APR 3 0 2003 Sta: 15 (20) **ENGINEERING DATA TRANSMITTAL**

Page 1 of 1

1. EDT 635919

| 2. To: (Receiving Organization) | 3. From: (Originating Organization) | 4. Related EDT No.: |
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| 1 | RPP-13873 | | 0 | Origin of Wastes in | N/A | 1 | 1 | 1 |
| | | | | Single-Shell Tanks | | | | |
| | | | | 241-T-110 and 241-T-111 | | | | |
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**16. KEY**

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**17. SIGNATURE/DISTRIBUTION**
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| Michael E Johnson M.E. Johnson 4/3/03 | John Kristofzski 4/23/03 | SMackay S.M. Mackay 04/3/03 | Ctrl No. _____ |
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| Distribution | M. E. Johnson | Date 04/04/03 |
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A-6001-401 (12/00)

# Origin of Wastes in Single-Shell Tanks 241-T-110 and 241-T-111

**Michael E. Johnson**
CH2MHILL Hanford Group, Inc.
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

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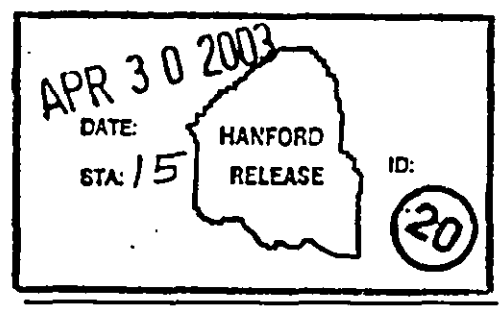
Key Words: Hanford, single-shell tank, T-110, T-111
224 Waste, 2C waste, second decontamination cycle

Abstract: A review of historical documents was conducted to determine the origin of wastes transferred into Hanford site tanks 241-T-110 and 241-T-111. These tanks received wastes from the 224-T Concentration building, second decontamination cycle waste and low activity cell drainage from the 221-T Bismuth Phosphate Plant. After modification of the 221-T Plant to an equipment decontamination facility, tank 241-T-111 received equipment decontamination waste.



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RPP-13873
Revision 0

# ORIGIN OF WASTES IN SINGLE-SHELL TANKS 241-T-110 AND 241-T-111

**M. E. Johnson**
CH2M HILL Hanford Group, Inc.

**Date Published**
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Prepared for the U.S. Department of Energy
Office of River Protection

## EXECUTIVE SUMMARY

A review of waste transfer documentation was conducted to determine the origin of waste transferred into single-shell tanks 241-T-110 and 241-T-111. This review was conducted to support decisions concerning disposition of the waste present in these tanks.

Tank 241-T-110 received second decontamination cycle (2C) waste from processing plutonium solutions at the 221-T Bismuth Phosphate plant from January 1945 through December 1954, 221-T Plant low activity cell drainage waste from June 1951 through December 1954, and 224-T Concentration building wastes from May 1952 through December 1954. Tank 241-T-111 received 2C waste from the 221-T Plant from January 1945 through October 1956, 221-T Plant low activity cell drainage waste from June 1951 through October 1956, 224-T Concentration building wastes from May 1952 through October 1956, and 221-T Plant equipment decontamination waste from February 1960 through June 1967.

The second decontamination cycle and 224-T building wastes originated from purification of plutonium solutions. The second decontamination cycle and 224-T building wastes are not waste originating from separating fission products from the uranium fraction of irradiated reactor fuel.

Gross alpha analyses have been conducted for the waste stored in tank 241-T-110, with the mean value reported as 53ηCi/g. An uncertainty estimate for the gross alpha analyses for the waste stored in tank 241-T-110 was recently evaluated (RPP-10983). The upper 95% confidence limit for the gross alpha analyses of the waste stored in tank 241-T-110 is 62ηCi/g. These analyses indicate that the concentration of alpha-emitting transuranic isotopes with half-life greater than 20 years is less than 100ηCi/g in the waste stored in tank 241-T-110.

The mean gross alpha analyses and lower 95% confidence limit for the waste stored in tank 241-T-111 are 371ηCi/g and 289ηCi/g, respectively (7G300-02-JGF-009). The sum of the concentrations of neptunium-237, plutonium-239, plutonium-240, and americium-241 (actinides) for the waste in tank 241-T-111 is approximately 181 ηCi/g of solids, which represents a conservative estimate of the total concentrations of alpha-emitting transuranic isotopes with half-life greater than 20-years.

## CONTENTS



## APPENDIX



## FIGURES



## TABLES

## LIST OF TERMS

| | |
|---|---|
| 1C | first cycle of the decontamination process |
| 2C | second decontamination cycle |
| CW | Coating waste |
| DOE | U.S. Department of Energy |
| lbs | pounds |
| MW | Metal waste |
| REDOX | Reduction-Oxidation |
| ηCi/g | nanocuries per gram |
| μCi/cc | microcuries per cubic centimeters |
| μCi/g | microcuries per gram |
| μg/cc | micrograms per cubic centimeters |

# 1.0 INTRODUCTION

The origin of the wastes in tanks 241-T-110 and 241-T-111 is important in determining the disposition of these wastes and the waste storage tanks. Section 2.0 discusses the origin of waste transferred into and removed from single-shell tanks 241-T-110 and 241-T-111. Section 3.0 provides a description of the different types of wastes that were generated at the Hanford Site chemical processing plants and transferred to the underground storage tanks 241-T-110 and 241-T-111. Section 4.0 provides a discussion on the transuranic radionuclide analyses of the wastes in tanks 241-T-110 and 241-T-111. The concentration of transuranic radionuclides present in these wastes is important to determining the disposition of these wastes. Section 5 summarizes the waste types that were transferred into tanks 241-T-110 and 241-T-111.

# 2.0 WASTE TRANSFER INTO AND WASTE REMOVAL FROM TANKS 241-T-110 AND 241-T-111

This section provides a brief description of tanks 241-T-110 and 241-T-111 and summarizes waste transfers into and waste removal from these tanks. In order to determine the origins of the wastes presently stored in tanks 241-T-110 and 241-T-111, publicly available reports for the Hanford Site were reviewed. With the exception of the waste status summary reports, all reports cited in this section are available electronically from the Hanford Declassified Document Retrieval System at http://www2.hanford.gov/declass/ or the DOE Information Bridge at http://www.osti.gov/bridge/. The waste status summary reports are available only as photocopies from Hanford Site Central Files organization.

## 2.1 DESCRIPTION OF TANKS 241-T-110 AND 241-T-111

Single-shell tanks 241-T-110 and 241-T-111 were originally constructed in 1944 as part of the Manhattan Project (HW-10475-C, chapter IX) and are two of the twelve, 100-series tanks in 241-T Tank Farm. The 100-series tanks are seventy-five-foot diameter underground tanks made of reinforced concrete with a steel liner on the bottom and sides. Each tank has a design capacity of 530,000 gallons at a liquid depth of sixteen-feet. The overflow pipe for tanks 241-T-110 and 241-T-111 is at an elevation that results in seventeen-feet of waste (~540,530 gallons) being retained in each tank. The overflow pipeline from tank 241-T-112 is at an elevation that results in eighteen-feet of waste (~573,530 gallons) being retained in this tank (HW-27035).

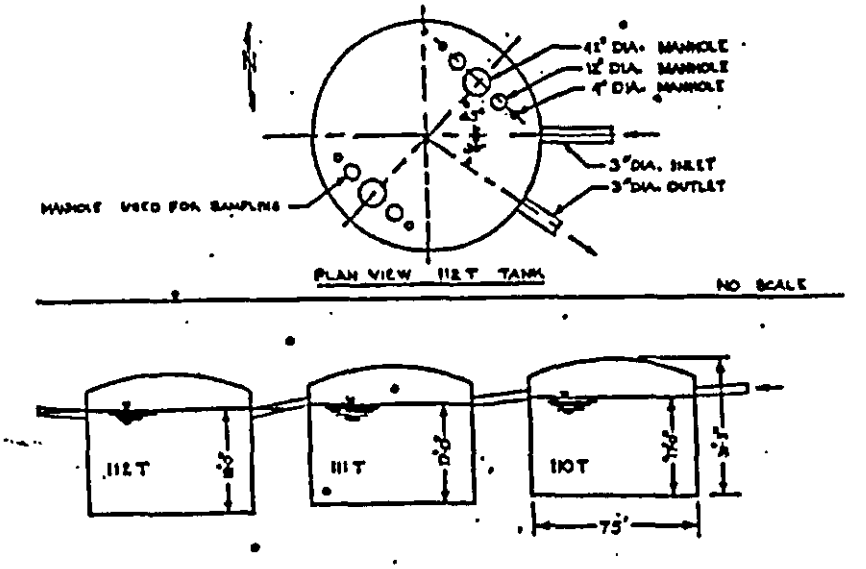
Tanks 241-T-110 and 241-T-111, along with tank 241-T-112, were connected together via underground piping to allow solution to cascade from the lead tank into the subsequent two tanks. Solids settled in each tank, with the supernatant overflowing from tank 241-T-112 through an underground pipeline to a crib. In addition to the overflow piping, each tank is equipped with four, 3-inch diameter stainless steel inlet pipes. Originally, only the inlet pipes from tank 241-T-110 were connected to diversion box 241-T-153, with the inlet pipes for the other tanks blanked off close to each tank (HW-10475-C, page 907 –908).

## 2.2 WASTE TRANSFERS RELATING TO TANKS 241-T-110 AND 241-T-111

This section describes waste transfers into and waste removal from tanks 241-T-110 and 241-T-111. Since tanks 241-T-110 and 241-T-111 were operated for a number of years as a three-tank cascade that included tank 241-T-112, this section includes a discussion of waste transfers into tank 241-T-112 and waste discharge to an underground crib. The design of the tank cascade system is shown in Figure 1 and resulted in tanks 241-T-110 and 241-T-111 being constantly filled with waste that then cascaded into tank 241-T-112. Figure 1 does not represent the current configuration of piping for these tanks. From 1947 through 1951, a jet was used to transfer waste from tank 241-T-112 to the crib. After modifying the disposal system in May 1951, waste was allowed to gravity overflow from tank 241-T-112 to the crib.

The volume and radioactive (plutonium, gross beta, and uranium) content of waste discharged from these tanks to underground cribs is summarized in references HW-17088, HW-20583, HW-25301, HW-28121, HW-33591, HW-38562, HW-44784, HW-72956, ISO-98, and ARH-1608. Appendix A provides a tabular listing of the volume of solids and total waste present in tanks 241-T-110, 241-T-111, and 241-T-112 for January 1945 through December 1975, after which these tanks were no longer used to receive wastes.

**Figure 1. Tanks 241-T-110, 241T-111, 241-T-112 Waste Tank Cascade System**



### 2.2.1 Second Decontamination Cycle (2C) Waste

The 241-T Tank Farm was originally constructed to receive waste from the 221-T Bismuth Phosphate plant (see Section 3.0). Tanks 241-T-110, 241-T-111, and 241-T-112 were operated as a cascade, with second decontamination cycle (designated as 2C) waste from the 221-T building being received into tank 241-T-110 beginning in December 1944 with chemical tracer runs (HAN-45800-DEL, page 1). According to the Army Corps of Engineers report for January 1945 (HAN-45800-DEL, page 4), six charges of material from 100-B reactor processed through the 221-T Plant.

Tanks 241-T-110, 241-T-111, and 241-T-112 continued to receive 2C waste through July 22, 1946, at which time these tanks were reported as being filled and 2C waste was diverted to tanks 241-T-105 and 241-T-106 (HAN-45800-DEL, page 64 and HW-7-4542-DEL, page 21). While tanks 241-T-110, 241-T-111, and 241-T-112 remained filled with 2C waste, tanks 241-T-105 and 241-T-106 continued to receive 2C waste from irradiated fuel reprocessing activities conducted at the 221-T Plant. Measurements of the solids depth in tanks 241-T-110, 241-T-111, and 241-T-112 were conducted in October 1946 using an ionization chamber indicated that only tank 241-T-110 contain solids, evenly distributed at a depth of approximately 38 inches, corresponding to ~84,030 gallons (H-7-5362-DEL, page 27).

Plans were initiated in October 1946 to dispose of the 2C supernatant contained in these tanks to an underground crib (HW-7-5362-DEL, page 27). A new underground crib (designated as 241-T-3) was constructed in 1947. Tank 241-T-110 would be used to settle solids that formed in the 2C waste, with the supernatant cascading by gravity flow into tank 241-T-111 and then into tank 241-T-112. The clarified 2C supernatant would be jetted from tank 241-T-112 to the underground crib. Crib disposal of the clarified 2C supernatant was authorized on an experimental basis (HW-10321). The 2C waste contained in tank 241-T-111 was jetted to this underground crib in September 1947 (HW-7795-DEL, page 26).

As part of the planned disposal of the 2C supernatant to the underground crib, separate waste transfer lines were routed to tanks 241-T-111 and 241-T-112. This would enable filling these tanks directly with 2C waste when tank 241-T-110 filled with solids and was no longer suitable as a settling tank. Approximately 20,000-gallons of 2C supernatant were jetted from tank 241-T-112 to the underground crib in November 1947 to enable a waste transfer line tie-in from diversion box 241-T-153 to tanks 241-T-111 and 241-T-112 (HW-8267-DEL, page 27). Crib disposal of additional 2C supernatant was delayed until a means to sample the soil in dry wells that surround the crib area was developed.

A tool for sampling the soil in dry wells surrounding the 2C disposal crib area was designed, constructed, and tested in February 1948 (HW-9191-DEL, page 28), but this tool proved unsuccessful in obtaining soil samples when used in March 1948 (HW-9595-DEL, page 30). However, approval was given to resume limited crib disposal of 2C supernatant in April 1948, since tanks 241-T-105 and 241-T-106 were nearly filled with 2C waste and additional storage space in the single-shell tanks was not available. Crib disposal of approximately 360,000 gallons of 2C waste from tank 241-T-105 was conducted in April 1948 (HW-9922-DEL, page 31).

Following extensive sampling of the soil surrounding the 2C waste disposal crib (HW-10166-DEL, page 31), crib disposal of 2C waste contained in tank 241-T-106 was conducted in July 1948 (HW-10714-DEL, page 32) and August 1948 (HW-10993-DEL, page 32). Crib disposal of approximately 450,000 gallons of the 2C waste in tank 241-T-112 was initiated on August 4, 1948 (HW-10993-DEL, page 35) and stopped in September 1948 (HW-11226-DEL, page 32) to allow installation of an experimental sand filter on the jet discharge from tank 241-T-112 to the crib. The experimental sand filter was installed to determine the feasibility of removing additional activity from the 2C supernatant being disposed to the crib. Crib disposal of the remainder of the 2C waste in tank 241-T-112 was completed in October 1948 (HW-11499, page 33).

With the emptying of tank 241-T-112 in August through October 1948, 2C waste was again routed from the 221-T Plant into the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 beginning in August 1948. Tank 241-T-110 was used to settle solids that formed in the 2C waste, with the supernatant cascading by gravity flow into tank 241-T-111 and then into tank 241-T-112. The clarified 2C supernatant was periodically jetted from tank 241-T-112 to the crib (HW-33591, pages 4 and 26) from August 1948 through May 1951. In May 1951, modifications were conducted that allowed the 2C supernatant waste to gravity overflow from tank 241-T-112 into the crib (HW-21260-DEL, page 57).

### 2.2.2 2C Waste Combined with Cell Drainage Waste

Beginning in June 1951, the neutralized, cell drainage waste from the 221-T Plant (designated as 5-6 waste) was combined with the 2C waste in the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 (HW-21506-DEL, page 56). Tank 5-6 in the 221-T Plant was used to collect low activity drainage from the process cells. The generation of cell drainage waste was intermittent and dependent on the frequency of leaks that developed in the 221-T Plant process equipment. High-activity cell drainage waste was collected in tank 5-9 and either reworked or transferred to single-shell tank 241-T-107 (see Section 3.1.1).

The low activity cell drainage was transferred to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 so "... that the major portion of the suspended plutonium carrying solids will settle out while the waste solution combines and cascades concurrently with the second decontamination cycle waste prior to underground cribbing by constant overflow" (HW-21506-DEL, page 56). The combined 2C waste and cell drainage waste from tank 5-6 were transferred to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. All three tanks were essentially filled with waste to the overflow pipeline. Solids gravity settled and supernatant gravity overflow from tank 241-T-112 into the crib.

### 2.2.3 2C, Cell Drainage, and 224-T Concentration Building Waste

Beginning on May 29, 1952, the waste from the 224-T Concentration building (designated as 224 waste) was discharged to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 along with the cell drainage waste collected in tank 5-6 and the 2C waste from the 221-T Plant (HW-27838, page 17). Section 3.1 provides a description of the plutonium concentration process

conducted in the 224-T Concentration building. These three waste streams (2C / 224 / 5-6) continued to be collected in the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. All three tanks were essentially filled with waste to the overflow pipeline. Solids gravity settled and supernatant gravity overflow from tank 241-T-112 into the crib.

In December 1954, tank 241-T-110 was reported as filled with sludge (530,000 gallons) and only tanks 241-T-111 and 241-T-112 were receiving the 2C / 224 / 5-6 waste streams (HW-34412, page 6). A review of Hanford Site monthly reports and waste status summary reports from 1955 to the present indicate that no additional waste was transferred into tank 241-T-110. This review also observed that the documented, volume of solids contained in this tank was recorded as high as 530,000 gallons and as little as 46,000 gallons, apparently due to inaccurate measurements.

Tanks 241-T-111 and 241-T-112 continued receiving the 2C / 224 / 5-6 waste streams and by March 1955, were reported as containing approximately 487,000-gallons and 33,000 gallons of sludge, respectively (HW-36001, page 6). This prompted the transfer in April 1955 of 115,000 to 133,000-gallons of sludge from tank 241-T-111 to tank 241-T-112 (HW-36553, page 6). Tank 241-T-111 was reported as containing approximately 362,000 gallons of solids after this transfer. Tank 241-T-112 was reported as having 33,000 gallons of solids before this transfer (HW-36001, page 6) and approximately 170,000 gallons of solids after this transfer (HW-37143, page 6). The solids were transferred from tank 241-T-111 into tank 241-T-112 to provide sufficient space in tank 241-T-111 for gravity settling of solids present in the 2C / 224 / 5-6 wastes before the clarified supernatant was overflowed to tank 241-T-112 and to the 241-T-3 crib (after 1958 referred to as the 216-T-7 crib).

The 241-T-3 crib continued to receive the supernatant overflowed from tank 241-T-112 until November 30, 1955, after which the 241-TX-153 crib (after 1958 referred to as the 216-T-19 crib) was used (HW-44784, pages 43 and 44). Additionally, approximately 700,000 gallons of waste was discharged from tank 241-T-112 to the 241-T trench number 5 on May 5, 1955, to empty this tank (HW-38562, page 28). Trench 241-T number 5 is also referred to as trench number 216-T-5 (HW-48518, page 42).

The 2C / 224 / 5-6 wastes continued to be transferred into the cascade of tanks 241-T-111 and 241-T-112 through March 20, 1956, when the final processing of irradiated fuels for plutonium recovery was completed in the 221-T Plant (HW-42219-DEL, page ED-5). Process equipment flushes using nitric acid and peroxide – caustic were conducted in the 221-T Plant from March 1956 (HW-42219-DEL, page ED-5) through September 1956 (HW-45707-DEL, page D-5) to recover plutonium and remove fission products from the equipment. The acid flushes were processed through the normal flowsheet, generating additional 2C and 224 wastes that were transferred to the cascade of tanks 241-T-111 and 241-T-112. The 221-T Plant was placed in standby status whereas the 224-T building was placed in lay-away status in October 1956 (HW-46432-DEL, page D-5). The volume of solids and liquid report in tanks 241-T-111 were 510,000 gallons and 20,000 gallons as of September 30, 1956 (HW-45738, page 6). The volume of solids and liquid report in tanks 241-T-112 were 170,000 gallons and 259,000 gallons as of September 30, 1956 (HW-45738, page 6).

Water transfers through the equipment in the 221-T Plant were conducted once per week beginning in October 1956 following chemical flushing to keep the gaskets installed in piping wetted (HW-46432-DEL, page D-5). If the gaskets dried out, leaks could develop if the equipment were restarted. Water transfers through the 221-T Plant equipment were continued through January 1957 (HW-48132-DEL, page D-6) and were terminated when the 221-T Plant was transitioned to final lay-away status in June 1957 (HW-51211-DEL, page D-6).

The disposition of the water transferred through process equipment in the 221-T Plant is not specified in the Hanford Site monthly reports or waste status summary reports. Reports that document radioactive liquid discharges to the ground for 1956 through 1959 do not indicate the discharge of any waste from tank 241-T-112 to the crib (number 241-TX-153 also known as the 216-T-19 crib) after August 1956 (HW-48518, page 35, HW-59359, page 7, and HW-63646, page 7). Tank 241-T-111 was filled to the overflow pipeline and the total waste volume in tank 241-T-112 fluctuated from 429,000 gallons (HW-45738, page 6) to 417,000 gallons (HW-50127, page 6) during this period, without any cause noted for the volume changes. Therefore, it cannot be determine with certainty whether the water used to wet equipment in 221-T Plant was discharged to tank 241-T-111 and 241-T-112.

### 2.2.4 Equipment Decontamination Waste

The 221-U Plant was being used to decontaminate equipment from the Reduction-Oxidation (REDOX) plant, which processed spent nuclear fuels to recover uranium and plutonium. In October 1958, plans were developed to convert the 221-T Plant for use as decontamination facility for equipment from the REDOX plant (HW-58051-DEL, page D-5) and use the 221-U Plant for another purpose. Work was conducted from February 1959 (HW-59434-DEL, page D-4) through June 1960 (HW-65935-DEL, page C-2) to convert the 221-T Plant to an equipment decontamination facility. Equipment decontamination activities were initiated at the 221-T Plant in July 1960, with the receipt of a failed multipurpose dissolver from the REDOX plant (HW-66271-DEL, page C-2).

The Hanford Site monthly reports and waste status summary reports indicate that no waste was transferred into or out of tanks 241-T-110, 241-T-111 and 241-T-112 from August 1956 through November 1959 during modifications to the 221-T Plant. In December 1959, 2,750 gallons of waste were transferred from 221-T Plant into tank 241-T-111 (HW-83906-C-RD, page 92), presumably resulting from the modifications conducted at 221-T Plant.

As part of readying 221-T Plant for this new mission, a route was established in November 1959 from the 221-T Plant to crib number 241-TY (later referred to as 216-TY-3 or 216-T-28) for disposal of low activity waste (HW-62864, page D-4). Low activity waste was transferred from 221-T Plant into the cascade of tanks 241-T-111 and 241-T-112 and then pumped from tank 241-T-112 to the underground crib. The waste status summary reports for the underground storage tanks at the Hanford Site indicate tank 241-T-112 received 3,000 gallons of waste from 221-T Plant in March 1960 (HW-64810, page 6 and HW-83906-C-RD, page 119) and 16,000 gallons in May 1960, with 44,000 gallons of waste pumped to the 241-TY-3 crib (HW-65643, page 6 and HW-83906-D-RD, page 131). Additional decontamination waste continued to be received periodically into the cascade of tanks 241-T-111 and 241-T-112 and

was pumped to the underground crib (216-T-28; then 216-T-36 after May 1967) through June 1967 (HW-83906-D-RD, HW-83906-E-RD, ISO-538, and ISO-674).

After July 1967, equipment decontamination waste from 221-T Plant was transferred directly into tank 241-T-112, with the supernatant discharged to crib number 216-T-36 (ARH-95). Tank 241-T-111 no longer was used to receive waste.

From July 1967 through June 1972, equipment decontamination waste was transferred from 221-T Plant into directly into tank 241-T-112. Waste was transferred from tank 241-T-112 to the REDOX plant for evaporation, with the concentrated waste transferred to other single-shell tanks (ARH-1200 C, ARH-1200 D, ARH-1666 A, B, C, D, ARH-2074 A, B, C, D, and ARH--2456 A, B). From July 1972 through June 1973, equipment decontamination waste was transferred from 221-T Plant into tank 241-T-112, and then to single-shell tank 241-U-107 (ARH-2456 C, D, and ARH-2794 A, B). After June 1973, tank 241-T-112 was no longer used to receive 221-T Plant decontamination waste. The equipment decontamination waste was transferred from 221-T Plant into tank 241-U-107 beginning in October 1973 (ARH-2794 D).

It should be noted that tank 241-T-112 received 106,000 gallons of a mixture of coating removal waste, B-Plant cesium ion exchange waste, and laboratory waste from tank 241-T-106 and 20,000 gallons of waste from diversion box catch tank 241-T-301 in January through March 1973 (ARH-2794A).

### 2.2.5 Comparison with Other Reports

Waste transfers into and waste removals from tanks 241-T-110 and 241-T-111 were summarized in *A History of the 200 Area Tank Farms* (WHC-MR-0132), *Waste Status and Transaction Record Summary for the Northwest Quadrant of the Hanford 200W Area* (WHC-SD-WM-TI-669, Rev. 1), *Historical Tank Waste Content Estimate for the Northwest Quadrant of the Hanford 200 West Area* (HNF-SD-WM-ER-351, Rev. 1), and *Waste Status and Transaction Record Summary (WSTRS) Rev. 4* (LA-UR-97-311). In general, the information cited in Sections 2.2.1 through 2.2.4 is in agreement with these previous reports.

These previous reports accurately state the volume of waste transferred into and removed from tanks 241-T-110 and 241-T-112, as well as the volume of solids and total waste stored in each tank. However, these previous reports do not indicate the types of waste that were transferred into the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. Specifically, these previous reports do not indicate that the waste transferred to this tank cascade from June 1951 through August 1956 was low activity cell drainage from tank 5-6 in 221-T Plant combined with 2C waste and 224 building waste. These previous reports indicate that the source of waste transferred into tank 241-T-111 from December 1959 through June 1967 was from 221-T Plant, but do not designate these wastes as originating from equipment decontamination conducted in the 221-T Plant (see Section 2.2.4).

# 3.0 TYPES OF TANK WASTE GENERATED AT THE HANFORD SITE CHEMICAL PROCESSING PLANTS

There were numerous spent nuclear fuel reprocessing, research and development, and waste management activities conducted at the Hanford Site starting in 1944. These spent nuclear fuel reprocessing, research and development, and waste management activities conducted in the processing plants are discussed further in the DOE/RL-97-02, *National Register of Historic Places Multiple Property Document Form - Historic, Archaeological and Traditional Cultural Properties of the Hanford Site, Washington February 1997.*

It has been established in Section 2.0 that second decontamination cycle (2C) wastes and tank 5-6 cell drainage wastes from the 221-T Bismuth Phosphate plant and 224-T building wastes were transferred into tanks 241-T-110, 241-T-111, and 241-T-112. Additionally, tanks 241-T-111 and 241-T-112 received equipment decontamination waste. The following sections provide a discussion of the wastes originating from operation of the 221-T Bismuth Phosphate plant and the 224-T Concentration building. Equipment decontamination waste from the 221-T Plant was previously discussed in Section 2.2.4.

## 3.1 B AND T BISMUTH PHOSPHATE PROCESS PLANTS

B- and T-Plants were constructed in 1944 through 1945 to separate plutonium from spent nuclear fuel using the bismuth phosphate process. Figure 2 shows a summary of the 221-B/T Plant bismuth phosphate process, which is referred to throughout this discussion.

In the bismuth phosphate process, the aluminum cladding of spent nuclear fuel elements was dissolved in boiling sodium nitrate solution, to which sodium hydroxide was slowly added (HW-10475-C, page 403). The cladding removal waste, sometimes referred to as coating waste (CW), was transferred to single-shell underground storage tanks (see item [1] in Figure 2).

The fuel element uranium cores (see item [2] in Figure 2) were then dissolved in nitric acid (HW-10475-C, chapter IV, page 405). Water and sulfuric acid were added to the dissolved uranium metal solution and the mixture was then transferred to the plutonium extraction section. The sulfuric acid formed a uranyl sulfate complex that prevented its precipitation as a phosphate in the subsequent plutonium extraction step (HW-10475-C, page 418).

Plutonium was extracted from the acid solution by addition of bismuth nitrate and phosphoric acid to form a bismuth phosphate carrier precipitate (HW-10475-C, page 503). The plutonium and bismuth phosphate carrier precipitate was centrifuged and washed with water to separate the acidic supernatant from the precipitate (see item [3] in Figure 2). The acidic solution remaining after the plutonium precipitation contained about 99 percent of the uranium, about 90 percent of the fission products. This separation process also removed and reduced the gamma radiation activity level in the plutonium precipitate by a factor of 10. However, zirconium is phosphate insoluble and zirconium-95 (10 percent of the activity) stayed with the plutonium product. The acidic uranium solution was then neutralized and transferred to the underground single-shell tanks as metal waste (MW). Recent laboratory testing of the bismuth phosphate flowsheet

confirms this partitioning of radionuclides (internal letter 7G300-02-NWK-024, "Bismuth Phosphate Process Radionuclide Partition Factors for the Hanford Defined Waste Model"). The laboratory tests indicate the percentage of cecium-137 and strontium-90 partitioned to the metal waste may have been as high as 100 percent and 89 percent, respectively.

The plutonium bearing cake was then dissolved in nitric acid and further decontamination of the plutonium to separate fission products was conducted (HW-10475-C, chapter VI). Sodium bismuthate, sodium dichromate, or potassium permanganate was added to oxidize the plutonium to the +6 valence-state. This step caused the bismuth phosphate to precipitate phosphate insoluble fission products ("by-product precipitation"), leaving the plutonium in solution. The precipitate was separated from the plutonium-bearing solution using centrifuges and washed to remove soluble plutonium. The plutonium was reduced to the +4 valence state to form a precipitate that could be separated from the remaining soluble fission products by centrifugation. The fission products separated from the plutonium product during this first cycle of the decontamination process (designated as 1C) were combined with the coating removal waste and transferred to single-shell tanks. The 1C waste (see item [4] in Figure 2), contained approximately 10 percent of all fission products and approximately 1.4 percent of the plutonium present in the original fuel charged to the plant (HW-23043, pages 20 and 22). After 1951, the Bismuth Phosphate process flowsheet was modified to include cerium and zirconium scavenger precipitation in the 1C by-product step to remove lanthanide and zirconium radionuclides from the plutonium product (HW-23043, page 16).

The plutonium solids were again dissolved in nitric acid. A second decontamination cycle (see item [5] in Figure 2) was conducted to reduced the gamma activity level by a factor of 10,000 from that in the previous dissolved metal solution, giving an overall process decontamination factor of 100,000 below that of the original solution (HW-10475-C, page 627). The second decontamination step essentially repeated the steps previously described for the first cycle decontamination. The second decontamination cycle wastes (designated as 2C) were also transferred to the single-shell tanks. The 2C waste contained less than 0.1 percent of the uranium and fission products and about 0.4 percent of the plutonium present in the original fuel charged to the plant (HW-23043, pages 26 and 28). The plutonium product from the bismuth phosphate process was subsequently concentrated in the 224-T and 224-B buildings using a lanthanum fluoride precipitation process.

Table 1 provides the flowsheet estimated compositions of the neutralized CW, MW, 1C, and 2C waste solutions generated from the bismuth phosphate plants based on the October 1, 1951 flowsheet (HW-23043). Additional analyses of the supernatant fraction of MW, 1C, and 2C that was stored in single-shell tanks are provided in Tables 2 and 3. The CW was combined with the 1C waste in the same tanks in the Bismuth Phosphate process. Note that the coating waste batch size shown in Table 1 is based on 6,600-lbs uranium, but that the metal waste dissolution batch size is based on 2,200-lbs uranium. These sample analyses support that the 2C waste contained less than 0.1 percent of the fission products. Analyses of the combined 2C / 224 building / tank 5-6 waste supernatant stored in tank 241-T-112 conducted on August 6, 1952 and September 24, 1952 indicate that the total beta emitters was comprised of 35 to 50 percent ruthenium, 35 to 50 percent cesium, 4 to 8 percent cerium, yttrium, and other rare earths, and 6 to 11 percent undetermined (HW-27035, page 8).

**Figure 2. Bismuth Phosphate Process Diagram**

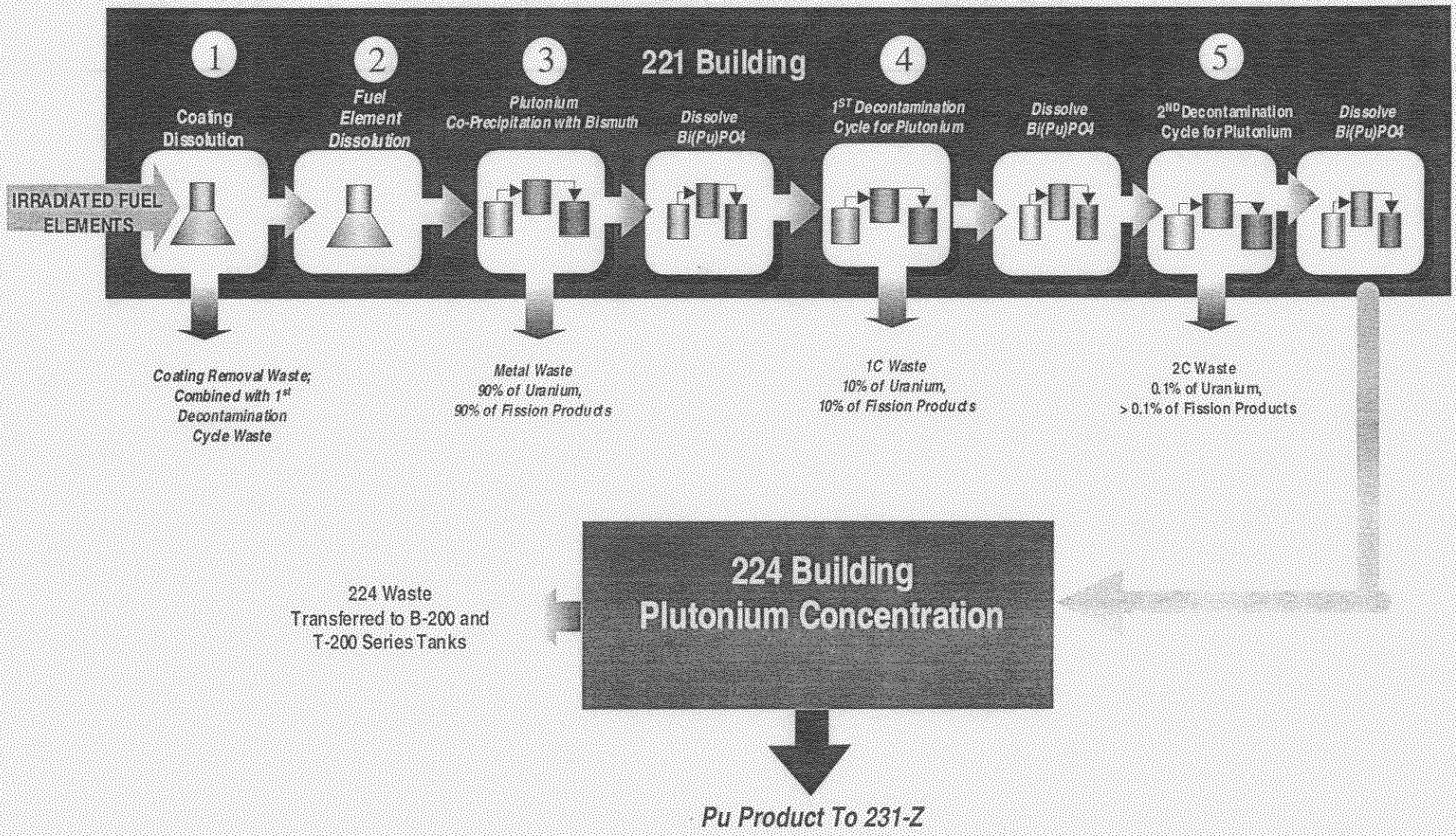


**Table 1. Estimated Composition of Bismuth Phosphate Plant Wastes**
**From October 1, 1951 Flowsheet [1]**

| Analyte [2] | Coating Removal Waste | Metal Waste | First Decontamination Cycle (1C) Waste | Second Decontamination Cycle (2C) Waste | 224 Building Waste |
|---|---|---|---|---|---|
| Plutonium | 3.3E-04 | 2.0E-04 | 6.0E-07 [4] | 1.6E-07 [5] | 1.68E-04 [6] |
| Uranium | 0.15 | | 0.235 [4] | Not reported | 2.04E-05 |
| Gamma | 6.6E+04 | 1.3E+07 | 2.3E+06 [4] | 1.13E+04 [5] | 1.13E+02 [6] |
| Sodium Aluminate ($NaAlO_2$) | 95.1 | | | | |
| Sodium Hydroxide (NaOH) | 43.6 | | | | |
| Sodium Nitrate ($NaNO_3$) | 61.8 | | | | |
| Sodium Nitrite ($NaNO_2$) | 56.0 | | | | |
| Sodium Silicate ($NaSiO_3$) | 4.3 | | | | |
| Uranyl nitrate (UHN) [3] | | 132 | | | |
| Fluorine (F) | | | | | 5.6 |
| Nitrate ($NO_3$) | | 9.7 | 93.1 | 61.3 | 42.4 |
| Sulfate ($SO_4$) | | 24.4 | 4.73 | 3.61 | 0.35 |
| Phosphate ($PO_4$) | | 25.2 | 26.2 | 23.0 | 3.05 |
| Sodium (Na) | | 83.2 | 47.3 | 36.7 | 36.8 |
| Bismuth (Bi) | | | 2.59 | 1.31 | 1.18 |
| Cerium (Ce) | | | 0.030 | | |
| Lanthanum (La) | | | | | 0.49 |
| Manganese (Mn) | | | | | 0.33 |
| Zirconium (Zr) | | | 0.030 | | |
| Iron (Fe) | | | 1.37 | 1.82 | |
| Chrome (Cr) | | | 0.16 | 0.06 | 0.17 |
| Ammonia ($NH_4$) | | | 1.98 | 1.71 | 0.12 |
| Silicon Hexa-Fluoride ($SiF_6$) | | | 4.35 | 3.67 | |
| Volume per Batch (gallons) | 795 | 2,380 | 2,040 | 2,090 | 2,200 |

Notes:

[1] See HW-23043

[2] Analyses are reported in grams per liter, except for gamma activity, which is counts/minute/mL.

[3] HW-23043, page 31, notes that uranium is not actually present in this form, but is probably as $NaUO_2PO_4$ and $Na_4(UO_2)_2CO_3$.

[4] Pu and Gamma concentrations were calculated from the compositions of tanks 13-4 and 14-3 (HW-23043, pages 20 and 22).

[5] Pu and Gamma concentrations were calculated from the compositions of tanks 18-4 and 19-3 (HW-23043, pages 26 and 28).

[6] Pu and Gamma concentrations were calculated from the compositions of tanks A-4, D-4, B-3, and F-8 (HW-23043, pages 39, 44, 48, and 54).

Note that the coating waste batch size shown in Table 1 is based on 6,600-lbs uranium, but that the metal waste dissolution batch size is based on 2,200-lbs uranium. These sample analyses support that the 2C waste contained less than 0.1 percent of the fission products.

### 3.1.1 221-B and 221-T Cell Drainage Waste

During the operation of the 221-B and 221-T Bismuth Phosphate plants, failure of process equipment, cooling jackets on process vessels, and piping occurred periodically, resulting in the discharge of cooling water, chemical solutions, and process solutions (e.g., MW, 1C, 2C wastes and plutonium product solutions) to the process cells. Each of the 40 process cells in the 221-B and 221-T Plants contained a sump that was equipped with a conductivity probe beginning in August 1946 to detect a liquid leak in the process cell (HW-7-4739-DEL, page 21). The sumps gravity drained to a 24-inch diameter vitrified clay pipe that traversed under each cell and discharged to a deep, open top, stainless steel tank, number 5-7 in section 5 (cell 10) (HW-10475-C, page 914).

Cell drainage collected in tank 5-7 was jetted to tank 5-6 or tank 5-9, which were used for sampling and chemical treatment of the cell drainage solution. Waste in tanks 5-6 and 5-9 could be jetted between these two tanks. High activity waste collected in 221-T Plant and 221-B Plant tanks 5-9 could be jetted to single-shell tank 241-T-107 and 241-B-107, respectively (HW-10475-C, page 918). Alternatively, the waste could be transferred to process vessels with the 221-T (or 221-B) Plant and processed to recover plutonium. An example of this practice is cited in the January 1948 monthly report for the Hanford Works (HW-8931-Del, page 28). The T-Plant stack drainage waste was also collected as part of the cell drainage until May 28, 1951, after which the stack drainage was routed to the cascade of single-shell tank 241-TX-113, 241-TX-114, and 241-TX-115 (HW-21260-DEL, page 58).

Cell drainage waste collected in tank 5-6 was transferred to reverse well number 216-T-3 from January 1945 through August 1946. Crib number 216-T-6 was used to dispose of the cell drainage waste from August 1946 through June 1951. After June 1951, cell drainage waste was transferred to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 (HW-55176, part V). The quantity and composition of the cell drainage solutions discharged from tank 5-6 varied (see HW-20583, page 4 and HW-33591, page 25). Table 4 provides analyses of cell drainage waste that was collected in tank 5-6 and transferred to either crib 216-T-6 or to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. As evident from the analyses provided in Table 4, the neutralized, low activity cell drainage waste contained soluble beta emitting radionuclides and plutonium.

## 3.2 224-B AND 224-T CONCENTRATION BUILDINGS

The process steps executed in the 224 buildings were as follows:

- The starting batch size received from the 221 buildings was 330 gallons.
- Plutonium solution from the 221 buildings was oxidized with sodium bismuthate to convert the plutonium to the +6 valence state.
- Phosphoric acid was added to produce a bismuth phosphate ($BiPO_4$) precipitate, with the plutonium still in solution. At this point, operators wanted to get rid of all the $BiPO_4$.
- The solution and precipitate were separated by centrifugation.
- Nitric acid was added to dissolve the $BiPO_4$ precipitate, with this solution removed as waste.
- Potassium permanganate ($KMnO_4$) was added to the plutonium solution to ensure all the plutonium was in the +6 valence state.
- Hydrogen fluoride and lanthanum salts were added to the plutonium solution producing a lanthanum fluoride precipitate. Fission products were carried with the lanthanum. This precipitate contained all the lanthanides (cerium, lanthanum, etc.) and residual ruthenium, samarium, europium, americium, and curium that the $BiPO_4$ could not carry out of the stream.
- The lanthanum fluoride precipitate was dissolved in nitric acid, neutralized with sodium hydroxide, and sent to waste storage tanks.
- Oxalic acid was added to the plutonium solution collected from the lanthanum fluoride precipitation step to reduce the plutonium to the +4 valence-state.
- Hydrogen fluoride and lanthanum salts were added to the plutonium solution producing a lanthanum fluoride and plutonium fluoride precipitate. The precipitate was centrifuged to collect the solids.
- Potassium hydroxide was added to convert the plutonium fluoride / lanthanum fluoride precipitate into lanthanum hydroxide and plutonium hydroxide solids.
- After centrifuging to separate the lanthanum hydroxide and plutonium hydroxide solids, these solids are reacted with nitric acid solution to dissolve the lanthanum and plutonium. The plutonium nitrate / lanthanum nitrate solution product was now ready for transfer to the 231-Z building or 234-5 building.

By this time, each original 330-gallon batch of plutonium-bearing solution that had entered the 224 Buildings was concentrated down to eight gallons. The liquid waste (designated as 224) from the lanthanum fluoride precipitation process was neutralized and transferred to the single-shell underground storage tanks. The resulting purified plutonium material was transferred to the 231-Z building and subsequently to the 234-5 building (Z Plant) beginning in 1949 for further processing.

**Table 2. Analyses of Bismuth Phosphate Process Supernatants Stored [1,2]**

| Waste Type | Tank | pH | Pu µg/liter | Gross Beta millicuries/liter | Gross Gamma millicuries/liter | Date Sampled |
|---|---|---|---|---|---|---|
| Metal Waste | T-101 | 10.1 | 70 | 200[5] | 70[5] | 12-12-1946 |
| Metal Waste | T-101 | 10 | 35 | 110[5] | 25[5] | 7-01-1947 |
| Metal Waste | T-102 | 9.9 | 60 | 120 | 20 | 7-01-1947 |
| Metal Waste | T-103 | 9.8 | 60 | 150 | 20 | 7-01-1947 |
| | | | | | | |
| 1C/CW | B-109 | 9.9 | 40 | 0.65 | 0.28 | 3-18-1947 |
| 1C/CW | C-112 | 9.9 | 12 | 12 | 4.4 | 3-18-1947 |
| | | | | | | |
| 2C | B-111 | 6.9 | 7.2E-02 | 2.0E-03 | 3.0E-03 | 7-1-1947 |
| 2C | B-112 | 6.8 | 4.32E?? [3] | 1.5E-03 | 3.0E-03 | 7-1-1947 |
| **Waste Type** | **Tank** | **pH** | **Pu µg/liter** | **Gross Beta Counts / minute/ cc** | **Gross Gamma Counts / minute/ cc** | **Date Sampled** |
| 2C | T-110 | Not reported [4] | 15 | 4.9E+04 | 30 | 7-13-1945 |
| 2C | T-110 | 9.8[4] | 19 | 6.9E+04 | 55 | 7-25-1945 |
| 2C | B-110 | 9.6[4] | 8.5 | 7.0E+04 | 55 | 7-25-1945 |

Notes:

[1] See HW-10728 and HW-3-3220.

[2] Solids formed in each of wastes, settling to the bottom of each tanks. These sample analyses are for the supernatant only and are not representative of the sludges.

[3] The reported Pu sample analyses for tank B-112 seems to be in error and lacking an exponent in HW-10728.

[4] Prior to October 1945, the 2C waste was neutralized to a pH of approximately 10. The waste collected in tanks 241-T-110, 241-T-111, and 241-T-112 were neutralized to about pH 7 after October 1945 to precipitate bismuth and plutonium (HW-3-3220, page 13).

[5] Decrease in gross beta and gross gamma concentrations shown for the T-101 waste samples is due to decay of fission products with short half-lives.

## Table 3. Analyses of Metal Waste and First Decontamination Cycle / Coating Waste Supernatant

| Tank | Date Filled | Pu µg/cc | Gross Beta µCi/cc | Gross Gamma µCi/cc | Sr µCi/cc | Cs µCi/cc | Ru µCi/cc | Rare Earths + Y – Ce µCi/cc | Ce µCi/cc | Nb µCi/cc | Zr µCi/cc | Te µCi/cc |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Analyses of Metal Waste Supernatant Following Uranium Extraction [1]** | | | | | | | | | | | | |
| C-106 | Not specified | | | | 0.44 | 54.2 | | | | | | |
| BX-108 | Not specified | | | | 0.26 | 132.4 | | | | | | |
| BX-109 | Not specified | | | | 1.08 | 56.3 | | | | | | |
| C-112 | Not specified | | | | 1.20 | 25.8 | | | | | | |
| C-109 | Not specified | | | | 0.46 | 40.7 | | | | | | |
| C-111 | Not specified | | | | 0.10 | 34.5 | | | | | | |
| Average Concentrations for Metal Waste | | | | | 0.59 | 57.3 | | | | | | |
| **Analyses of First Decontamination Cycle (1C) Waste Mixed with Coating Removal Waste (CW) [2]** | | | | | | | | | | | | |
| B-107 | 8-1945 | 1.7E-02 | 0.135 | 0 055 | 0 011 | 0.10 | | | | | | |
| T-107 | 9-1945 | 1.5E-03 | 0.170 | 0.093 | 0.0013 | 0.20 | | | | | | |
| B-108 | 12-1945 | 2.0E-02 | 0.183 | 0.044 | 0.022 | 0.12 | | | | | | |
| T-108 (Top) | 12-1945 | 2.0E-02 | 0.25 | 0.073 | 0 12 | 0.17 | 0 0066 | 0.047 | 0.007 | 0 0018 | 0 | 1.2E-05 |
| T-108 (Bottom) | 12-1945 | 2.0E-02 | 0.25 | 0.070 | 0.12 | Not reported | 0 0065 | 0.029 | 0.0066 | 0.0024 | 0 | 3E-05 |
| T-109 | 3-1946 | 2 6E-03 | 0.14 | 0 082 | 0.00038 | 0.15 | | | | | | |
| B-109 | 4-1946 | 1.8E-02 | 0.16 | 0.051 | 0.01 | 0 11 | | | | | | |
| T-104 (Top) | 7-1946 | 3E-03 | 0.51 | 0.130 | 0 00013 | 0.13 | 0.058 | 0.004 | 0.051 | 0 028 | 0 010 | 2.4E-05 |
| T-104 (Bottom) | 7-1946 | 3E-03 | 0.52 | 0.160 | 0.00037 | Not reported | 0.059 | 0.003 | 0 050 | 0.028 | 0.015 | 3.6E-05 |
| C-110 | 8-1946 | 2E-03 | 0.14 | 0.0067 | 0 00026 | 0.11 | | | | | | |
| C-111 | 11-1946 | 4.2E-03 | 0.16 | 0 069 | 0.01 | 0.13 | | | | | | |
| C-112 | 4-1947 | 3.1E-03 | 0.14 | 0 064 | 0.005 | 0.13 | | | | | | |
| U-110 | 4-1947 | 2.1E-04 | 0.13 | 0.069 | 0.00011 | 0.17 | | | | | | |
| U-111 | 10-1947 | 3.4E-04 | 0.12 | 0.060 | 0.00023 | 0.14 | | | | | | |
| TX-109 [3] | 9-1949 | 2.7E-05 | 2.8 | 2.2 | 0.00087 | 0.27 | 0.34 | 0 0085 | 0.0035 | 0.34 | 1.2 | 8E-05 |
| **Average Concentrations for 1C / CW** | | **7.67E-03** | **0.39** | **0.22** | **0.02** | **0.15** | | | | | | |

Notes:

[1] HW-36717, *Decontamination of Uranium Recovery Process Stored Wastes Interim Report*, May 16, 1955, W. W. Schulz, General Electric Company, Richland, Washington.

[2] HW-20195, *Radioactive Content of Stored Bismuth Phosphate First Cycle Waste Supernatants*, February 5, 1951, General Electric Company, Richland, Washington.

[3] Tank TX-109 exhibits higher gross beta and gross gamma radioactivity since this tank was sampled shortly after filling and the short-lived fission products (e.g., Ru, Nb, and Zr) had not decayed appreciably.

**Table 4. Composition of Tank 5-6 Cell Drainage Waste from 221-T Plant**

| Year | Month | Liters | Pu Grams | Total Beta Activity Curies | Comment |
|---|---|---|---|---|---|
| Tank 5-6 Cell Drainage Transferred to 216-T-6 Crib [1,2] | | | | | |
| 1948 | January | 839,900 | 49 | 88 | Total beta activity does not include radioactive iodine. Samples were measured for total alpha activity. Calculated Pu mass assumes that all alpha activity measured in samples was Pu. Uranium activity in samples contributed less than 8% of the total alpha activity [1]. |
| | February | 724,461 | 8 | 73 | |
| | March | 586,188 | 3 | 789 | |
| | April | 842,778 | 9 | 461 | |
| | May | 918,007 | 5 | 72 | |
| | June | 971,810 | 9 | 295 | |
| | July | 1,057,015 | 6 | 130 | |
| | August | 831,662 | 4 | 248 | |
| | September | 857,327 | 5 | 361 | |
| | October | 830,083 | 4 | 116 | |
| | November | 980,411 | 6 | 214 | |
| No records could be located for December 1948 through August 1949. | | | | | |
| 1949 | September | 260,000 | 32 | 365 | |
| | October | 360,000 | 41 | 2800 | |
| | November | 340,000 | 38.2 | 333 | |
| | December | 430,000 | 48 | 250 | |
| 1950 | January | 410,000 | 44 | 210 | |
| | February | 330,000 | 28.5 | No data reported | |
| | March | 370,000 | 35 | No data reported | |
| | April | 450,000 | 35.6 | 294 | |
| | May | 370,000 | 33.9 | 363 | |
| | June | 430,000 | 36.6 | 2142 | |
| | July | 520,000 | 43.6 | 600 | |
| | August | 590,000 | 44.9 | 741 | |
| | September | 480,000 | 42.3 | 850 | |
| | October | 620,000 | 47.3 | 858 | |
| | November | 540,000 | 50.9 | 600 | |
| | December | 590,000 | 42.1 | 850 | |
| No records could be located for January 1951 through December 1951. Beginning in June 1951, Tank 5-6 cell drainage waste along with 2C waste was routed to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. | | | | | |

**Table 4. Composition of Tank 5-6 Cell Drainage Waste from 221-T Plant**

| Year | Month | Liters | Pu Grams | Total Beta Activity Curies | Comment |
|---|---|---|---|---|---|
| Tank 5-6 Cell Drainage Waste Discharged to the Cascade of Tanks 241-T-110, 241-T-111, and 241-T-112 [3,4] | | | | | |
| 1952 | January | 595,000 | 5.2 | 440 | |
| | February | 498,000 | 6.9 | 850 | |
| | March | 643,000 | 8.2 | 920 | |
| | April | 623,000 | 8.8 | 660 | |
| | May | 318,000 | 1.8 | 84 | |
| | June | 392,000 | 3.0 | 97 | |
| | July | 600,000 | 4.1 | 160 | Beginning in July 1952, 224 building waste, along with tank 5-6 cell drainage and 2C wastes were routed to the cascade of tanks 241-T-110, 241-T-111, and 241-T-112. Values reported are for tank 5-6 cell drainage waste only. |
| | August | 670,000 | 6.5 | 265 | |
| | September | 260,000 | 1.9 | 675 | |
| | October | 430,000 | 3.0 | 310 | |
| | November | 490,000 | 2.7 | 95 | |
| | December | 540,000 | 3.3 | 240 | |
| 1953 | January | 490,000 | 2.4 | 130 | |
| | February | 530,000 | 3.9 | 480 | |
| | March | 660,000 | 5.0 | 245 | |
| | April | 390,000 | 2.0 | 180 | |
| | May | 490,000 | 1.8 | 220 | |
| | June | 660,000 | 3.5 | 590 | |
| | July | 280,000 | 0.9 | 65 | |
| | August | 490,000 | 2.4 | 100 | |
| | September | 560,000 | 7.8 | 195 | |
| | October | 560,000 | 6.8 | 1,840 | |
| | November | 710,000 | 8.7 | 1,085 | |
| | December | 740,000 | 8.8 | 885 | |
| 1954 | January | 830,000 | 10.4 | 1,680 | |
| | February | 820,000 | 14.2 | 16,420 | |
| | March | 860,000 | 18.6 | 5,305 | |
| | April | 540,000 | 8.4 | 2,175 | |
| | May | 790,000 | 10.6 | 1,760 | |
| | June | 810,000 | 9.5 | 2,390 | |
| | July | 1,030,000 | | | Radionuclide content not reported separately for 5-6 Cell drainage waste from July 1954 thru June 1955 (HW-38562, page 26). |
| | August | 1,150,000 | | | |
| | September | 1,090,000 | | | |
| | October | 800,000 | | | |
| | November | 730,000 | | | |
| | December | 1,100,000 | | | |
| 1955 | January | 1,370,000 | | | |
| | February | 950,000 | | | |
| | March | 1,460,000 | | | |
| | April | 1,380,000 | | | |

**Table 4. Composition of Tank 5-6 Cell Drainage Waste from 221-T Plant**

| Year | Month | Liters | Pu Grams | Total Beta Activity Curies | Comment |
|---|---|---|---|---|---|
| | May | 1,410,000 | | | |
| | June | 1,440,000 | | | |
| The volume and radionuclide content of tank 5-6 cell drainage waste were not recorded separate from other wastes transferred into the cascade of tanks 241-T-110, 241-T-111, and 241-T-112 after July 1954. | | | | | |

Notes:

[1] HW-11908
[2] HW-20583
[3] HW-25301
[4] HW-33591
[5] Analyses of the combined 2C / 224 building / tank 5-6 waste supernatant stored in tank 241-T-112 conducted on August 6, 1952 and September 24, 1952 indicate that the total beta emitters was comprised of 35 to 50% ruthenium, 35 to 50% cesium, 4 to 8% cerium, yttrium, and other rare earths, and 6 to 11% undetermined (HW-27035, page 8).

## 4.0 TRANSURANIC ANALYSES OF WASTE IN TANKS 241-T-110 AND 241-T-111

The Department of Energy uses several factors to determine the disposition of radioactive wastes (DOE M 435.1). One of these factors is the concentration of alpha-emitting transuranic isotopes with half-life greater than 20 years present in the radioactive waste.

Analyses of specific alpha-emitting transuranic isotopes in the waste stored in tank 241-T-110 have not been conducted. Gross alpha analyses have been conducted for the waste stored in tank 241-T-110, with the mean value reported as 53ηCi/g. The gross alpha analysis tends to over estimate the sum of alpha-emitting transuranic isotopes, since U-238 is included in the gross alpha analysis. The uncertainty estimates for the gross alpha analyses for the waste stored in tank 241-T-110 were recently evaluated (RPP-10983). The upper 95% confidence limit for the gross alpha analyses of the waste stored in tank 241-T-110 is 62ηCi/g. These analyses indicate that the concentration of alpha-emitting transuranic isotopes with half-life greater than 20 years is less than 100ηCi/g in the waste stored in tank 241-T-110.

The mean gross alpha analyses and lower 95% confidence limit for the waste stored in tank 241-T-111 are 371ηCi/g and 289ηCi/g (7G300-02-JGF-009). The gross alpha analyses of the waste in tank 241-T-111 are support by analyses of this waste for americium-241, and plutonium 239/240. The sum of the americium-241 and plutonium 239/240 analyses indicates that the transuranic waste concentration is approximately 181ηCi/g in the waste stored in tank 241-T-111 (7G300-02-JGF-009).

## 5.0 SUMMARY

Tanks 241-T-110 received 2C waste from reprocessing of spent nuclear fuel at the 221-T Plant from January 1945 through December 1954, cell drainage waste from June 1951 through December 1954, and 224 wastes from May 1952 through December 1954. Tank 241-T-111 received 2C waste from the 221-T Plant from January 1945 through October 1956, cell drainage waste from June 1951 through October 1956, 224 wastes from May 1952 through October 1956, and equipment decontamination waste from February 1960 through June 1967.

Gross alpha analyses have been conducted for the waste stored in tank 241-T-110, with the mean value reported as 53ηCi/g. The upper 95% confidence limit for the gross alpha analyses of the waste stored in tank 241-T-110 is 62ηCi/g. The mean gross alpha analyses and lower 95% confidence limit for the waste stored in tank 241-T-111 are 371ηCi/g and 289ηCi/g (7G300-02-JGF-009). The sum of the americium-241 and plutonium 239/240 analyses is approximately 181ηCi/g in the waste stored in tank 241-T-111.

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# APPENDIX A

## VOLUME OF SOLIDS AND TOTAL WASTE IN TANKS 241-T-110, 241-T-111, AND 241-T-112

### January 1945 through December 1975

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| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Percent Filled | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-7-1293-DEL | 1945 | Jan | Not reported | | | | | | |
| HW-7-1388-DEL, page 18 | | Feb | 7.8% | | | | | | |
| HW-7-1544-DEL, page 21 | | March | 9.7% | | | | | | |
| HW-7-1649-DEL, page 20 | | April | 12.0% | | | | | | |
| HW-7-1793-DEL, page 22 | | May | 15.4% | | | | | | |
| HW-7-1981-DEL, page 23 | | June | 17.6% | | | | | | |
| HW-7-2177-DEL, page 22 | | July | 21.2% | | | | | | |
| HW-7-2361-DEL, page 21 | | August | 26.4% | | | | | | |
| HW-7-2548-DEL, page 22 | | September | 32.6% | | | | | | "Technical Department work has demonstrated that the precipitate formed on neutralization will carry more residual product into the sludge at pH of 7 than at the pH of 9 to 10 previously used. Consequently, the second cycle wastes are now being neutralized to a pH of about 7. This may permit disposal of the supernatant solution through dry-wells at some future date ..." |
| HW-7-2706-DEL, page 21 | | October | 38.7% | | | | | | "The second decontamination cycle waste in tank (110) in the T Plant waste storage area was filled and began to cascade into the second tank of the series on about October 15." |
| HW-7-2957-DEL, page 21 | | November | 49.0% | | | | | | |
| HW-7-3171-DEL, page 21 | | December | 58.5% | | | | | | |
| HW-7-3378-DEL, page 24 | 1946 | Jan | 67.1% | | | | | | |
| HW-7-3566-DEL, page 21 | | Feb | 74.3% | | | | | | |
| HW-7-3751-DEL, page 21 | | March | 78.4% | | | | | | |
| HW-7-4004-DEL, page 21 | | April | 86.1% | | | | | | |
| HW-7-4193-DEL, page 21 | | May | 91.3% | | | | | | |

| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Percent Filled | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-7-4343-DEL, page 23 | | June | 97.5% | | | | | | |
| HW-7-4542-DEL, page 21-22 | | July | 100.0% | | | | | | "The installation of a new underground line from diversion box 153 in the T Waste Area to the second cascade tank in the X104 series permitted the diversion, on 7-22-46, of second cycle waste and stack drainage from T Plant to the remaining two tanks in this series." |
| HW-7-4739-DEL, page 23 | | August | 100.0% | | | | | | 2C waste transferred from 221-T into T-105, which cascades to T-106. |
| HW-7-5194-DEL, page 26 | | September | 100.0% | | | | | | |
| HW-7-5362-DEL, page 27-28 | | October | 100.0% | | | | | | "Tanks X-110-T, X-111-T and X-112-T in T Plant were checked by means of ionization chambers and it was determined that while the sludge level in the first tank was evenly distributed on the bottom of the tank to a depth of 38", there was no indication of sludge in the second and third tanks in the series." 38" of sludge corresponds to ~84,030-gallons. |
| HW-7-5505-DEL, page 28 | | November | 100.0% | | | | | | |
| HW-7-5630-DEL, page 25 | | December | 100.0% | | | | | | |
| HW-7-5802-DEL, page 26 | 1947 | Jan | 100.0% | | | | | | |
| HW-7-5944-DEL, page 25 | | Feb | 100.0% | | | | | | "Excavation for an underground crib system and tile file adjacent to the 241 T Waste Storage Tank Farm in T Plant for the proposed handling of second cycle waste supernatants was started in February." |
| HW-7-6048-DEL, page 24 | | March | 100.0% | | | | | | |
| HW-7-6184-DEL, page 26 | | April | 100.0% | | | | | | |
| HW-7-6391-DEL, page 24 | | May | 100.0% | | | | | | |
| HW-7-7454-DEL, page 26 | | June | 100.0% | | | | | | |
| HEW-7283-DEL, page 26 | | July | 100.0% | | | | | | |
| HEW-7504-DEL, page 27 | | August | 100.0% | | | | | | |
| HW-7795-DEL, page 26-27 | | September | 71.0% | | | | | | "In T Plant, one tank, X-111-T, containing second cycle waste was disposed of to the recently installed underground crib system (Project C-120)." |

| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Percent Filled | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-7997-DEL, page 27 | | October | 67.0% | | | | | | 2C waste transferred from 221-T into T-105, which cascades to T-106. |
| HW-8267-DEL, page 29 | | November | 67.0% | | | | | | "In order to safely complete the tie-in of the two lines from the 153-T diversion box to the X-111T and X-112T underground waste storage tanks, 20,000-gallons of second cycle waste were jetted from X-112T tank to the second cycle waste crib in T Plant. No further jetting of second cycle waste will be done until the perforating device mentioned in last month's report is available." |
| HW-8438-DEL, page 27 | | December | 67.0% | | | | | | 2C waste transferred from 221-T into T-105, which cascades to T-106. |
| HW-8931-DEL, page 28 | 1948 | Jan | 67.0% | | | | | | 2C waste transferred from 221-T into T-105, which cascades to T-106. |
| HW-9191-DEL, page 30 | | Feb | 67.0% | | | | | | 2C waste transferred from 221-T into T-105, which cascades to T-106. |
| HW-9595-DEL, page 32 | | March | 70.8% | | | | | | Tanks T-105 and T-106 are filled with 2C waste. 2C waste transferred from 221-T into cascade of T-110, T-111, and T-112. |
| HW-9922-DEL, page 31-32 | | April | 75.1% | | | | | | ~360,000-gallons of 2C waste jetted from T-105 to crib. |
| HW-10166-DEL, page 33 | | May | 79.3% | | | | | | |
| HW-10378-DEL, page 30 | | June | 84.1% | | | | | | |
| HW-10714-DEL, page 32-33 | | July | 89.0% | | | | | | 2C waste jetted from tank T-106 to crib. |
| HW-10993-DEL, page 35-36 | | August | 67.5% | | | | | | "The cribbing of tank X-112-T was started on August 4, 1948 and was nearing completion at month end." |
| HW-11226-DEL, page 32-33 | | September | 66.0% | | | | | | "At T Plant the cribbing of the X-112-T tank was discontinued after approximately 450,000 gallons of waste had been jetted to the crib to permit installation of an experimental sand filter for the purpose of determining the feasibility of removing the activity from the waste supernatant by this method prior to discharging it to the ground." |
| HW-11499-DEL, page 33-34 | | October | 66.8% | | | | | | "At T Plant, the cribbing of second cycle wastes in tank X-112-T was completed." |
| HW-11835-DEL, page 36 | | November | 71.0% | | | | | | |
| HW-12086-DEL, page 38 | | December | 77.3% | | | | | | |

| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Percent Filled | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-12391-DEL, page 39 | 1949 | Jan | 84.4% | | | | | | |
| HW-12666-DEL, page 35 | | Feb | 89.7% | | | | | | |
| HW-12937-DEL, page 40-41 | | March | 87.2% | | | | | | "The cribbing of second cycle waste supernatant from X-112-T tank was started on March 17, 1949. At month end 151,250-gallons of this material has been jetted to the crib. Average age of material being cribbed is estimated to be nine months. Analysis of a sample of the waste being cribbed is as follows: AT 100 c/m/ml, Beta's 1730 c/m/ml, Gamma's 10 c/m/ml, pH 7.1, suspended solids 0.1%, Uranium nil. |
| HW-13190-DEL, page 39-40 | | April | 71.0% | | | | | | "The cribbing of second cycle waste from X-112-T tank which was started on March 17, 1949, was continued with a total of 319,000-gallons being jetted to the crib during this month." |
| HW-13561-DEL, page 41-41 | | May | 71.9% | | | | | | "The cribbing of second cycle waste from X-112-T tank, which was started in March, was completed with 55,000-gallons being cribbed during this month." |
| HW-13793-DEL, page 41 | | June | 87.2% | | | | | | Reported percent fill may be error. |
| HW-14043-DEL, page 43 | | July | 77.6% | | | | | | |
| HW-14338-DEL, page 44 | | August | 81.9% | | | | | | |
| HW-14596-DEL, page 43 | | September | 86.2% | | | | | | |
| HW-14916-DEL, page 44 | | October | 92.4% | | | | | | |
| HW-15267-DEL, page 43-45 | | November | 82.6% | | | | | | ""In order to provide additional space for the storage and settling of second decontamination cycle wastes in the X-110-T series of tanks in the 241-T area, cribbing of supernatant from X-112-T (final tank in 110-T series) was resumed on November 18 ...". "Cribbing of 215,000-gallons of supernatant was completed during the month." |
| HW-1550-DEL, page 42-43 | | December | 69.4% | | | | | | "Cribbing of 578,000-gallons of second cycle waste from X-112-T tank in the 200 West Area was concluded on December 19, for a total of 2,955,000-gallons of this type waste cribbed in the 200 West Area since cribbing of second cycle supernatant was first initiated." |
| HW-15843-DEL, page 45 | 1950 | Jan | 76.2% | | | | | | |
| HW-17056-DEL, page 45 | | Feb | 81.8% | | | | | | |
| HW-17410-DEL, page 47-49 | | March | 89.9% | | | | | | "A total of 27,300-gallons of second cycle decontamination waste having its origin from the bismuth phosphate process semi-works, which was formerly operated in the 300 Area, was placed in the X-112-T waste storage tank during this month." |

| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Percent Filled | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-17660-DEL, page 46-47 | | April | 92.0% | | | | | | "Cribbing of supernatant from X-112-T second cycle waste storage tank in the 200 West Area was started late in the month when this tank became 85% filled". |
| HW-17971-DEL, page 44-45 | | May | 71.9% | | | | | | "In 200 West Area, the cribbing of supernatant from X-112-T second cycle waste storage tank, started late in April, has totaled 462,000-gallons to date". |
| HW-18221-DEL, page 43-45 | | June | 70.8% | | | | | | "Approximately 129,000-gallons of second cycle waste supernatant were cribbed during the month from the 112-T tank in 200 West Area". |
| HW-18473-DEL, page 46 | | July | 79.5% | | | | | | |
| HW-18740-DEL, page 50 | | August | 89.4% | | | | | | |
| HW-19021-DEL, page 49 | | September | 97.2% | | | | | | |

| Reference | Year | Period | Cascade of Tanks T-110, T-111, and T-112 Waste Volume (x 1000 gallons) | | | | | | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| HW-19325-DEL, page 49-50 | | October | 1382 | | | | | | "With the X-112-B and X-112-T tanks each becoming half full during the month, cribbing of the second decontamination cycle waste from each was resumed. A total of 327,250-gallons in T Plant and 507,700 gallons in B Plant had been cribbed by month end without incident." |
| HW-19622-DEL, page 49 | | November | 1154 | | | | | | "A total of 349,250-gallons of second decontamination cycle waste supernatant was cribbed from X-112-T tank in the 200 West Area during the month." |
| HW-19842-DEL, page 50-51 | | December | 1073 | | | | | | "Disposal of second decontamination cycle waste to underground cribs was made in December as tabulated below:<br>200 East Area from tank X-112-B: 249,000-gallons<br>200 West Area from tank X-112-T: 118,200-gallons |
| HW-20161-DEL, page 50 | 1951 | Jan | 1297 | | | | | | |
| HW-20438-DEL, page 50 | | Feb | 1448 | | | | | | "Cribbed as necessary." |
| HW-20671-DEL, page 54 | | March | 1467 | | | | | | "143,000-gallons cribbed from 112-T." |
| HW-20991-DEL, page 52-53 | | April | 1596 | | | | | | "Cribbed when necessary."<br>"The tie-line from tank 241-T-112 to the 241-T crib was completed during the month on Project C-415, which will allow constant overflow of settled second decontamination cycle waste in conjunction with Section 5 waste." [Section 5 waste is low-activity cell drainage from T Plant tank 5-6 ] |
| HW-21250-DEL, page 56-57 | | May | 1629 | | | | | | "185,600-gallons estimated cribbed by cascade."<br>"The settled second cycle decontamination cycle waste started to overflow constantly from the 241-T-112 tank on May 8, 1951 and has continued uneventfully since that time. It is expected that Section 5 waste effluents, originating in the Canyon Buildings, will be combined with second cycle decontamination wastes at both B and T Plants, during June." |
| HW-21506-DEL, page 55 | | June | 1629 | | | | | | "Cascades to Crib".<br>"... parallel changes were completed in both the 200 East and West Areas, whereby the Section 5 waste effluents, originating in the Canyon Buildings, were combined with the second decontamination cycle waste facilities, rather than being discharged directly to underground cribs." |
| HW-21802-DEL, page 41 | | July | 1629 | | | | | | "Cascades to Crib". |
| HW-22075-DEL | | August | Not reported | | | | | | |
| HW-22304-DEL | | September | Not reported | | | | | | |
| HW-22610-DEL | | October | Not reported | | | | | | |
| HW-22875-DEL | | November | Not reported | | | | | | |
| HW-23140-DEL | | December | Not reported | | | | | | |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| no report | 1952 | Jan | | | | | | | Hanford Site monthly reports only list percent filled for cascade prior to 1952. |
| HW-27897 | | Feb | | | | | | | No information on individual tanks |
| HW-27898 | | March | 530 | Not reported | 530 | Not reported | 569 | Not reported | T-110, T-111, T-112 operate as cascade and receive 2C waste. T-112 cascades to crib. |
| HW-27838 | | April to June | 530 | Not reported | 530 | Not reported | 569 | Not reported | On 5-29-52, 224-T wastes were tied into 5-6 stream feeding to 110-111-112-T at diversion box 241-T-152. |
| HW-27839 | | July to Sept. | 530 | Not reported | 530 | Not reported | 569 | Not reported | 5-6, 2C and 224 waste routed to these tanks. T-112 cascades to crib. |
| HW-27840 | | Oct. to Dec. | 530 | Not reported | 530 | Not reported | 569 | Not reported | |
| HW-27841 | 1953 | Jan | 530 | Illegible | 530 | Illegible | 569 | Illegible | |
| HW-27842 | | Feb | 530 | 530 | 530 | 191 | 519 | 29 | |
| HW-27775 | | March | 530 | 530 | 530 | 191 | 569 | 29 | |
| HW-28043 | | April | 530 | 530 | 530 | 233 | 569 | 34 | |
| HW-28377 | | May | 530 | 530 | 539 | 235 | 569 | 35 | |
| HW-28712 | | June | 530 | 530 | 530 | 246 | 569 | 45 | |
| HW-29054 | | July | 530 | 530 | 530 | 252 | 569 | 50 | |
| HW-29242 | | August | 530 | 521 | 530 | 186 | 569 | 2 | |
| HW-29624 | | September | 530 | 521 | 530 | 213 | 569 | 2 | |
| HW-29905 | | October | Illegible | Illegible | Illegible | Illegible | Illegible | Illegible | |
| HW-30250 | | November | 530 | 523 | 530 | 229 | 569 | 6 | |
| HW-30498 | | December | 530 | 530 | 530 | 230 | 569 | 7 | |
| HW-30851 | 1954 | Jan | Illegible | Illegible | Illegible | Illegible | Illegible | Illegible | |
| HW-31126 | | Feb | 530 | 530 | 530 | 277 | 569 | 22 | |
| HW-31374 | | March | 530 | 530 | 530 | 299 | 569 | 33 | |
| HW-31811 | | April | 530 | 530 | 530 | 299 | 569 | 33 | |
| HW-32110 | | May | 530 | 530 | 530 | 299 | 569 | 33 | |
| HW-32389 | | June | 530 | 530 | 530 | 312 | 569 | 33 | |
| HW-32697 | | July | 530 | 530 | 530 | 345 | 569 | 33 | |
| HW-33002 | | August | 530 | 530 | 530 | 355 | 569 | 33 | |
| HW-33396 | | September | Illegible | Illegible | Illegible | Illegible | Illegible | Illegible | |
| HW-33544 | | October | 530 | 530 | 530 | 377 | 569 | 33 | |
| HW-33904 | | November | 530 | 530 | 530 | 417 | 569 | 33 | |
| HW-34412 | | December | Illegible | Illegible | Illegible | Illegible | Illegible | Illegible | T-110 full of sludge. T-111 and T-112 active 2C and 224 waste cascade to crib. |
| HW-35022 | 1955 | Jan | Illegible | Illegible | Illegible | Illegible | Illegible | Illegible | |
| HW-35628 | | Feb | 530 | 530 | 530 | 430 | 569 | 33 | T-111 and T-112 active 2C and 224 waste cascade to crib. |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| HW-36001 | | March | 530 | 530 | 530 | 487 | 569 | 33 | T-111 and T-112 active 2C and 224 waste cascade to crib. |
| HW-36553 | | April | 530 | 530 | 398 | 362 | 322 | 166 | T-111 pumping to T-112 at month end. 833,000-gallons supernatant pumped to open ditch. |
| HW-37143 | | May | 530 | 530 | 530 | 387 | 569 | 170 | T-112 cascades to crib. |
| HW-38000 | | June | 530 | 530 | 530 | 402 | 569 | 170 | T-112 cascades to crib. |
| HW-38401 | | July | 530 | 530 | 530 | 408 | 569 | 170 | |
| HW-38926 | | August | 530 | 530 | 530 | 417 | 569 | 170 | |
| HW-39216 | | September | 530 | 530 | 530 | 430 | 569 | 170 | |
| HW-39850 | | October | 530 | 530 | 530 | Illegible | 569 | 170 | |
| HW-40208 | | November | 530 | 530 | 530 | 465 | 569 | 170 | |
| HW-40816 | | December | 530 | 530 | 530 | 465 | 569 | 170 | T-112 pumps to crib at intervals. |
| HW-41038 | 1956 | Jan | 530 | 530 | 530 | 482 | 442 | 170 | T-112 pumps to crib at intervals. |
| HW-41812 | | Feb | 530 | 530 | 530 | 499 | 472 | 170 | |
| HW-42394 | | March | 530 | 530 | 530 | 507 | 439 | 170 | |
| HW-42993 | | April | 530 | 530 | 530 | 510 | 441 | 170 | |
| HW-43490 | | May | 530 | 530 | 530 | 510 | 435 | 170 | |
| HW-43895 | | June | 530 | 530 | 530 | 510 | 429 | 170 | T-111 Receives from T Plant. T-112 pumps to crib at intervals. |
| HW-44860 | | July | 530 | 530 | 530 | 510 | 429 | 170 | |
| HW-45140 | | August | 530 | 530 | 530 | 510 | 429 | 170 | |
| HW-45738 | | September | 530 | 530 | 530 | 510 | 429 | 170 | |
| HW-46382 | | October | 530 | 530 | 530 | Not reported | 439 | Not reported | |
| HW-47052 | | November | 530 | 530 | 530 | 510 | 451 | 170 | |
| HW-47640 | | December | 530 | 530 | 530 | 510 | 470 | 170 | |
| HW-48144 | 1957 | Jan | 481 | 530 | 543 | 510 | 475 | 170 | T-112 estimated reading. |
| HW-48846 | | Feb | 481 | 530 | 554 | 510 | 475 | 170 | T-112 estimated reading. |
| HW-49523 | | March | 481 | 530 | 560 | 510 | 422 | 170 | T-112 latest electrode reading. |
| HW-50127 | | April | 483 | 530 | 560 | 510 | 417 | 170 | |
| HW-50617 | | May | 527 | 530 | 560 | 510 | | 170 | HW-50617 not legible. Values from HW-83906-C-RD, page 46. Corrected T-110 reading. |
| HW-51348 | | June | 527 | 530 | 560 | 510 | 448 | 170 | |
| HW-51858 | | July | 527 | 530 | 557 | 510 | 414 | 170 | |
| HW-52414 | | August | 527 | 46 | 557 | 510 | 417 | 170 | |
| HW-52932 | | September | 527 | 46 | 557 | 510 | 417 | 170 | |
| HW-53573 | | October | 527 | 46 | 557 | 510 | 417 | 170 | |
| HW-54067 | | November | 527 | 46 | 557 | 510 | 417 | 170 | |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| HW-54519 | | December | 527 | 46 | 557 | 510 | 417 | 170 | |
| HW-54916 | 1958 | Jan | 527 | 46 | 557 | 510 | 417 | 170 | |
| HW-55264 | | Feb | 527 | 46 | 557 | 510 | 420 | 170 | |
| HW-55630 | | March | 527 | 46 | 557 | 510 | 420 | 170 | |
| HW-55997 | | April | 527 | 46 | 557 | 510 | 420 | 170 | |
| HW-56357 | | May | 527 | 46 | 524 | 510 | 420 | 170 | Corrected calculation for T-111 waste volume. |
| HW-56761 | | June | 527 | 46 | 524 | 510 | 420 | 170 | |
| HW-57122 | | July | 527 | 46 | 524 | 510 | 420 | 170 | |
| HW-57550 | | August | 527 | 46 | 524 | 510 | 420 | 170 | |
| HW-57711 | | September | 527 | 46 | 527 | 510 | 420 | 170 | |
| HW-58201 | | October | 527 | 46 | 527 | 510 | 422 | 170 | |
| HW-58579 | | November | 527 | 46 | 527 | 510 | 425 | 170 | |
| HW-58831 | | December | 527 | 46 | 527 | 510 | 425 | 170 | |
| HW-59204 | 1959 | Jan | 527 | 46 | 527 | 510 | 425 | 170 | |
| HW-59586 | | Feb | 527 | 46 | 524 | 510 | 439 | 170 | |
| HW-60065 | | March | 524 | 46 | 524 | 510 | 439 | 170 | |
| HW-60419 | | April | 524 | 46 | 524 | 510 | 439 | 170 | |
| HW-60738 | | May | 524 | 46 | 524 | 510 | 442 | 170 | |
| HW-61095 | | June | 524 | 46 | 524 | 510 | 444 | 170 | |
| HW-61582 | | July | 524 | 46 | 524 | 510 | 444 | 170 | |
| HW-61952 | | August | 524 | 46 | 524 | 510 | 444 | 170 | |
| HW-62421 | | September | 524 | 46 | 524 | 510 | 442 | 170 | |
| HW-62723 | | October | 524 | 46 | 524 | 510 | 442 | 170 | |
| HW-63083 | | November | 524 | 46 | 524 | 510 | 442 | 170 | |
| HW-63559 | | December | 524 | 46 | 527 | 510 | 442 | 170 | T-111 received 2,750-gallons of waste from 221-T (HW-83906-D-RD, page 92). |
| HW-63896 | 1960 | Jan | 524 | 46 | 527 | 510 | 442 | 170 | |
| HW-64373 | | Feb | 524 | 46 | 527 | 510 | 447 | 170 | |
| HW-64810 | | March | 524 | 46 | 527 | 510 | 450 | 170 | T-112 received 3,000-gallons 221-T waste. |
| HW-65272 | | April | 524 | 46 | 527 | 510 | 450 | 170 | |
| HW-65643 | | May | 524 | 46 | 527 | 510 | 422 | 170 | T-112 received 16,000-gallons from 221-T. Pumped out to TY crib 44,000-gallons. |
| HW-66187 | | June | 524 | 46 | 527 | 510 | 429 | 170 | T-112 received 7,000-gallons from 221-T. |
| HW-66557 | | July | 524 | 46 | 527 | 510 | 461 | 170 | T-112 received 32,000-gallons from 221-T. |
| HW-66827 | | August | 524 | 46 | 527 | 510 | 461 | 170 | |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| HW-67696 | | September | 524 | 46 | 527 | 510 | 461 | 170 | |
| HW-67705 | | October | 524 | 46 | 527 | 510 | 461 | 170 | |
| HW-68291 | | November | 524 | 46 | 527 | 510 | 461 | 170 | |
| HW-68292 | | December | 524 | 46 | 529 | 510 | 403 | 170 | T-112 jetted 58,000-gallons to TY crib. |
| HW-71610 | 1961 | Jan. to June | 524 | 46 | 527 | 510 | 395 | 170 | T-112 received 221-T waste and pumped to TY crib. |
| *HW-83906-D-RD pg. 197* | *1961* | *Jan. to June* | *524* | *530* | *521* | *510* | *396* | *170* | *T-111 cascades to T-112. T-112 receives 221-T crib waste and pumps to TY crib.* |
| HW-72625 | 1961 | Jul to Dec. | 524 | 46 | 527 | 510 | 395 | 170 | |
| *HW-83906-E-RD pg. 8* | *1961* | *Jul to Dec.* | *524* | *530* | *527* | *510* | *395* | *170* | *T-111 receives waste from 221-T. Cascades to T-112, which is pumped to TY crib.* |
| HW-74647 | 1962 | Jan. to June | 524 | 46 | 524 | 510 | 442 | 170 | 221-T waste cascades from T-111 to T-112 and then pumped to cribs. |
| HW-76223 | 1962 | Jul to Dec. | 524 | 46 | 524 | 510 | 395 | 170 | 221-T waste cascades from T-111 to T-112 and then pumped to cribs. |
| HW-78279 | 1963 | Jan. to June | 524 | 46 | 524 | 510 | 395 | 170 | 221-T waste cascades from T-111 to T-112 and then pumped to cribs. |
| HW-80379 | 1963 | Jul to Dec. | 524 | 46 | 524 | 510 | 430 | 170 | T-111 received wastes from 221-T cascades to T-112, which is pumped to TY crib. |
| HW-83308 | 1964 | Jan. to June | 524 | 46 | 524 | 510 | 430 | 170 | 221-T waste cascades from T-111 to T-112 and then pumped to cribs. |
| HW-83906-E-RD pg. 58 | 1964 | Jul to Dec. | 524 | 46 | 524 | 510 | 433 | 170 | T-111 received wastes from 221-T cascades to T-112, which is pumped to TY crib. |
| HW-83906-E-RD pg. 64 | 1965 | Jan. to June | 530 | 46 | 541 | 510 | 442 | 170 | T-111 received wastes from 221-T cascades to T-112, which is pumped to TY crib. |
| HW-83906-E-RD pg. 70 | 1965 | July to Sept. | 530 | 46 | 537 | 510 | 447 | 170 | T-111 receives waste from 221-T, cascades to T-112, which is pumped to the TY crib. |
| HW-83906-E-RD pg. 78 | 1965 | Oct. to Dec. | 530 | 46 | 540 | 510 | 408 | 170 | T-111 receives waste from 221-T. T-112 waste pumped to TY crib. |
| no report | 1966 | Jan. to March | | | | | | | |
| HW-83906-E-RD pg. 86 | 1966 | April to June | 530 | 46 | 539 | 510 | 425 | 170 | T-111 receives waste from 221-T. Cascades to 112-T, pumped to TY crib. |
| ISO-538 | 1966 | July to Sept. | 532 | 508 | 538 | 442 | 392 | 40 | 221-T waste cascades from T-111 to T-112, then pumps to cribs. |
| ISO-674 | 1966 | Oct. to Dec. | 532 | 508 | 538 | 442 | 392 | 40 | 221-T waste cascades from T-111 to T-112, then pumps to cribs. |
| ISO-806 | 1967 | Jan. to March | 532 | 508 | 538 | 442 | 508 | 40 | 221-T waste cascades from T-111 to T-112, then pumps to cribs. |
| ISO-967 | 1967 | April to June | 534 | 508 | 538 | 442 | 362 | 40 | Transferred 146,000-gallons from T-112 to TX-118. |
| | | | | | | | | | **Beginning in July 1967, waste status summary reports indicate that equipment decontamination waste from 221-T Plant was routed to T-112.** |
| ARH-95 | 1967 | July to Sept. | 534 | 508 | 538 | 442 | 73 | 40 | 289,000-gallons transferred from T-112 to TX-118 |
| ARH-326 | 1967 | Oct. to Dec. | 534 | 508 | 540 | 442 | 371 | 170 | T-112 Received 298,000-gallons from 221-T |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| ARH-534 | 1968 | Jan. to March | 535 | 46 | 538 | 510 | 508 | 170 | T-112 Received 141,000-gallons from 221-T |
| ARH-721 | 1968 | April to June | 534 | 508 | 538 | 442 | 237 | 40 | T-112 Transferred 382,000-gallons to REDOX Evaporator. Received 111,000-gallons from 221-T. |
| ARH-871 | 1968 | July to Sept. | 534 | 508 | 538 | 442 | 365 | 40 | T-112 Transferred 125,000-gallons to REDOX Evaporator. Received 253,000-gallons from 221-T. |
| ARH-1061 | 1968 | Oct. to Dec. | 534 | 508 | 538 | 447 | 266 | 24 | T-112 Transferred 354,000-gallons to REDOX Evaporator. Received 255,000-gallons from 221-T. |
| ARH-1200 A | 1969 | Jan. to March | 534 | 508 | 538 | 447 | 406 | 24 | T-112 Transferred 86,000-gallons to REDOX Evaporator. Received 226,000-gallons from 221-T. |
| ARH-1200 B | 1969 | April to June | 534 | 508 | 538 | 447 | 165 | 24 | T-112 Transferred 20,000-gallons to REDOX Evaporator. Received 227,000-gallons from 221-T. Transferred 448,000 to 103-TY. |
| ARH-1200 C | 1969 | July to Sept. | 534 | 508 | 538 | 447 | 354 | 24 | T-112 received 189,000-gallons of decontamination waste from 221-T Plant. |
| ARH-1200 D | 1969 | Oct. to Dec. | 534 | 293 | 537 | 233 | 174 | 33 | T-112 received 232,000-gallons of decontamination waste from 221-T Plant. T-112 transferred 413,000-gallons to REDOX evaporators. |
| ARH-1666 A | 1970 | Jan. to March | 534 | 293 | 539 | 233 | 290 | 33 | T-112 Transferred 111,000-gallons to REDOX Evaporator. Received 228,000-gallons from 221-T. |
| ARH-1666 B | 1970 | April to June | 534 | 293 | 538 | 233 | 343 | 32 | T-112 Transferred 109,000-gallons to REDOX Evaporator. Received 161,000-gallons from 221-T. |
| ARH-1666 C | 1970 | July to Sept. | 534 | 293 | 539 | 233 | 351 | 32 | T-112 Transferred 132,000-gallons to REDOX Evaporator. Received 140,000-gallons from 221-T. |
| ARH-1666 D | 1970 | Oct. to Dec. | 534 | 293 | 539 | 233 | 370 | 32 | T-112 Transferred 119,000-gallons to REDOX Evaporator. Received 138,000-gallons from 221-T. |
| ARH-2074 A | 1971 | Jan. to March | 534 | 293 | 540 | 233 | 395 | 32 | T-112 Transferred 76,000-gallons to REDOX Evaporator. Received 100,000-gallons from 221-T. |
| ARH-2074 B | 1971 | April to June | 534 | 293 | 545 | 233 | 298 | 32 | T-112 Transferred 244,000-gallons to REDOX Evaporator. Received 147,000-gallons from 221-T. |
| ARH-2074 C | 1971 | July to Sept. | 534 | 293 | 539 | 233 | 342 | 32 | T-112 Transferred 116,000-gallons to REDOX Evaporator. Received 160,000-gallons from 221-T. |
| ARH-2074 D | 1971 | Oct. to Dec. | 534 | 293 | 541 | 233 | 399 | 32 | T-112 Transferred 87,000-gallons to REDOX Evaporator. Received 144,000-gallons from 221-T. |
| ARH-2456 A | 1972 | Jan. to March | 535 | 293 | 538 | 233 | 378 | 32 | T-112 Transferred 260,000-gallons to REDOX Evaporator. Received 237,000-gallons from 221-T. |
| ARH-2456 B | 1972 | April to June | 535 | 293 | 540 | 233 | 404 | 32 | T-112 Transferred 146,000-gallons to REDOX Evaporator. Received 174,000-gallons from 221-T. |

| Reference | Year | Period | T-110 | T-110 | T-111 | T-111 | T-112 | T-112 | Comments from Reference Document |
|---|---|---|---|---|---|---|---|---|---|
| | | | Waste Volume (x 1000 gallons) | | | | | | |
| | | | Total | Sludge | Total | Sludge | Total | Sludge | |
| PPD-493-7-DEL | | | | | | | | | REDOX Evaporators shutdown 7-5-1972. Waste to be stored in tanks and processed in 242-T or 242-S evaporators. |
| ARH-2456 C | 1972 | July to Sept. | 535 | 293 | 539 | 233 | 468 | 32 | T-112 received 136,000-gallons of decontamination waste from 221-T Plant. T-112 transferred 71,000-gallons to U-107. |
| ARH-2456 D | 1972 | Oct. to Dec. | 535 | 293 | 539 | 233 | 329 | 32 | T-112 received 148,000-gallons of decontamination waste from 221-T Plant. T-112 transferred 286,000-gallons to U-107. |
| ARH-2794A | 1973 | Jan. to March | 536 | 293 | 536 | 233 | 217 | 32 | T-112 Transferred 332,000-gallons to 107-U. T-112 received 199,000-gallons from 221-T and 20,000-gallons from 301-T catch tank |
| ARH-2794 B | 1973 | April to June | 536 | 293 | 536 | 233 | 508 | 32 | T-112 Transferred 180,000-gallons to 107-U. T-112 Received 120,000-gallons from 221-T and 350,000-gallons from 106-T. |
| ARH-2794 C | 1973 | July to Sept. | 531 | 293 | 535 | 233 | 505 | 32 | |
| ARH-2794 D | 1973 | Oct. to Dec. | 531 | 293 | 534 | 233 | 505 | 32 | 221-T Decontamination solution routed to U-107 |
| ARH-CD-133A | 1974 | Jan. to March | 531 | 293 | 534 | 233 | 505 | 32 | |
| ARH-CD-133B | 1974 | April to June | 475 | 293 | 490 | 233 | 236 | 32 | Transferred 59,000-gallons from T-110 to S-110, 28,000-gallons from T-111 to S-110, 14,000 from T-111 to T-109, and 273,000 from T-112 to S-110. |
| ARH-CD-133C | 1974 | July to Sept. | 483 | 293 | 485 | 485 | 101 | 32 | Transferred 8,000-gallons of water into T-110. Transferred 136,000-gallons from T-112 to S-110. |
| ARH-CD-133D | 1974 | Oct. to Dec. | 483 | 466 | 488 | 488 | 101 | 32 | T-111 removed from service. |
| ARH-CD-336A | 1975 | Jan. to March | 483 | 466 | 488 | 488 | 101 | 32 | |
| ARH-CD-336B | 1975 | April to June | 483 | 466 | 488 | 488 | 101 | 32 | |
| ARH-CD-336C | 1975 | July to Sept. | 483 | 466 | 488 | 488 | 101 | 32 | |
| ARH-CD-336D | 1975 | Oct. to Dec. | 483 | 466 | 488 | 488 | 101 | 32 | |
| | | | | | | | | | |

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