for the LLLW system of Building 3525. LLLW is produced from the decontamination and cleanup of the hot cells used in the disassembly and examination process (Figure 2.14-3). The tank may contain radioactive materials from Building 3525.

The analytical data (Figure 2.14-6) of the waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank F-501.

2.14.2.3 Corrosion Protection Measures

Tank F-501 is located in an underground concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.14.2.4 Documented Age

Tank F-501 was installed in 1964.

2.14.3 Standards for Containment/Release Detection

2.14.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank F-501 is constructed of type 304L SS. The vault containing Tank F-501 is constructed of reinforced concrete but is not provided with a liner, nor does it have a protective coating on the concrete.

The assessment concludes that the vault containing Tank F-501 is not constructed of or lined with materials that are compatible with the stored waste.

2.14.3.2 Placed on a Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank F-501 is located in an underground, reinforced concrete vault (Figure 2.14-4). The tank vault foundation is a 8'6" x 9'0" x 1'0" thick, reinforced concrete base slab. The tank vault floor elevation is 790'0", which is 10'6" below finished grade (EL. 800'6"). The concrete base slab is designed with a minimum allowable 28-day compressive strength of 3000 psi.

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The assessment concludes that the vault foundation supporting the secondary containment system is properly designed.

2.14.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank F-501 is provided with a tank level monitor and is located in an underground vault. Any leakage from Tank F-501 is gravity fed to a 1'0" x 1'0" x 1'0" deep sump where accumulation of liquid will be detected by a moisture probe that will activate an alarm locally and in the Waste Operations Control Center.

The assessment concludes that Tank System F-501 is provided with a leak detection system.

2.14.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank F-501 vault bottom slopes to a 1'0" x 1'0" x 1'0" deep sump. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment system is designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.14.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank F-501 is located in a reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank F-501 is located in a below-grade vault with dimensions of 6'6" x 7'0" x 7'0" high (from finished vault floor) and provides containment for 2382 gal of liquid compared with a nominal full tank content of 400 gal for Tank F-501.

The assessment concludes that the vault is sufficient to contain the full tank volume.

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Infiltration

Site and storm drainage around the perimeter of the vault containing Tank F-501 provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around the vault containing Tank F-501 slope away from the vault conveying rainwater to storm drain catch basin inlets (Figure 2.14-5). Finished grades around the vault are maintained at a minimum of 1'0" below perimeter walls to prevent water run-on. The 1'0" thick, reinforced concrete tank vault walls have an external waterproofing membrane and the roof plug joints are caulked with a resilient type sealer. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 790'0", which is 10'6" below grade (EL. 800'6").

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank F-501 secondary containment structure is constructed with 2" x 4" keyways and chemical-resistant, polyvinyl chloride (PVC) water stops in all below-grade construction joints.

The assessment concludes that the secondary containment structure is constructed with chemical-resistant water stops.

Vapor Protection, Vessel Vent System

Tank F-501 is provided with a tank offgas system (primary system); however, a vault space ventilation system (secondary system) is not provided.

Tank F-501 is vented through a HEPA-filtered tank offgas system with an airflow of 100 CFM, which maintains the tank at a negative pressure relative to the vault pressure (Figure 2.14-3).

The assessment concludes that Tank F-501 is provided with a means to protect against the formation and ignition of vapors; however, a vault space ventilation system is not provided.

2.14.4 Supplemental Information

2.14.4.1 Ancillary Equipment

Single-wall piping and transfer equipment associated with Tank F-501 are located inside the vault, which provides secondary containment. Piping and support equipment are fabricated from 304L SS, which is the same material as that used in Tank F-501. The transfer piping and support equipment are exposed to the same liquids as Tank F-501; therefore, 304L SS is an acceptable material for the support equipment.

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The assessment concludes that the ancillary equipment is properly designed for leak detection and secondary containment.

2.14.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank F-501.

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2.14.5 References

Binford, F. T., and S. D. Orfi. 1979. *The Intermediate Liquid Waste System at the Oak Ridge National Laboratory Description and Safety Analysis*. ORNL/TM-6959. Oak Ridge National Laboratory.

Energy Systems Drawing S-20566-Y-108-E, Concrete Sections and Details, Dated 3/24/60 (No Revision No.).

Energy Systems Drawing H-20566-Y-203-E, Flow Diagram Cell Exhaust System and Radioactive Offgas System, Revision 1.

Energy Systems Drawing H-20566-Y-202-E, Flow Diagram, Cells, Hot Equipment, Storage Area, Decontamination Area, and Maintenance Room, Revision 1.

Energy Systems Drawing S-20566-Y-103-E, Foundation-Basement Plan and Details, Revision 2.

Energy Systems Drawing S-20566-Y-101-E, Plot Plan and Boring Data, Revision 2.

Energy Systems Drawing A-20566-Y-002-E, Plan-Basement, Revision 1.

Energy Systems Drawing H-20566-Y-218-E, Radioactive Offgas Pit and RHD Pit, Revision 2.

Energy Systems Drawing H-20566-Y-225-E, Radioactive Offgas System, Revision 2.

LLLW Generator Survey 1990 for Building 3525.

Oak Ridge National Laboratory. 199. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMCO-201.

Figure 2.14-1 Location of Building 3525

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Figure 2.14-2
Layout of Tank F-501

CONCRETE STORAGE PAD

PLAN VIEW
(SHOWING PIT COVER)

Figure 2.14-3 Schematic of the Liquid Low-Level Waste System

Figure 2.14-4 Tank F-501 Vault

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Figure 2.14-5
Grading Plan

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**Figure 2.14-6
Analytical Data**

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	<u>U-233</u>	(b) Quantities	<u>Trace</u>
	<u>U-235</u>		<u>Trace</u>
	<u>U-238</u>		<u>Trace</u>
	<u>Pu-239</u>		<u>Trace</u>
	<u>Th-232</u>		<u>Trace</u>
	<u>Kr-85</u>		<u>Trace</u>
	<u>Cs-137</u>		<u>50.00 Ci/year</u>
	<u> </u>		<u> </u>

(b) Others (i.e. acids, bases, organics, cleaners, etc.)

<u>nitric acid</u>	<u>5.0 gal/year</u>
<u>sodium hydroxide</u>	<u>5.0 gal/year</u>
<u>Mr. Clean</u>	<u>5.0 gal/year</u>
<u>sodium bisulfate</u>	<u>200.0 gal/year</u>

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2.15 Tank T-13

2.15.1 Tank Summary

Tank T-13 is a nominal, 4000-gal, vertical tank installed in 1979 at the New Hydrofracture Facility (NHF) near Building 7860 (Figures 2.15-1 and 2.15-2). Tank T-13 is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, type 304L SS-lined, reinforced concrete vault. Tank T-13 is used as a liquid low-level waste (LLLW) storage tank at the NHF and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.15.2 Standards for Design Demonstration

2.15.2.1 Tank Description and Design Standards

Tank Description

Tank T-13 is located near Building 7860 in an underground vault. The tank is used and managed by the Waste Management and Remedial Actions Division and is part of the Melton Valley NHF area.

Tank T-13 is a nominal, 4000-gal, vertical tank constructed of 304L SS. The tank has an outside diameter of 7'0" and a vertical straight sidewall length of 12'3" with an ASME dished lower head and a flat plate upper head. The lower head and shell have a nominal thickness of 1/2". The upper head has a nominal thickness of 7/8". The tank operates under negative pressure.

Design Standards

The applicable codes and standards used for Tank System T-13 and its associated vault and piping are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials (ASTM) A48, C91, C139, C144, and D1751;

American Concrete Institute (ACI) 301-72;

American Concrete Pipe Association (ACPA);

Atomic Energy Commission (AEC) General Design Criteria, Appendix 63;

Minimum Safety Requirements, AEC-Oak Ridge Office (ORO);

Occupational Safety and Health Administration (OSHA);

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American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

ASHRAE Handbook—Systems;

American Conference of Governmental Industrial Hygienists (ACGIH);

Air Moving and Conditioning Association (AMCA) Standards Handbook—Publication 99,

AMCA Fans and Systems—Publication 201;

AMCA Directory—Publication 261;

National Fire Protection Association (NFPA) No. 90A—Air Conditioning and Ventilating Systems;

NFPA No. 91—Blower and Exhaust Systems;

National Electric Code;

Design, Construction, and Testing of High Efficiency Air Filtration Systems for Nuclear Applications—Nuclear Safety Information Center 65;

Underwriters' Laboratories, Inc.;

Factory Mutual Engineering Corporation;

American National Standards Institute (ANSI);

Instrumentation Society of America (ISA); and

American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Codes.

2.15.2.2 Generic Description of Tank Contents

Tank T-13 is designed to serve as a waste tank for the NHF and was previously used to store concentrated LLLW for disposal (Figure 2.15-3). The contents of Tank T-13 have not been characterized.

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2.15.2.3 Corrosion Protection Measures

Tank T-13 is located in an underground, 304L SS-lined, reinforced concrete vault. The tank shell has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.15.2.4 Documented Age

Tank T-13 was installed in 1979.

2.15.3 Standards for Containment/Release Detection

2.15.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substances(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness To Prevent Failure

Tank T-13 is constructed of type 304L SS. The vault bottom and sides are lined with type 304L SS (Figure 2.15-4).

The assessment concludes that the SS lining material is compatible with the waste and designed to prevent migration of waste into the concrete.

2.15.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank T-13 is located in an underground, 304L SS-lined, reinforced concrete vault. The vault foundation is 14'9" x 20'0" x 1'8" thick (Figure 2.15-5). The slab was designed to withstand a compressive stress of 4000 psi. The tank vault floor elevation is 767'6", which is 20'0" below grade.

The assessment concludes that the vault foundation supporting the tank secondary containment system is properly designed.

2.15.3.3 Provided with a Leak Detection System to Operate or Detect Failure of Either Primary or Secondary Containment or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank T-13 is provided with a tank level monitor and is located in a 304L SS-lined vault. Any leakage from Tank T-13 is gravity fed to an SS-lined sump where accumulation of liquid will be detected by a level indicator, and an alarm will sound in Building 7860.

The assessment concludes that Tank System T-13 is provided with a leak detection system.

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2.15.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank T-13 vault floor slopes to a 1'2" x 3'10" x 3'0" deep, 304L SS-lined sump. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.15.3.5 Secondary Containment for Tank Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank T-13 is located in an SS-lined, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank T-13 is located in an underground, SS-lined, vault designed to be leaktight. The SS-lined portion of the vault is 9'8" x 14'6" x 4'3" high (from finished vault floor) and provides a containment volume of approximately 4456 gal compared with a nominal full tank content of 4000 gal for Tank T-13.

The assessment concludes that the SS-lined portion of the vault is sufficient to contain the full tank volume.

Infiltration

Site and storm drainage around the perimeter of the vault containing Tank T-13 provides for surface water runoff to prevent any buildup of surface water during rainfall. Site grades around the vault containing Tank T-13 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the vault are maintained at a minimum of 6" below perimeter vault walls to prevent run-on (Figure 2.15-6). The 2'6" thick, reinforced concrete tank vault walls are provided with an external waterproof fiber boarding and a waterproof coating to prevent infiltration. All piping penetrations were made using cast-in-place sleeves and an external sealant. The vault roof consists of a system of 2'6" thick, removable, reinforced concrete shield plugs. The joints between the plugs are sealed to minimize the potential for inleakage. The use of a waterproofing system minimizes the potential for infiltration of groundwater into the vault. The tank vault finished floor elevation is 767'6", which is 20'0" below grade.

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The tank vault is designed with a 4", polyvinyl chloride (PVC) pipe located around the foundation base to provide a foundation drainage system. The pipe header is routed to the storm water sewer.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The Tank T-13 secondary containment structure is constructed with chemical-resistant PVC water stops in all below-grade construction joints.

The assessment concludes that the secondary containment structure is constructed with chemical-resistant water stops.

Vapor Protection, Vessel Vent System

Tank T-13 is vented to the SS-lined vault via an open overflow/ventilation pipe. The vault is maintained at a pressure of -1.0" water gauge (wg) by drawing air through a roughing filter and a HEPA filter (normal flow rate through the filter system is negligible because the only source of inlet air is leakage through the vault walls). The HEPA-filtered air is exhausted in the well cell, which is also maintained at a pressure of -1.0" wg (Figure 2.15-7).

The assessment concludes that the Tank System T-13 is provided with a means to protect against the formation and ignition of vapors.

2.15.4 Supplemental Information

2.15.4.1 Ancillary Equipment

Single-wall piping associated with Tank T-13 is located inside the vault, which provides secondary containment for the piping. Any leaking fluid is captured in an SS-lined sump. Piping and related equipment such as pumps, jet ejectors, and valves are fabricated from 304L SS, which is the same material as that used in Tank T-13 and the vault liner. The transfer piping and associated equipment are exposed to the same liquids as Tank T-13; therefore, 304L SS is acceptable for the support equipment.

The assessment concludes that the ancillary equipment is properly designed for leak detection and secondary containment.

2.15.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell

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operations and decontamination, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system that includes Tank T-13.

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2.15.5 References

Energy Systems Drawing S3E-21255-B028, General Structural Notes, Revision B.

Energy Systems Drawing H3E-21255-G003, Hydrofracture Building 7860 Environmental Control Plans and Sections, Revision F.

Energy Systems Drawing S3E-21255-B001, Hydrofracture Building 7860 Foundation Plan, Revision C.

Energy Systems Drawing A3E-21255-B015, Hydrofracture Building 7860 Removable Concrete Shield Plugs Plan and Details, Revision C.

Energy Systems Drawing A3E-21255-B011, Hydrofracture Building 7860 Sections, Revision F.

Energy Systems Drawing I3E-21255-E003, Instrumentation Diagram Liquid Process, Revision H.

Energy Systems Drawing P3E-21255-C017, Liquid Flow Diagram, Revision D.

Energy Systems Drawing P3E-21255-CO38, Process Piping Slotting Waste Collection Tank T-13, Revision D.

Energy Systems Drawing C3E-21255-A010, Site Plan Grading Sections No. 1, Revision B.

Energy Systems Drawing S3E-21255-B010, Slotting Waste Pit and Metering Pit Plan and Wall Elevations, Revision C.

Energy Systems Drawing S3E-21255-B011, Slotting Waste Pit and Metering Pit Sections and Details, Revision C.

Oak Ridge National Laboratory. *The Specifications for the Construction of New Hydrofracture Facility*. Invitation No. DE-AC05-79OR20319.

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. Department of Waste Minimization Planning and Certification. WM-WMC0-201.

Figure 2.15-1 Location of the New Hydrofracture Facility at ORNL

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Figure 2.15-2
Layout of Tank T-13

Figure 2.15-3
Schematic of the Liquid Low-Level Waste System

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Figure 2.15-4 Tank Vault Stainless Steel Liner

Figure 2.15-5 Tank Vault Stainless Steel Liner

Figure 2.15-6 New Hydrofracture Facility Grading Plan

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Figure 2.15-7 Tank T-13 H&V Diagram

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2.16 Tank S-223

2.16.1 Tank Summary

Tank S-223 is a nominal, 3000-gal, horizontal tank installed in 1955 near the Fission Product Development Laboratory (Building 3517) at the main Bethel Valley Complex (Figures 2.16-1 and 2.16-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank S-223 is used to collect liquid low-level waste (LLLW) from Building 3517 and inleakage from tank-farm cell sumps and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.16.2 Standards for Design Demonstration

2.16.2.1 Tank Description and Design Standards

Tank Description

Tank S-223 is located in a reinforced concrete vault with Tank S-523. The tank is used and managed by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank S-223 are approximately E 30975 and N 21775. Tank S-223 is a 3000-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 7'0" and an overall length of 10'6". The shell and heads have a nominal thickness of 1/4". The tank operates at slightly less than atmospheric pressure.

Design Standards

The applicable codes and standards used for Tank System S-223 are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials A15-52T, A160-52T, A16-52T, A305-53T, A185-37, C39-49, C192-52T, C31-49, C33-52T, C39-49, C40-48, C42-49, C94-48, C150-53, and D544-52T;

Federal Specifications LLL-F-321, Class A LLLF321;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

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American Society of Mechanical Engineers (ASME);

American Welding Society; and

Underwriters' Laboratories, Inc.

2.16.2.2 Generic Description of Tank Contents

Tank S-223 is designed to collect LLLW from a variety of operations such as supernate from cesium and strontium precipitation operations, raffinates from a cesium-144 extraction process, and general decontamination solutions (Figure 2.16-3).

The analytical data (Figure 2.16-4) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank S-223.

2.16.2.3 Corrosion Protection Measures

Tank S-223 is located in an underground, epoxy-coated, reinforced concrete vault and has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.16.2.4 Documented Age

Tank S-223 was installed in 1955.

2.16.3 Standards for Containment/Release Detection

2.16.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substance(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness to Prevent Failure

Tank S-223 is constructed of type 304L SS. The interior of the tank vault is provided with a three-coat system of Amercoat 23 and 33 epoxy (Figure 2.16-5).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy coating is compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.16.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank S-223 is located in an underground, reinforced concrete vault (Figure 2.16-6). Tank S-223 shares the vault with Tank S-523. The vault foundation is a 14'0" x 32'0" x 1'3" thick, reinforced concrete base slab that rests on limestone.

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The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

2.16.3.3 Provided with a Leak Detection System That is Designed and Operated to Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank S-223 is provided with a tank level monitor and is located within an epoxy-coated, reinforced concrete vault. The vault floor is sloped to a sump where accumulation of liquid will be detected by a level sensor that will activate an alarm in the operating area of Building 3517.

The assessment concludes that the secondary containment system is provided with a leak detection system.

2.16.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank S-223 vault floor slopes to a 1'0" x 1'0" x 2'0", epoxy-coated sump with a containment volume of 15 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.16.3.5 Secondary Containment for Tank System Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank S-223 is located in a below-grade, epoxy-coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank S-223 is located in a below-grade, epoxy-coated, reinforced concrete vault designed to be leaktight. The vault measures 12'0" x 30'0" x 12'0" high, providing a containment volume of approximately 32,300 gal of liquid compared to a full tank content of 3000 gal for Tank S-223.

The assessment concludes that the epoxy-coated portion of the vault provides sufficient containment to contain the full tank volume.

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Infiltration

Site and storm drainage design around the perimeter of the vault provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Tank Vault S-223 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the tank vault are maintained at a minimum of 6" below perimeter walls to prevent run-on (Figure 2.16-7). The reinforced concrete external walls are provided with an asphalt or coal tar type felt membrane forming a waterproofing system that minimizes the potential for infiltration of groundwater into the vault. Prevention of inleakage into the secondary containment system is accomplished by sealed, 3'0" thick, reinforced concrete roof plugs.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The secondary containment structure is constructed with keyways in the below-grade construction joints. The use of water stops is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the construction joints because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of water stops is not considered significant.

Vapor Protection, Vessel Vent System

Building 3517 is provided with a ventilation system that is designed to maintain a negative pressure within Tank Vault S-223. Tank S-223 is provided with a tank offgas system that maintains the tank at a negative pressure. Exhaust gases pass through a high-efficiency particulate air (HEPA)-filtered treatment system before being exhausted to the atmosphere (Figure 2.16-8).

The assessment concludes that Tank System S-223 is provided with a means to prevent the formation and ignition of vapors.

2.16.4 Supplemental Information

2.16.4.1 Ancillary Equipment

Piping within the confines of the vault is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used for Tank S-223. The transfer piping and associated equipment are exposed to the same liquids as Tank S-223; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system are provided secondary containment by the coated vault.

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The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.16.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontaminations, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system, which includes Tank S-223.

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2.16.5 References

Construction Specification, Multicurie Fission Products Pilot Plant in Building 3517. Invitation No. 401-55-8A.

Energy Systems Drawing P3E-20013-C017, Building 3517 Low-Level Waste Collection Underground Piping and Pit Location, Revision 0.

Energy Systems Drawing P3E-20013-C018, Building 3517 Low-Level Waste Collection Profile Double Contained Pipe, Revision 0.

Energy Systems Drawing P3E-20013-C019, Building 3517 Low-Level Waste Collection Partial Plan, Section and Details, Revision 0.

Energy Systems Drawing P3E-20013-C020, Building 3517 Low-Level Waste Collection Double Contained Pipe Detail, Revision 0.

Energy Systems Drawing P3E-20013-C021, Building 3517 Low-Level Waste Collection, Piping Details, Revision 0.

Energy Systems Drawing E3E-20013-D027, Building 3517 Low-Level Waste Collection, ORNL Signal System Sections and Details, Revision 0.

Energy Systems Drawing S3E-20013-B002, Building 3517 Low-Level Waste Collection, Valve Pit 2A Section and Detail, Revision 0.

Energy Systems Drawing E31394, Building 3517, Phase II, Jet and Piping Schedule, Dated 4/10/58 (No Revision No.).

Energy Systems Drawing D24327, Building 3517, Phase II, Piping Schedule, Process Line, Revision 3.

Energy Systems Drawing D24341, Building 3517, Phase II, Piping Schedule, Service Line, Revision 3.

Energy Systems Drawing D24398, Building 3517, Phase II, Piping Plan Cell 23, Revision 3.

Energy Systems Drawing D26832, Building 3517, Phase II, Piping Cell 25 Plan 1, Revision 4.

Energy Systems Drawing D26833, Building 3517, Phase II, Piping Cell 25 Plan 2, Revision 3.

Energy Systems Drawing D26834, Building 3517, Phase II, Piping Cell 25 Plan 3, Revision 3.

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Energy Systems Drawing D26835, Building 3517, Phase II, Piping Cell 25 Section A-A, Revision 3.

Energy Systems Drawing D26836, Building 3517, Phase II, Piping Cell 25 Section C-C, Revision 6.

Energy Systems Drawing D26837, Building 3517, Phase II, Piping Cell 25 Section D-D, Revision 5.

Energy Systems Drawing D26838, Building 3517, Phase II, Piping Plan Cell 26, Revision 2.

Energy Systems Drawing D22805, Building 3517, Foundation Plan and Detail, Revision 3.

Energy Systems Drawing D22806, Building 3517, Elevations, Foundation Walls, Revision 4.

Energy Systems Drawing D22807, Building 3517, Elevations, Foundation Plan Tank Farm, Revision 2.

Energy Systems Drawing D22808, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22809, Building 3517, Tank Farm, Sections and Details, Revision 1.

Energy Systems Drawing D22810, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22811, Building 3517, Plan Tank Farm Sleeves, Revision 5.

Energy Systems Drawing D22812, Building 3517, Sections and Details, Tank Farm Sleeves, Revision 6.

LLLW Generator Survey 1990 for Building 3517.

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. WM-WMCO-201. Department of Waste Minimization Planning and Certification.

Figure 2.16-1 Location of Tank S-223

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Figure 2.16-3 Schematic of the LLW System

Figure 2.16-4
Analytical Data For Liquid

LLLW GENERATOR SURVEY - 1990
(Tank System S-223)

Isotopes: <u>Cs-137</u>	Quantities: <u>500.00 Ci/year</u>
<u>Sr-90</u>	<u>500.00 Ci/year</u>
<u> </u>	<u> </u>
Others (i.e. acids, bases, organics, cleaners, etc.)	
<u>nitric acid</u>	<u>25.0 gal/year</u>
<u>turco decon 4502</u>	<u>25.0 lbs/year</u>
<u>oxalic acid</u>	<u>25.0 lbs/year</u>
<u>sodium hydroxide</u>	<u>25.0 lbs/year</u>
<u>Mr. Clean</u>	<u>Unknown</u>
<u>Ajax liquid</u>	<u>Unknown</u>
<u>Planisol</u>	<u>Unknown</u>
<u> </u>	<u> </u>

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Figure 2.16-5 Tank S-223 Vault

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Figure 2.16-8 Tank S-223 H&V Diagram

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2.17 Tank S-324

2.17.1 Tank Summary

Tank S-324 is a nominal, 1000-gal, horizontal tank installed in 1955 near the Fission Product Development Laboratory (Building 3517) at the main Bethel Valley Complex (Figures 2.17-1 and 2.17-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank S-324 is used to collect liquid low-level waste (LLLW) from Building 3517 and inleakage from tank-farm cell sumps and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.17.2 Standards for Design Demonstration

2.17.2.1 Tank Description and Design Standards

Tank Description

Tank S-324 is located in a reinforced concrete vault. The tank is used and managed by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank S-324 are approximately E 30975 and N 21775. Tank S-324 is a 1000-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 5'4" and an overall length of 6'0". The shell and heads have a nominal thickness of 1/4". The tank operates at slightly less than atmospheric pressure.

Design Standards

The applicable codes and standards used for Tank System S-324 are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials A15-52T, A160-52T, A16-52T, A305-53T, A185-37, C39-49, C192-52T, C31-49, C33-52T, C39-49, C40-48, C42-49, C94-48, C150-53, and D544-52T;

Federal Specifications LLL-F-321, Class A LLLF321;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

American Society of Mechanical Engineers (ASME);

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American Welding Society; and

Underwriters' Laboratories, Inc.

2.17.2.2 Generic Description of Tank Contents

Tank S-324 is designed to collect LLLW from a variety of operations such as supernate from cesium and strontium precipitation operations, raffinates from a cesium-144 extraction process, and general decontamination solutions (Figure 2.17-3).

The analytical data (Figure 2.17-4) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank S-324.

2.17.2.3 Corrosion Protection Measures

Tank S-324 is located in an underground, epoxy-coated, reinforced concrete vault and has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.17.2.4 Documented Age

Tank S-324 was installed in 1955.

2.17.3 Standards for Containment/Release Detection

2.17.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substance(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness to Prevent Failure

Tank S-324 is constructed of type 304L SS. The interior of the tank vault is provided with a three-coat system of Amercoat 23 and 33 epoxy (Figure 2.17-5).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy coating is compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.17.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank S-324 is located in an underground, reinforced concrete vault (Figure 2.17-6). The vault foundation is a 14'0" × 32'0" × 1'3" thick, reinforced concrete base slab that rests on limestone.

The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

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2.17.3.3 Provided with a Leak Detection System That is Designed and Operated to Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank S-324 is provided with a tank level monitor and is located within an epoxy-coated, reinforced concrete vault. The vault floor is sloped to a sump where accumulation of liquid will be detected by a level sensor that will activate an alarm in the operating area of Building 3517.

The assessment concludes that the secondary containment system is provided with a leak detection system.

2.17.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank S-324 vault floor slopes to a 1'0" x 1'0" x 2'0", epoxy-coated sump with a containment volume of 15 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.17.3.5 Secondary Containment for Tank System Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank S-324 is located in a below-grade, epoxy-coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank S-324 is located in a below-grade, epoxy-coated, reinforced concrete vault designed to be leaktight. The vault measures 12'0" x 30'0" x 12'0" high, providing a containment volume of approximately 32,300 gal of liquid compared to a full tank content of 1000 gal for Tank S-324.

The assessment concludes that the epoxy-coated portion of the vault provides sufficient containment to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of the vault provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Tank Vault S-324 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around

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the tank vault are maintained at a minimum of 6" below perimeter walls to prevent run-on (Figure 2.17-7). The reinforced concrete external walls are provided with an asphalt or coal tar type felt membrane forming a waterproofing system that minimizes the potential for infiltration of groundwater into the vault. Prevention of inleakage into the secondary containment system is accomplished by sealed, 3'0" thick, reinforced concrete roof plugs.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The secondary containment structure is constructed with keyways in the below-grade construction joints. The use of water stops is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the construction joints because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of water stops is not considered significant.

Vapor Protection, Vessel Vent System

Building 3517 is provided with a ventilation system that is designed to maintain a negative pressure within Tank Vault S-324. Tank S-324 is provided with a tank offgas system that maintains the tank at a negative pressure. Exhaust gases pass through a high-efficiency particulate air (HEPA)-filtered treatment system before being exhausted to the atmosphere (Figure 2.17-8).

The assessment concludes that Tank System S-324 is provided with a means to prevent the formation and ignition of vapors.

2.17.4 Supplemental Information

2.17.4.1 Ancillary Equipment

Piping within the confines of the vault is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used for Tank S-324. The transfer piping and associated equipment are exposed to the same liquids as Tank S-324; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system are provided with secondary containment by the coated vault.

The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

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2.17.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontaminations, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system, which includes Tank S-324.

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2.17.5 References

Construction Specification Multicurie Fission Products Pilot Plant in Building 3517. Invitation No. 401-55-8A.

Energy Systems Drawing P3E-20013-C017, Building 3517 Low-Level Waste Collection Underground Piping and Pit Location, Revision 0.

Energy Systems Drawing P3E-20013-C018, Building 3517 Low-Level Waste Collection Profile Double Contained Pipe, Revision 0.

Energy Systems Drawing P3E-20013-C019, Building 3517 Low-Level Waste Collection Partial Plan, Section and Details, Revision 0.

Energy Systems Drawing P3E-20013-C020, Building 3517 Low-Level Waste Collection Double Contained Pipe Detail, Revision 0.

Energy Systems Drawing P3E-20013-C021, Building 3517 Low-Level Waste Collection, Piping Details, Revision 0.

Energy Systems Drawing E3E-20013-D027, Building 3517 Low-Level Waste Collection, ORNL Signal System Sections and Details, Revision 0.

Energy Systems Drawing S3E-20013-B002, Building 3517 Low-Level Waste Collection-Valve Pit 2A Section and Detail, Revision 0.

Energy Systems Drawing E31394, Building 3517, Phase II, Jet and Piping Schedule, Dated 4/10/58 (No Revision No.).

Energy System Drawing D24327, Building 3517, Phase II, Piping Schedule, Process Line, Revision 3.

Energy Systems Drawing D24341, Building 3517, Phase II, Piping Schedule, Service Line, Revision 3.

Energy Systems Drawing D24398, Building 3517, Phase II, Piping Plan Cell 23, Revision 3.

Energy Systems Drawing D26832, Building 3517, Phase II, Piping Cell 25 Plan 1, Revision 4.

Energy Systems Drawing D26833, Building 3517, Phase II, Piping Cell 25 Plan 2, Revision 3.

Energy Systems Drawing D26834, Building 3517, Phase II, Piping Cell 25 Plan 3, Revision 3.

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Energy Systems Drawing D26835, Building 3517, Phase II, Piping Cell 25 Section A-A, Revision 3.

Energy Systems Drawing D26836, Building 3517, Phase II, Piping Cell 25 Section C-C, Revision 6.

Energy Systems Drawing D26837, Building 3517, Phase II, Piping Cell 25 Section D-D, Revision 5.

Energy Systems Drawing D26838, Building 3517, Phase II, Piping Plan Cell 26, Revision 2.

Energy Systems Drawing D22805, Building 3517, Foundation Plan and Detail, Revision 3.

Energy Systems Drawing D22806, Building 3517, Elevations, Foundation Walls, Revision 4.

Energy Systems Drawing D22807, Building 3517, Elevations, Foundation Plan Tank Farm, Revision 2.

Energy Systems Drawing D22808, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22809, Building 3517, Tank Farm, Sections and Details, Revision 1.

Energy Systems Drawing D22810, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22811, Building 3517, Plan Tank Farm Sleeves, Revision 5.

Energy Systems Drawing D22812, Building 3517, Sections and Details, Tank Farm Sleeves, Revision 6.

LLLW Generator Survey 1990 for Building 3517.

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. WM-WMCO-201. Department of Waste Minimization Planning and Certification.

Figure 2.17-1 Location of Tank S-324

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Figure 2.17-2 Layout of Tank S-324

Figure 2.17-3 Schematic of the LLLW System

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Figure 2.17-4
Analytical Data For Liquid

LLW GENERATOR SURVEY - 1990
(Tank System S-324)

Isotopes: <u>Cs-137</u>	Quantities: <u>500.00 Ci/year</u>
<u>Sr-90</u>	<u>500.00 Ci/year</u>
<u> </u>	<u> </u>
Others (i.e. acids, bases, organics, cleaners, etc.)	
<u>nitric acid</u>	<u>25.0 gal/year</u>
<u>turco decon 4502</u>	<u>25.0 lbs/year</u>
<u>oxalic acid</u>	<u>25.0 lbs/year</u>
<u>sodium hydroxide</u>	<u>25.0 lbs/year</u>
<u>Mr. Clean</u>	<u>Unknown</u>
<u>Ajax liquid</u>	<u>Unknown</u>
<u>Planisol</u>	<u>Unknown</u>
<u> </u>	<u> </u>

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Figure 2.17-5 Tank S-324 Vault

SECTION A-A

Figure 2.17-7 Tank S-324 Grading Plan

Figure 2.17-8 Tank S-324 H&V Diagram

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2.18 Tank S-523

2.18.1 Tank Summary

Tank S-523 is a nominal, 1000-gal, horizontal tank installed in 1955 near the Fission Product Development Laboratory (Building 3517) at the main Bethel Valley Complex (Figures 2.18-1 and 2.18-2). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in an underground, reinforced concrete vault. Tank S-523 is used to collect liquid low-level waste (LLLW) from Building 3517 and inleakage from tank-farm cell sumps and is classified as a Federal Facility Agreement (FFA) Category B tank.

2.18.2 Standards for Design Demonstration

2.18.2.1 Tank Description and Design Standards

Tank Description

Tank S-523 is located in a reinforced concrete vault with Tank S-223 and is used and managed by the Chemical Technology Division. The Oak Ridge National Laboratory (ORNL) coordinates for Tank S-523 are approximately E 30975 and N 21775. Tank S-523 is a 1000-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 5'4" and an overall length of 6'0". The shell and heads have a nominal thickness of 1/4". The tank operates at slightly less than atmospheric pressure.

Design Standards

The applicable codes and standards used for Tank System S-523 are identified herein. The codes and standards listed are those identified on either the design drawings or the construction specifications.

American Society for Testing and Materials A15-52T, A160-52T, A16-52T, A305-53T, A185-37, C39-49, C192-52T, C31-49, C33-52T, C39-49, C40-48, C42-49, C94-48, C150-53, and D544-52T;

Federal Specifications LLL-F-321, Class A LLLF321;

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals;

ASHRAE Guide and Data Book—Applications;

ASHRAE Guide and Data Book—Equipment;

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American Society of Mechanical Engineers (ASME);

American Welding Society; and

Underwriters' Laboratories, Inc.

2.18.2.2 Generic Description of Tank Contents

Tank S-523 is designed to collect LLLW from a variety of operations such as supernate from cesium and strontium precipitation operations, raffinates from a cesium-144 extraction process, and general decontamination solutions (Figure 2.18-3).

The analytical data (Figure 2.18-4) of waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank S-523.

2.18.2.3 Corrosion Protection Measures

Tank S-523 is located in an underground, epoxy-coated, reinforced concrete vault and has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.18.2.4 Documented Age

Tank S-523 was installed in 1955.

2.18.3 Standards for Containment/Release Detection

2.18.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substance(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness to Prevent Failure

Tank S-523 is constructed of type 304L SS. The interior of the tank vault is provided with a three-coat system of Amercoat 23 and 33 epoxy (Figure 2.18-5).

The assessment concludes that, according to manufacturer's specifications, the vault's epoxy coating is compatible with the stored waste and designed to prevent migration of waste into the concrete.

2.18.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank S-523 is located in an underground, reinforced concrete vault (Figure 2.18-6). Tank S-523 shares the vault with Tank S-223. The vault foundation is a 14'0" x 32'0" x 1'3" thick, reinforced concrete base slab that rests on limestone.

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The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

2.18.3.3 Provided with a Leak Detection System That is Designed and Operated to Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank S-523 is provided with a tank level monitor and is located within an epoxy-coated, reinforced concrete vault. The vault floor is sloped to a sump where accumulation of liquid will be detected by a level sensor that will activate an alarm in the operating area of Building 3517.

The assessment concludes that the secondary containment system is provided with a leak detection system.

2.18.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank S-523 vault floor slopes to a 1'0" x 1'0" x 2'0", epoxy-coated sump with a containment volume of 15 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.18.3.5 Secondary Containment for Tank System Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank S-523 is located in a below-grade, epoxy-coated, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank S-523 is located in a below-grade, epoxy-coated, reinforced concrete vault designed to be leaktight. The vault measures 12'0" x 30'0" x 12'0" high, providing a containment volume of approximately 32,300 gal of liquid compared to a full tank content of 1000 gal for Tank S-523.

The assessment concludes that the epoxy-coated portion of the vault provides sufficient containment to contain the full tank volume.

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Infiltration

Site and storm drainage design around the perimeter of the vault provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Tank Vault S-523 slope away from the tank vault conveying rainwater to storm drain catch basin inlets. Finished grades around the tank vault are maintained at a minimum of 6" below perimeter walls to prevent run-on (Figure 2.18-7). The reinforced concrete external walls are provided with an asphalt or coal tar type felt membrane forming a waterproofing system that minimizes the potential for infiltration of groundwater into the vault. Prevention of inleakage into the secondary containment system is accomplished by sealed, 3'0" thick, reinforced concrete roof plugs.

The assessment concludes that the system is designed to minimize the potential for infiltration.

Water Stops

The secondary containment structure is constructed with keyways in the below-grade construction joints. The use of water stops is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the construction joints because the vault is externally waterproofed, internally coated, and provided with an alarmed leak detection and removal system. Therefore, the lack of water stops is not considered significant.

Vapor Protection, Vessel Vent System

Building 3517 is provided with a ventilation system that is designed to maintain a negative pressure within Tank Vault S-523. Tank S-523 is provided with a tank offgas system that maintains the tank at a negative pressure. Exhaust gases pass through a high-efficiency particulate air (HEPA)-filtered treatment system before being exhausted to the atmosphere (Figure 2.18-8).

The assessment concludes that Tank System S-523 is provided with a means to prevent the formation and ignition of vapors.

2.18.4 Supplemental Information

2.18.4.1 Ancillary Equipment

Piping within the confines of the vault is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used for Tank S-523. The transfer piping and associated equipment are exposed to the same liquids as Tank S-523; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system are provided with secondary containment by the coated vault.

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The assessment concludes that the ancillary equipment inside the vault is properly designed for leak detection and secondary containment.

2.18.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontaminations, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system, which includes Tank S-523.

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2.18.5 References

Construction Specification, Multicurie Fission Products Pilot Plant in Building 3517. Invitation No. 401-55-8A.

Energy Systems Drawing P3E-20013-C017, Building 3517 Low-Level Waste Collection Underground Piping and Pit Location, Revision 0.

Energy Systems Drawing P3E-20013-C018, Building 3517 Low-Level Waste Collection Profile Double Contained Pipe, Revision 0.

Energy Systems Drawing P3E-20013-C019, Building 3517 Low-Level Waste Collection Partial Plan, Section and Details, Revision 0.

Energy Systems Drawing P3E-20013-C020, Building 3517 Low-Level Waste Collection Double Contained Pipe Detail, Revision 0.

Energy Systems Drawing P3E-20013-C021, Building 3517 Low-Level Waste Collection, Piping Details, Revision 0.

Energy Systems Drawing E3E-20013-D027, Building 3517 Low-Level Waste Collection, ORNL Signal System Sections and Details, Revision 0.

Energy Systems Drawing S3E-20013-B002, Building 3517 Low-Level Waste Collection-Valve Pit 2A Section and Detail, Revision 0.

Energy Systems Drawing E31394, Building 3517, Phase II, Jet and Piping Schedule, Dated 4/10/58 (No Revision No.).

Energy Systems Drawing D24327, Building 3517, Phase II, Piping Schedule-Process Line, Revision 3.

Energy Systems Drawing D24341, Building 3517, Phase II, Piping Schedule-Service Line, Revision 3.

Energy Systems Drawing D24398, Building 3517, Phase II, Piping Plan Cell 23, Revision 3.

Energy Systems Drawing D26832, Building 3517, Phase II, Piping Cell 25 Plan 1, Revision 4.

Energy Systems Drawing D26833, Building 3517, Phase II, Piping Cell 25 Plan 2, Revision 3.

Energy Systems Drawing D26834, Building 3517, Phase II, Piping Cell 25 Plan 3, Revision 3.

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Energy Systems Drawing D26835, Building 3517, Phase II, Piping Cell 25 Section A-A, Revision 3.

Energy Systems Drawing D26836, Building 3517, Phase II, Piping Cell 25 Section C-C, Revision 6.

Energy Systems Drawing D26837, Building 3517, Phase II, Piping Cell 25 Section D-D, Revision 5.

Energy Systems Drawing D26838, Building 3517, Phase II, Piping Plan Cell 26, Revision 2.

Energy Systems Drawing D22805, Building 3517, Foundation Plan and Detail, Revision 3.

Energy Systems Drawing D22806, Building 3517, Elevations, Foundation Walls, Revision 4.

Energy Systems Drawing D22807, Building 3517, Elevations, Foundation Plan Tank Farm, Revision 2.

Energy Systems Drawing D22808, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22809, Building 3517, Tank Farm, Sections and Details, Revision 1.

Energy Systems Drawing D22810, Building 3517, Tank Farm, Sections and Details, Revision 2.

Energy Systems Drawing D22811, Building 3517, Plan Tank Farm Sleeves, Revision 5.

Energy Systems Drawing D22812, Building 3517, Sections and Details, Tank Farm Sleeves, Revision 6.

LLLW Generator Survey 1990 for Building 3517.

Oak Ridge National Laboratory. 1991. *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory*. WM-WMCO-201. Department of Waste Minimization Planning and Certification.

Figure 2.18-1 Location of Tank S-523

Figure 2.18-2 Layout of Tank S-523

Figure 2.18-3 Schematic of the LLLW System

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Figure 2.18-4
Analytical Data For Liquid

LLW GENERATOR SURVEY - 1990
(Tank System S-523)

Isotopes: <u>Cs-137</u>	Quantities: <u>500.00 Ci/year</u>
<u>Sr-90</u>	<u>500.00 Ci/year</u>
<u></u>	<u></u>
Others (i.e. acids, bases, organics, cleaners, etc.)	
<u>nitric acid</u>	<u>25.0 gal/year</u>
<u>turco decon 4502</u>	<u>25.0 lbs/year</u>
<u>oxalic acid</u>	<u>25.0 lbs/year</u>
<u>sodium hydroxide</u>	<u>25.0 lbs/year</u>
<u>Mr. Clean</u>	<u>Unknown</u>
<u>Ajax liquid</u>	<u>Unknown</u>
<u>Planisol</u>	<u>Unknown</u>
<u></u>	<u></u>

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Figure 2.18-5 Tank S-523 Vault

Figure 2.18-8 Tank S-523 H&V Diagram

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2.19 Tank LA-104

2.19.1 Tank Summary

Tank LA-104 is a nominal, 296-gal, horizontal tank installed in 1960 in the Radioisotope Development Laboratory (Building 3047) at the main Bethel Valley Complex (Figure 2.19-1). The tank is constructed of ASME SA-240, type 304L stainless steel (SS) and is located in the vacuum jet pit in the basement of Building 3047. Tank LA-104 was designed as a vacuum surge tank for use in nonradiological experiments requiring vacuum. Tank LA-104 is classified as a Federal Facility Agreement (FFA) Category B tank.

2.19.2 Standards for Design Demonstration

2.19.2.1 Tank Description and Design Standards

Tank Description

Tank LA-104 is located in the basement of Building 3047. The tank is used and managed by the Oak Ridge National Laboratory (ORNL) Chemical Technology Division and is part of the Bethel Valley Liquid Low-Level Waste (LLLW) System. Tank LA-104 is a 296-gal, horizontal tank constructed of type 304L SS. The tank has an outside diameter of 3'0" and an overall length of 5'0". The shell and heads have a nominal thickness of 3/16". The tank operates at slightly less than atmospheric pressure.

Design Standards

American Society for Testing and Materials (ASTM) A 15-52T, A 160-52T, A 305-53T, A 185-37, C 39-49, C 192-52T, C 31-49, C 33-52T, C 39-49, C 40-38, C 42-49, C 94-48, C 150-53, and D 544-52T.

Federal Specifications LLL-F-231 Class A LLLF34

American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals

ASHRAE Guide and Data Book—Applications

ASHRAE Guide and Data Book—Equipment

American Society of Mechanical Engineers (ASME)

American Welding Society (AWS)

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2.19.2.2 Generic Description of Tank Contents

Tank LA-104 was designed as a vacuum surge tank for use in nonradiological experiments requiring vacuum (Figure 2.19-2).

The analytical data (Figure 2.19-3) of the waste stream contaminants from the generators are representative of the waste transferred to and stored in Tank LA-104.

2.19.2.3 Corrosion Protection Measures

Tank LA-104 is located in an underground, reinforced concrete vault and has no direct contact with the soil or water. Cathodic protection measures are not required for external corrosion.

2.19.2.4 Documented Age

Tank LA-104 was installed in 1960.

2.19.3 Standards for Containment/Release Detection

2.19.3.1 Constructed of or Lined with Materials That are Compatible with Stored Waste(s) or Substance(s) to Be Placed in the Tank System and Shall Have Sufficient Strength and Thickness to Prevent Failure

Tank LA-104 is constructed of type 304L SS. The vault containing Tank LA-104 is constructed of reinforced concrete but is not provided with a liner, nor does it have a protective coating on the concrete.

The assessment concludes that the vault is not constructed of or lined with materials that are compatible with the stored waste and is not designed to prevent migration of waste into the concrete.

2.19.3.2 Placed on Foundation or Base Capable of Providing Support to the Secondary Containment System

Tank LA-104 is located in an underground, reinforced concrete vault (Figure 2.19-4). The vault foundation is a 9'9" x 14'9" x 8" thick, reinforced concrete slab.

The assessment concludes that the vault foundation is properly designed to support the secondary containment system.

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2.19.3.3 Provided with a Leak Detection System That is Designed and Operated to Detect Failure of Either Primary or Secondary Containment Structure or the Presence of Any Measurable Release of Hazardous or Radioactive Constituents

Tank LA-104 is provided with a tank level monitor and is located in an underground reinforced concrete vault. The vault floor is sloped to a sump where accumulation of liquid will be detected by a moisture probe.

The assessment concludes that the secondary containment system is provided with a leak detection system.

2.19.3.4 Sloped or Otherwise Designed or Operated to Drain and Remove Liquids Resulting from Leaks, Spills, or Precipitation

The Tank LA-104 vault floor slopes to a 1'0" x 1'0" x 1'0", sump with a containment volume of 7.48 gal. The sump provides a low point within the tank vault to drain liquids to an instrumented location. A pumping system is provided to remove liquids that accumulate in the sump.

The assessment concludes that the secondary containment is sloped and designed to drain and remove liquids resulting from leaks, spills, or precipitation.

2.19.3.5 Secondary Containment for Tank System Shall Include One or More of the Following: A Liner, a Vault, a Double-Walled Tank, or an Equivalent Device Approved by the United States Environmental Protection Agency

Tank LA-104 is located in a below-grade, reinforced concrete vault. The following sections address specific components of the vault system.

Containment

Tank LA-104 is located in a below-grade, reinforced concrete structure. The vault measures 8'0" x 12'3" x 10'0" high, providing a containment volume of approximately 7330 gal of liquid compared to a full tank content of 296 gal for Tank LA-104.

The assessment concludes that the containment structure provides sufficient containment to contain the full tank volume.

Infiltration

Site and storm drainage design around the perimeter of Building 3047, which contains Tank LA-104, provides for surface water runoff to prevent buildup of surface water during rainfall. Site grades around Building 3047 slope away from the building conveying rainwater to storm drain catch basin

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inlets. Finished grades around Building 3047 are maintained at a minimum of 6" below perimeter walls to prevent run-on. The reinforced concrete walls are provided with an external waterproofing membrane system that minimizes the potential for infiltration of groundwater.

Water Stops

The secondary containment structure is constructed with keyways in the below-grade construction joints. The use of water stops is not included in the design drawings or construction specifications. However, it is unlikely that water from outside the system or LLLW from inside the system will penetrate the construction joints because the vault is externally waterproofed and provided with a leak detection and removal system. Therefore, the lack of water stops is not considered significant.

Vapor Protection, Vessel Vent System

Building 3047 is provided with a ventilation system that is designed to maintain a negative pressure within Tank Vault LA-104. Tank LA-104 is provided with a tank offgas system that is designed to maintain the tank at a negative pressure.

The assessment concludes that Tank System LA-104 is provided with a means to prevent the formation and ignition of vapors.

2.19.4 Supplemental Information

2.19.4.1 Ancillary Equipment

Piping within the confines of the vault is single wall. Piping and related equipment such as jet ejectors and valves are fabricated from 304L SS, which is the same material as that used for Tank LA-104. The transfer piping and associated equipment are exposed to the same liquids as Tank LA-104; therefore, 304L SS is acceptable for the support equipment. Piping and related equipment within the confines of the vault system are provided secondary containment by the vault.

2.19.4.2 Waste Acceptance Criteria

Radioactively contaminated liquid wastes at ORNL are generated by various activities within the research and operating divisions. These activities include radiochemical processing, routine hot cell operations and decontaminations, and various waste treatment and environmental protection processes. The variations in composition of the waste streams are limited by the waste acceptance criteria that specify activity and concentration limits for waste discharged into the LLLW system. The *Waste Acceptance Criteria for Liquid Waste Treatment Systems at the Oak Ridge National Laboratory* (Oak Ridge National Laboratory, 1991), dated July 1991, is a guide for liquid waste generators to determine the proper means of disposal for LLLW. The criteria provide future discharge guidelines for the LLLW system, which includes Tank LA-104.

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2.19.5 References

Energy Systems Drawing S-20399-Y-20, Concrete First Floor Plan and Details, Revision 1.

Energy Systems Drawing 40060-310, Piping Equipment Isometrics, Instrumentation Details, and Hot Drain Shielding, Revision 2.

Energy Systems Drawing N3E020399A102, Ventilation Systems Flow Diagram, Revision 0.

Energy Systems Drawing M-20399-Y-069-B, Radioisotope Development Laboratory Vacuum Surge Tank, No revision number.

Energy Systems Drawing P-20399-Y-008-E1, Engineering Flow Diagram, Revision 1.

Energy Systems Drawing S-20399-Y-004-B, Civil Site Development, No revision number.

Energy Systems Drawing D-37735, Site Topography, No revision number.

Energy Systems Drawing S-10979, Construction and Operation Areas, No revision number.

Robinson, S. M., M. DePaoli, and A. B. Walker. 1991. Federal Facility Agreement Contingency Upgrade and Replacement Plans for the ORNL Active Low-Level Radioactive Waste Tank System. ORNL/TM-11795. Oak Ridge National Laboratory.

Construction Specifications, Radioisotope Development Laboratory Building 3047.

Figure 2.19-1
Location of Tank LA-104

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Figure 2.19-2 Schematic of the LLLW System

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Figure 2.19-3
Analytical Data For Liquid

LLLW SURVEY

WASTE STREAM CONTAMINANTS:

(a) Isotopes:	<u>Co-60</u>	Quantities:	<u>Trace</u>
	<u>Gd-153</u>		<u>Trace</u>
	<u>Eu-152</u>		<u>Trace</u>
	<u>Eu-154</u>		<u>Trace</u>
	<u> </u>		<u> </u>
(b) Others (i.e. acids, bases, organics, cleaners, etc.)			
	<u>nitric acid (3M)</u>		<u>60.0 l/year</u>
	<u>ammonium hydroxide</u>		<u>Trace</u>
	<u>potassium permanganate</u>		<u>60.0 lbs/year</u>
	<u>oxalic acid</u>		<u>72.0 lbs/year</u>
	<u>citric acid</u>		<u>24.0 lbs/year</u>
	<u>Ajax liquid</u>		<u>48.0 gal/year</u>

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Figure 2.19-4
Tank LA-104 Vault

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- 73-74. Vista Research, Inc., 100 View Street, P.O. Box 998, Mountain View, CA 94042
- 75-76. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831

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