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Revision 0

Engineering Study of 50 Miscellaneous Inactive Underground Radioactive Waste Tanks Located at the Hanford Site, Washington

Prepared for the U.S. Department of Energy
Office of Environmental Restoration and
Waste Management

Westinghouse Hanford Company Richland, Washington

Hanford Operations and Engineering Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

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ACRONYMS

AAMS	Aggregate Area Management Study
ACGIH	American Conference of Governmental Industrial Hygienists
ALARA	As Low As Reasonable Achievable
ASTM	American Standard Test Methods
$BiPO_4$	bismuth phosphate
CASS	Computer Automated Surveillance System
CERCLA	Comprehensive Environmental Compensation and Liability Act
CMS	Corrective Measures Study
CW	coating waste
D & RCP	Decommissioning and RCRA Closure Program
DCG	derived concentration guide
DOE	U.S. Department of Energy
DPM	disintegrations per minute
DST	double-shell tank
EB	evaporator bottoms
Ecology	Washington State Department of Ecology
EDTA	ethylenediaminetetraacetic acid
EPA	U.S. Environmental Protection Agency
ERA	expedited response action
ERDF	Environmental Restoration Disposal Facility
ERRA	Environmental Restoration and Remedial Action
FIC	Food Instruments Corporation
FS	Feasibility Study
GRE	gas release event
HEDTA	hydroxylethyl-ethylenediaminetetraacetic acid
HLW	high-level waste
ILL	interstitial liquid level
IRM	interim remedial measure
ITS	in-tank solidification
LEL	lower explosive limit
LFL	lower flammability limit
LFI	limited field investigation
LLW	low-level waste
LOW	liquid observation well
M	molar
MRP	Management Requirements and Procedures
MTCA	Washington State Model Toxics Control Act
MW	metal waste
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure level
PFP	Plutonium Finishing Plant
PIF	Plutonium Isolation Facility
PRF	Plutonium Recovery Facility

ACRONYMS (Cont.)

PUREX	Plutonium Uranium Extraction
RARA	Radiation Area Remedial Action
RCRA	Resource Conservation and Recovery Act
REDOX	reduction-oxidation
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
SST	single-shell tank
SSTCP	Single-Shell Tank Closure Program
TBP	tributyl phosphate
TOC	total organic carbon
TLV	threshold limit value
TRAC	Track Radioactive Constituents
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic
TSD	treatment, storage and disposal
TWRS	Tank Waste Remediation Systems
VOM	Volt Ohm meter
WHC	Westinghouse Hanford Company
WIDS	Waste Information Data System
WIPP	Waste Isolation Pilot Plant
WMP	Waste Management Program

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1.0 INTRODUCTION

This engineering study addresses 50 inactive underground radioactive waste tanks. The tanks were formerly used for the following functions associated with plutonium and uranium separations and waste management activities in the 200 East and 200 West Areas of the Hanford Site:

- settling solids prior to disposal of supernatant in cribs and a reverse well
- neutralizing acidic process wastes prior to crib disposal
- receipt and processing of single-shell tank (SST) waste for uranium recovery operations
- catch tanks to collect water that intruded into diversion boxes and transfer pipeline encasements and any leakage that occurred during waste transfer operations
- waste handling and process experimentation.

Most of these tanks have not been in use for many years. Several projects have been planned and implemented since the 1970's and through 1985 to remove waste and interim isolate or interim stabilize many of the tanks. Some tanks have been filled with grout within the past several years.

Responsibility for final closure and/or remediation of these tanks is currently assigned to several programs including Tank Waste Remediation Systems (TWRS), Environmental Restoration and Remedial Action (ERRA), and Decommissioning and Resource Conservation and Recovery Act (RCRA) Closure (D & RCP). Some are under facility landlord responsibility for maintenance and surveillance (i.e. Plutonium Uranium Extraction [PUREX]). However, most of the tanks are not currently included in any active monitoring or surveillance program.

1.1 PURPOSE AND OBJECTIVES

The purpose and objectives of this study are to compile all available existing information on the miscellaneous inactive tanks and evaluate the information to determine the following:

- potential safety issues in their current configuration
- tank integrity issues
- data needs and recommendations for resolving issues
- potential methods of monitoring the tanks and characterizing wastes
- priorities for resolving safety issues and/or investigation and closure or remediation of the tanks.

In addition, this study provides recommendations for programmatic integration with other restoration activities in the 200 Area. The tanks addressed in this study are adjacent to and associated with numerous other facilities throughout the 200 Area where a variety of restoration activities will be conducted. Therefore, this program integration is needed to ensure that environmental restoration measures conducted for the miscellaneous tanks are consistent with measures at adjacent facilities. Program integration is also needed to ensure that restoration activities throughout the 200 Area are appropriately prioritized and scheduled to address human health and environmental concerns, while balancing the demand for and limitations on resources. This will also help to ensure that restoration activities are cost effective and meet Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) milestones.

1.2 REPORT ORGANIZATION

The report is organized to provide sufficient information in the body of the text to give a comprehensive summary and overview without so much detail that it becomes cumbersome. However, it was also felt that a thorough compilation of the information obtained should be provided to establish a baseline for future activities associated with these tanks. This will facilitate future investigations by eliminating the need for duplicating the extensive file searches and data compilation activities conducted to prepare this report. Therefore, appendices are provided for complete and detailed summary of all available relevant information for the miscellaneous tanks.

In addition to this introductory section, the report contains the following sections and appendices:

- Section 2.0, Background and Summary of Existing Information, includes a description of the locations, construction details and operating history, interim stabilization and isolation status, summary of waste generating processes, and summary of waste inventories and composition (if known) for the 50 miscellaneous tanks addressed in this report.

- Section 3.0, Evaluation of Regulatory Requirements, includes an overview of the regulatory requirements pertaining to these tanks including the Tri-Party Agreement, RCRA (and the State Dangerous Waste Regulations), Comprehensive Environmental Compensation and Liability Act (CERCLA) and U.S. Department of Energy (DOE) Orders; a discussion of WHC programs responsible for managing activities associated with compliance with these requirements, and a description of currently planned activities to comply with the requirements.

- Section 4.0, Evaluation of Safety Issues, includes a discussion and evaluation of chemical and radiological safety issues and tank integrity. The safety issues evaluated include those that are currently being addressed by TWRS for SSTs, as they pertain to wastes in the miscellaneous tanks. The discussion of tank integrity issues includes both an evaluation of leak/release potential and structural integrity.

- Section 5.0, Monitoring and Characterization Considerations, includes a discussion of potential constraints which should be considered prior to monitoring or characterization of the miscellaneous tanks.

- Section 6.0, Prioritization for Tank Characterization and Remediation, includes a discussion of the issues relevant to prioritizing activities such as safety and closure issues, resource and program integration, provides a methodology and criteria to be used for prioritizing activities at the tanks related to these issues, and recommends initial priorities for the tanks.

- Section 7.0, Conclusions and Recommendations, provides both the conclusions of the evaluation conducted for the miscellaneous tanks and recommendations for addressing any unresolved issues.

Appendices:

- Appendix A, Tank Specific Data Sheets
- Appendix B, History of Waste Generating Processes
- Appendix C, Monitoring and Characterization Methods and Techniques
- Appendix D, Pertinent Correspondence

2.0 BACKGROUND AND SUMMARY OF EXISTING INFORMATION

This section provides a summary of existing information on 50 miscellaneous inactive radioactive waste tanks located at the Hanford Site. Information is provided on the locations, construction specifications, operating history, and waste inventory. The composition is based on sampling and analytical data, if available. If sampling data is not available, the likely waste composition, based on process knowledge, is estimated.

The information in this section is largely based on information obtained from reports that have been prepared over the past several years including Neilsen 1992; Rymarz and Speer 1991; the Aggregate Area Management Studies, and the Waste Information Data System (WIDS), as well as many other documents that are referenced. Database and file searches of the WHC Tank Farm Information Center files, Central Files, Records Holding Area archive files and the 222-S Laboratory "Process Aids" files. Employee interviews were also conducted in the effort to eliminate data gaps.

This section contains four sub-sections:

2.1) Location and General Description: this subsection discusses the categories of miscellaneous waste tanks, the physical configuration of these waste tanks, and the specific locations and interconnections for each of these tanks.

2.2) History of Operations: this subsection discusses the operating history of each processing plant and correlates chemical and radiological waste streams with the specific miscellaneous tanks. In addition, information concerning unplanned releases associated with the various miscellaneous tanks is provided in this section.

2.3) Isolation/Stabilization Status: this subsection describes isolation and stabilization activities performed under previous Hanford project activities, and identifies ongoing monitoring and surveillance activities.

2.4) Radiological and Chemical Constituents: this subsection uses the data presented in sub-sections 2.2 and 2.3 and information from Appendices A and B to provide a list of chemical and radiological contaminants for each miscellaneous tank. Specific sample and analysis data will be used when available, with the understanding that the validity of the data is suspect if the methods and protocols used to obtain the data are not functionally or statistically sound. For example, single waste samples cannot represent an entire tank's contents with high statistical confidence. In most cases there have been no sample activities, or sampling has been limited to identifying only specific contaminants/properties (such as total plutonium or total alpha contamination). The "Process Aids" files maintained by the 222-S Laboratory have provided significantly to the chemical and analytical data for tank contents reported in the Appendix A data sheets. Where no specific sample data is available, the contaminants associated with the waste processes are used to provide potential contaminants/composition of the waste contents.

Two appendices have been included in this report to expand upon the contents of this chapter. Appendix A provides data sheets to support and expand upon the contents of this chapter for each miscellaneous tank. Appendix B provides characteristics of waste-generating processes associated with the miscellaneous tanks.

2.1 LOCATION AND GENERAL DESCRIPTIONS

This section provides general information on each category of miscellaneous tanks. The referenced graphics and tables can be located at the end of this section. Appendix A provides tank summary and flow diagrams for each of the tanks.

2.1.1 Location

The miscellaneous inactive tanks addressed in this report are located in both the 200 East and 200 West Areas in the central portion of the Hanford Site (Figure 2-1). Detailed information including the coordinates for tank locations and reference drawing numbers for each of the individual tanks are provided in Table 2-1.

The miscellaneous tanks are generally located near facilities previously used for waste handling, transfer, treatment, storage and disposal associated with the various plutonium and/or uranium separations processes. These facilities include the single-shell tank (SST) farms and chemical processing facilities.

Sixteen of the miscellaneous tanks are located in the 200 East Area (Figure 2-2). These sixteen tanks include seven catch tanks, one experimental tank, two neutralization tanks, one settling tank, one "waste handling" or holding tank, and four tanks which were located in a concrete vault used for processing SST waste during uranium/thorium recovery operations. These tanks are dispersed among five operable units. The operable units containing miscellaneous tanks are listed in DOE-RL (1993a) and include:

- 200-BP-7 (2 individual tanks, and 4 tanks in the 244-BXR vault)
- 200-BP-6 (5 tanks)
- 200-SO-1 (3 tanks)
- 200-PO-3 (1 tank)
- 200-PO-5 (1 tank)

The remaining 34 miscellaneous tanks are located in the 200 West Area (Figure 2-3). These include 11 catch tanks, one neutralization tank, six settling tanks, and 16 tanks in three processing vaults (244-TXR, 244-UR, and 241-WR vaults). These tanks are dispersed among ten operable units as listed in DOE-RL (1993a) including:

- 200-RO-2 (2 tanks)
- 200-RO-3 (1 tank)
- 200-RO-4 (1 tank)
- 200-TP-2 (1 tank)
- 200-TP-4 (1 tank)
- 200-TP-5 (5 individual tanks and 3 tanks in the 244-TXR vault)
- 200-TP-6 (1 tank)
- 200-UP-2 (2 individual tanks and 9 tanks in the 241-WR vault)
- 200-UP-3 (4 tanks in the 244-UR vault)

- 200-ZP-2 (2 individual tanks and 2 tanks in the 231-W-151 vault)

2.1.2 General Descriptions

The 50 miscellaneous tanks addressed in this report can be grouped into six categories based on their function. These include 18 catch tanks, 3 neutralization tanks, 7 settling tanks, 20 processing tanks used during uranium/thorium recovery operations located in four vaults, 1 waste handling tank, and 1 experimental tank.

2.1.2.1 Catch Tanks. Catch tanks are components of tank farm support for collecting spills and/or leaks during waste transfers between processing facilities and tank farms. Diversion boxes are below-grade concrete structures with removable concrete covers. They contained connections to underground piping between tank farms and processing plants. By replacing jumpers within a diversion box, the waste from a processing plant could be routed to any number of tank farms. The catch tank inlet lines were connected to drains in the diversion boxes and/or pipeline encasements, so that the catch tanks would accumulate waste as the spills or leaks occurred. Catch tanks also received any water from rainfall or snowmelt, and any windblown dust that entered the diversion boxes.

The catch tanks are all direct buried carbon steel tanks, with the exception of one tank, which is ASTM A-70 flange grade steel. Fifteen of the tanks are horizontal cylinders, 8 to 10 ft. in diameter, and 15.5 to 40 ft. long. These tanks are referred to as the 302 series catch tanks (Figure 2-4). The other three tanks are referred to as the 301 series catch tanks and are each located approximately 10 ft. below grade, vertically configured with a diameter of 20 ft., and a height of 19 ft. (Figure 2-5). The 301 series catch tanks have a nominal volume of 35,000 gal. The tanks were constructed with coal tar coating for corrosion protection. Cathodic protection was added later, was not maintained, and was determined inoperable in the 1970's. However, replacement systems were installed during site-wide cathodic protection upgrades in the mid-1980's (LaSalle and Morgan 1990).

2.1.2.2 Vault Tanks (Uranium and Thorium Recovery). Twenty inactive tanks are located in vaults that were used to support the uranium and thorium recovery missions. The 244-BXR, 244-TXR, and 244-UR vaults were all used specifically to pretreat waste prior to uranium recovery operations at the U Plant. The 241-WR vault was used for similar missions and also provided interim storage for thorium nitrate solutions recovery (Harlow 1974a).

The vault tanks were constructed in below-grade concrete enclosures called vaults. Each of the tanks was constructed of stainless steel with the exception of three tanks (described below) that were constructed of 1/4 in. steel plate. The following paragraphs contain general construction details for the various vault tanks.

<u>244-BXR Vault</u>

The 244-BXR vault is constructed with 2 foot thick concrete walls and currently contains four tanks. Each tank is in a separate compartment and each compartment with its own sump (Figure 2-6). The vault originally had five tanks; however, the 244-BXR-004 tank was removed in 1963. Three of the remaining tanks are constructed of stainless steel and the other, tank 244-BXR-001, is constructed of 1/4 in. carbon steel plate. The tanks are vertically oriented and have dished bottoms and heads. The 244-BXR-001 and 244-BXR-011 tanks each have a nominal volume of 50,000 gal. The 244-BXR-002 and 244-BXR-003 tanks each have a nominal volume of 15,000 gal (Neilsen 1992).

244-TXR Vault

The 244-TXR vault is located below grade and constructed with two foot re-inforced concrete walls to provide shielding. The 244-TXR vault (Figure 2-7) originally had four tanks; however, the 244-TXR-004 tank was removed in 1963. The vault configuration is very similar in construction to the 244-BXR vault. The 244-TXR vault is smaller in size than the 244-BXR vault, with dimensions of 51 ft. deep, 24 ft. wide, and 74 ft. long. Two of the three tanks (244-TXR-002 and 244-TXR-003) are constructed of stainless steel and each has a nominal volume of 15,000 gal. The 244-TXR-001 tank is constructed of 1/4 in. carbon steel plate with a nominal volume of 50,000 gal. Each of the 244-TXR vault tanks are vertically oriented with dished bottoms and heads (Neilsen 1992).

244-UR Vault

The 244-UR vault was constructed similar to the 244-BXR vault; however, the dimensions and configuration vary slightly. Figure 2-8 provides a graphical representation of this vault. The four tanks are each vertically oriented with dished bottoms and heads. Three of the tanks are constructed of stainless steel while the fourth tank, 244-UR-001, is constructed of 1/4 in. steel plate (Neilsen 1992).

241-WR Vault

The 241-WR vault is a two level concrete structure with shielding walls, sumps, and tanks (Figure 2-9). The vault contains a lower level with five tanks (241-WR-001 through 241-WR-005) which is a radioactive (hot) zone, and an upper level with four tanks (241-WR-006 through 241-WR-009) which is a non-radioactive (cold) zone. The nine tanks are each constructed of welded stainless steel and are 20 ft. in diameter by 19 ft., 2 in. deep with dished bottoms and heads. The nominal capacity of each tank is 50,000 gal (Neilsen 1992).

2.1.2.3 Neutralization Tanks. Three neutralization tanks are included in this evaluation; 270-W, 241-CX-71, and 270-E-1. These tanks were used for the neutralization of acidic processing and tank waste. Neutralization was achieved through the direct contact of acidic waste with limestone. Limestone was added to the three tanks through the use of charging chutes (Neilsen 1992). The influent was introduced to the tank and percolated through the limestone, thereby neutralizing the waste and generating a salt (acid-base reaction). The neutralized effluent was discharged to cribs.

Tank 270-W and Tank 270-E-1

These two tanks, shown in Figure 2-10, were constructed identically. The tanks were 9 ft. in diameter by 9 ft. high with a nominal capacity of 3,780 gal. The tanks were constructed of stainless steel, 10 ft. below grade, on a reinforced concrete foundation pad. A 10-foot long by 40-in. diameter charging carbon steel chute was used to add limestone.

Tank 241-CX-71

This tank was constructed of stainless steel 3.5 ft. below grade, is 5 ft. in diameter by 6.85 ft. high, has a design capacity of 1,000 gal and was constructed on a reinforced concrete foundation pad (Figure 2-11). This tank currently contains a bottom layer of sludge, then limestone and the remainder filled with grout.

2.1.2.4 Settling Tanks. There are seven tanks categorized as settling tanks. These tanks include the 361 series tanks (241-B-361, 241-T-361, and 241-U-361 and 241-Z-361), tank 241-Z-8 (silica gel tank), and two tanks located in the 231-W-151 vault. The settling tanks were all used to settle solids during waste/chemical transfers between tank farms, processing plants, and cribs (Rymarz and Speer 1991).

The 361 series settling tanks (241-B-361, 241-T-361, 241-U-361) are concrete tanks, 20 ft. in diameter by 19 ft. high with a nominal volume of 36,000 gal (see Figure 2-5). The tanks have a 6 in. thick wall of reinforced concrete (Rymarz and Speer 1991).

The 241-Z-361 tank (Figure 2-12) is a rectangular concrete tank with a 3/8 in. thick welded steel lining, has a sloping bottom, a side wall depth of 17 to 18 ft, and has a nominal volume of 40,500 gal. The concrete walls, floor, and ceiling are approximately 12 in. thick (Neilsen 1992).

The 241-Z-8 tank is a horizontal cylindrical steel tank, constructed of welded steel plate, with a volume of 15,400 gal (Figure 2-13). The tank top is approximately 6 ft. below grade (Rymarz and Speer 1991).

The 231-W-151 tanks are located in a concrete vault of 12 in. thick reinforced concrete (Figure 2-14). The upper three ft. of the vault are above grade and the base of the vault is 13.5 ft. below grade. Tank 231-W-151-001 is 9 ft. in diameter by 9 ft. deep with a nominal volume of 4,000 gal. Tank 231-W-151-002 is 5 ft. in diameter by 7 ft. deep with a nominal volume of 950 gal (Neilsen 1992).

2.1.2.5 Experimental Tank. The 241-CX-72 tank is located in the Semiworks Area and was an experimental tank used to study the characteristics of self-concentrating waste from the PUREX process (Rymarz and Speer 1991). The 241-CX-72 tank is vertically oriented, 40 in. in diameter by 35.7 ft. high with welded steel construction of 3/8 in. thick steel plate, stiffening rings around the outside, and a nominal volume of 2,300 gal (Figure 2-15). The tank rests on a concrete pad inside a 6-foot diameter steel caisson with the tank top 14 ft. below grade. A cylindrical heater is located just above each stiffening ring. A number of penetrations extend through the tank top, including an agitator (Rymarz and Speer 1991).

2.1.2.6 Waste Handling Tank. The 241-CX-70 tank, was used as a holding tank for Semiworks waste. The tank stored high-level process waste from pilot plant activities. The tank is constructed of concrete with a 1/4 in. stainless steel plate liner and is 20 ft. in diameter by 15 ft. deep (Figure 2-16). The tank top is approximately 11 ft. below grade with a 42 in. manway having a concrete cover. The nominal volume of this tank is 30,000 gal (Rymarz and Speer 1991).

2.2 HISTORY OF OPERATIONS

This section addresses the chemical processing and waste management activities at the Hanford Site to provide a geographical and time relationship with the miscellaneous tanks. The discussion of chemical processing activities (2.2.1) and waste management activities (2.2.2) provide a description of the activities performed, the period of operation, and the correlation with the miscellaneous tanks. The results of this assessment are summarized in Section 2.4. A more detailed discussion of process operations is provided in Appendix B.

2.2.1 Chemical Processing Operations

A majority of the waste generated at the Hanford Site was the result of chemical processing activities. These waste generating processes are best categorized by process facility to allow a correlation with the miscellaneous tanks. The facilities and waste generating processes are discussed in the following sections.

2.2.1.1 B Plant. B Plant operated at the Hanford Site from 1945 through the early 1980's. The primary missions of the plant over those years included defense production and waste management. The processes performed at B Plant which generated waste streams contributing to the contents of the miscellaneous tanks are:

- Bismuth Phosphate Process
- Concentrator Operation
- Waste Fractionation Process
- Cell Washing

The characteristics of the waste streams generated by these processes are provided in Appendix B of this report. The following paragraphs describe the miscellaneous tanks associated with the waste generation from each of these processes.

Catch Tanks

Five catch tanks were associated with B Plant and received waste from the Bismuth phosphate process and the waste fractionation process. The five miscellaneous catch tanks associated with the B Plant process waste streams are connected to diversion boxes used for the routing of waste from B Plant to the single shell tanks in B, BX, and BY tank farms (Neilson 1992). The five catch tanks are the 241 series tanks B-301, B-302B, BX-302A, BX-302B, and BX-302C. The two B catch tanks (B-301 and B-302B) began operation in 1945 while the three BX catch tanks began operation in 1948 (DOE-RL 1993b). These tanks all operated throughout the history of waste transfers from B Plant to the single shell tanks.

The bismuth phosphate process was used for the extraction of plutonium from irradiated nuclear fuel. The process generated four waste streams: metal waste (MW), coating waste (CW), first cycle decontamination waste (1C), and second cycle decontamination waste (2C) (Welty 1988, Winters et al. 1991, and Gerber 1991). The bismuth phosphate process was run at B Plant from 1945 through 1952.

The waste fractionation process was operated from 1968 to 1978 (Gerber 1991) to separate strontium and cesium from waste in a variety of tank farms. This process is of interest to this study due to the use of organic chelating agents. Organics in Hanford waste tanks have been a primary contributor to several of the safety issues associated with the single shell tanks discussed in Section 4.0 of this report. The five catch tanks discussed above for the bismuth phosphate process are also associated with the waste fractionation process since the waste streams generated by this process were discharged to the B, BX, and BY tank farms. No unplanned releases were identified as associated with this waste process.

Only two of the five catch tanks received unplanned releases. The 241-B-302B tank is associated with unplanned release UPR-200-E-77 and the 241-BX-302C catch tank is associated with UPR-200-E-78. These two unplanned releases are defined by the B Plant Aggregate Area Management Study as follows:

- UPR-200-E-77 was caused by work on a leaking jumper in the B-151 diversion box connected to catch tank 241-B-302B. The release occurred in 1946 and consisted of metal waste. It was estimated that 1 Ci of fission products contaminated the ground surrounding the diversion box.
- UPR-200-78 was caused by pressure testing the leins and jumpers in the BX-155 diversion box connected to the 241-BX-302C catch tank. It is estimated that 10 Ci of fission products contaminated the ground surrounding the diversion box. No date has been identified for this release.

270-E-1 Neutralization Tank

B Plant operated a concentrator to minimize the volume of waste generated by the plant. Liquid was concentrated to separate the high level waste into the concentrate (bottoms) and low level waste into steam. Only one miscellaneous tank was associated with this process. This tank, the 270-E-1 neutralization tank, received the concentrator condensate. The acidic condensate was percolated through a fixed limestone bed contained within the tank. The neutralized effluent overflowed from 270-E-1 and discharged to the 216-B-12 crib.

The B Plant AAMS (DOE-RL 1993b) states that the date of operation of tank 270-E-1 was from 1952 to 1970, however, 1974 correspondence on tank isolation indicates that the period of operation was from 1952 through 1957 (Harlow 1974b). Examination of process drawings (H-2-44502, Sheet 22) indicates the inlet and outlet lines to tank 270-E-1 were blanked off in the early 1960's.

One unplanned release, UN-200-E-64, has been identified as potentially associated with this tank. The unplanned release was discovered in 1984 on the west side of the 216-B-64 basin with ^{137}Cs and ^{90}Sr contamination at up to 100,000 ct/min. It is not known whether the unplanned release is due to transfer line failure or tank failure; however, the contamination is from the type of waste routed to tank 270-E-1 (DOE-RL 1993b). Burrowing ants have been identified as responsible for spreading this contamination over a 2 acre area.

241-B-361 Settling Tank

One settling tank, 241-B-361, was used to collect liquid wastes and allow settling of solids by reducing fluid velocity. After settling, the low level liquid waste was discharged to the 216-B-5 reverse well (DOE-RL 1993b). The tank received low level, low salt alkaline waste from Cell 5 and 6 washing operations ($BiPO_4$ waste) and additional waste from the 224-B concentration facility. The tank operated from 1945 through 1947. No unplanned releases are associated with this tank (DOE-RL 1993b).

2.2.1.2 T Plant. T Plant utilized the $BiPO_4$ process from 1944 through 1956 (Waite 1991). In 1956 the $BiPO_4$ process was discontinued and T Plant was deactivated. T Plant was converted to an equipment storage, decontamination, and experimental facility. The experimental activities were constructed in cells 1 and 2 of T Plant (the "head-end").

The waste streams generated by the $BiPO_4$ process at T Plant have similar composition to those discussed for B Plant (See Appendix B). The experimental activities conducted at the head-end facility generated small amounts of non-radioactive waste that were disposed of in the chemical sewer system and are not relevant to the miscellaneous tanks. The miscellaneous tanks associated with the operation of T Plant include seven catch tanks and one settling tank. These tanks are discussed below.

Catch Tanks

Seven inactive 301 series catch tanks are associated with the operation of T Plant including 241-T-301B, 241-TX-302A, 241-TX-302B, 241-TX-302BR, 241-TX-302XB, 241-TY-302A, and 241-TY-302B. These tanks are each connected to diversion boxes which were included in the process routing of waste from T Plant to single shell tanks. Of these seven tanks, only one tank is associated with an unplanned release. The one unplanned release, UPR-200-W-131, occurred in 1953 and resulted from leaky jumpers. An area five ft. in diameter was contaminated around the diversion box 241-TX-155, connected to the 241-TX-302B catch tank. The waste type was not identified; however, the associated process mission was the $BiPO_4$ process (DOE-RL 1992a).

241-T-361 Settling Tank

One settling tank, 241-T-361, was operated for the settling of solids from cell washing activities at T Plant. Low level, low salt, alkaline waste from 221-T and 224-T was routed to tank 241-T-361 and discharged to the 216-T-3 reverse well from 1945 to 1946 and to the 216-T-6 crib from 1946 to 1947. No unplanned releases are associated with this tank. This tank was operated from 1945 to 1946 (DOE-RL 1992a).

2.2.1.3 U Plant. The primary mission of U Plant was uranium recovery. The facility is identical to T and B Plants and was constructed in 1944 to support the $BiPO_4$ process. However, B Plant and T Plant provided sufficient processing capacity and U Plant was never used for plutonium separations. The facility began operations as a uranium recovery plant in 1952 and operated as such until 1958 (DOE-RL 1992b). Additional descriptions of the processing activities of U Plant are provided in Appendix B.

The miscellaneous tanks associated with the operation of U Plant include the tanks in the 244-BXR, 244-TXR, 244-UR, and 241-WR vaults; one settling tank; and one neutralization tank. There are no inactive catch tanks associated with U Plant. A description of these tanks and their association to U Plant processes is provided in the following sections.

244-BXR, 244-TXR, and 244-UR Vaults

These three vaults received waste from the SSTs associated with B Plant, T-Plant, and U Plant. The 244-BXR vault received metal waste from B Plant tank farms (B, BX, and BY), the 244-TXR vault received metal waste from the T Plant tank farms (T, TX, and TY), and the 244-UR vault received metal waste from the U Plant tank farms (U-101, U-102, and U-103) (Harlow 1974a). The metal waste contained uranium hydroxide present as a precipitate. This caused the waste to slurry and made waste transfers difficult. To alleviate the precipitation, the waste was acidified in the 244-BXR, 244-TXR, and 244-UR vaults by the addition of nitric acid. The acidified waste was then sent to U Plant for uranium recovery. Each of these vaults contain tanks which were used for storage of nitric acid, accumulator tanks for the receipt and storage of metal waste, and tanks which were used for the mixing of nitric acid with metal waste. Appendix A provides a detailed summary of the tank activities for each of these three vaults including process diagrams to correlate waste activities with specific single shell tanks.

One unplanned release was identified for the 244-UR vault. No unplanned releases were identified for the 244-BXR or 244-TXR vaults. The unplanned release for the 244-UR vault, UPR-200-W-24, occurred in 1953 and was the result of a chemical reaction in the 244-UR-002 blending tank. The waste type was metal waste supernate and readings of 500 to 1000 ct/min were observed. The contaminated area was backfilled and stabilized; however, the vault lies in a low area and water runoff has spread contamination beyond the immediate vault area. Additional information on the results of this release and the current status of the vault can be found in Appendix A.

241-WR Vault

The 241-WR vault was used for the storage of uranyl nitrate hexahydrate, nitric acid, and tributyl phosphate in support of the uranium recovery operations (1952 - 1958), and stored thorium nitrate solution (1958 - 1976) in support of the REDOX and PUREX processes (DOE-RL 1992b). The vault was deactivated in 1976.

An undocumented contamination incident occurred in the early 1960's when a tank overflowed and filled its cell (DOE-RL 1992b). When the tank was subsequently pumped out, it floated loose from its base, rupturing its lines, jumpers, and mechanical connections. A significant cleanup effort was required to return the facility to operational status.

241-U-361 Settling Tank

One settling tank is associated with U Plant operations. This tank, 241-U-361, served as a settling tank for liquid wastes enroute to the 216-U-1 and 216-U-2 cribs. The waste streams routed through the settling tank included cell drainage, UO_3 conversion waste, 276-U solvent scrubbing waste, and UO_3 equipment decontamination.

One unplanned release is associated with this tank. This release, UN-200-W-19, is reported as organic waste and cell drainage from the TBP and UO_3 plants which overflowed to the ground by way of the tank and crib vents in the spring of 1953. Ground decontamination was attempted and the area was then backfilled, delimited with a wooden fence, and posted with radiation zone signs (DOE-RL 1992b, Baldridge 1959). However, available information suggests that the tank has never been pumped out.

270-W Neutralization Tank

The 270-W neutralization tank was operated to neutralize process condensate from U Plant. As with the 270-E-1 neutralization tank, operated for B Plant, acidic condensate was routed through a limestone bed in the tank prior to discharge to a crib. Neutralized effluent was sent to the 216-U-8 crib from 1952 through 1960 and to the 216-U-12 crib from 1960 through 1970 (Neilsen 1992).

A maintenance building, 2715-UA, was constructed directly above the tank, and visual inspection of the site indicates that the charging and vent risers were cut to below ground level and a cement slab poured over them (Harlow 1974b). No unplanned releases are associated with this tank.

2.2.1.4 Z Plant. Z Plant, also referred to as the plutonium finishing plant, consists of numerous facilities which supported the purification of the plutonium extracted by the three separations processes ($BiPO_4$, REDOX, and PUREX). There are four miscellaneous tanks, all settling tanks, associated with the operation of Z Plant facilities. These tanks are discussed individually below. Additional information for each tank can be found in Appendix A. Specific processes, as they relate to the miscellaneous tanks, are summarized below while a more detailed description of the history of Z Plant is provided in Appendix B of this report.

241-Z-8 Settling Tank

The RECUPLEX process used solvent extraction technology to remove plutonium from Plutonium Finishing Plant (PFP) waste streams based on the formation of an organic-plutonium complex which is preferentially soluble in an organic solvent. This waste stream was discharged directly to the 241-Z-8 settling tank, also referred to as the silica gel tank (DOE-RL 1992c). Waste liquids were discharged from the 241-Z-8 settling tank to the 216-Z-8 french drain. No records were identified for the disposal history of spent silica gel from the 241-Z-8 tank; however, available information suggests that the tank has never been pumped out. A reported 3.5 lb of plutonium were present in the tank as of 1974 (DOE-RL 1992c). The use of this tank was discontinued in April 1962 (DOE-RL 1992c). There are no identified unplanned releases associated with this tank.

241-Z-361 Settling Tank

The 241-Z-361 settling tank received waste from the Plutonium Recovery Facility (PRF), the PFP or 234-5Z, and the Americium Recovery Process in the 242-Z Facility. The character of each waste stream is provided in Appendix B and summarized below. The PRF utilized a similar process to the RECUPLEX process, utilizing a carbon tetrachloride/tributyl phosphate extraction process. The primary waste streams generated by the PRF included spent aqueous solutions, spent organic wastes, and non-contact waste water. These waste streams were routed to the soil column via the 241-Z-361 settling tank (DOE-RL 1992c).

The 234-5 Z plant (PFP) was operated to convert plutonium nitrate to plutonium metal. Three process lines were operated over a forty year period. Each of these three processes created a high salt, acidic (PH $\leq$2), low organic waste stream which contained detectable quantities of plutonium and other TRU elements (Jensen 1990, DOE-RL 1992c).

231-W-151 Settling Tanks

The Z Plant analytical and development laboratories are currently housed in the 234-5Z building; however, historically, analytical and development laboratories are also reported to have been housed in the 231-Z Building (Stenner et al. 1988). The laboratory provides analytical services for PFP activities.

The laboratory process waste from 75 floor drains was routed through the 231-W-151 settling tanks 231-W-151-001 and 231-W-151-002 (Neilsen 1992). Both tanks in the vault drained to the 216-Z-7 crib (Neilsen 1992). No treatment activities are known to have occurred within these tanks. Chemical and radionuclide analyses are available for samples from these tanks as shown in Appendix A.

2.2.1.5 S Plant. The S Plant facilities began operation in 1951 with a reduction-oxidation process (REDOX) in the 202-S facility to replace the $BiPO_4$ process. The REDOX process was the first process designed to recover both plutonium and uranium (Gerber 1991). Operations at the 202-S plant were discontinued in 1967 and the REDOX process was replaced with the PUREX process. The 222-S analytical laboratory began operations in 1951 and provides high-level and low-level chemical and radiological analytical services for all activities in the 200 Areas. This laboratory is still in operation.

S Plant had four miscellaneous tanks (tanks 240-S-302, 241-S-302A, 241-S-302B, and 241-SX-302) associated with its operation. These tanks were all catch tanks associated with diversion boxes and were designed to accept overflows and spills from diversion boxes (DOE-RL 1992d). Each of the catch tanks was used in support of waste transfer operations from REDOX and/or the 222-S laboratory activities. Tank 241-S-302A experienced liquid level decreases between February and March 1990. In August 1991 a new tank was installed and existing waste lines rerouted from tank 241-S-302A to the new tank. Three lines from the 241-S-302A tank were cut and capped (Neilsen 1992). Tank 240-S-302 is also assumed to have leaked, according to Occurrence Report 77-58 (DOE-RL 1992d).

2.2.1.6 PUREX Facility. The plutonium/uranium extraction (PUREX) process began operation in 1956 in the 202A facility and operated until 1972. A second operating mission was performed from 1983 until final shutdown in 1992. This process was the last of the plutonium separation processes at the Hanford site. The main purpose of the facility was to extract plutonium, uranium, and neptunium from irradiated fuel rods discharged from defense production reactors located in the 100 Area (Gerber 1991).

Only one miscellaneous inactive tank is associated with the PUREX facility. This tank is 241-A-302B catch tank which began operation in 1956 and supported waste transfers from processing and decontamination operations (DOE-RL 1993c). There are no unplanned releases associated with this catch tank.

2.2.1.7 Semiworks (C Plant) Facility. The C Plant facilities were originally constructed in 1949 to provide pilot plant activities in support of the REDOX process and were converted to a pilot plant for PUREX in 1954. The primary facility is the 201-C process building. The facility was used to operate these two processes, on a pilot scale, with waste streams similar to those for the REDOX and PUREX processes. The semi-works facility was also used as a pilot plant for the B Plant Waste Fractionization process. Several million curies of fission products were processed during these operations. The facility ceased operation and decommissioning was initiated in 1983 (DOE-RL 1993d).

There are four miscellaneous tanks associated with the C Plant facilities. These tanks are the 241-C-301C catch tank, the 241-CX-70 waste handling tank, the 241-CX-71 neutralization tank, and the 241-CX-72 experimental tank. These tanks are each addressed below.

241-C-301C Catch Tank

This catch tank operated from 1946 through 1985 in support of the Semiworks facilities (DOE-RL 1993c). The tank is associated with four diversion boxes, 241-C-151, -152, -153, and -154. The catch tank is associated with waste transfers to the 241-C tank farm. There are no documented unplanned releases associated with the operation of this catch tank.

241-CX-70 Waste Handling Tank

This inactive miscellaneous tank received high level process waste from the REDOX process at the 201-C facility and was used from 1952 through 1957 (Rymarz and Speer 1991). There are no unplanned releases identified as associated with this tank.

241-CX-71 Neutralization Tank

This tank provided flow through neutralization of acidic 201-C process condensate and the coil and condensate cooling water stream prior to discharge to the 216-C-1 crib. It may have also received process condensates from REDOX and PUREX pilot plant operations, decontamination flushes, and Hot Shop sink waste (DOE-RL 1993d). To achieve neutralization, a limestone bed was employed within the tank. Upon dissolution of the limestone by the acidic waste, additional limestone was added through a large central riser pipe. The Semiworks Source Aggregate Area Management Study (DOE-RL 1993d) indicates that very little historical information is available on this tank. No unplanned releases have been documented for this tank (DOE-RL 1993d).

241-CX-72 Experimental Tank

This tank was used experimentally for one year during 1957 - 1958. The purpose of the tank was to provide experimental data on complex waste self concentration from the PUREX process at the Semiworks facility (Rymarz and Speer 1991). There are no unplanned releases associated with this tank (DOE-RL 1993d).

2.2.2 Waste Management Activities

Throughout the history of operations at the Hanford Site, management of the waste generated by the chemical processing plants has been an integral part of the site's mission. Management of the waste included treatment, storage, handling, volume reduction, and disposal. This section provides a discussion of these issues, as they relate to the operation and/or content of the miscellaneous tanks.

2.2.2.1 Tank Farm Operations. There are 177 radioactive waste storage tanks in the 200 East and West Areas of the Hanford Site, including 149 single shell tanks and 28 double shell tanks (Hanlon 1993). The operation of these tanks has involved numerous secondary processes performed either directly within the tank or between tanks. These include tank to tank transfers, cascading and settling, and self-concentration. These operations may have an impact on the miscellaneous tanks due to the waste composition changes from original process discharges and in correlating known SST waste to miscellaneous tanks.

Of primary interest are those SSTs which are listed as "watch-list" tanks (see Table 2-2). These tanks have known safety hazards and any correlation of SSTs to miscellaneous tanks may help identify potential hazards with the miscellaneous tanks.

The demand for tank farm space has historically been very strong at the Hanford Site. To accommodate operation of a new process, or relocate a particular waste type for ease of operation, waste would be transferred from one tank to another, sometimes within a tank farm and sometimes between tank farms. The high quantity of these tank farm transfers and their complexity makes estimating waste composition a difficult process. The miscellaneous tanks most affected by the inter-tank transfers were the catch tanks. These tanks were connected to diversion boxes which could be reconfigured to accommodate waste transfers to and from a variety of sources. This makes correlation of SST wastes to miscellaneous tanks questionable since research indicates that full knowledge of all waste transfer routings, and particularly associated quantitative information on waste spillage and leakage, is not available. This means that reliable quantitative information on miscellaneous tank waste content, especially catch tanks, cannot be derived through only process knowledge.

In addition to correlation with SSTs, REDOX and PUREX high-level wastes contained high enough levels of fission products for the wastes to self-boil from the heat generated by nuclear decay. This was unexpected, but the potential space-saving value was recognized (Gerber 1991). In some cases, condensate from boiling was discharged to cribs and trenches, thereby effecting a certain reduction of high-level waste volumes in tanks. This in-tank process would cause concentration of the contaminants; thus, any miscellaneous tanks identified that received waste from these tanks would have a higher level of contaminants due to self concentration than estimated from the reference materials for the process generated waste stream.

2.2.2.2 Evaporator/Concentration Operations. One widely used waste reduction method involved evaporation of wastes. The resulting evaporator bottoms (EB) contained the same chemicals as in the original feed, but at considerably higher concentrations. This reduced volume of highly concentrated waste was returned to the SSTs for storage.

This process was carried out by two methods. One method made use of in-tank heating to remove water. The other involved the transfer of the liquid waste to a standard evaporator located in a separate building. Bottoms from these evaporators were returned to the SSTs (Anderson 1990).

The impact of evaporation on miscellaneous tanks is similar to that of waste self boiling. The steam generated during evaporation processes was discharged to cribs while the concentrated slurry was returned to tank farms. This would tend to cause the waste in the tank farms to have a higher radiological content than if estimated solely from process knowledge. During transfers between tank farms, waste which leaked into diversion boxes, and subsequently catch tanks, would be more concentrated than waste transfers from processing plants to tank farms.

2.2.2.3 Cesium Scavenging Using Ferrocyanide. In 1953, the ferrocyanide process was started to reduce the volume of wastes that had to be stored in SSTs (Waite 1991). The objective of the ferrocyanide process was to precipitate the soluble long-lived ^{137}Cs from tributyl phosphate process waste (also 1C waste from $BiPO_4$) so it could be discharged to the soil column.

Scavenging process testing was initiated at U Plant in October 1953. Production scavenging of uranium recovery wastes began at U Plant in September 1954. The scavenged wastes were routed from U Plant to the BY SSTs in the 200 East Area. After allowing at least a week for settling, supernatant was pumped off for disposal in a crib or trench. Accumulated sludge was periodically pumped to tanks BY-104 or -105. Production scavenging and waste routing as outlined above continued until June 1957.

Beginning in May 1955, wastes that were stored in 200 East Area from the earlier uranium recovery processing were also scavenged using the ferrocyanide process. The wastes were routed to the 244-CR vault in 200 East Area for "in-farm" scavenging. The waste then was routed back to SSTs for settling (primarily C-108, -109, -111, and -112) and the supernatant subsequently was pumped to the BY cribs and one of the BX trenches in the 200 East Area until 1956. Starting in 1956, the supernatant was discharged to the BC cribs and specific retention trenches in the 200 East Area. The "in-farm" scavenging in the 244-CR vault ended in December 1957. The last of these wastes were discharged to the ground in January 1958.

In addition to the scavenging of uranium-recovery waste, scavenging of T Plant 1C wastes (from the $BiPO_4$ process) occurred from December 1954 to March 1956 (Scheele et al. 1991). This scavenging was of the "in-plant" type. The waste from this scavenging were routed to tank TY-101, -103, and -104 for settling.

Ferrocyanide scavenging impacts the process chemistry and the ferrocyanide safety issues associated with any of the miscellaneous tanks that received ferrocyanide wastes. A schematic has been developed which shows the ferrocyanide process routing along with any of the miscellaneous tanks present along the process routes (Figure 2-17). From this, it can be observed that six tanks and one sump may have received ferrocyanide waste:

- 241-T-301B
- 241-TX-302B
- 241-TY-302A
- 241-C-301
- 241-WR-001 (sump as well)
- 241-WR-002 (sump as well)
- 244-BXR vault, sump 002

Waste management operations throughout the following years, including tank-to-tank transfers, may have caused some small quantities of ferrocyanide waste to be spread to additional miscellaneous tanks. It is assumed that miscellaneous tanks such as catch tanks in configurationally close proximity to tank farms now containing ferrocyanide waste list tanks will contain at least measurable amounts of ferrocyanides. These miscellaneous tanks are included in the more extensive listing of Table 2-2 than that depicted on Figure 2-17. However, the quantity of ferrocyanide in these tanks is expected to be well below hazard levels and tanks indicated as "ferrocyanide" are shown in Chapter 4 to present a low risk.

2.2.2.4 Organics. Significant amounts of organic materials are present in the tank wastes at the Hanford Site. These organic compounds originated from a variety of processes and operations and are widely distributed in the SSTs and DSTs. Eight of these tanks contain organic chemicals at levels probably exceeding three percent total organic carbon mixed with the oxidizing salts' sodium nitrate/sodium nitrite (Hill and Babad 1991), which warrants their inclusion on the tank safety watch list. It is conceivable that some of the miscellaneous tanks may also contain significant levels of organic compounds mixed with nitrates and nitrites. Examination of the sources and fate of the organic materials in waste streams may suggest which, if any, of the inactive miscellaneous tanks may have received significant amounts of these materials.

The principal organic compounds found in wastes included solvents [e.g., NPH (normal paraffin hydrocarbons), hexone, and carbon tetrachloride], complexing agents [EDTA (ethylenediaminetetraacetic acid) and HEDTA (N-(hydroxyethyl)-ethylenediaminetetraacetic acid), reagents for solvent actinide and fission product extraction, buffering or denitrification reagents (e.g., citric acid and sugar), and general laboratory reagents (Hill and Babad 1991). Appendix B lists the organic chemicals used at the Hanford Site, correlated by operations and processes. Combining process operating history with organic chemical use provides a qualitative indication of organics in miscellaneous tanks. From process history it is apparent that almost all catch tanks contain some quantity of organic material. Vault tanks are unlikely to contain any appreciable quantity of organics since these tanks received only metal waste for uranium recovery operations. The 241-CX-70, 241-CX-71 and 241-CX-72 tanks likely received high quantities of organics from C Plant activities. The Z Plant settling tanks, especially the 231-W-151-001 and 231-W-151-002 tanks, likely received enough organics to cause potential flammability or vapor emission concerns. The 361 series settling tanks and the 270-E-1 and 270-W neutralization tanks received some organics; however process history on quantities of organics remaining in the tanks is not sufficient to determine if the level is high enough to cause safety issues.

Appendix A identifies the possible organic composition for each miscellaneous tank. Appendix B specifies organic chemicals used for each process. Chapter 4 discusses the safety issues associated with organics.

2.3 ISOLATION/STABILIZATION STATUS OF MISCELLANEOUS TANKS

Most of the miscellaneous inactive tanks were interim stabilized and interim isolated before September 1985, with the majority being isolated by Project B-231 (Table 2-3) (Prosk and Smith 1986). This project interim stabilized and interim isolated numerous catch tanks, vaults, diversion boxes, diverter stations, valve pits, and pipeline encasements to prevent inadvertent liquid additions to these facilities and to protect the environment from possible releases of radioactive materials (McVey 1980). Wastes in these inactive facilities were first interim stabilized by removing liquid to reduce the mobility of radiological contaminants, and the wastes and facility were then interim isolated for safe storage until final disposal (Prosk and Smith 1986).

Bell (1984) defined "interim stabilized" as the condition of an inactive waste storage or auxiliary tank when all liquid that is technically and economically practical to remove has been removed. Because the miscellaneous tanks each have a total volume less than 82,500 gal, they were not considered to be candidates for jet pumping of interstitial liquid (Bell 1984). Only supernatant liquid was considered in the interim stabilization of these tanks. The interim stabilization criteria were to pump down the low radioactivity supernatant liquid as far as practical (4 in. from bottom or the solids/sludge level) and transfer the liquid waste into a tank truck for disposal into a DST. Supernatant volumes of 400 gal or less were considered to be economically and technically non-pumpable to a tank truck. If the supernatant liquid was too highly radioactive to be pumped to a tank truck without dilution, then overground piping to an underground tank or receiver vessel was considered. Supernatant volumes of 5,000 gal or less were considered to be economically and technically non-pumpable via overground piping (Bell 1984).

Early in the isolation program, new gaskets were not routinely added to all above ground tank access risers. During the Project B-231 interim isolation of the various miscellaneous tanks, all above ground tank access risers were re-gasketed with a new 1/8 in. thick Blue African asbestos gasket and a new 150-lb blind flange (Figure 2-18). A minimum of four bolts were used to secure 1/2 in. thick flanges on small risers and 1 in. thick flanges on 12 in. diameter or larger risers (Prosk and Smith 1986).

The polyurethane weather cover system used to seal above ground structures for interim isolation shown in Figure 2-19 consists of a paint-on primer coat, a minimum 2 in. thick layer of polyurethane foam applied in-place, and a two-coat system of silicone membranes which provides a vapor/moisture barrier and ultraviolet protection for the foam (Prosk and Smith 1986).

Individual tank evaluations were performed during Project B-231 to determine whether and when a tank was to be considered interim stabilized. These tank evaluations, along with the then current tank or sump liquid and solid level measurements, were documented and approved on a Stabilization Evaluation Form, which then became part of the project records (Bell 1984). A search of the Project B-231 project files found forms for all the miscellaneous tanks except for tanks 241-B-301, 241-Z-8, 241-Z-361 and the 241-WR vault tanks. Liquid and solid level measurements obtained from the Stabilization Evaluation forms or the most recent data available are compiled in Table 2-3. Because measurements were typically obtained just prior to tank isolation, they are the best available data concerning current tank waste volumes. However, the volume calculations for the 244-BXR, 244-TXR, and 244-UR vault sumps provided on the stabilization evaluation forms differ from calculations made using sump calibration tables reported in Bendixsen (1982). These volume differences generally range from a few gallons to approximately 300 gal. One exception is the 244-BXR-0011 tank sump which has a difference of nearly 4500 gal. As noted in Table 2-3, some of the tanks have conflicting liquid level measurements recorded on the forms. Rymarz and Speer (1991) indicate that tank 241-T-361 contains 11,000 gal of supernatant, where as the stabilization form indicates no liquid in the tank. Because of the measurement and volume discrepancies noted above, the accuracy of data in Table 2-3 is questionable until it can be confirmed.

Catch tanks were isolated with their associated diversion box as part of the isolation of the various SST tank farm units (Figure 2-20). The wall nozzles in the diversion box which were connected to active facilities or other tank farm units were sealed, the leak detector was removed, and the box itself was sealed by weather covering with polyurethane foam (Prosk and

Smith 1986). When the diversion box was sealed, the catch tank draining it was isolated. The above ground risers were all sealed and all utilities were disconnected. Just before final sealing, the tanks were pumped, if necessary, to meet stabilization criteria (Bell 1984). The liquid level sensor was removed and polyurethane foam was applied to seal the catch tank, if necessary. No direct surveillance has been maintained after interim isolation (Prosk and Smith 1986).

Daily monitoring is performed on four of the 18 tanks. These tanks include assumed leakers: 240-S-302, 241-S-302A, and 241-TX-302B. Tank 241-A-302B may be a leaker based on recorded data. The monitoring is performed to detect liquid leaks from or into the tanks. No safety monitoring (temperature, moisture, organic vapor) is performed for any of the catch tanks. The monitoring data is maintained in Tank Farm Surveillance files and is summarized in monthly reports (Hanlon 1994).

Vaults 244-BXR, 244-TXR, 244-UR, and 241-WR were isolated as a unit with their directly associated diversion boxes (Figure 2-19) (Prosk and Smith 1986). The vault tanks remain undisturbed. Utilities were disconnected as near as possible to the main supplies. Any direct-buried lines connected to the vault were sealed at the wall nozzles. The ventilation system was disconnected and sealed, and unnecessary instrument and electrical enclosures were removed. Just before the vault was sealed, the diversion boxes which drained to it were sealed as discussed above. The vault tanks and sumps were then pumped, if necessary, to meet stabilization criteria (Bell 1984). The liquid level sensor(s) were removed and polyurethane foam was applied to seal the vault covers. No direct surveillance has been maintained after interim isolation (Prosk and Smith 1986).

The neutralization and settling tanks have each been interim isolated. Specific data with respect to isolation of these tanks is provided in Table 2-3 and the tank specific summary sheets of Appendix A.

The 241-CX-72 tank was filled with grout in 1986 since it was believed to be empty. Later a contaminated actuator rod was accidently pulled from the tank and investigations indicated there was waste material in the tank under the grout. Plans were made to drill out the grout and sample the underlying waste. More recently, plans to drill out the grout have been abandoned (Subrahmanyam 1989).

In 1988 the sludge in the 241-CX-70 tank was sluiced and flushed and in 1992 the tank was completely emptied. A Trace Tek leak detection system is installed and is monitored monthly for leakage into the tank.

2.4 CONTENT AND COMPOSITION OF MISCELLANEOUS TANKS

This section provides a description of potential tank composition, or where possible, the existence of actual sample and analysis data. The lack of specific sample and analysis data for a majority of the tanks requires estimating the potential waste composition, and where possible, maximum levels of constituents for all of the miscellaneous tanks. To accomplish this, the chemical and radiological constituents are addressed in two separate forms. The first, as discussed in section 2.4.1, is a discussion of the waste stream composition developed using process knowledge. This allows the presentation of the entire spectrum of radiological and chemical species which may be in any particular miscellaneous tank. The second data presentation (Section 2.4.2) involves referencing available sample data, or engineering findings, as documented in the numerous research materials available for this study.

The volume of waste, both supernate and sludge, is an important characteristic for the miscellaneous tanks since very full tanks may impose an environmental or personnel hazard, while empty tanks likely pose no hazards. Figures 2-21 and 2-22 provide a graphical representation of the miscellaneous tank contents.

2.4.1 Composition of Waste by Area

Chemical and radiological species were discharged to the tanks from separations and recovery activities at the various facilities, including:

- B Plant and T Plant - $BiPO_4$
- U Plant - Uranium Recovery
- Z Plant - Plutonium Finishing
- S Plant - REDOX Process
- A Plant - PUREX Process
- C Plant - Semiworks (REDOX and PUREX Processes)

A comprehensive list of chemicals and radionuclides used in these processes was developed during the preparation of the Source Aggregate Area Management Studies. This list is presented in Appendix B. This list of chemical and radiological species provides a starting point for determining components within any of the miscellaneous tanks. The listing is generic and incomplete with respect to processes not included in the separations and recovery of plutonium and uranium, specifically with respect to laboratory/analytical activities, cesium and strontium concentration, ferrocyanide scavenging, and any potential effects of radiolysis.

The Source Aggregate Area Management Study Reports also included comprehensive lists of chemicals and radiological species discharged to each of the aggregate areas. These lists are provided in Appendix B for each operating facility and provide a detailed list of constituents which could be expected in any of the miscellaneous tanks associated with a particular aggregate area.

The use of these generalized lists is necessary only when there is no sample and analysis data, or there is a technical reason for suspecting the validity of the available data. Section 2.4.2 discusses the contents of each miscellaneous tank and/or categories of tanks.

2.4.2 Tank Specific Content and Composition

This section provides tank specific information on the content and composition of the 50 inactive miscellaneous tanks. Appendix A provides tank specific data sheets. To the extent possible, these data sheets provide individual tank radiological and chemical profiles (estimates or referenced data) or types of process wastes expected to be present.

2.4.2.1 Catch Tanks. In general, the catch tanks have the least amount of data available of any of the miscellaneous tanks.

In order to provide a basis for qualitative estimation of the chemical species and radionuclides in the waste in the catch tanks, simplified process flow diagrams have been prepared for each of the catch tanks (see data sheets in Appendix A). The diagrams show the diversion boxes and tank farms immediately associated with the catch tanks. The chemical and radiological profile of the associated single shell tanks should be comparative (as a worst case scenario) with the profile of the miscellaneous tank since the catch tanks received transfer piping leakage and spills of waste transfers to and from these tank farms. For example, the flow diagram for catch tank 241-C-301 indicates that this tank may have received spillage and/or leakage associated with transfers to and from the C tank farm. Consequently, it is reasonable to assume that the constituents of the 241-C-301 catch tank are similar to the constituents of the C tank farm. Similarly, each catch tank can be loosely associated with specific tank farms as indicated on the flow diagrams. Although this is not an exact technique for estimating catch tank content, it does provide a reasonable first approximation consistent with the scope of this study.

To apply this approach, knowledge of the waste inventories contained in the tank farms is required. However, complex waste management operations over decades of time have made accurate, quantitative definition of present chemical and radionuclide inventories in the tank farms impossible without significant sampling and analysis efforts, which will take years to complete. Estimates have been performed, most notably using the TRAC computer model (Droppo et al. 1991). Unfortunately, as the applicability and accuracy of these estimates are suspect, they cannot be used. However, the amounts and types of specific wastes originally consigned to the various SSTs in the tank farms are well known (Anderson 1990). This information has been used to correlate catch tanks to likely waste types and amounts they received by drawing the comparison to catch tanks' periods of operation with periods of active waste transfers. For example, tank 241-C-301 is assumed to contain the waste types involved in active C Tank Farm waste transfers for the period 1949 - 1980 (the years of use of 241-C-301). The periods of active waste transfers for the relevant tank farms, broken down by waste types, are given in Appendix B. Also included are available chemical information on waste content and a key to the abbreviations used for the waste types.

Certain limitations and uncertainties are associated with this approach. They are as follows:

- Most of the catch tanks were operated through the life of the processing missions and then sat idle until isolation in the mid-1980's. From the end of the processing missions to isolation the tanks received only precipitation from rainfall, snow melt, and condensation. This would tend to dilute the contents of the catch tanks.

- Most of the diversion boxes received spills and leaks, which were then "cleaned" by flushing the waste to the catch tanks. This would also tend to dilute the contents of the catch tanks.

- Single shell tank activities such as cascading and settling, inter-tank farm transfers, and evaporation would have specific impacts on the species specific concentration levels in the tank farms (and consequently in the catch tanks). These are difficult to characterize and account for.

- The effects of documented, and undocumented, unplanned releases on the catch tanks further complicates comparative characterization. If an unplanned release consisted solely of metal waste, and the associated tank group received a wide variety of waste types, then the comparative technique does not give a complete picture of the true situation.

The following paragraphs provide specific references to known contents of the various catch tanks.

<u>301 Series Catch Tanks</u>

Analytical data for the 301 series of catch tanks indicates that the supernatant in the tanks has a moderately basic pH (8.5 to 9.3) and a low level of fissile material. The cesium content is also very low. Sludge samples and assays are not available. From the available information, the supernatant does not contain chemical constituents which would constitute designation as a dangerous waste (Neilsen 1992). Appendix A lists specific contaminants for each of the 301 series tanks.

<u>302 Series Catch Tanks</u>

There are no generic waste content estimates available for the 302 series tanks. Specific tank references to volume and content are provided in Table 2-3 and Appendix A and summarized below. References for the data below are provided in Appendix A.

241-A-302B: 3,100 gal, dilute PUREX process waste. No unplanned releases associated with this tank.

241-B-302B: Unplanned release of metal waste associated with tank. 4,930 gal of waste remaining in tank.

241-BX-302A: Mixed waste, metal waste. Remaining volume of 835 gal (sludge). No unplanned releases associated with this tank.

241-BX-302B: Mixed waste, metal waste. Remaining volume of 1,044 gal. No unplanned releases associated with this tank.

241-BX-302C: Unplanned release of salt waste associated with this tank, containing approximately 10 Ci of mixed fission products. Remaining volume of 863 gal.

240-S-302: Received low-level, dilute laboratory waste. Recent measurements (05/24/93) indicate that the waste level in the tank includes solids volume of 2,284 gal with an estimated 100 gal of interstitial liquid (Hanlon 1993). Approximately 600 gal of rainwater were released from this tank between June 1985 and January 1986.

241-S-302A: REDOX type wastes. Partially filled with grout, approximately 5,270 gal of waste remain. No unplanned releases associated with tank.

241-S-302B: REDOX type waste. Empty. No unplanned releases associated with this tank. See data sheet for further information on estimated waste types the tank probably received.

241-SX-302: REDOX type waste. Remaining waste volume of 1,355 gal. No unplanned releases associated with this tank.

241-TX-302A: Mixed waste, metal waste. Processing and decontamination waste. Remaining volume of 2,480 gal. No unplanned releases associated with this site.

241-TX-302B: Mixed waste, metal waste. Processing and decontamination waste. Remaining volume 1,425 gal. One unplanned release of unknown volume is associated with the tank. The release occurred in 1953 and was likely $BiPO_4$ waste.

241-TX-302BR: Mixed waste, metal waste. Contents unknown. No unplanned releases associated with this tank.

241-TX-302XB: Mixed waste and metal waste. Remaining volume of 353 gal. No unplanned releases associated with this tank.

241-TY-302A: Mixed waste, metal waste. Processing and decontamination operations. Remaining volume of 450 gal. No unplanned releases associated with this site.

241-TY-302B: Mixed waste, metal waste. Processing and decontamination operations. Tank listed as empty. No unplanned releases associated with this site.

2.4.2.2 Vault Tanks. There are four sets of vault tanks. The 244-BXR, 244-TXR, and 244-UR vaults all performed virtually identical missions of metal waste pretreatment for uranium recovery. The 241-WR vault also performed pre-treatment for uranium recovery; in addition, this nine tank vault performed thorium storage and recovery missions in support of U Plant operations. The remaining volume in these vault tanks are provided in Table 2-3 and on the tank specific data sheets provided in Appendix A. The content of these vault tanks has been reported at a very high sludge to supernatant ratio. In particular, the 244-TXR vault has a reported ratio of less than 1% supernatant with respect to sludge, according to project interim isolation records (Neilsen 1992). The 244-UR vault tanks 244-UR-001 and 244-UR-003 have been pumped down to a minimum heel. A radiation reading of 1 mrad/hr was obtained from the 244-UR-002 tank, versus a reading of 1.5 rad/hr taken from the 244-TXR-002 tank. Thus, it is postulated by Neilsen (1992) that the radiological content of this tank is much lower than for the 244-TXR or 244-BXR vaults. The 244-BXR-011 tank was identified by Neilsen (1992) as the tank having the highest radiological content within the 244-BXR vault based on sample and analysis data. The composition of these vault tanks is provided in the data sheets in Appendix A.

The 241-WR vault tanks are empty of wastes, as reported in 1981 correspondence, with the exception of Tank 009, which is reported to contain 23,000 gal of liquid (DiPietro 1979).

2.4.2.3 Settling Tanks. The composition of the settling tanks is discussed below and provided in more detail in the data sheets of Appendix A. The primary reference for the 361-Series settling tanks is Rymarz and Speer (1991). The primary reference for the 231-W-151 tanks is Neilsen (1992). Unplanned release references for each are from the Source Aggregate Area Management Study Reports for the associated tanks.

Settling Tank 241-B-361

This tank received low level, low salt, alkaline radioactive liquid wastes from 5-6 W Cell washings in 221-B and wastes from the bismuth phosphate processing in the 224-B Building. Tank solids now present consist primarily of bismuth phosphate. The sludge moisture content of this tank was approximately 70% in 1980. The sludge was reported to contain an estimated 2.46 kg of plutonium, 2 million Ci of strontium (isotopes 89 and 90), and approximately 125 Ci of cesium (Rymarz and Speer 1991). However, this reference indicated a strontium concentration of 23 microcuries per gram of sludge. With a sludge specific gravity of 1.29 g/cc, the 22,000 gal of sludge would contain approximately 1.07 x 10^8 grams of sludge. With the stated level of 23 microcuries per gram, the sludge would contain approximately 2,500 Ci of strontium. Thus, the reported strontium content of 2 millions Ci is believed to be incorrect. This is also confirmed by the WIDS database, which reports 1,060 Ci beta/gamma and also correlates with summaries of liquid discharges to the ground for the time period July 1952 to June 1954, which reflect Sr concentrations that would result in Sr accumulations far less than 2 million Ci (Ruppert and Heid 1954).

Settling Tank 241-T-361

Settling tank 241-T-361 received drainage from the 221-T Building (low-level waste from uranium recovery process) and decontamination wastes from the 224-T Building. A 1984/87 estimate indicated an inventory of 15,500 Ci of beta/gamma and 2 kg of plutonium. A 1974 report indicated that the maximum amount of plutonium in the tank could be no more than 390 grams. However, summaries of liquid radioactive wastes discharged to the ground in the 200 Areas for the time period of July 1952 through June 1954, support the higher 2 kg inventory for Pu (Ruppert and Heid 1954). Records do not indicate that anything was added to the tank after 1950 (Rymarz and Speer 1991). The WIDS database indicates a radionuclide content of 2,125 Ci beta/gamma with an unknown plutonium content.

Settling Tank 241-U-361

Settling tank 241-U-361 received drainage from the 221-U Building (low-level waste from uranium recovery process) and decontamination wastes from the 224-U Building. One estimate of the plutonium and uranium content was 42.5 grams of plutonium and 4,026 kg of uranium. Another estimate based on a sample of sludge in 1976 indicated a plutonium and uranium content of 1 gram and 69,000 kg, respectively. Records for the sludge indicate the specific gravity at 1.49; therefore, a gallon of in-place sludge would weigh approximately 12.4 lb. The total weight of the sludge is approximately 325,000 lb (147,700 kg). If the sludge contained 69,000 kg of uranium the percent of uranium would be approximately 47%. This is not realistic, as the sludge is reported to contain 65.6% water, 27.2% sodium nitrate and 10% other salts. It is expected that the uranium content estimate is less than 6,900 kg and is probably close to 4,000 kg (Rymarz and Speer 1991). The WIDS database indicates a radionuclide content of 2,125 Ci beta/gamma with an unknown plutonium content. One unplanned release is associated with this tank, consisting of organic waste and radioactive liquid waste. Very high levels of radioactivity were monitored at the site following the release (11.5 R/hr)(DOE-RL 1992b).

Settling Tank 241-Z-361

This tank contains 20,000 gal of sludge and 200 gal of supernatant. The sludge is heterogeneous, layered, and appears to have the consistency of mud. The apparent moisture content of the sludge is approximately 30% and may or may not include the supernatant (Rymarz and Speer 1991). The primary mission of Z plant was to process plutonium and therefore the expected plutonium content of the sludge would be high. Estimates of the plutonium concentration are in the range of 0.1 to 1.3 g per liter (the assumed value of 26.8 kg of plutonium is at the low end of this range). The WIDS database reports a content of 30 to 75 kg plutonium. A recent criticality analysis (Carter and Brown 1976) indicated that even with the highest estimate of plutonium content, the tank contents would remain subcritical even with up to 85% moisture loss, and that a criticality event is not possible under all credible scenarios of surveillance.

241-Z-8 Settling Tank

This was a solids settling tank for the backflush of the feed filters for the RECUPLEX process. It was also known as the Silica gel settling tank. Overflow from the tank went to the 216-Z-8 french drain. Analytical sampling of the tank indicates a plutonium content between 8 and 1,444 grams.

231-W-151 Tanks

According to 1974 laboratory reports, the 231-W-151-001 tank contains a negligible amount of plutonium, while 231-W-151-002 contains about 228 grams of plutonium in the sludge and less than 0.001 grams of plutonium in the supernatant. There is no evidence that there is plutonium in the vault. Radiation surveys indicate a 10 mrem/hr reading at the hatch cover and 100 mrem/hr at the tank tops (Neilsen 1992).

2.4.2.4 Neutralization Tanks. The neutralization tanks associated with the concentrator operations at B Plant and U Plant, 270-E-1 and 270-W, are not well documented with respect to composition. This issue was briefly addressed in the Neilsen (1992) report; however, no specific data was provided. The remaining neutralization tank, 241-CX-71, is discussed below.

241-CX-71 Neutralization Tank

Tank 241-CX-71 received condensates from the REDOX and PUREX processes and decontamination flushes from PUREX and the Semiworks Facility. Consequently, a wide variety of chemicals could be present in the tank (Neilsen 1992). Appendix B contains a list of chemicals likely to be in the tank.

Liquid and sludge samples where obtained from the tank in October 1990. These contained ppb range concentration of methylethylhexene, xylene and toluene, and 21 ppm cyanide (Neilsen 1992). Radionuclide estimates are available based upon a liquid sample taken from the tank in 1974. The results decayed to March 1, 1992, indicate the following (Neilsen 1992):

pH	=	6.8
O.T.R.	=	3.0 mrad/hr
$^{89,90}Sr$	=	16.2 μCi/gal
^{137}Cs	=	5.9 μCi/gal.

The sludge would tend to have higher levels of radionuclides than the liquid.

2.4.2.5 Experimental Tank: Tank 241-CX-72. Evidence suggests that the remaining solids in the tank (not the grout introduced into the tank) are the same as the "salt cake" found in high level waste tanks containing PUREX waste. Three smears from the "Hot" end of the agitator rod were reported to contain alpha activities of 2,000, 7,000, and 8,000 disintegrations per minute (dpm), respectively and gamma activities of 2.64E3, 4.46E3, and 5.81E3 pCi, respectively (Subrahmanyam 1989). Estimates of the radionuclides present indicate between 150 and 200 gram of plutonium 239 as fluoride compounds. The WIDS database specifies 3 Ci of plutonium. This tank has been reported to contain 6,000 Ci of beta/gamma in one source, and 10,000 Ci of Cs^{137} in another source. If the tank received only PUREX type wastes the tank contents should not be hazardous, but if flushing chemicals were used, the composition is unknown (Rymarz and Speer 1991).

2.4.2.6 Tank 241-CX-70. According to the WIDS database, storage tank 241-CX-70 was used to store high-level waste in support of the Semiworks process. It accumulated a layer of sludge during its five year period of use in the 50's. After residual supernate removal in 1979 but before the sludge sluicing in 1988, the tank had contained about 4.75 ft. of sludge (10,300 gal), containing: 20 Ci of $Pu^{239/240}$, 500 Ci Cs^{137}, 2,900 Ci Sr^{90}, 7.8 tons $NaNO_3$, 1.1 tons $NaNO_2$, 1.2 tons NaF, 0.5 tons $Al_2(SO_4)_3$, and 0.2 tons Na_2CrO_4. In 1988, tank volume was reduced to 2,839 liters (750 gal). In 1992 all remaining liquids and solids were drummed and transferred to the Hanford Central Waste Complex. The tank is now empty. A Trace Tek (TM) leak detection system has been installed in the tank which is monitored monthly. The access manway has been covered and sealed against the weather and the above grade risers have blind flanges installed (DOE-RL 1993d)(Appendix D, page D-1).

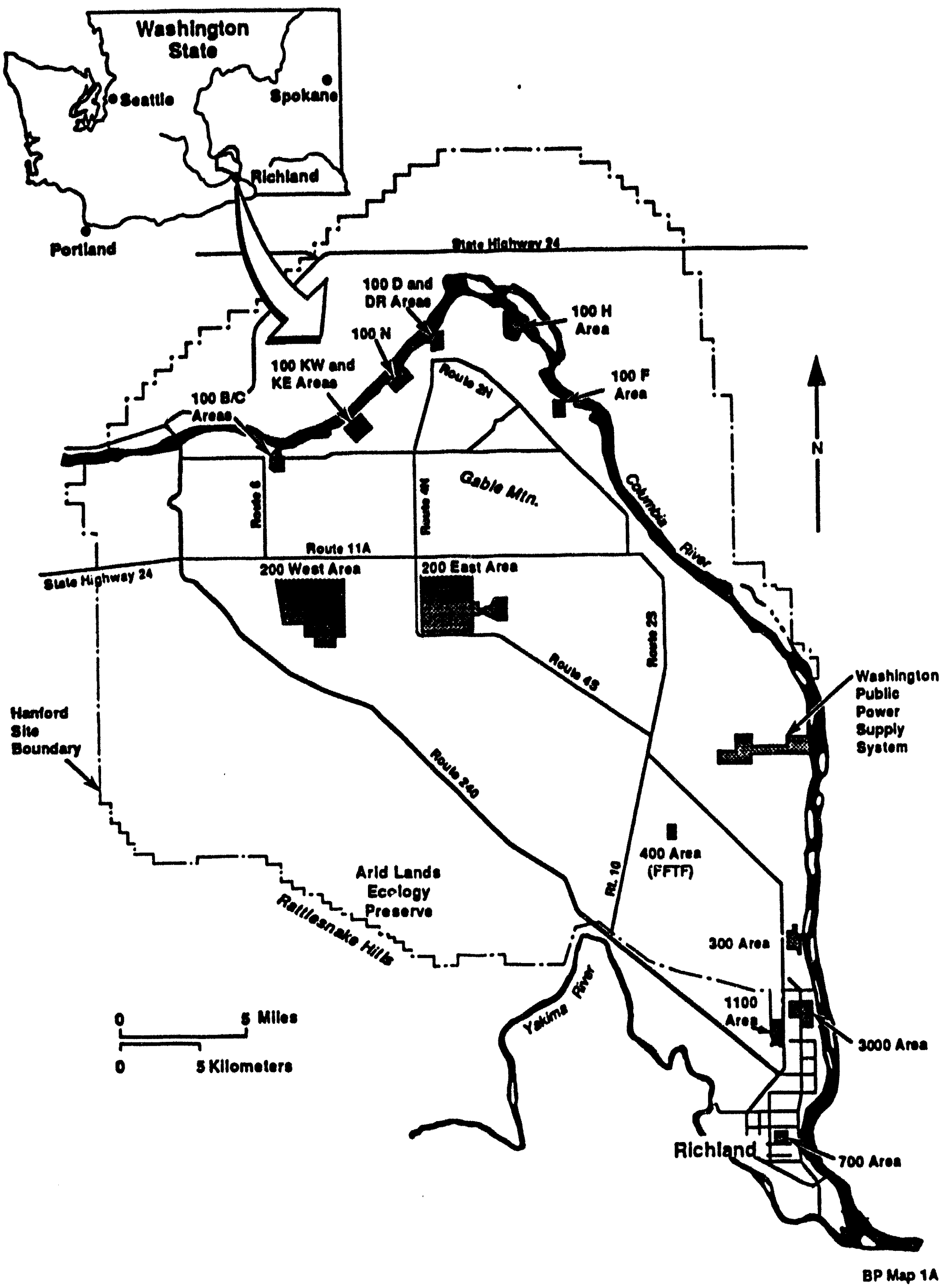


Figure 2-1. Hanford Site Map.

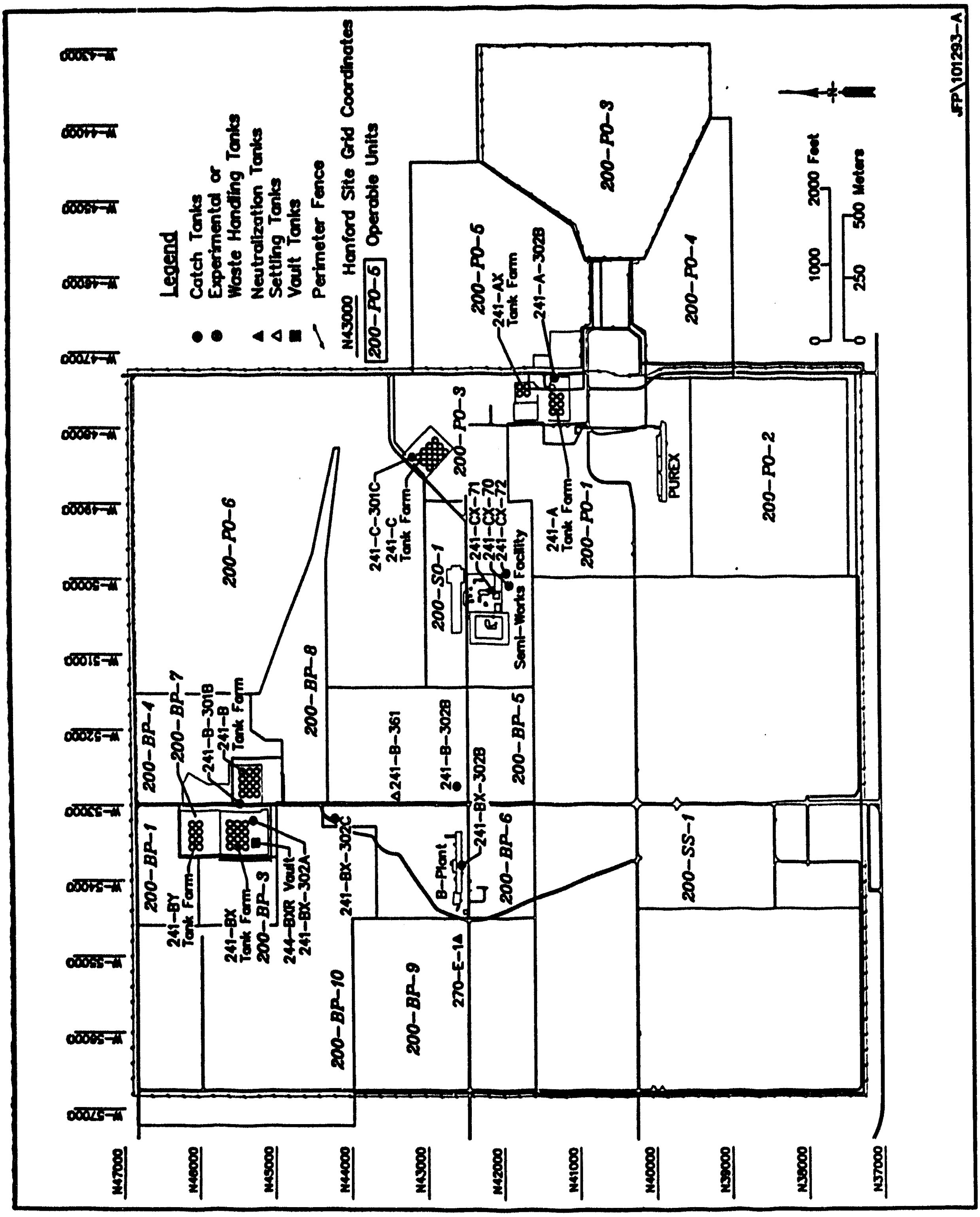


Figure 2-2. 200 East Area Miscellaneous Inactive Underground Radioactive Waste Tanks.

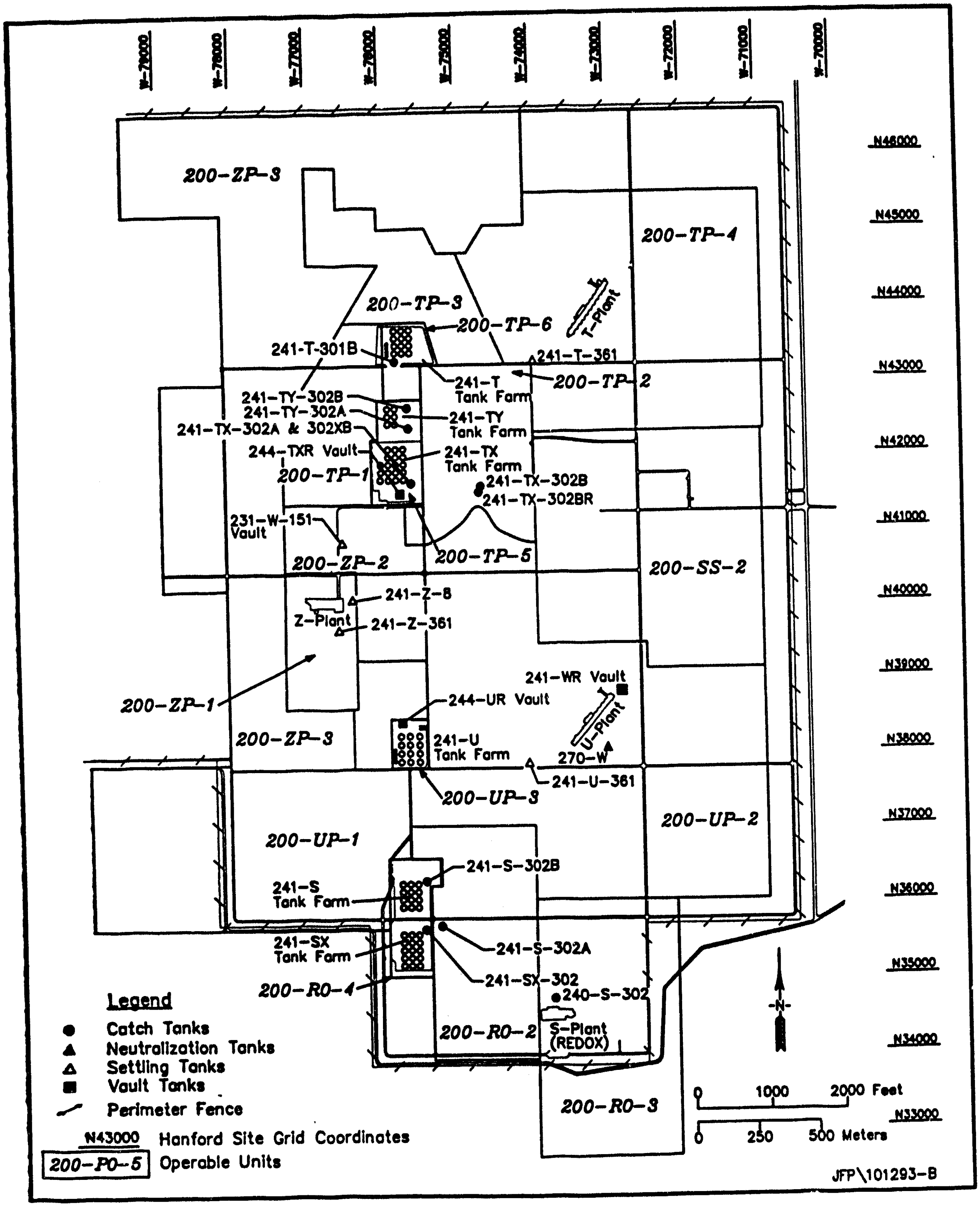


Figure 2-3. 200 West Area Miscellaneous Inactive Underground Radioactive Waste Tanks.

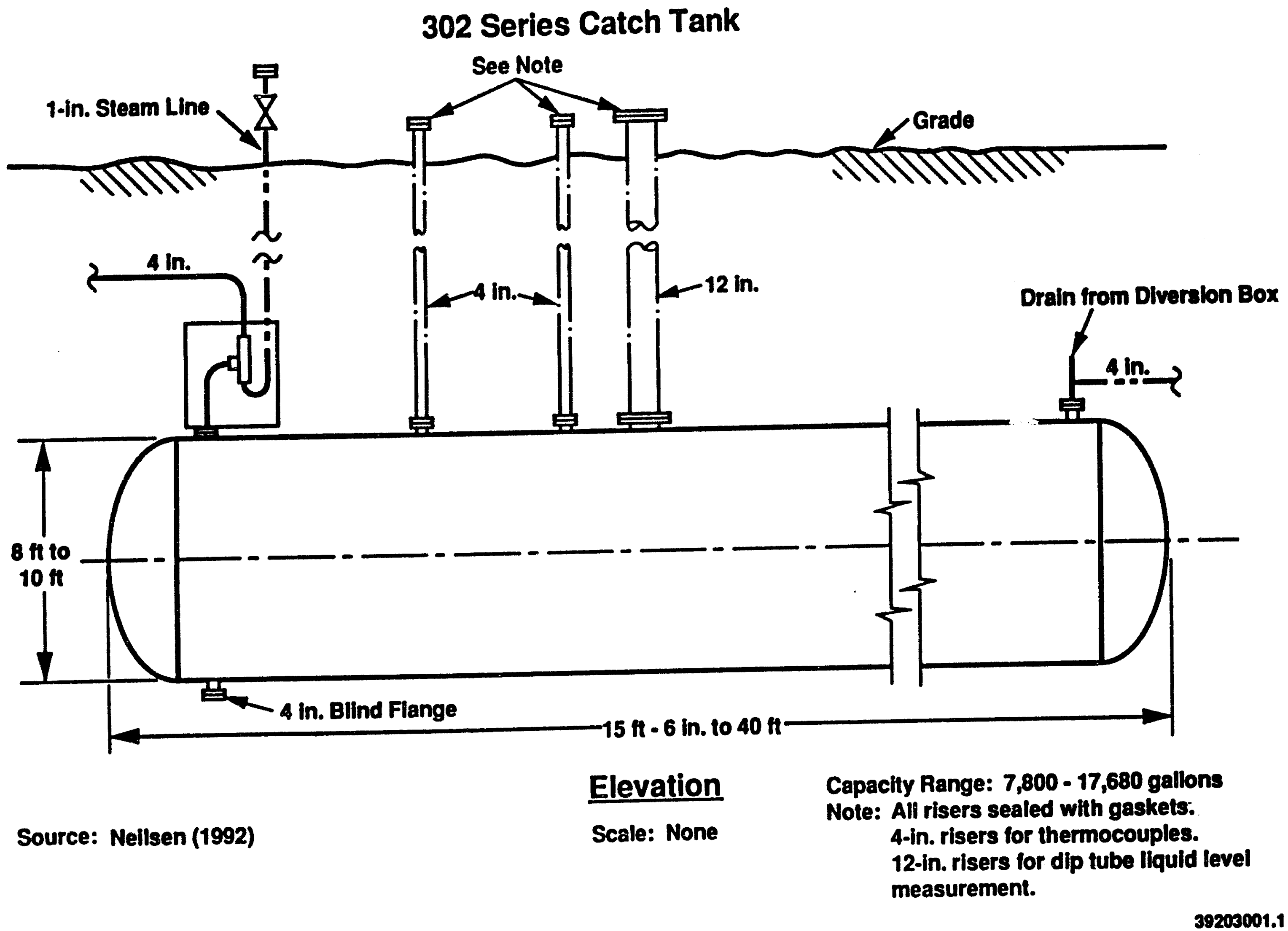
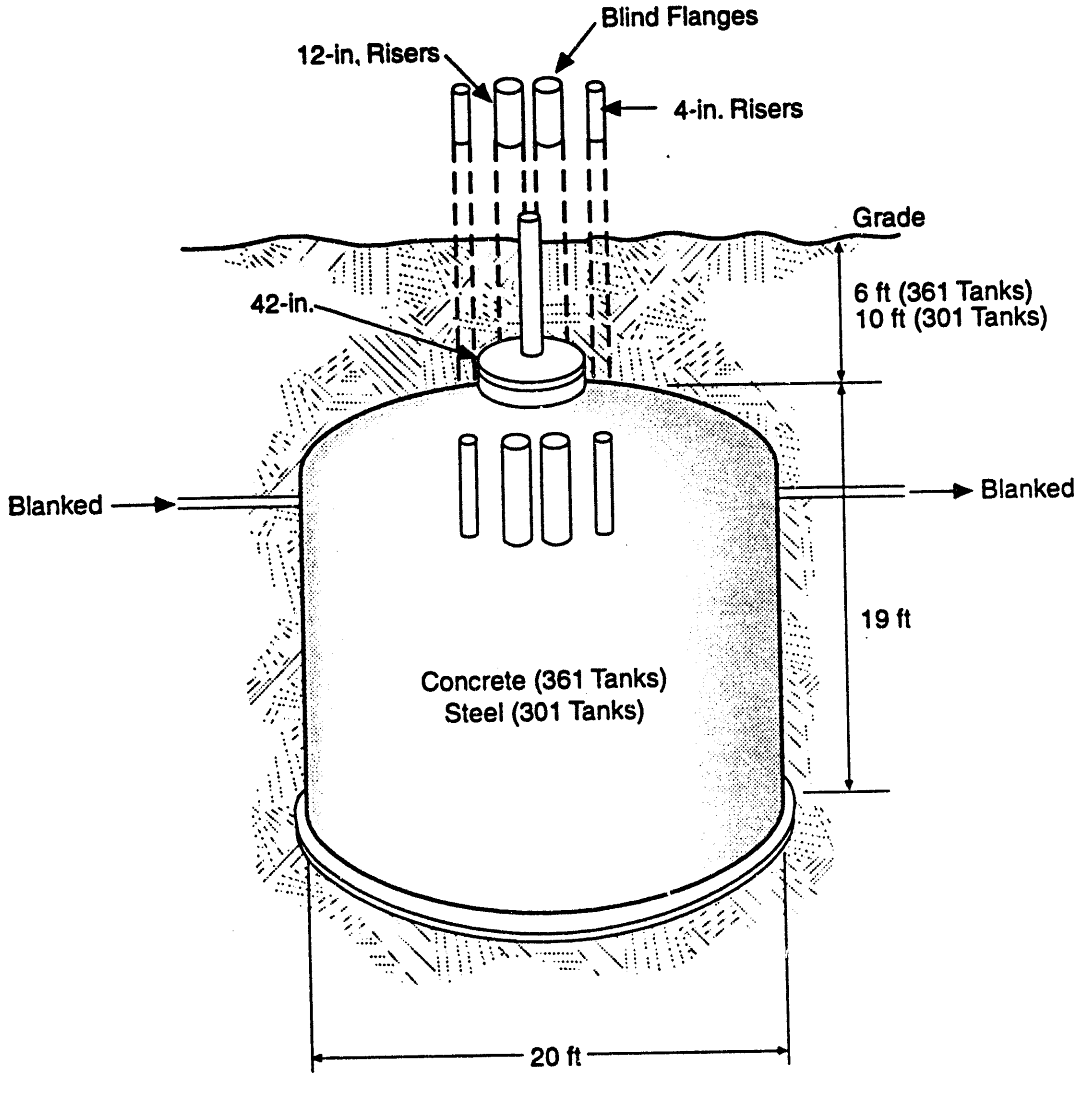


Figure 2-4. 302 Series Catch Tank.

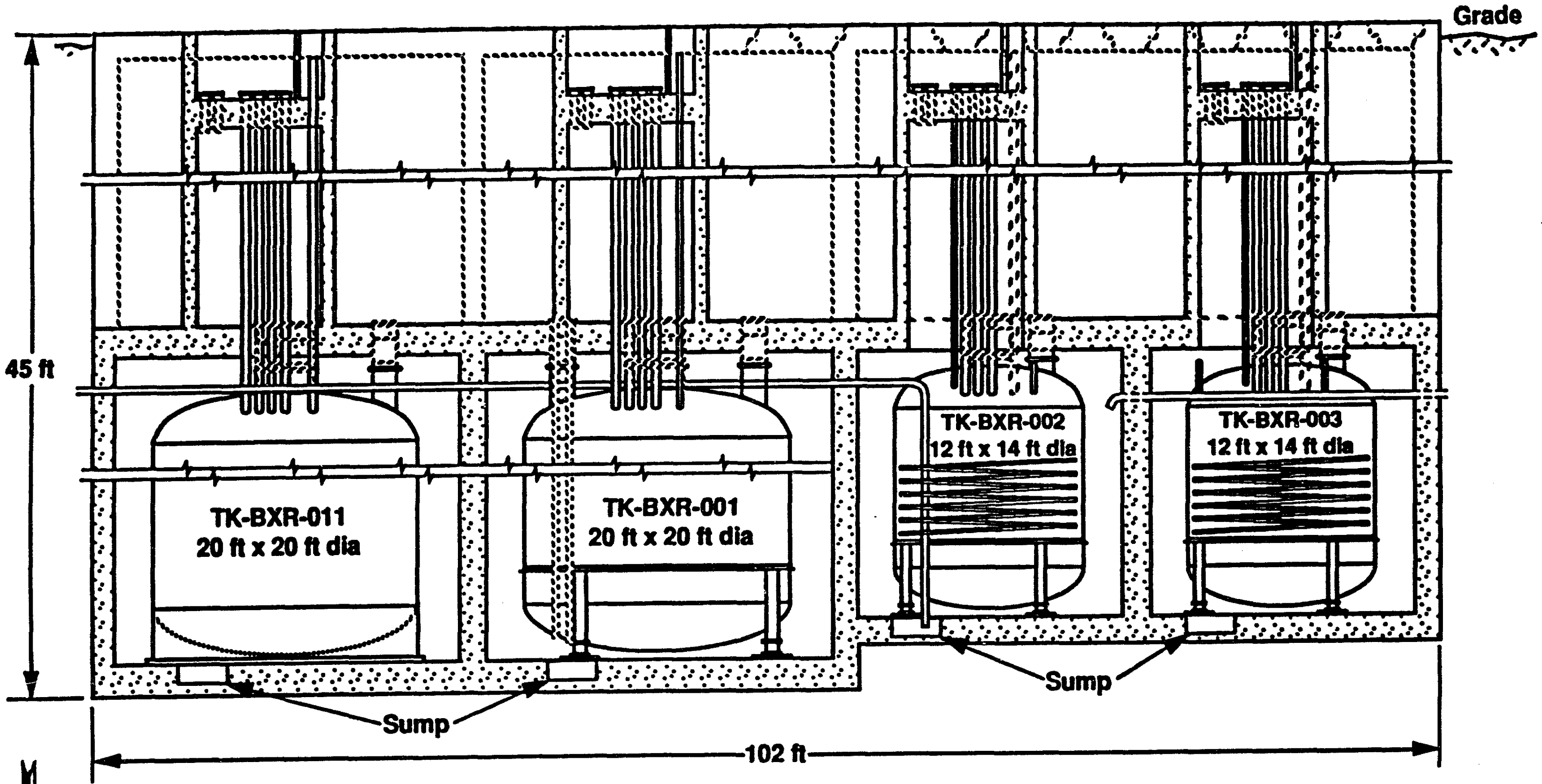


Note: 4-in. central riser is not present
in 301 series catch tanks

Source: Rymarz and Speer (1991)

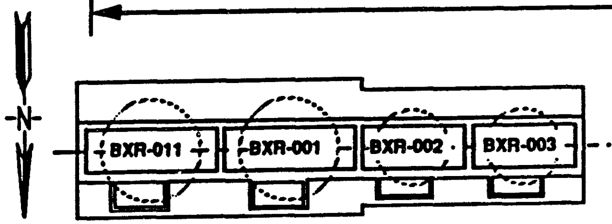
Figure 2-5. 301 Series Catch Tanks and Settling Tanks 241-B-361, 241-T-361 and 241-U-361.

923 E043/48972/2-2-94



Elevation

Scale: None



Key Plan

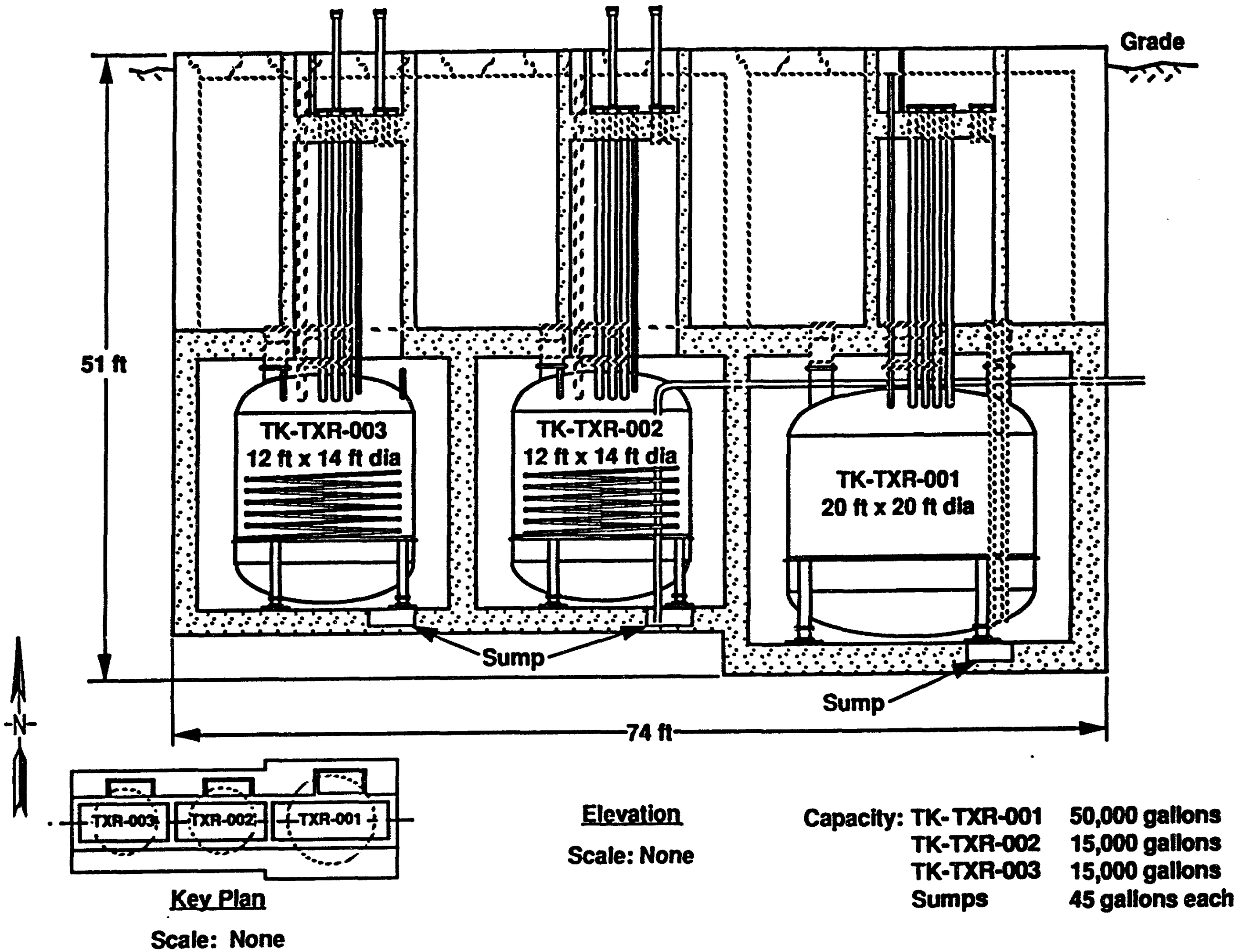
Scale: None

Capacity:	TK-BXR-001	50,000 gallons
	TK-BXR-011	50,000 gallons
	TK-BXR-002	15,000 gallons
	TK-BXR-003	15,000 gallons
	Sumps	45 gallons each

Source: Neilsen (1992)

39203001.6

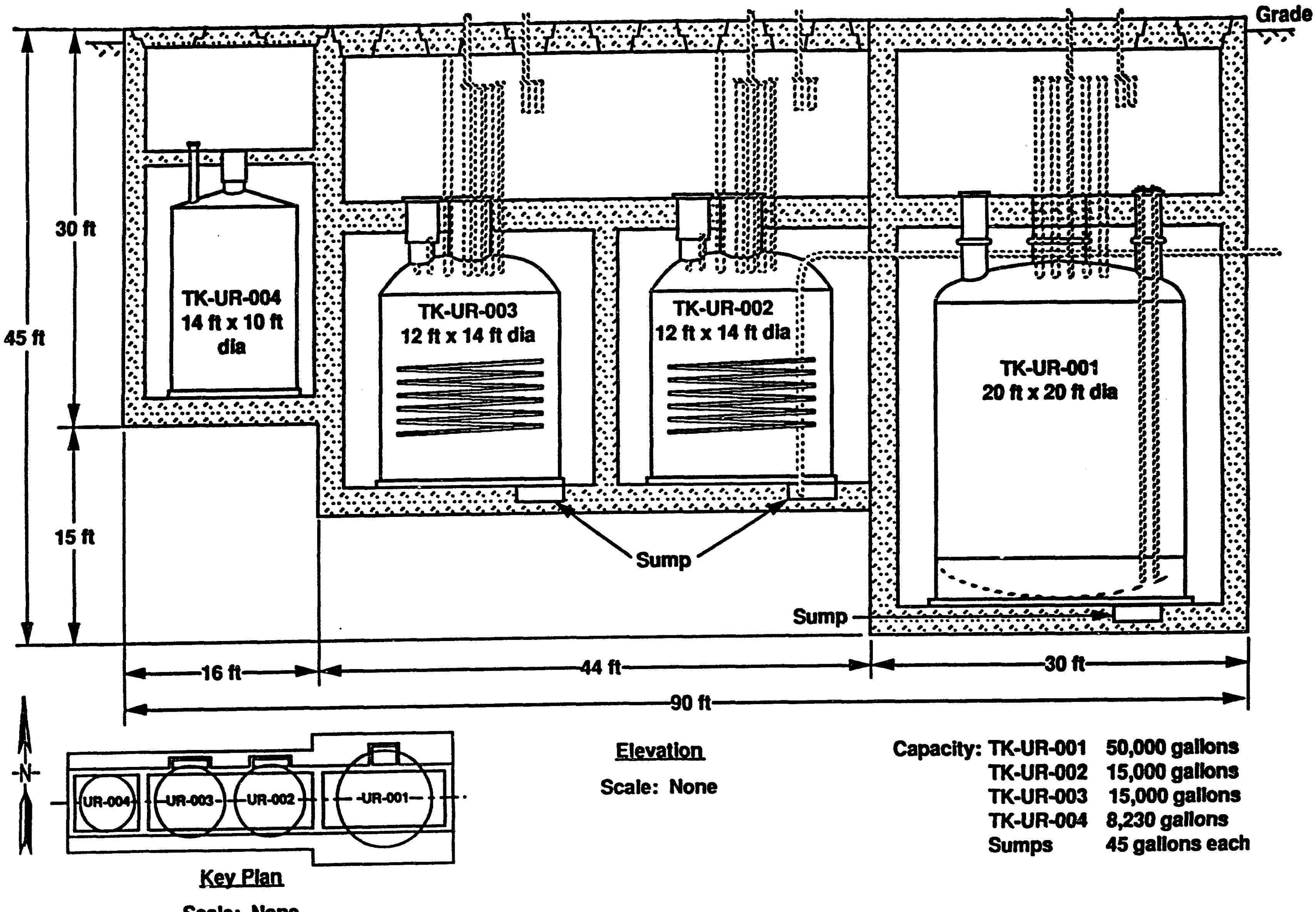
Figure 2-6. 244-BXR Vault and Tanks.



Source: Modified from Neilsen (1992)

Figure 2-7. 244-TXR Vault and Tanks.

39203001.7



Source: Neilsen (1992)

Figure 2-8. 244-UR Vault and Tanks.

39203001.5

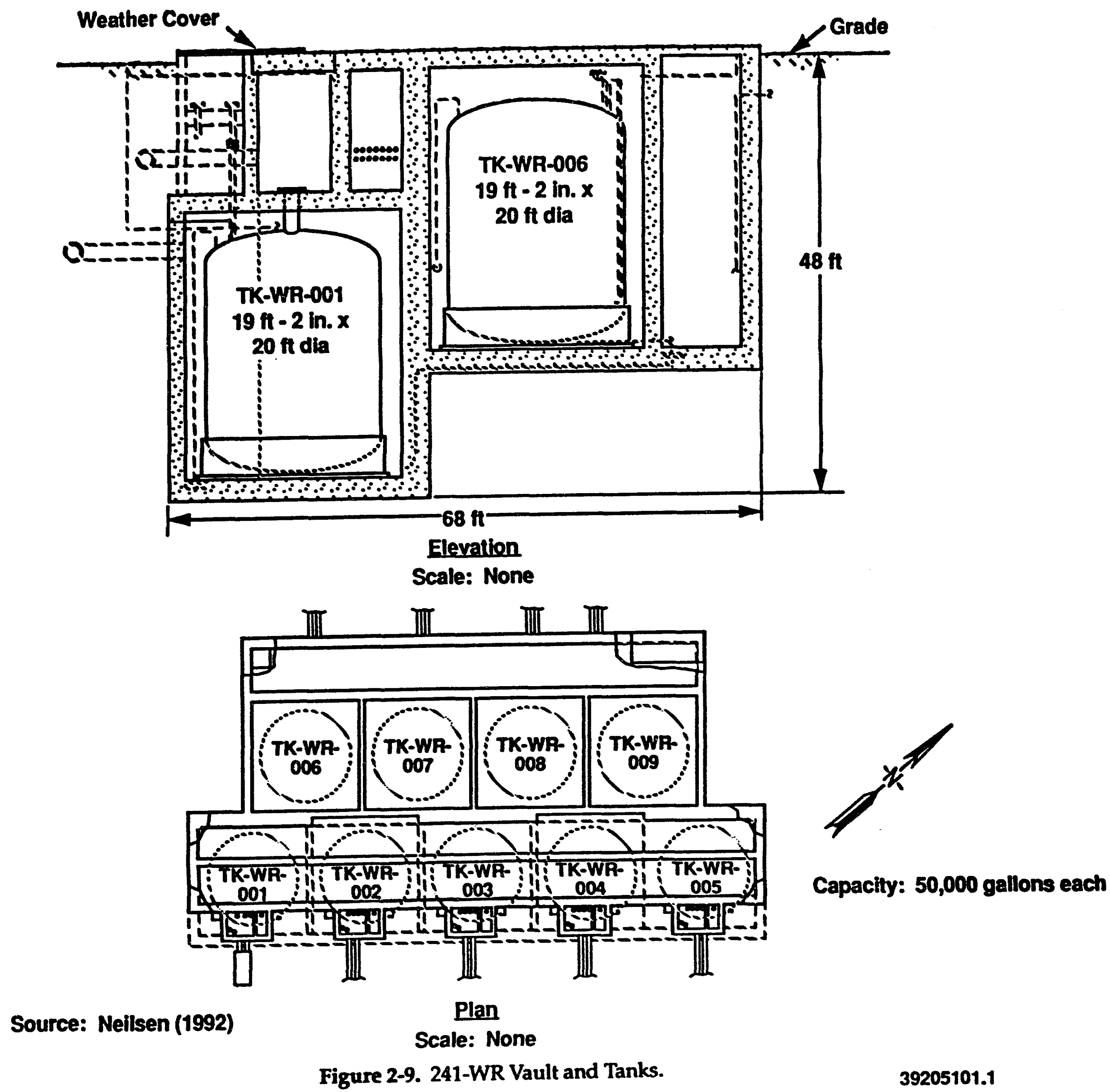
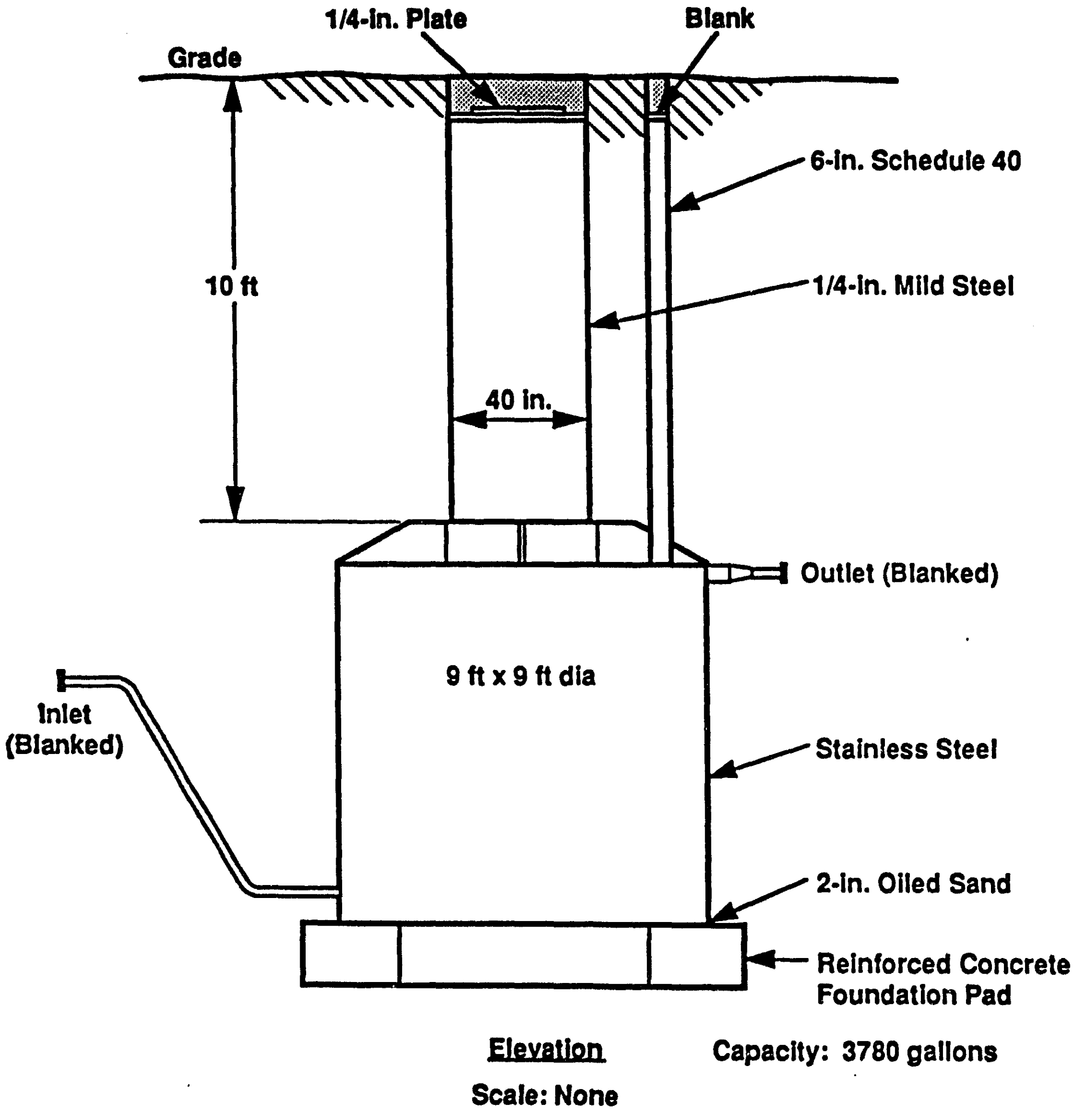


Figure 2-9. 241-WR Vault and Tanks.



Source: Neilsen (1992) and Rymarz and Speer (1991)

39203001.2

Figure 2-10. 270-W Tank and 270-E-1 Tank.

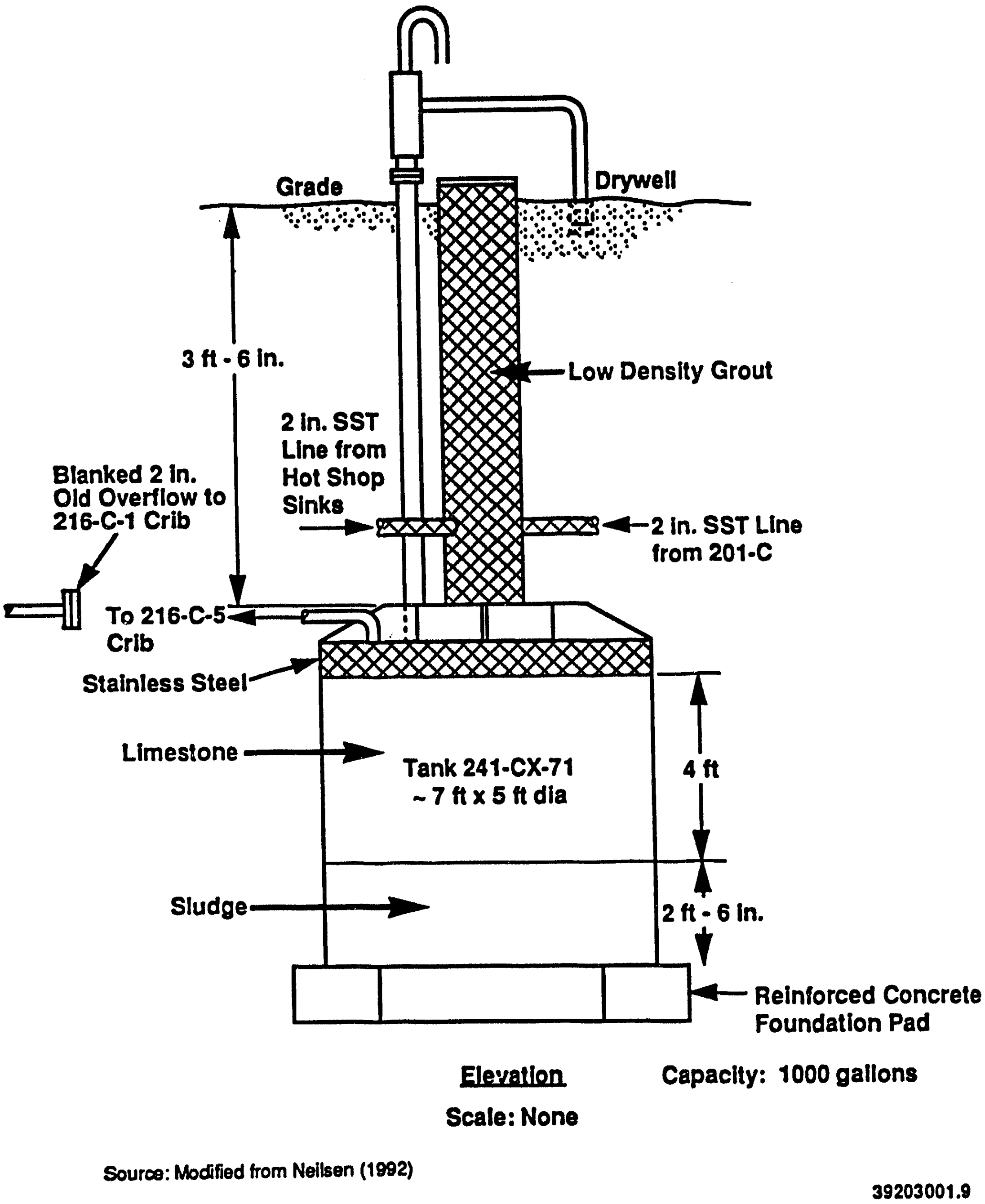
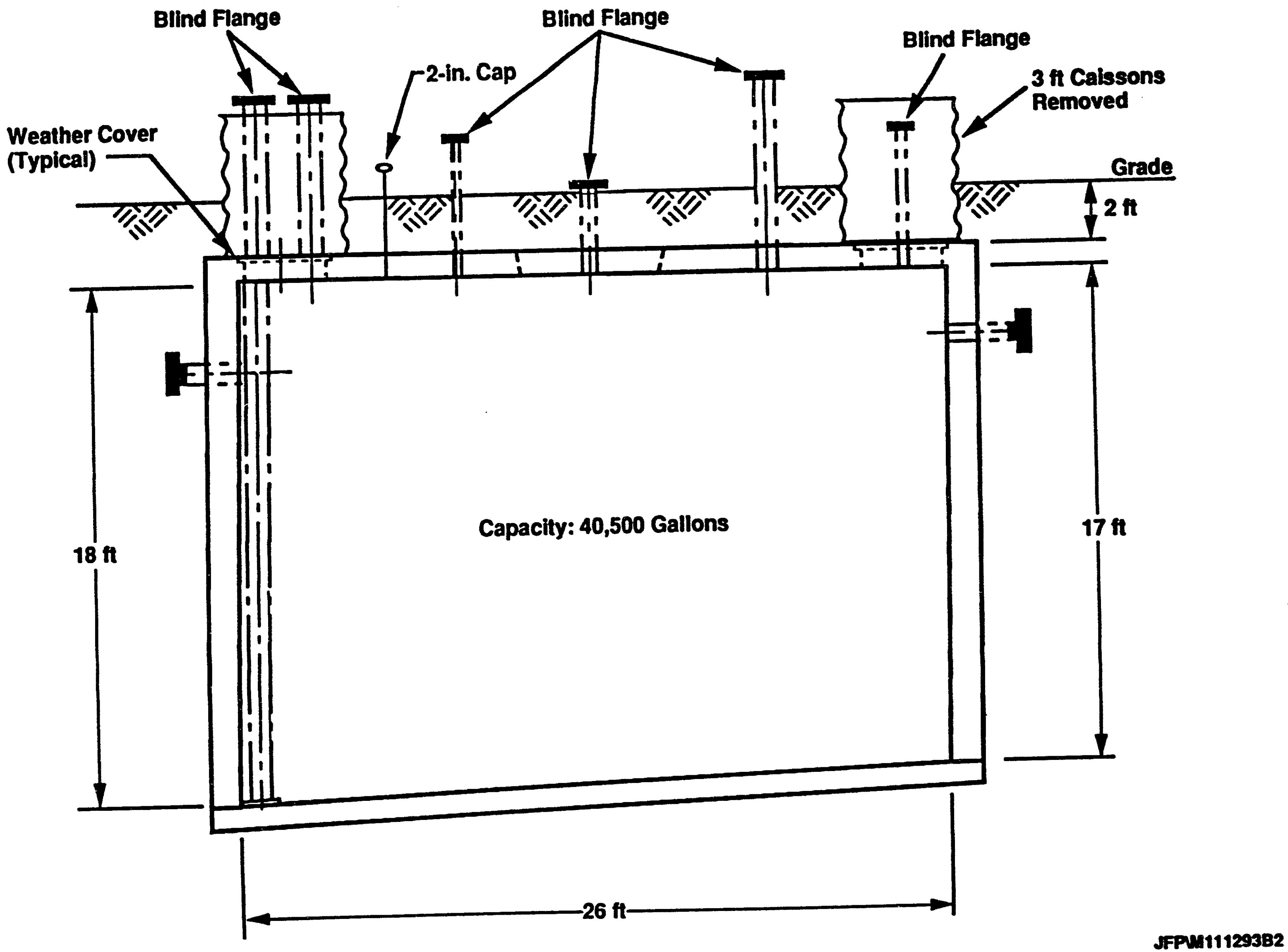
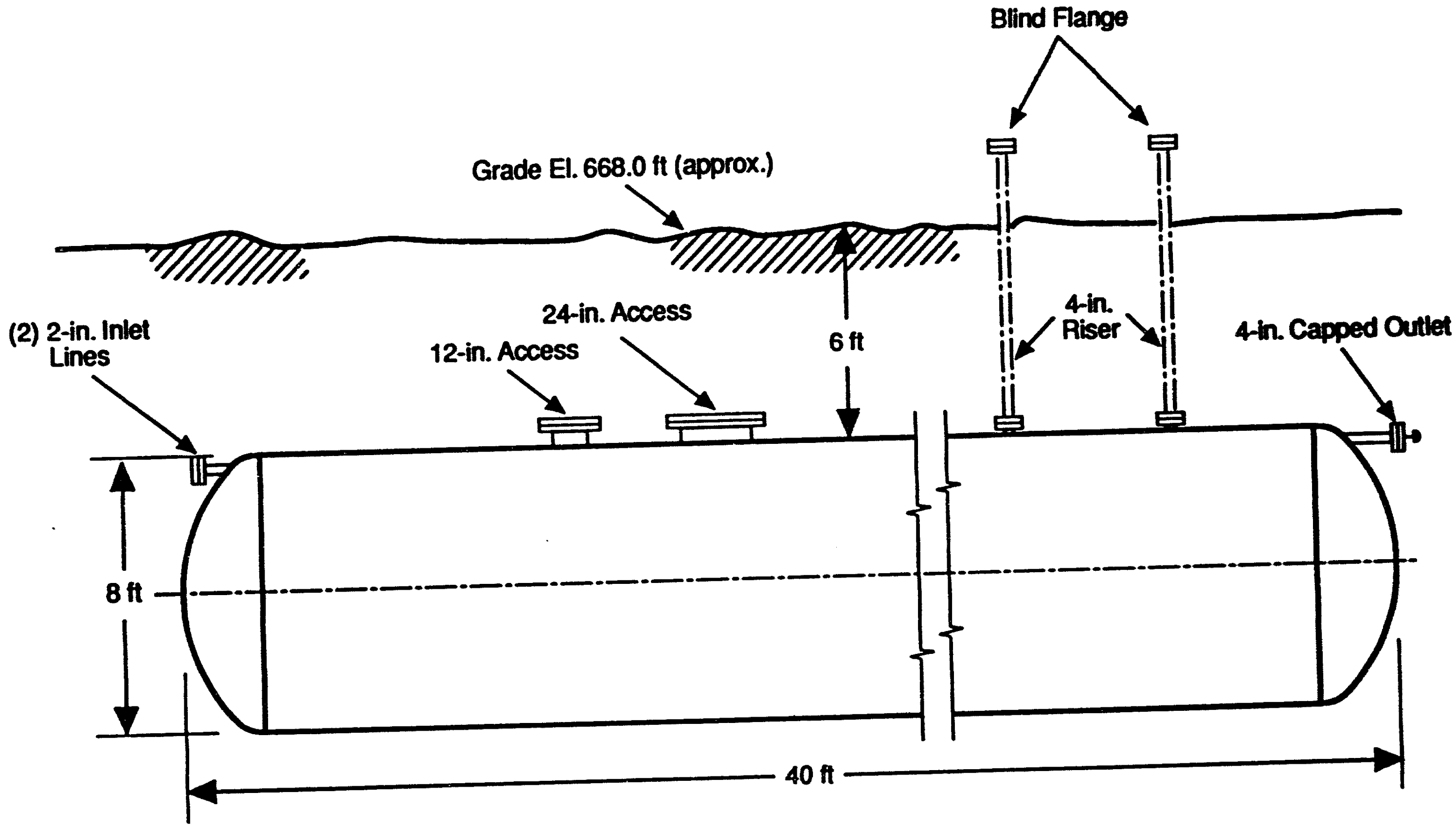


Figure 2-11. Tank 241-CX-71.



Source: Modified from Rymarz and Speer (1991)

Figure 2-12. 241-Z-361 Settling Tank.



Capacity Range: 15,000 gallons
Scale: None

Figure 2-13. Tanks 241-Z-8.

923 E043/48973/2-2-94

Source: Modified from Rymarz and Speer (1991)

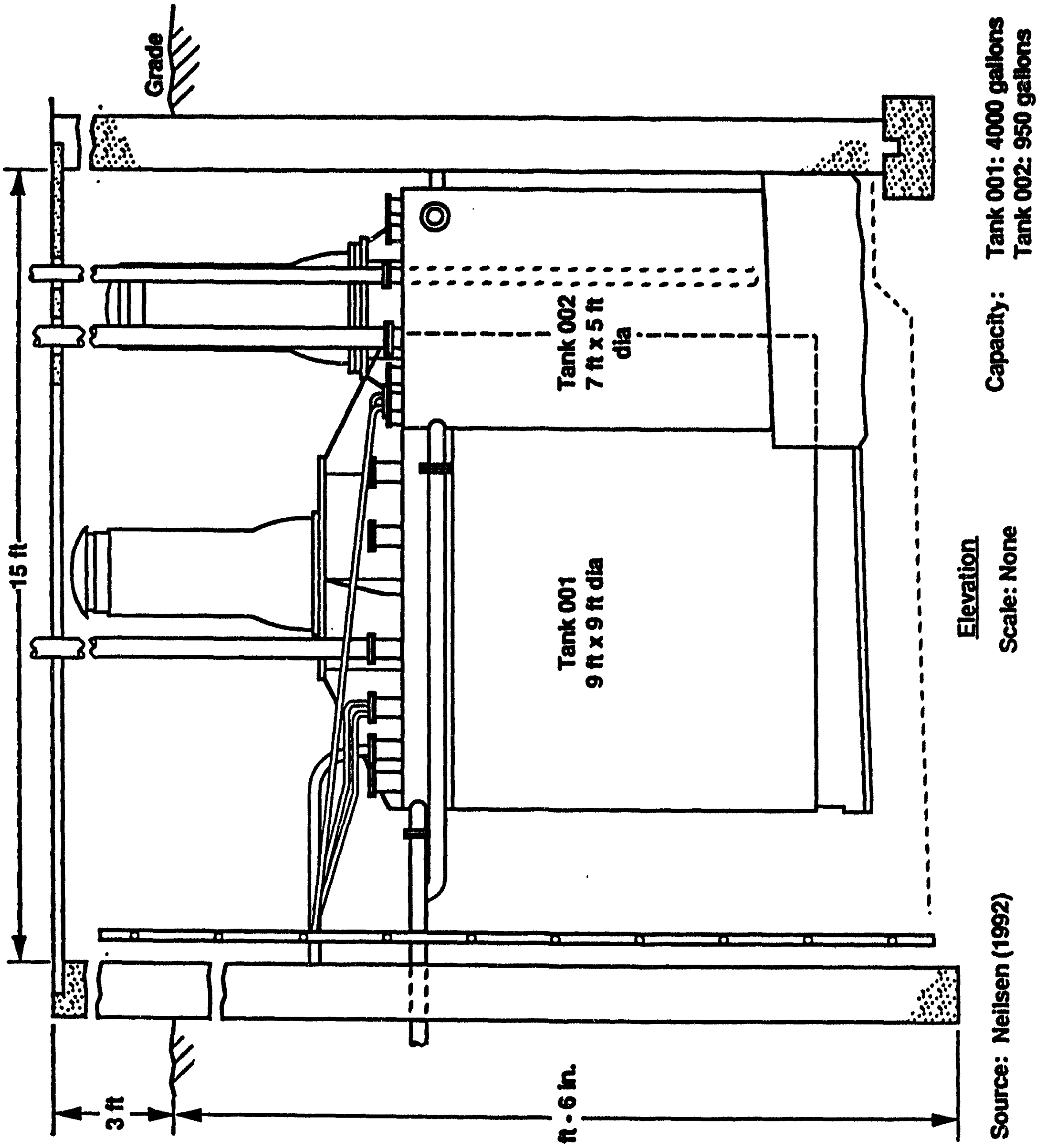
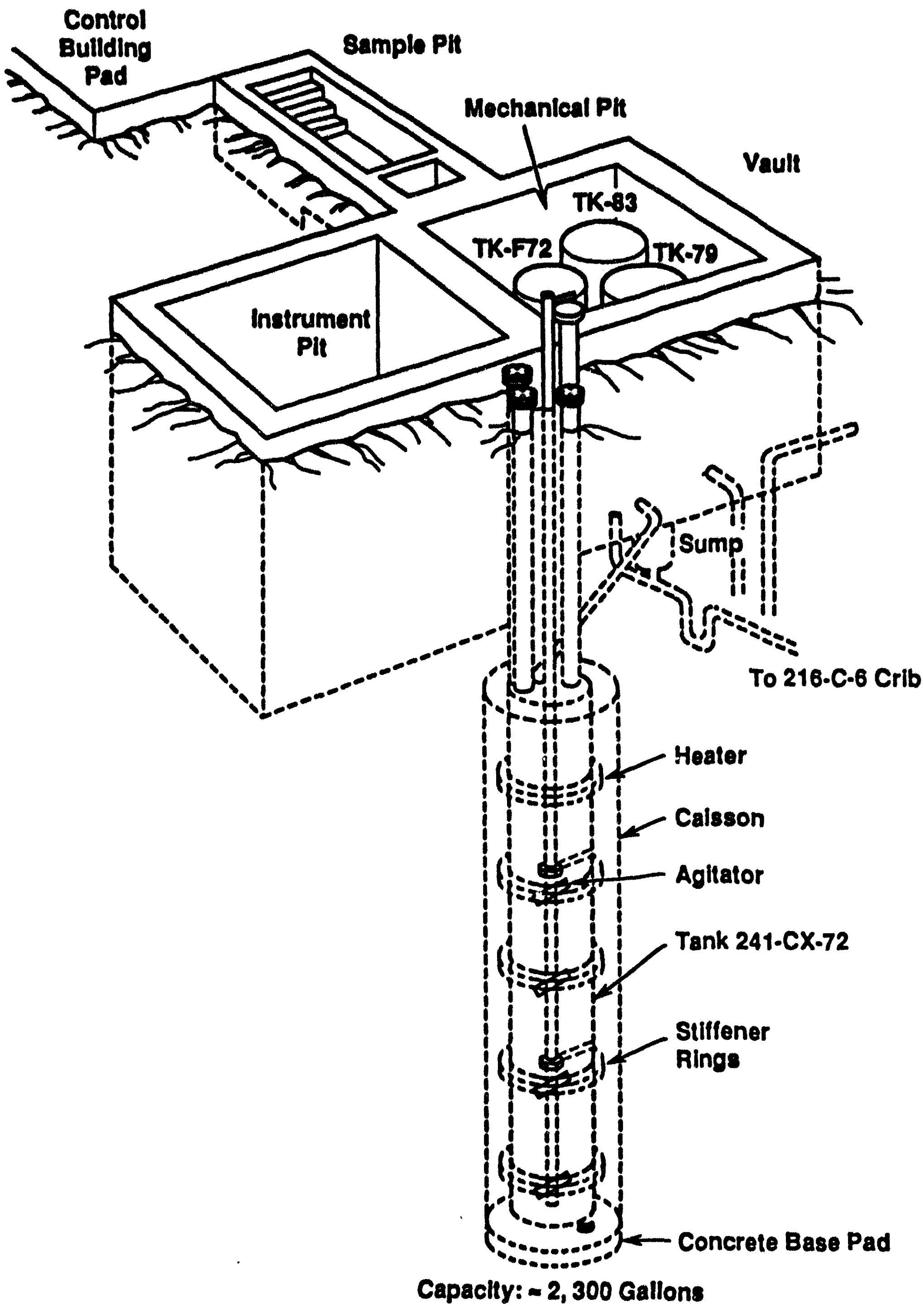


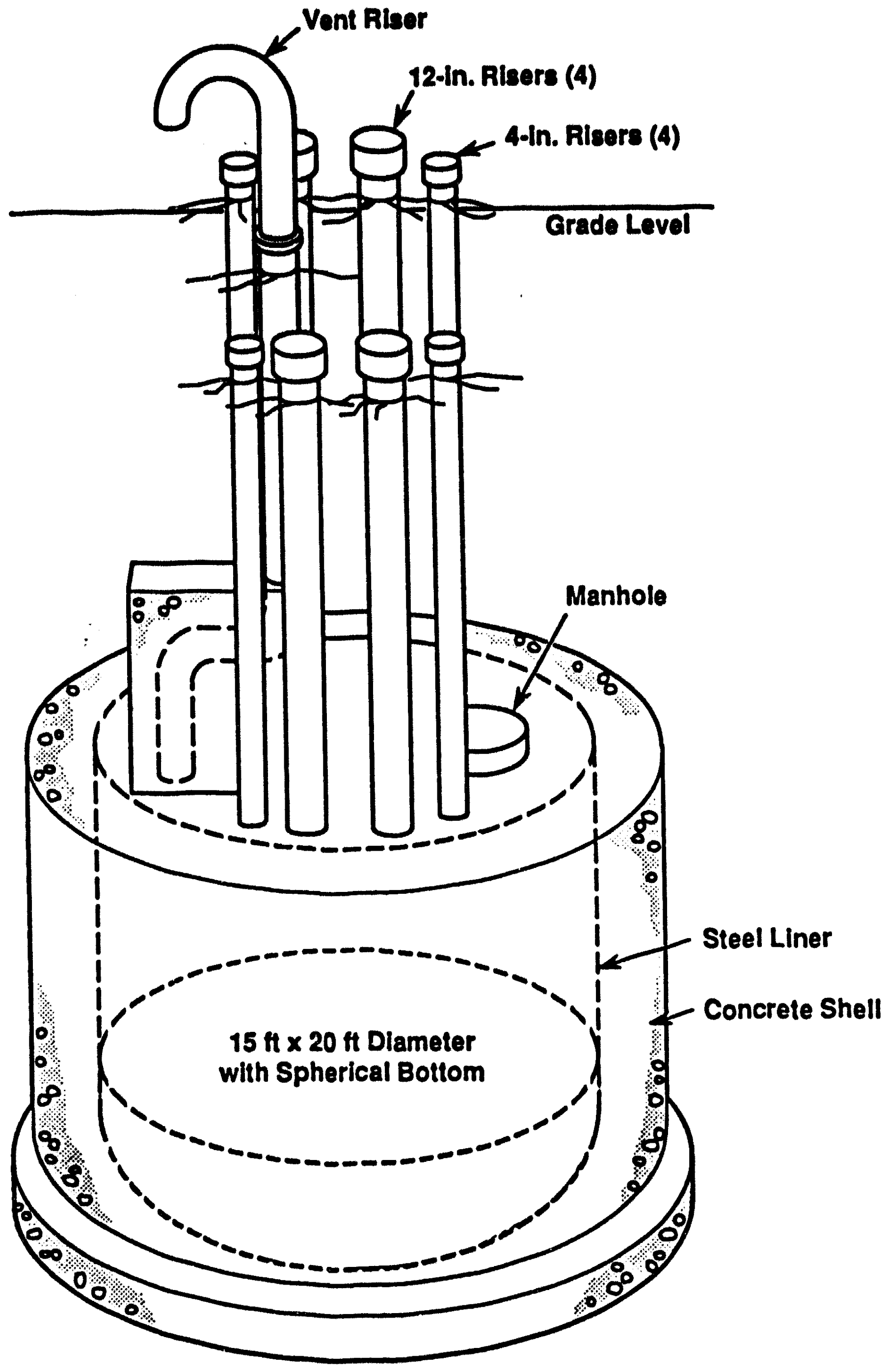
Figure 2-14. 231-W-151 Vault and Tanks.



Source: DOE-RL (1993d)

H9302010.2

Figure 2-15. Tank 241-CX-72.

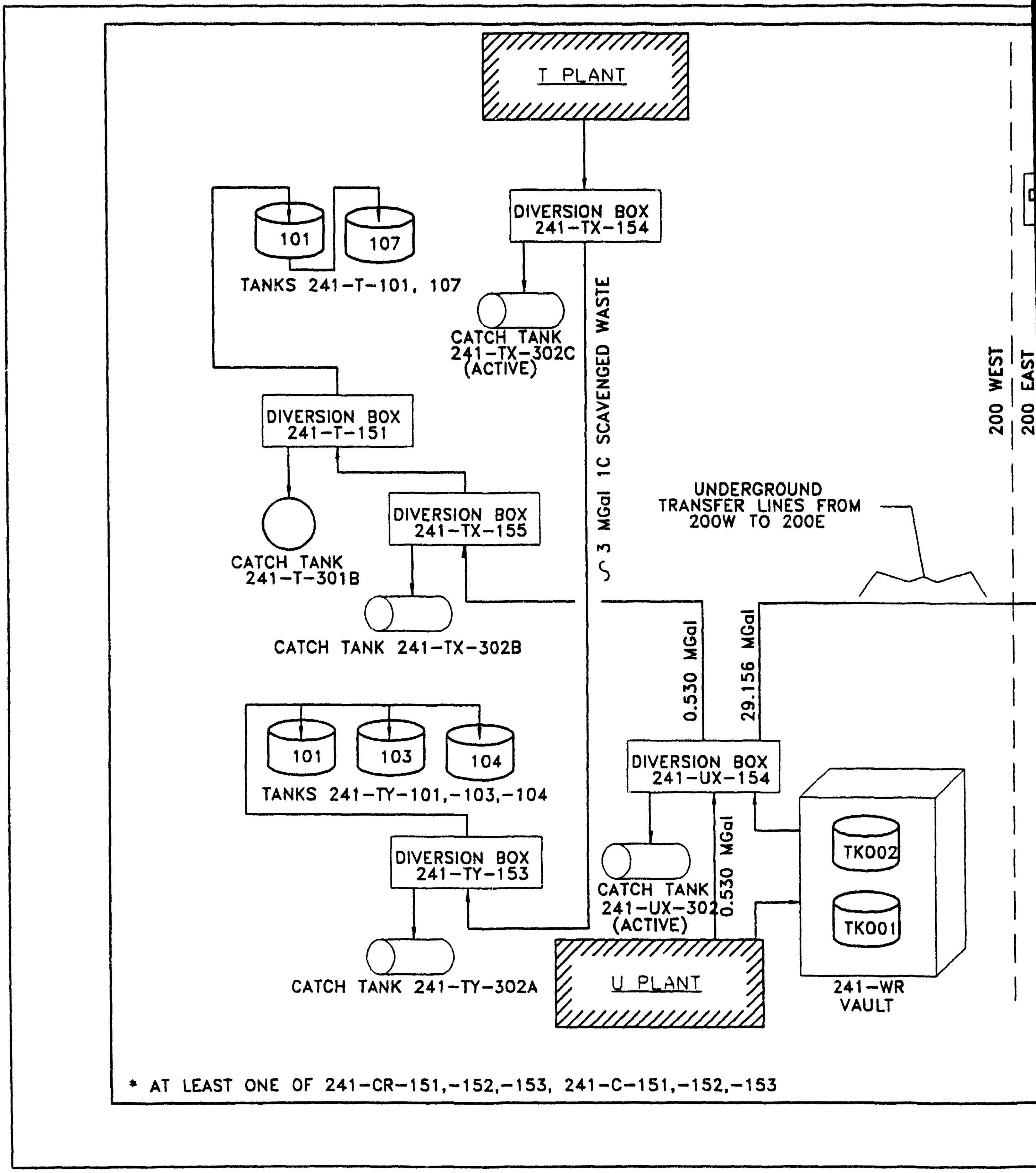


Capacity: 30,000 gallons

Source: DOE-RL (1993d)

H9302010.3

Figure 2-16. Tank 241-CX-70.


T PLANT
DIVERSION BOX 241-TX-154
101
107
TANKS 241-T-101, 107
CATCH TANK 241-TX-302C (ACTIVE)
3 MGal 1C SCAVENGED WASTE
DIVERSION BOX 241-T-151
DIVERSION BOX 241-TX-155
CATCH TANK 241-T-301B
CATCH TANK 241-TX-302B
UNDERGROUND TRANSFER LINES FROM 200W TO 200E
200 WEST
200 EAST
0.530 MGal
29.156 MGal
101
103
104
TANKS 241-TY-101,-103,-104
DIVERSION BOX 241-UX-154
DIVERSION BOX 241-TY-153
CATCH TANK 241-UX-302 (ACTIVE)
0.530 MGal
TK002
TK001
CATCH TANK 241-TY-302A
U PLANT
241-WR VAULT
* AT LEAST ONE OF 241-CR-151,-152,-153, 241-C-151,-152,-153

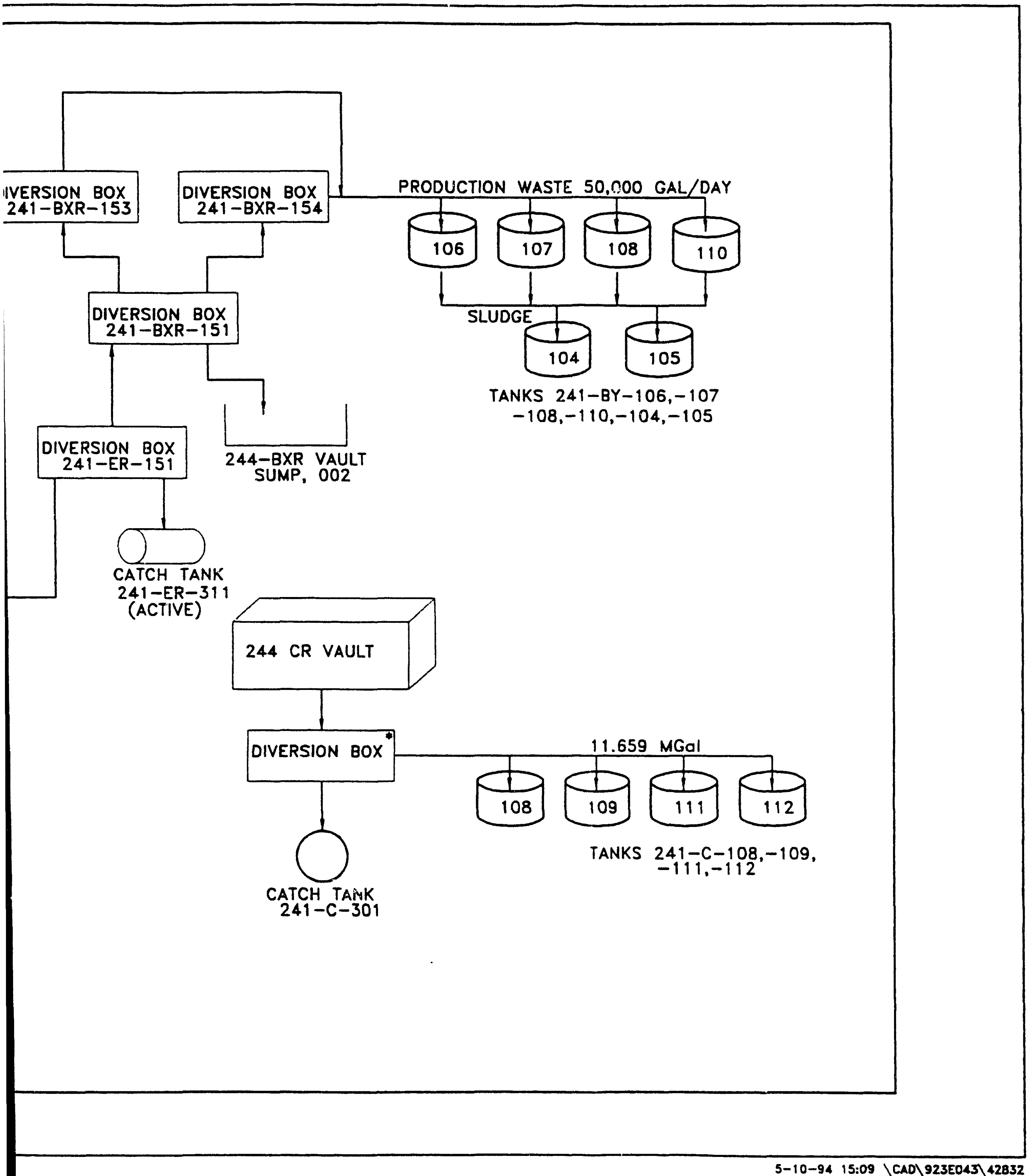
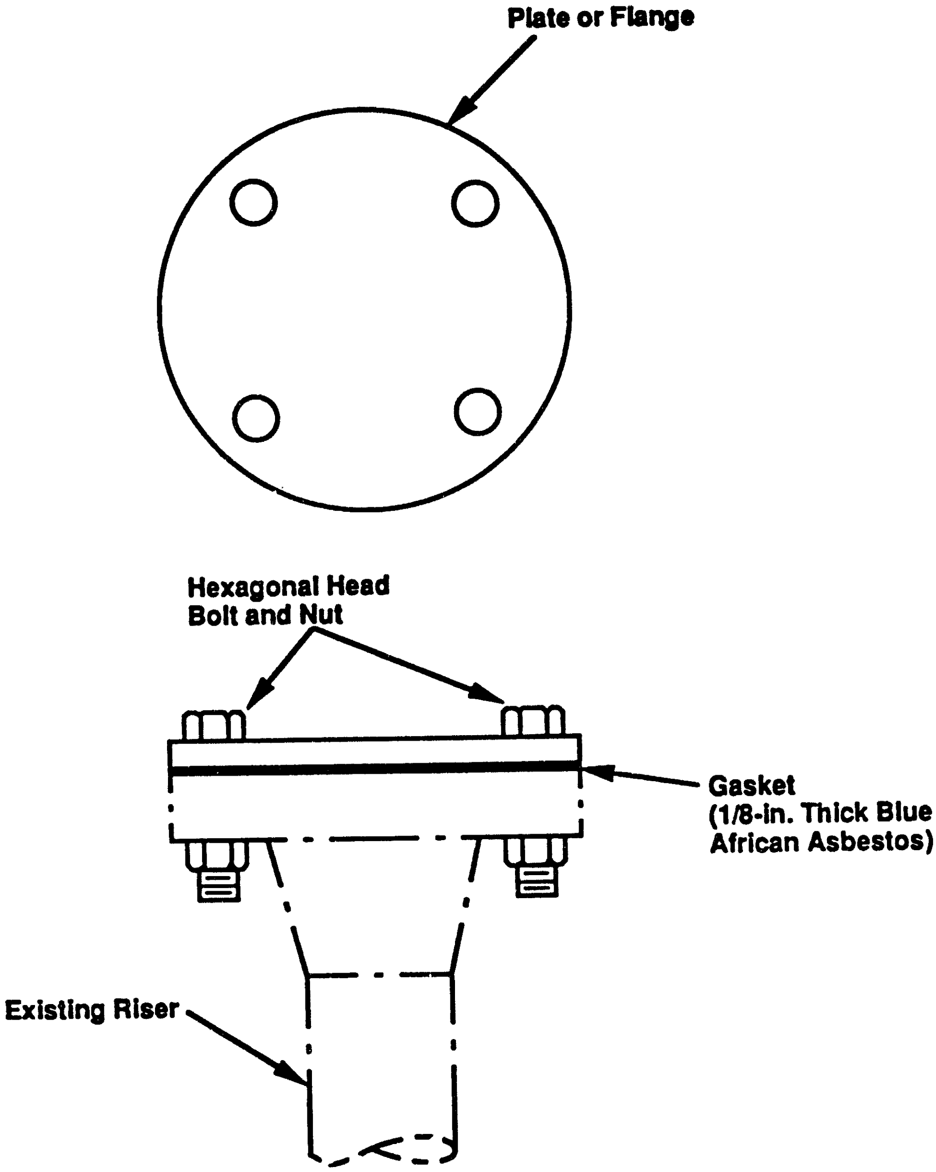


Figure 2-17. Routing of Ferrocyanide Scavenging Wastes.



Source: Prosk and Smith (1986)

Figure 2-18. Riser Closure.

JFP\M111293-B3

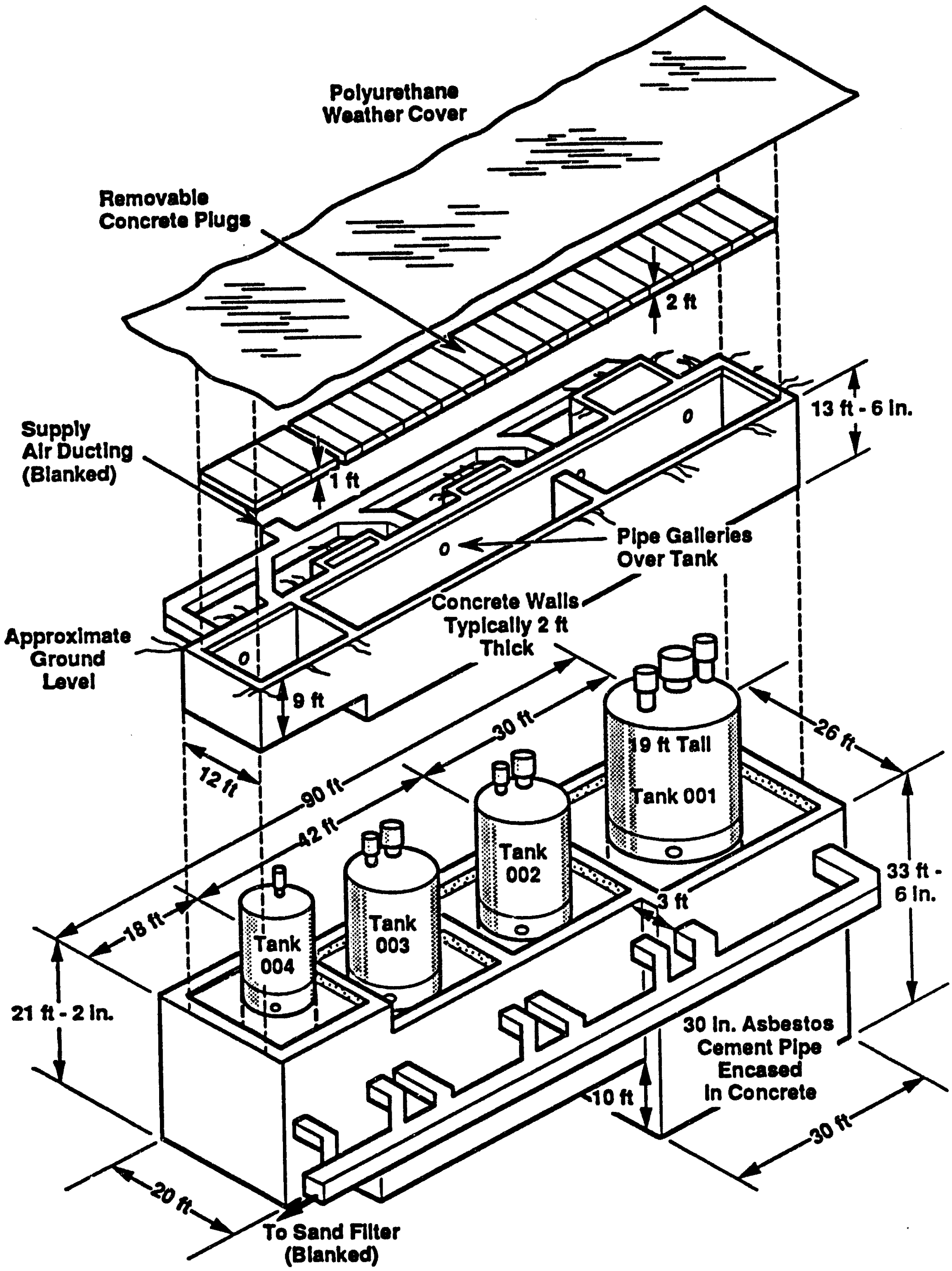
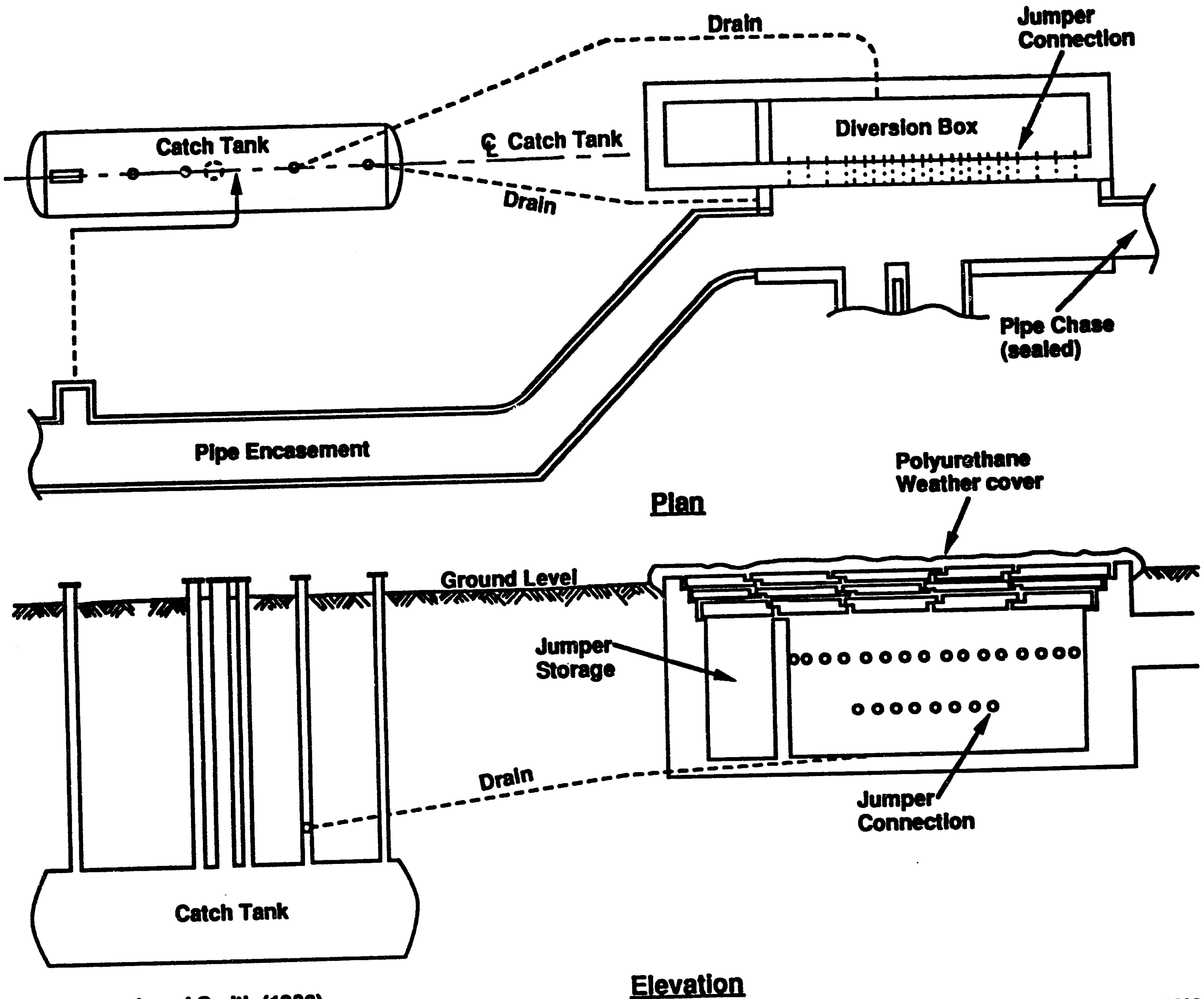


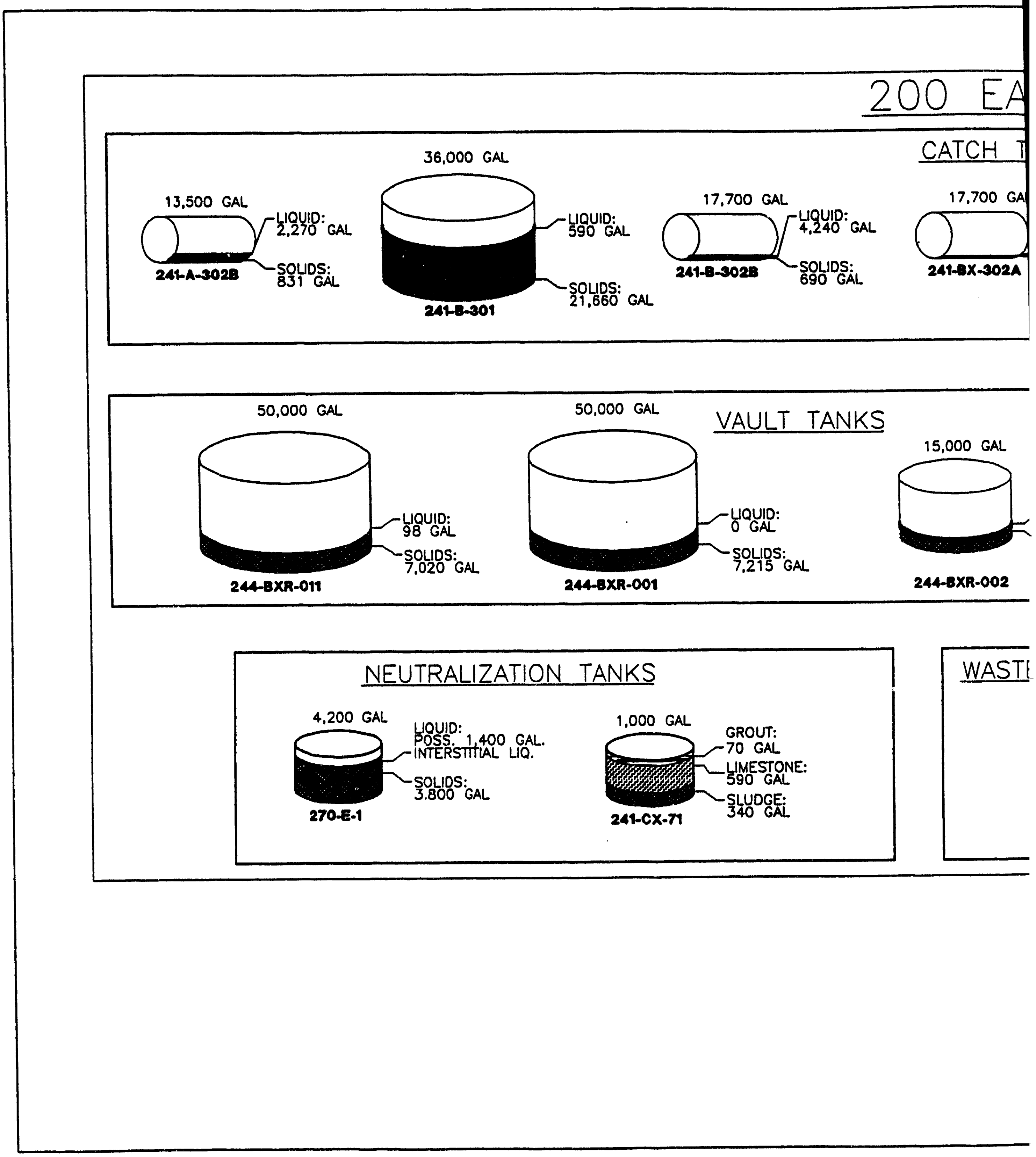
Figure 2-19. Typical Isolated Vault.



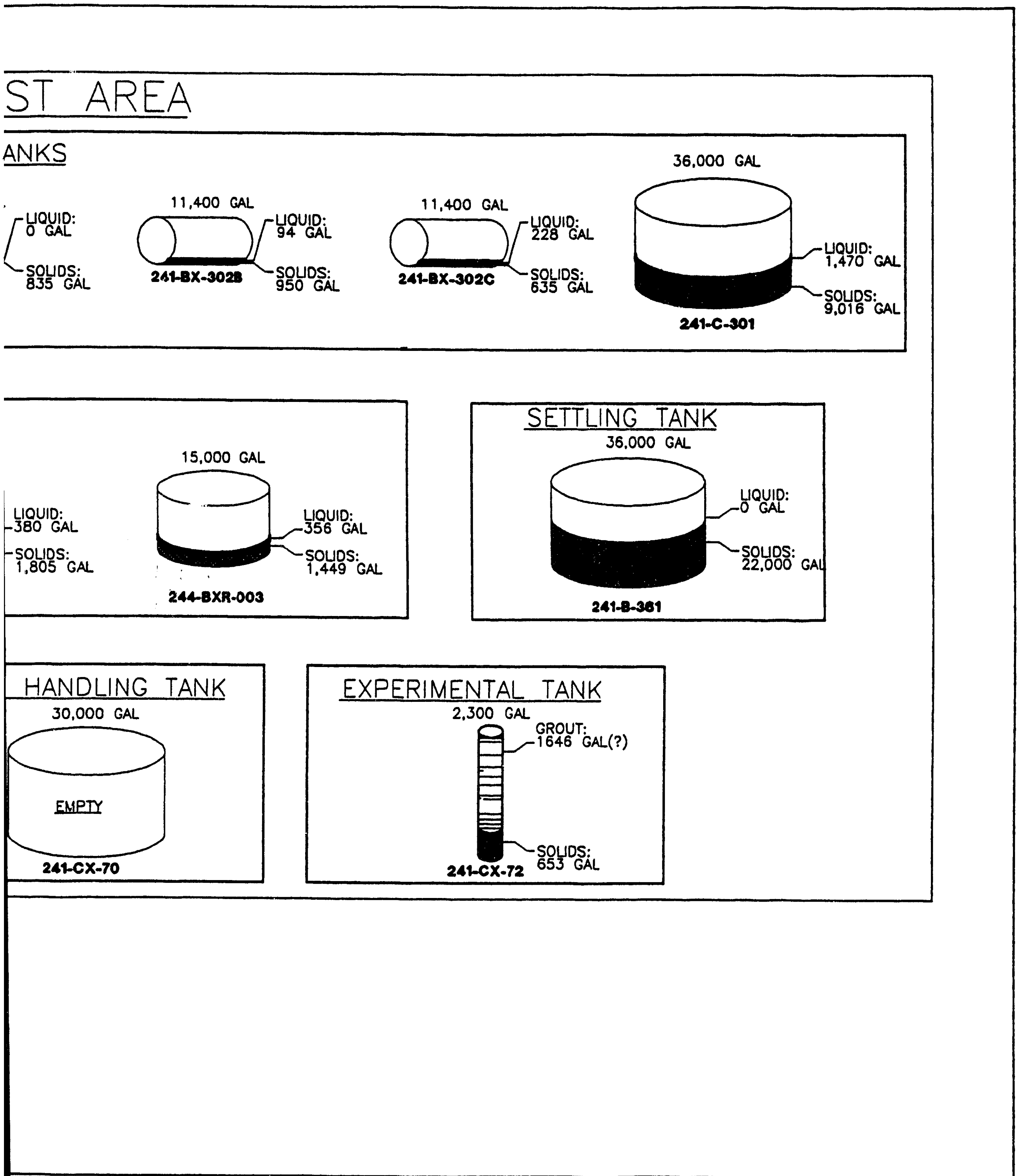
Source: Prosk and Smith (1986)

JFP\M111293-B4

Figure 2-20. Isolated Transfer Facility.

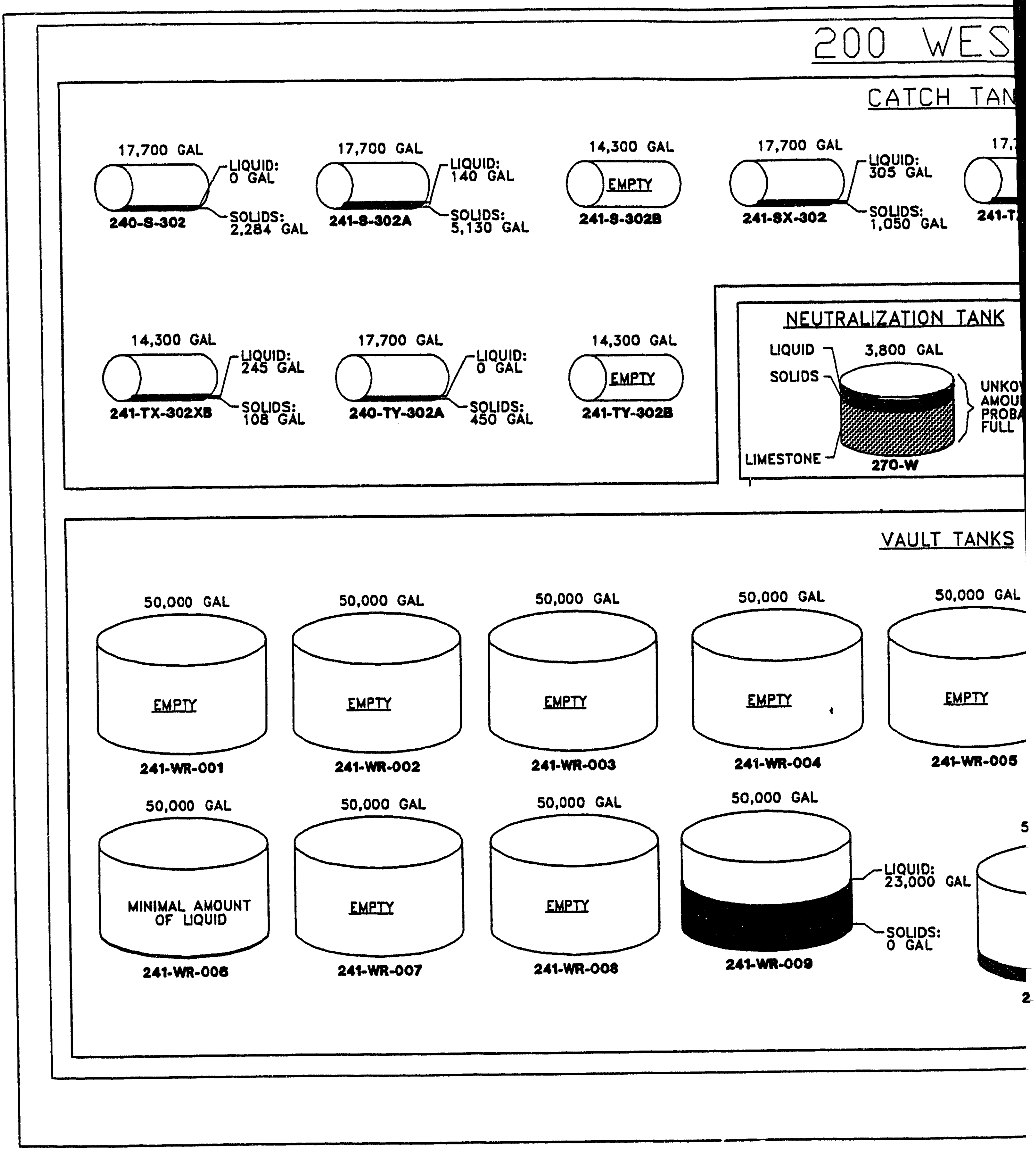


200 EA
CATCH T
13,500 GAL
LIQUID: 2,270 GAL
SOLIDS: 831 GAL
241-A-302B
36,000 GAL
LIQUID: 590 GAL
SOLIDS: 21,660 GAL
241-B-301
17,700 GAL
LIQUID: 4,240 GAL
SOLIDS: 690 GAL
241-B-302B
17,700 GA
241-BX-302A
VAULT TANKS
50,000 GAL
LIQUID: 98 GAL
SOLIDS: 7,020 GAL
244-BXR-011
50,000 GAL
LIQUID: 0 GAL
SOLIDS: 7,215 GAL
244-BXR-001
15,000 GAL
244-BXR-002
NEUTRALIZATION TANKS
4,200 GAL
LIQUID: POSS. 1,400 GAL. INTERSTITIAL LIQ.
SOLIDS: 3.800 GAL
270-E-1
1,000 GAL
GROUT: 70 GAL
LIMESTONE: 590 GAL
SLUDGE: 340 GAL
241-CX-71
WASTE



2-9-94 17:08 \JSS\923E043\42836

Figure 2-21. 200 East Area Tanks.



200 WES
CATCH TAN
17,700 GAL
LIQUID: 0 GAL
SOLIDS: 2,284 GAL
240-S-302
17,700 GAL
LIQUID: 140 GAL
SOLIDS: 5,130 GAL
241-S-302A
14,300 GAL
EMPTY
241-S-302B
17,700 GAL
LIQUID: 305 GAL
SOLIDS: 1,050 GAL
241-SX-302
14,300 GAL
LIQUID: 245 GAL
SOLIDS: 108 GAL
241-TX-302XB
17,700 GAL
LIQUID: 0 GAL
SOLIDS: 450 GAL
240-TY-302A
14,300 GAL
EMPTY
241-TY-302B
NEUTRALIZATION TANK
LIQUID
SOLIDS
3,800 GAL
LIMESTONE
270-W
VAULT TANKS
50,000 GAL
EMPTY
241-WR-001
50,000 GAL
EMPTY
241-WR-002
50,000 GAL
EMPTY
241-WR-003
50,000 GAL
EMPTY
241-WR-004
50,000 GAL
EMPTY
241-WR-005
50,000 GAL
MINIMAL AMOUNT OF LIQUID
241-WR-006
50,000 GAL
EMPTY
241-WR-007
50,000 GAL
EMPTY
241-WR-008
50,000 GAL
LIQUID: 23,000 GAL
SOLIDS: 0 GAL
241-WR-009

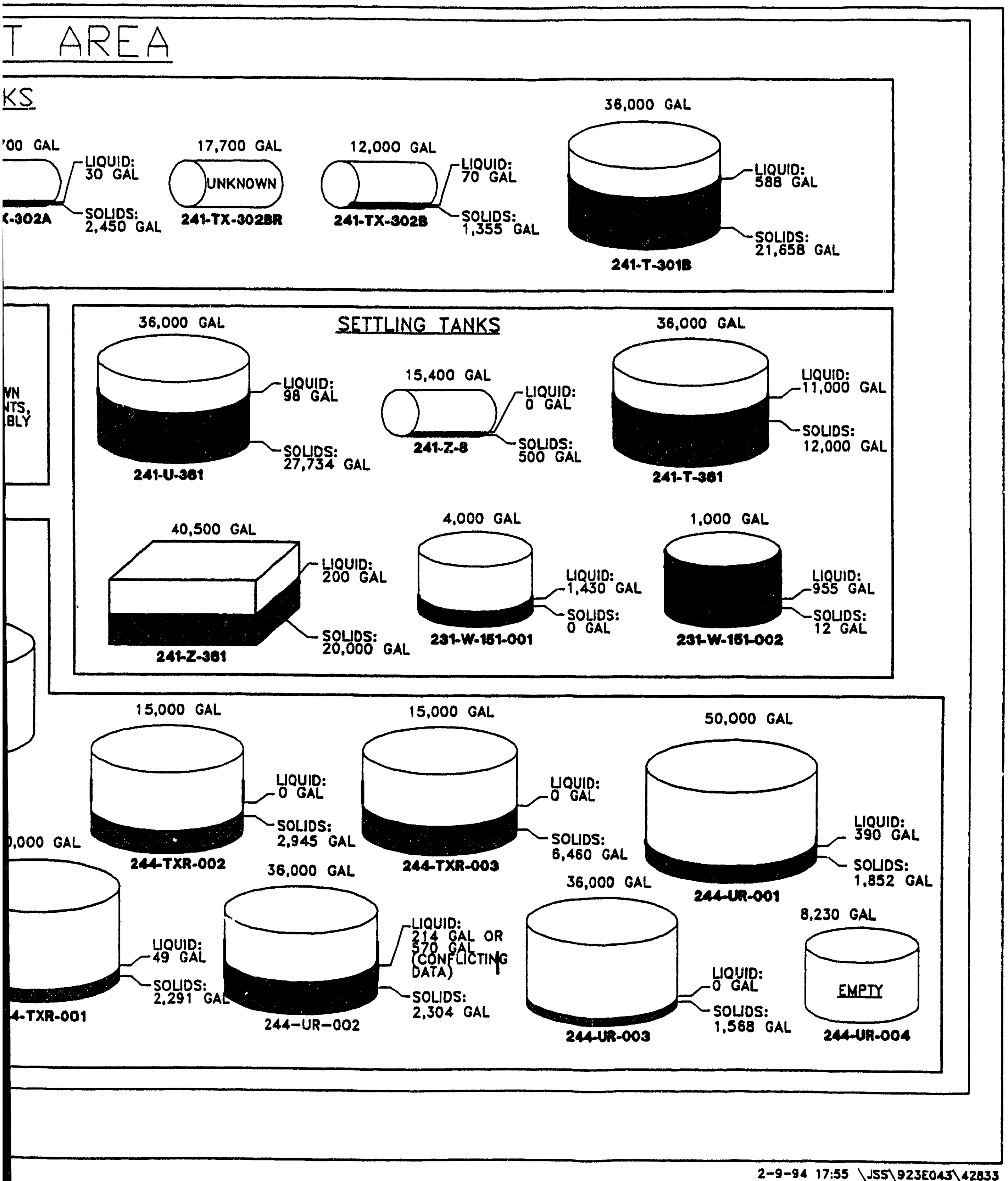


Figure 2-22. 200 West Area Tanks.

Table 2-1. Locations of Miscellaneous Tanks. (Sheet 1 of 3)

TANK NUMBER	COORDINATES	REFERENCE[1]	COMMENTS
240-S-302	N34698.5/W73866.33	H-2-71663; H-2-5200; H-2-5211	
241-A-302B	N41250/W47345	Neilsen 1992	
	?/W47345	H-2-57452	DRWGS DO NOT GIVE NORTH COORDINATES FOR TANK 241-A-302B
	?/W47345	H-2-71303	
241-B-301	N45439/W52950	Neilsen 1992	TANK COORDINATES ARE DIFFERENT
	N45437.51/W52965	H-2-71646	
241-B-302B	N42568/W52771	Neilsen 1992	NEILSEN REFERENCE DRAWINGS CALL TANK 241-B-302 (DRWGS. W-77092, D-61682)
241-B-361	N43400/W52890	Rymarz and Speer 1991; H-2-71677	
241-BX-302A	N45280/W53186	Neilsen 1992	
	N45280.5/W53186.5	H-2-618	
241-BX-302B	N42533/W53807	Neilsen 1992	TANK COORDINATES ARE SLIGHTLY DIFFERENT
	N42528.0/W53808.5	H-2-635	
	N42528.0/W53807.0	H-2-857	
241-BX-302C	N44210/W53186	Neilsen 1992	
	N44210.0/W53186.5	H-2-638; H-2-44501, SH. 118	
241-C-301	N43160/W48480	Neilsen 1992	NEILSEN REFERENCE DRWGS DO NOT GIVE TANK COORDINATES
	N43152.37/W43478.13	H-2-71648	
241-CX-70	N42100/W50200	Rymarz and Speer 1991	TANK COORDINATES ARE DIFFERENT
	N42050.0/W50137.0	H-2-44501, SH. 82; H-2-4420	
241-CX-71	N42110/W50190	Neilsen 1992	COORDINATES APPEAR TO BE ESTIMATED
241-CX-72	N42058.0/W50072.5	H-2-4420	TANK COORDINATES ARE DIFFERENT
	N42080.5?/W50090.0	H-2-4422	
241-S-302A	N35670/W75360	Neilsen 1992	TANK COORDINATES ARE DIFFERENT
	N35680.0/W75374.75	H-2-71664	

Table 2-1. Locations of Miscellaneous Tanks. (Sheet 2 of 3)

TANK NUMBER	COORDINATES	REFERENCE[1]	COMMENTS
241-S-302B	N36265/W75540	Neilsen 1992	TANK COORDINATES ARE SLIGHTLY DIFFERENT; W COORDINATE ON H-271650 DRWG IS NOT TANK CENTER
	N36265.0/W7735.0	H-2-71650	
241-SX-302	N35570/W75585	Neilsen 1992	TANK COORDINATES ARE DIFFERENT
	N35579.83/W75582.0	H-2-71650	
241-T-301B	N43232/W75837	Neilsen 1992	TANK COORDINATES ARE SLIGHTLY DIFFERENT
	N43235.0/W75837.5	H-2-71652	
241-T-361	N43225/W74000	Rymarz and Speer 1991	TANK COORDINATES ARE DIFFERENT
	W43300.0/W74145.0	H-2-7167	
241-TX-302A	N41570/W75640	Neilsen 1992	TANK COORDINATES ARE SLIGHTLY DIFFERENT
	N41570.0/W75640.79	H-2-71652	
241-TX-302B	N41474/W74754	Neilsen 1992	NEILSEN USED SAME TANK COORDINATES FOR TX-302B AND TX-302BR. H-2-43011 SHOWS 1ST TK REPLACEMENT, H-2-2636 SHOWS 2ND TK REPLACEMENT. SEE NOTE #3, H-2-2-833 FOR EXPLANATION OF TANK REPLACEMENTS.
	N41511.29/W74749	H-2-2536;	
241-TX-302BR	N41474/W74754	Neilsen 1992	
	N41478.85/W74754.41	H-2-2536; H-2-43011	
241-TX-302XB	N41623/W75679	Neilsen 1992	
	N41623.85/W75679.65	H-2-807	
241-TY-302A	N42358/W75670	Neilsen 1992	
	N42338.5/W75673.5	H-2-2233; H-2-71652	
241-TY-302B	N42608/W75715	Neilsen 1992	N COORDINATE IS FROM THE NORTHERN END OF THE TANK
	N42622.0/W75684.17	H-2-71652; H-2-44511, SH 126; H-2-2234	
241-U-361	N37830/W74160	Rymarz and Speer 1991	TANK COORDINATES ARE DIFFERENT
	N37880.0/W74145.0	H-2-44511, SH. 61; H-2-71676	

Table 2-1. Locations of Miscellaneous Tanks. (Sheet 3 of 3)

TANK NUMBER	COORDINATES	REFERENCE[1]	COMMENTS
241-Z-361	N39500/W76600	Rymarz and Speer 1991	TANK COORDINATES ARE DIFFERENT; N39560.0 TAKEN FROM THE NORTH PART OF INSIDE TANK WALL
	N39560.0/W76600.0	H-2-16024; H-2-16460; H-2-71679	
241-Z-8	N40000.0/W76327.5	H-2-71679; H-2-16553	W COORDINATE IS FROM THE WESTERN END OF THE TANK
270-E-1	N42600/W544OO	Rymarz and Speer1991	TANK COORDINATES ARE DIFFERENT
	N42540.0/W54730	H-2-71678	
270-W	N38042/W73100	Neilsen 1992	
	N380452.5/W73100.00	H-2-71678	
244-BXR VAULT TANKS 001,002, 003, 011	N45201/W53531	Neilsen 1992	CENTERLINE OF TANKS IS N45201
	N45214.92/W53481.0	H-2-71656	COORDINATES DEFINE THE NE CORNER OF THE BXR VAULT
244-TXR VAULT TANKS 001, 002, 003	N41475/W75795	Neilsen 1992	
	N41470.0/W75760.0	H-2-71662	N41470.0 IS CENTERLINE OF TANKS, W75760.0 IS FROM EASTERN OUTSIDE WALL OF TK 001 CELL
244-UR VAULT TANKS 001, 002, 003, 004	N38390/W75750	Neilsen 1992	
	N38390.0/W75797.0	H-2-71658; H-2-71659	N COORDINATE IS CENTERLINE OF TANKS, W COORDINATE IS FROM WESTERN OUTSIDE WALL
231-W-151 VAULT TANKS 001, 002	N40800/W76596	Neilsen 1992	
241-WR VAULT TANKS 001, 002, 003, 004, 005, 006, 007, 008, 009	N38850/W72850	Neilsen 1992	COORDINATES APPEAR TO DEFINE THE CENTER OF VAULT

[1] H-x-xxxx refers to reference drawing number

Table 2-2. Watch List Tanks. (Page 1 of 2)

Tank	Watch List Category	Associated Miscellaneous Tanks[1]
A-101 AX-101 AX-103	Hydrogen	-
S-102 S-111 S-112 SX-101 SX-102 SX-103 SX-104 SX-105 SX-106 SX-109	Hydrogen	241-S-302 241-S-302A 241-S-302B (Empty) 241-SX-302
T-110	Hydrogen	241-T-301B 244-TXR Vault
U-103 U-105 U-108 U-109	Hydrogen	244-BXR Vault 244-TXR Vault 244-UR Vault 244-WR Vault
B-103	Organic Salts	241-B-301 241-B-302B 241-BX-302A 241-BX-302B 241-BX-302C 244-BXR Vault
C-103	Organic Salts	241-C-301
S-102 SX-106	Organic Salts	240-S-302 241-S-302A 241-S-302B (Empty) 241-SX-302
TX-105 TX-118	Organic Salts	241-T-301B 241-TX-302B 241-TX-302BR 241-TX-302XB 241-TY-302A 241-TY-302B 244-TXR Vault

Table 2-2. Watch List Tanks. (Page 2 of 2)

Tank	Watch List Category	Associated Miscellaneous Tanks[1]
U-106 U-107	Organic Salts	244-BXR Vault 244-TXR Vault 244-UR Vault 244-WR Vault
BX-102 BX-106	Ferrocyanide	241-B-301 241-B-302B 241-BX-302A 241-BX-302B 241-BX-302C 244-BXR Vault
BY-103 BY-104 BY-105 BY-106 BY-107 BY-108 BY-110 BY-111 BY-112		
C-108 C-109 C-111 C-112	Ferrocyanide	241-C-301
TX-118	Ferrocyanide	241-T-301B 241-TX-302B 241-TX-302BR 241-TX-302XB 241-TY-302A 241-TY-302B 244-TXR Vault
TY-101 TY-103 TY-104		
C-106	High Heat	241-C-301

(1) Includes only tanks with direct transfers between tank farms and processing plants. Does not include tank to tank transfers.
- Not Applicable
Reference: Hanlon (1993)

Table 2-3. Anticipated Current Waste Volume Status of Miscellaneous Tanks. (Sheet 1 of 5)

Tank Designation	Isolation Project	Date Isolated	Remaining Solids Level (inches)	Remaining Solids Volume (gals)	Solids Level Meas. Date	Remaining Liquid Level (inches)	Remaining Liquid Volume (gals)	Liquid Level Meas. Date	Remaining Total Waste Volume (gals)	Notes	Liquid Depth (in)
241-A-302B	B-138	Sep-85	12.00	-	2/22/89	30.00	-	3/1/89	3,600[1]	Interim stabilized Jan-90. Monitored.	-
241-B-301	B-231	7/8/85	110.50	21,660	7/8/85	113.50	590	7/8/85	22,250		3.00
241-B-302B	B-231	5/16/85	9.00	690	Aug-84	35.00	4,240	5/10/85	4,930		26.00
241-BX-302A	B-231	3/15/85	10.25	835	3/14/84	10.25	0	3/14/84	835		0.00
241-BX-302B	B-231	5/8/85	17.00	950	Aug-84	18.00	94	5/8/85	1,044		1.00
241-BX-302C	B-231	4/15/85	13.00	635	4/11/85	16.00	228	4/11/85	863		3.00
241-C-301	B-231	6/3/85	46.00	9,016	6/3/85	53.50	1,470	6/3/85	10,486		7.50
240-S-302[1]	-	Mar-Apr87	20.40	-	5/24/93	20.40	-	5/24/93	2,276[1]	Est. 100 gal. interstial liquid. Monitored.	-
241-S-302A[2]	B-231	Aug-91	36.00	5,130	May-91	-	-	-	5,130[1]	Has 2' grout over 1' sand. Monitored.	-
241-S-302B	B-231	12/4/84	0.00	0	Sep-84	0.00	0	Sep-84	0		0.00
241-SX-302	B-231	12/4/84	12.00	1,050	Nov-84	14.25	305	Nov-84	1,355		2.25
241-T-301B	B-231	7/8/85	110.50	21,658	6/25/85	113.50	588	6/25/85	22,246		3.00
241-TX-302A	B-231	12/4/84	21.40	2,450	Sep-84	21.50	30	Sep-84	2,480		0.10
241-TX-302B	B-231	12/4/84	14.30	-	Sep-84	14.75	-	Sep-84	1,320[1]	Monitored	-
241-TX-302BR	C-362	Feb-Mar54	-	-	-	-	-	-	-	Contents unknown	see notes
241-TX-302XB	B-231	6/20/85	3.00	108	Jun-85	6.50	245	Jun-85	353		3.50
241-TY-302A	B-231	6/27/85	6.75	450	6/25/85	6.75	0	6/25/85	450		0.00

Table 2-3. Anticipated Current Waste Volume Status of Miscellaneous Tanks. (Sheet 2 of 5)

Tank Designation	Isolation Project	Date Isolated	Remaining Solids Level (inches)	Remaining Solids Volume (gals)	Solids Level Meas. Date	Remaining Liquid Level (inches)	Remaining Liquid Volume (gals)	Liquid Level Meas. Date	Remaining Total Waste Volume (gals)	Notes	Liquid Depth (in)
241-TY-302B	B-231	12/4/84	0.00	0	Aug-84	0.00	0	Aug-84	0		0.00
241-CX-72	-	1986	120.00	653	1989	120.00	0	1989	653	Has grout over 10' waste	0.00
241-CX-71	-	1986	76.20	930	1990	76.20	0	1990	930	Grout over 4' limestone +2.35' sludge	see notes
270-E-1[3]	B-231	1985	91.00	3,800	1974	-	-	-	3,800	Poss. 1400 gal. interstitial liq.	0.00
270-W[2]	-	Mar-70	-	-	-	-	-	-	-	Limestone sludge expected	
241-B-361	B-231	1985	105.50	20,628	1985	105.50	0	1985	20,678	No pumpable liquids	0.00
241-T-361	B-231	1985	125	24,500	1985	125	0	1985	24,500		0.00
241-U-361	B-231	7/18/85	141.50	27,734	1984-85	142.00	98	1984-85	27,832	Little or no liquid noted	0.50
241-Z-8[3]	B-231	1974, '85	7.00	500	Jul-74	7.00	0	Oct-74	500	Liq. removed 10-19-74	0.00
241-Z-361[3]	B-231	1973, '85	96.00	20,000	May-75	98.50	200	May-75	20,200	Layered "mud-like" sludge	2.50
241-CX-70	-	May-92	0.00	0	May-92	0.00	0	May-92	0	Tank is empty and dry	0.00
244-BXR-011	B-231	Mar-85	36.00	7,020	Apr-84	36.50	98	Apr-84	7,118		0.50
244-BXR-011 sump	B-231	Mar-85	40.25	4,200	1/24/85	40.25	0	1/24/85	4,200	Soft sludge	0.00
244-BXR-001	B-231	Mar-85	37.00	7,215	Nov-84	37.00	0	Nov-84	7,215		0.00

Table 2-3. Anticipated Current Waste Volume Status of Miscellaneous Tanks. (Sheet 3 of 5)

Tank Designation	Isolation Project	Date Isolated	Remaining Solids Level (inches)	Remaining Solids Volume (gals)	Solids Level Meas. Date	Remaining Liquid Level (inches)	Remaining Liquid Volume (gals)	Liquid Level Meas. Date	Remaining Total Waste Volume (gals)	Notes	Liquid Depth (in)
244-BXR-001 sump	B-231	Mar-85	0.00	0	Apr-84	4.00	12	Apr-84	12		4.00
244-BXR-002	B-231	Mar-85	19.00	1,805	2/13/85	23.00	380	2/13/85	2,185		4.00
244-BXR-002 sump	B-231	Mar-85	11.00	33	2/13/85	13.00	250	2/13/85	283		2.00
244-BXR-003	B-231	Mar-85	15.25	1,449	Apr-84	19.00	356	2/18/85	1,805		3.75
244-BXR-003 sump	B-231	Mar-85	58.00	7,690	2/18/85	62.00	616	2/18/85	8,306	Soft sludge	4.00
244-TXR-001	B-231	Nov-84	11.75	2,291	Oct-84	12.00	49	Oct-84	2,340		0.25
244-TXR-01 sump	B-231	Nov-84	1.25	4	Oct-84	3.00	5	Oct-84	9		1.75
244-TXR-002	B-231	Nov-84	31.00	2,945	Oct-84	31.00	0	Oct-84	2,945		0.00
244-TXR-002 sump	B-231	Nov-84	0.00	0	Oct-84	5.00	15	Oct-84	15		5.00
244-TXR-003	B-231	Nov-84	68.00	6,460	Oct-84	68.00	0	Oct-84	6,460		0.00
244-TXR-003 sump	B-231	Nov-84	6.50	20	Oct-84	7.50	3	Oct-84	23		1.00
244-UR-001	B-231	10/16/85	9.50	1,852	Jul-84	11.50	390	Jul-84	2,242		2.00
244-UR-001 sump	B-231	10/16/85	12.75	262	Jul-84	16.75 or 36.75	1204 or 3568	6/26/85	1466 or 3830	Conflicting liquid level data	4 or 24
244-UR-002	B-231	10/16/85	24.25	2,304	7/11/85	26.5 or 30.25	214 or 570	7/11/85	2518 or 2874	Conflicting liquid level data	2.25 or 6
244-UR-002 sump	B-231	10/16/85	4.5 or 11	14 or 33	7/8/85	16.5 or 11	1143 or 0	7/8/85	33 or 1157	Conflicting level data	0 or 12
244-UR-003	B-231	10/16/85	16.50	1,568	Jul-84	16.50	0	Jul-84	1,568		0.00

Table 2-3. Anticipated Current Waste Volume Status of Miscellaneous Tanks. (Sheet 4 of 5)

Tank Designation	Isolation Project	Date Isolated	Remaining Solids Level (inches)	Remaining Solids Volume (gals)	Solids Level Meas. Date	Remaining Liquid Level (inches)	Remaining Liquid Volume (gals)	Liquid Level Meas. Date	Remaining Total Waste Volume (gals)	Notes	Liquid Depth (in)
244-UR-003 sump	B-231	10/16/85	23.00	2,300	Jul-84	23.0 or 47.0	0 or 3696	6/21/85	2300 or 5996		0 or 24
244-UR-004	B-231	10/16/85	-	-	-	-	-	-	-	Volumes unknown. Used for 60% nitric acid.	see notes
231-W151-001[2]	-	-	0.00	0	5/9/74	36.00	1,430	5/9/74	1,430		36.00
231-W151-002[2]	-	-	1.00	12	5/9/74	78.00	955	5/9/74	967		77.00
241-WR-001	B-231	1984-85	-	-	-	5.00	-	11/2/81	0	No stabilization form available	
241-WR-001 sump	B-231	1984-85	-	-	-	68.00	-	11/2/81	-	No stabilization form available.	
241-WR-002	B-231	1984-85	-	-	-	0.00	0	11/2/81	0	No stabilization form available	
241-WR-002 sump	B-231	1984-85	-	-	-	208.00	-	11/2/81	-	Poss. 70,000 gal. if tank floating. Solids volume unknown.	
241-WR-003	B-231	1984-85	-	-	-	0.00	0	11/2/81	0	No stabilization form available	
241-WR-003 sump	B-231	1984-85	-	-	-	6.50	-	11/2/81	-	Sump volume not known	
241-WR-004	B-231	1984-85	-	-	-	0.00	0	10/30/81	0	No stabilization form available	
241-WR-004 sump	B-231	1984-85	-	-	-	3.50	-	10/30/81	-	Sump volume not known	

Table 2-3. Anticipated Current Waste Volume Status of Miscellaneous Tanks. (Sheet 5 of 5)

Tank Designation	Isolation Project	Date Isolated	Remaining Solids Level (inches)	Remaining Solids Volume (gals)	Solids Level Meas. Date	Remaining Liquid Level (inches)	Remaining Liquid Volume (gals)	Liquid Level Meas. Date	Remaining Total Waste Volume (gals)	Notes	Liquid Depth (in)
241-WR-005	B-231	1984-85	-	-		0.00	0	10/30/81	0	No stabilization form available	
241-WR-005 sump	B-231	1984-85	-	-	-	0.00	0	10/30/81	0	No stabilization form available	
241-WR-006[4]	B-231	1984-85	0.00	0	1/29/79	minimum	minimum	3/29/78	minimum	Minimum heel	min.
241-WR-006 sump[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00
241-WR-007[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00
241-WR-007 sump[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00
241-WR-008[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00
241-WR-008 sump[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00
241-WR-009[4]	B-231	1984-85	0.00	0	1/29/79	13	23,000	3/29/78	23,000	No stabilization form available	118.00
241-WR-009 sump[4]	B-231	1984-85	0.00	0	1/29/79	0.00	0	3/29/78	0	No stabilization form available	0.00

Notes:
Liquid and sludge levels taken from Project B-231 stabilization evaluation forms except where noted.
[1]Data from Hanlon (1994).
[2]Data from Nielsen 1992.
[3]Data from Rymarz and Speer 1991.
[4]Data from DiPietro 1979.
- No Data

3.0 EVALUATION OF REGULATORY REQUIREMENTS

This section evaluates regulatory requirements that pertain to management of the miscellaneous inactive underground radioactive waste tanks. The first part of this section discusses potential regulatory requirements applicable to the miscellaneous tanks including CERCLA, and RCRA past-practice and treatment, storage and disposal (TSD) facility requirements for management and closure of the miscellaneous radioactive waste tanks. Corresponding Washington State regulations are also discussed as well as DOE Orders pertaining to radioactive waste management. The regulatory discussion is followed by a discussion of how closure and/or remediation of the miscellaneous tanks is currently incorporated into Hanford Site restoration activities and identifies Hanford Site programs currently responsible for the management of the tanks.

3.1 OVERVIEW OF REGULATORY REQUIREMENTS

3.1.1 Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement)

The Tri-Party Agreement (Ecology et al. 1992) was developed by the DOE, EPA, and Ecology and signed in May 1989. The Tri-Party Agreement ensures that the environmental impacts of past and present operations at the Hanford Site are investigated and appropriately remediated as required under CERCLA and RCRA past-practice regulations and that hazardous waste management activities are conducted in accordance with RCRA and the Washington State Dangerous Waste Regulations (Chapter 173-303 WAC). The Tri-Party Agreement provides a management umbrella of sufficient scope to cover all CERCLA past-practice, RCRA past-practice and RCRA TSD activities on the Hanford Site.

The Tri-Party Agreement was revised in 1991 to incorporate the Hanford Site Past-Practice Strategy (DOE-RL 1992e) developed by EPA, DOE and Ecology. The Hanford Site Past-Practice Strategy presents a streamlined approach to meet statutory requirements and integrate the CERCLA Remedial Investigation/Feasibility Study (RI/FS) and RCRA past-practice RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) guidance into a single process for remediation of the Hanford Site at the earliest date. The Hanford Site Past-Practice Strategy emphasizes the use of existing data, integration of past-practice units with RCRA closure investigations, conducting interim remedial actions, and conducting focussed RI/FSs to reach decisions necessary to initiate remedial actions and complete cleanup projects on an operable unit and aggregate area basis (DOE-RL 1992b).

As part of the 1991 Tri-Party Agreement revisions, the 200 Area has been divided into eight source aggregate area management units and two groundwater aggregate area management units (DOE-RL 1992b). Each aggregate area is further divided in one or more operable units. The intent behind designation of operable units was to group associated waste management units together so that they may be characterized under one work plan. The definition of operable units is an ongoing process and Change Control Form C-93-04 recently reassigned several of the miscellaneous tanks addressed in this report to new operable units (Ecology et al. 1993a). The current operable units for each of the miscellaneous tanks are identified in Table 3-1.

As indicated in Table 3-1, the miscellaneous tanks subject to this engineering study are identified in the Tri-Party Agreement Action Plan as RCRA TSDs, RCRA past-practice units or

CERCLA past-practice units. The EPA is lead agency for CERCLA units and Ecology is lead agency for RCRA TSDs and RCRA past-practice units. Several of the miscellaneous tanks addressed in this report were not originally included in the Tri-Party Agreement. However, a Tri-Party Agreement Change Control Form C-93-05 was recently approved and assigns additional miscellaneous tanks to operable units and lead agency responsibility (Ecology et al. 1993b).

Negotiations between the Tri-Party Agreement signatories presented in the October 1993, Tentative Agreement on Tri-Party Negations directly affect the management and remediation pathway for 22 of the miscellaneous tanks which are located within the six operable units containing SSTs. Prior to the October 1993 negotiations, the Tri-Party Agreement Action Plan identified the SSTs for closure as TSD facilities and the ancillary equipment as RCRA past-practice units. The revised Tri-Party Agreement recommends that all SST ancillary equipment located within the boundary of each tank farm be closed as RCRA TSD facilities (Ecology et al. 1993c). The change control form states that this approach will reduce potential duplication of effort that would have resulted from implementation of both the RCRA 3004(u) past-practice corrective action RFI/CMS process and TSD unit closure pursuant to WAC 173-303-610.

3.1.2 RCRA and Washington State Dangerous Waste Regulations

The RCRA regulates the generation, transportation, storage, treatment and disposal of hazardous waste. Washington State Dangerous Waste Regulations implement the federal hazardous waste regulations and provide for regulation of state designated dangerous waste. These regulations establish specific, design, operation, monitoring, closure and post-closure care requirements for TSD facilities. On November 23, 1987, Ecology was given authorization by EPA to regulate mixed waste within the state. The requirements for tank systems are specified in WAC 173-303-640 and general closure requirements are provided in WAC 173-303-610, Closure and Post-Closure Care for TSD facilities.

Authority for cleanup of spills and releases of hazardous waste to the environment as a result of past practices is established under RCRA Section 3004(u). Ecology has been granted authority through the Tri-Party Agreement as lead agency for RCRA past-practice activities conducted at the Hanford Site. Amendments to the Dangerous Waste Regulations effective January 6, 1994, authorize Ecology (with support from EPA Region X) to use the existing state cleanup authority under the Model Toxics Control Act (MTCA) for RCRA corrective actions. These amendments to the Dangerous Waste Regulations provide a consistent set of cleanup goals, standards and procedures applicable for RCRA corrective actions under 3004(u), RCRA closure requirements and MTCA cleanup actions.

3.1.2.1 RCRA TSD. RCRA TSD requirements are not applicable to the miscellaneous tanks if tanks containing mixed waste have not been actively managed since November 23, 1987 when Ecology was given authority to regulate mixed waste. If miscellaneous tanks containing mixed waste are determined to have been actively managed since November 23, 1987 they may be determined by Ecology to be subject to RCRA TSD requirements. The definition of "actively" managed is subject to interpretation and any re-classification of waste unit categories under the Tri-Party Agreement is subject to negotiation between the three signatories.

Because the miscellaneous tanks addressed in this report are all inactive, and a final status permit will not be obtained for them, any tanks defined as RCRA TSD facilities are subject to interim status requirements as defined in WAC 173-303 and 40 CFR Part 265. The Dangerous

Waste Regulations in WAC 173-303-400, incorporate by reference the interim status standards for management of hazardous waste in tanks in 40 CFR Part 265 Subpart J and the closure requirements in 40 CFR 265 Subpart G. Under final status the requirements of WAC 173-303-610 and WAC 173-303-640 apply to closure activities for tanks.

General operating requirements for existing tanks require that tanks be evaluated to determine if they are leaking or unfit for use. The assessment must be sufficient to determine the structural integrity of the tank and compatibility with wastes stored. All tanks must be provided with secondary containment unless an approved variance is issued.

Closure and post-closure care for tank systems is specified in 40 CFR 265.197. At closure, all hazardous waste and residue must be removed from the tank and system components or tank and system components decontaminated. Contaminated soils and equipment must also be removed or decontaminated. If all contamination cannot be removed or decontaminated, the tank system may be closed under the requirements for landfills. In the past, Ecology has defined clean closure as removal to background concentrations or detection limits for any listed or characteristic wastes, and at least the designation level for state-only dangerous wastes. The January 6, 1994, amendments to WAC 173-303 incorporate use of existing state cleanup authority established under MTCA to determine health risk-based cleanup criteria for use in RCRA closures. This rule allows owner/operators to meet RCRA closure requirements, including clean closure, using MTCA in Chapters 173-340-700 through 173-340-760 WAC (excluding WAC 173-340-745) to demonstrate clean closure of dangerous waste management units.

As indicated previously, RCRA TSD requirements apply to miscellaneous tanks that contain mixed waste and have been actively managed after November 23, 1987. As shown in Table 3-1, three tanks, the 241-CX-70, 241-CX-71 and 241-CX-72 tanks addressed in this report meet the criteria for regulation as a TSD facility. However, as noted previously, the amended Tri-Party Agreement reclassifies all RCRA past-practice units (including miscellaneous tanks and other ancillary equipment) located within the boundary of SST operable units requiring closure as TSD facilities.

3.1.2.2 RCRA Past-Practice. At Hanford, RCRA past-practice authority applies to operable units containing RCRA TSD waste management units that received mixed waste after November 19, 1980 (the effective date of RCRA) that were abandoned or closed prior to November 23, 1987, the date Ecology was given authorization to regulate mixed waste. Closure of RCRA past-practice waste management units is conducted using the RFI/CMS process.

As noted in Table 3-1, 21 tanks are currently identified as RCRA past-practice units. An additional five tanks, that have not been assigned to unit categories under the Tri-Party Agreement, meet this criteria. However, tanks located in SST operable units will eventually be subject to RCRA TSD closure due to the recent Tri-Party Agreement negotiations (Ecology et al. 1993c).

Both the RFI/CMS and CERCLA RI/FS process are being implemented in accordance with the Hanford Site Past-Practice Strategy (DOE-RL 1992e), wherein investigations are conducted with a "bias for action." Work plans are developed for operable units that identify facilities needing immediate attention for conducting expedited response actions (ERAs), identify high-priority facilities where a limited field investigation (LFI) is needed to implement interim remedial measures (IRMs) and that defer lower priority facilities and facilities needing more information to the full RFI/CMS process.

3.1.3 CERCLA Remedial Actions

CERCLA was enacted by Congress to provide for liability, compensation, cleanup and emergency response for hazardous substance release to the environment and to clean up inactive hazardous waste disposal sites. CERCLA is implemented through the National Contingency Plan (NCP), 40 CFR 300, with EPA delegated as the enforcement authority. The NCP provides a consistent set of rules and procedures for the cleanup of contaminated sites. For sites listed on the NPL, scoping level documents are prepared using existing information that assists in the evaluation of the site, determines if interim actions are required, and identifies the sequence of activities necessary for site remediation. The RI/FS provides the process for data collection, evaluation, and selection of a preferred remedial alternative. The EPA placed the 200 Area of the Hanford Site on the NPL under CERCLA. Inclusion on the NPL initiates the RI/FS process for characterizing the nature and extent of contamination, assessing the risks to human health and the environment, and selecting of remedial actions.

As noted previously, a streamlined process, the Hanford Site Past-Practice Strategy, has been identified for conducting CERCLA activities at Hanford (DOE-RL 1992e). The RI/FS process under CERCLA will be used to remediate CERCLA past-practice units. CERCLA past-practice authority applies to units that received hazardous substances and were abandoned prior to promulgation of RCRA on November 19, 1980; any mixed waste disposal site that was abandoned between November 19, 1980 and November 23, 1987, the date Ecology received EPA authorization to manage mixed waste under RCRA; or any radioactive waste site requiring cleanup since RCRA does not regulate radioactive waste. As indicated in Table 3-1, 17 miscellaneous tanks meet this definition and are identified as CERCLA past-practice sites in the Tri-Party Agreement.

3.1.4 DOE Orders

Radiation protection and radioactive waste management requirements promulgated under the *Atomic Energy Act of 1954*, as amended, are implemented at DOE facilities as DOE Orders. This section summarizes two DOE Orders that are directly relevant to management and remediation of the miscellaneous inactive underground radioactive waste tanks.

3.1.4.1 DOE Order 5820.2A Radioactive Waste Management. This order specifies the policies, guidelines and minimum requirements for DOE management of radioactive and mixed waste at contaminated facilities. DOE Order 5820.2A provides management requirements for high-level waste (HLW), TRU and low-level waste (LLW).

Retrievable HLW is to be disposed in a geologic repository according to the requirements of the *Nuclear Waste Policy Act of 1982*, as amended. This DOE Order notes that HLW that is difficult to retrieve may be disposed of in place. In-situ disposal requires periodic monitoring capable of determining the need for corrective measures. Requirements for existing facilities that manage HLW prior to disposal are also specified in DOE Order 5820.2A. Storage operations require that the waste be characterized consistent with radiation protection requirements and also with requirements under hazardous waste regulations. DOE Order 5820.2A prohibits the storage of new waste in tanks without secondary containment. Storage units with only primary containment must be equipped with means to determine and monitor tank volumes and with ventilation systems that maintain airborne emissions below regulatory levels. DOE Order 5820.2A requires the preparation and implementation of contingency action plans to respond to leaks, releases, or other emergencies.

Disposal of TRU waste is to be managed in compliance with the specifications of the Waste Isolation Pilot Plant (WIPP). DOE Order 5820.2A specifies that material with TRU waste concentrations greater than 100 nCi/g shall be managed as TRU waste. Interim storage requirements for TRU waste specified in DOE Order 5820.2A are consistent with RCRA requirements and require that interim storage facilities comply with permitting requirements from all applicable DOE Orders, and federal and state regulations. Existing buried TRU waste at inactive DOE waste sites is to be managed according to the "Comprehensive Implementation Plan for DOE Defense Buried Transuranic-Contaminated Waste Programs," (Everette et al. 1988). The implementation plan provides facility closure in compliance with CERCLA and other DOE, EPA, and state requirements.

DOE Order 5820.2A requires that LLW management practices limit external exposure to radioactive material released to the environment to levels that will not result in an effective dose equivalent to any member of the public in excess of 25 mrem/yr and that any air release meet the emission limits specified in 40 CFR 61. DOE Order 5820.2A also specifies that radiation exposure be limited to as low as reasonably achievable (ALARA). LLW disposal systems must be capable of limiting the effective dose equivalent received by inadvertent intruders into the disposal system after institutional controls cease to not more than 100 mrem/yr or 500 mrem for a single acute exposure.

DOE Order 5820.2A specifies that decommissioning of radioactively contaminated facilities is to be conducted to ensure that releases of radioactivity and hazardous material comply with federal and state standards. As necessary, the CERCLA RI/FS process is used to identify and evaluate remedial alternatives. Environmental review may be performed according to NEPA, RCRA or CERCLA review processes.

3.1.4.2 DOE Order 5400.5 Radiation Protection of the Public and Environment. Radiation Protection of the Public and Environment, DOE Order 5400.5 applies the ALARA process to radiation protection. The ALARA process is not a dose-based limit, but a feasibility limit, in that exposures should be as far below applicable limits as practical. The feasibility limit should account for social, economic, technical, and public policy considerations. The ALARA process includes procedures for evaluating alternative operations and other factors to reduce radiation exposures. DOE Order 5400.5 uses derived concentration guides (DCGs) as the discharge limits for radioactively contaminated releases to air, surface waters, aquifers, soil, and sanitary sewage systems.

The basic public dose limit is 100 mrem effective dose equivalent per year in excess of naturally occurring background. The dose from Hanford Site operations to any offsite individual resulting from all effluent release pathways (gaseous or liquid, including ground- or surface water used for drinking, irrigation or recreation) shall not exceed 100 mrem EDE. A threshold concentration of 0.04 times the DCG, measured at the point of release into the environment has been established at the Hanford Site to insure that off-site releases of radioactive liquids do not exceed regulatory limits (WHC 1991). However, the DOE Order notes that per the federal Clean Air Act, airborne emissions resulting from routine DOE activities are not to cause members of the public to receive an annual EDE of 10 mrem. Hanford Site contractor policy specifies that the annual average concentration of radionuclides released to the environment via airborne release are not to exceed an administrative control value of 1 times the DCG-public value at the point of emission (WHC 1991). Radiological protection requirements are established for residual radioactive material and cleanup of residual materials. DOE Order 5400.5 identifies circumstances where supplemental limits or exceptions to the standards may be implemented.

The proposed DOE rule, Radiation Protection of the Public and the Environment (10 CFR 834) published in the March 23, 1993 Federal Register (58 FR 16268), promulgates the standards presently found in DOE Order 5400.5. The proposed rule retains the substantive portions of the DOE order and differs from the existing order in format, enhanced emphasis on the ALARA process, and changes in the usage of DCGs. The proposed rule identifies DCGs not as "acceptable" discharge limits, but to be used as reference values for estimating potential dose and determining compliance with the requirements of the proposed rule.

3.2 PROGRAM DESCRIPTION AND RESPONSIBILITY

This section identifies Hanford Site programs that have been assigned management responsibilities for miscellaneous tanks per Master Requirements and Procedures (MRP) 5.10, Waste Management Unit Management (Rew and Kion 1990). Primary responsibility for the miscellaneous tanks is divided between the ERRA, the TWRS, and Decommissioning and RCRA Closure Program (D & RCP). Program responsibilities for the miscellaneous tanks have not been finalized. Responsibilities will be assigned or re-assigned to the various programs once decisions for tank remediations have been made.

3.2.1 Environmental Restoration and Remedial Action Program

The ERRA Program implements the DOE National Environmental Restoration Program at the Hanford Site. The ERRA program implements the requirements of CERCLA and RCRA activities and is the Hanford Site interface for Tri-Party Agreement activities in these areas. The ERRA program also includes management activities associated with surveillance, maintenance, decommissioning and radiation reduction activities.

3.2.2 Tank Waste Remediation System

The TWRS Program covers all activities for tank waste that involve waste receipt, safe storage, treatment and disposal on-site, or packaging for off-site disposal. Tank waste is defined as all existing waste stored in SSTs, DSTs, and also includes all new waste added to these facilities. TWRS program scope encompasses existing SST and DST support facilities such as waste storage tanks, pipelines, treatment and disposal facilities for LLW. Supporting facilities are defined as the total TWRS infrastructure including tank upgrades. The former Single-Shell Tank Closure Program and the Waste Management Program that had responsibilities for operation and maintenance of active waste management facilities associated with tank systems have been incorporated into the TWRS program.

Closure of SSTs and DSTs is not within the scope of the TWRS program. Tank closure is addressed by the ERRA program. Closure activities conducted under the ERRA program will be coordinated with TWRS on a case-by-case basis (Baynes et al. 1993).

3.2.3 Decommissioning and RCRA Closure Program

The D & RCP is responsible for safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities and RCRA closures. D & RCP includes the Radiation

Area Remedial Action (RARA) program activities of surveillance, maintenance, decontamination and stabilization of inactive facilities (DOE-RL 1992b).

3.3 CURRENT PLANNED ACTIVITIES FOR CLOSURE/REMEDIATION

3.3.1 Single-Shell Tank Closure/Corrective Action Work Plan

The Single-Shell Tank Closure/Corrective Action Work Plan (DOE-RL 1989) developed, pursuant to the Tri-Party Agreement, presents the current program for development and implementation of RCRA closure and corrective action for operable units containing SSTs. The work plan presents existing information concerning SSTs and ancillary equipment, identifies data needs, and presents remediation strategies.

Several catch tanks and the 244-BXR, 244-TXR and 244-UR vaults and associated tanks are located within operable units containing SSTs. These tanks are considered ancillary equipment and in accordance with the Work Plan would be considered RCRA past-practice units to be remediated under the RFI/CMS process while the SSTs will undergo closure through the RCRA closure process.

The Work Plan strategy directs RCRA closure and RCRA past-practice pathways to proceed in parallel until the Corrective Measures Study is issued for RCRA past-practice units and a Closure Plan is issued for the TSD facilities (DOE-RL 1989). Following issuance of these reports, the two approaches merge for development of field and process demonstrations, development of implementation plans, implementation of selected closure and corrective measures, issuance of post closure permits, if required, and post closure care. As noted previously, the revised Tri-Party Agreement, Milestone M-45-00 categorizes all facilities located within operable units containing SSTs for TSD closure and submittal of a closure plan is not required until 2004 (Ecology et al. 1993c).

Currently the followup planning, investigation and engineering studies are heavily focussed on retrieval of SST waste in order to achieve specific Tri-Party Agreement milestones. No specific closure/corrective action activities are currently underway for the miscellaneous tanks identified as SST ancillary equipment.

3.3.2 Aggregate Area Management Studies, RI/FS and RFI/CMS Work Plans

Aggregate Area Management Studies (AAMS) were drafted to initiate the process for conducting restoration activities for the 200 Area in accordance with the Hanford Site Past-Practice Strategy (DOE-RL 1992e). The AAMS reports serve as scoping level documents that assemble existing information, evaluate the data, evaluate potential remedial technologies and present management recommendations. The AAMS provide management recommendations for conducting restoration activities that include identifying the waste management units for conducting ERAs or IRMs, identifying sites where additional data can be obtained via LFIs, and identifying sites where needed data will be obtained through the RI process. In addition, the AAMS defer many waste management units (including most of the miscellaneous tanks) to other Hanford Site programs.

The miscellaneous tanks subject to this engineering study are contained within seven different AAMS reports (three of the miscellaneous tanks 270-W, 241-TX-302BR, and

241-TX-302XB were not discussed in the AAMS reports). Management recommendations for the 47 miscellaneous radioactive waste tanks addressed in the AAMS are presented in Table 3-1 and include the following:

- two tanks identified as candidates for ERAs
- four tanks identified for LFI/IRMs
- four tanks identified for RIs
- 37 tanks are deferred for decision making under other programs.

The 216-Z-8 and 216-Z-361 settling tanks were the only tanks identified in the AAMS reports as candidates for ERAs. The rationale stated in the Z Plant AAMS for identifying these tanks as candidates for an ERA was that the tanks contain drainable liquids and are over 30 years old (DOE-RL 1992c). Most of the miscellaneous tanks (including all the 361 series settling tanks) meet this criteria. However, they were recommended in other AAMS reports for different pathways.

The 241-U-361 and 241-T-361 settling tanks and the two settling tanks associated with the 231-W-151 vault have been identified in AAMSs for the LFI/IRM pathways (DOE-RL 1992a,b,c). A work plan has recently been drafted for the 200-UP-2 operable unit which describes the LFI activities proposed for the 241-U-361 tank (DOE-RL 1992b). The suggested investigations are limited to surface radiation surveys, limited surface soil sampling and sampling soils from borings in and adjacent to the 216-U-1 crib (which received effluent discharged from 241-U-361). Intrusive sampling to characterize wastes in the 241-U-361 tank have not been included.

The 241-B-361 settling tank, the 241-CX-70, 241-CX-71 and 241-CX-72 tanks are each proposed to be remediated under the full RI/FS pathway (DOE-RL 1993b,d). The Semi-Works AAMS notes that the 241-CX-70, 241-CX-71 and 241-CX-72 tanks may be reclassified from RCRA units to CERCLA past-practice units (DOE-RL 1993d).

The AAMS reports defer restoration decision-making for the other 37 miscellaneous tanks to other Hanford Site programs. The AAMS reports deferred evaluation of 19 of the miscellaneous tanks located in operable units containing SSTs to the Single-Shell Tank Closure Program (SSTCP) and four other tanks to the Waste Management Program (WMP). Subsequent to the development of the AAMS reports, there has been a reorganization of the Hanford Site programs. Both of these programs are now combined under TWRS. Types of tanks deferred to these programs include catch tanks and tanks in the 244-BXR and the 244-TXR uranium recovery vaults (DOE-RL 1993b, 1992a).

The remaining 14 miscellaneous tanks were deferred to the Decommissioning and RCRA Closure programs (D & RCP). Deferred tanks include the nine 241-WR vault tanks and the 270-E-1 neutralization tank (DOE-RL 1992b, 1993b). There were some inconsistencies noted in the U Plant AAMS report in the management recommendations for the 244-UR vault. The text discussion recommends deferral to the SSTCP; however, Table 9-3 of the AAMS report identifies the D & RCP as the program responsible for remediation of the vault (DOE-RL 1992b).

3.4 SUMMARY OF PLANNED ACTIVITIES AND REGULATORY REQUIREMENTS

As described in the previous sections a variety of activities have been planned and management recommendations made for the 50 miscellaneous inactive tanks. However, an overall consistent approach to address potential safety issues (discussed in the following section of this report) and the regulatory requirements for closure and environmental restoration of the various categories of miscellaneous tanks have not been developed. For example, the settling tanks are identified for three different pathways including candidates for ERAs, LFIs/IRMs and RI/FS.

Regulatory categories (i.e. RCRA TSDs, RCRA past-practice, and CERCLA past-practice) assigned to the tanks are also somewhat inconsistent among the different categories of tanks. This may not be a significant issue, as the intent as stated in the Tri-Party Agreement is that these programs will be implemented in a consistent and integrated manner. In addition, recent revisions to the State Dangerous Waste Regulations provide a consistent approach that is applicable to both corrective action at RCRA past-practice units and to closure of RCRA TSDs.

One of the primary impacts of the regulatory category distinction is the resulting regulatory lead agency and organizations assigned responsibility for oversight, as well as the DOE and WHC programs assigned responsibility for restoration activities. Oversight by different lead agencies, and even the different programs within Ecology, can result in inconsistent approaches and difficulties with integration of activities across program lines. This need for integration of approaches and activities across programs for DOE and WHC, as well as the regulatory agencies, is one of the primary recommendations of this engineering study. Some possible approaches for management and integration are presented in Section 7.

Table 3-1. Current Regulatory and Administrative Status of Miscellaneous Radioactive Waste Tanks. (Page 1 of 3)

Tank Number	Description	Operable Unit	Planned Action as identified in the AAMS	AAMS Report	Tri-Party Agreement Lead Agency	Tri-Party Agreement Unit Category
231-W-151-001	Settling	200-ZP-2	LFI/IRM	Z Plant	EPA[1]	CPP[1]
231-W-151-002	Settling	200-ZP-2	LFI/IRM	Z Plant	EPA[1]	CPP[1]
240-S-302	Catch Tank	200-RO-3	WMP[2]	S Plant	[3]	[3]
241-WR Vault						
241-WR-001	Uranium Recovery	200-UP-2	D & RCP[4]	U Plant	[3]	CPP
241-WR-002	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-003	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-004	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-005	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-006	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-007	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-008	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-WR-009	Uranium Recovery	200-UP-2	D & RCP	U Plant	[3]	CPP
241-A-302B	Catch Tank	200-PO-5	SSTCP[5]	Purex	[3]	[3]
241-B-301	Catch Tank	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
241-B-302B	Catch Tank	200-BP-6	SSTCP	B Plant	[3]	CPP
241-B-361	Settling	200-BP-6	RI[6]	B Plant	[3]	CPP
241-BX-302A	Catch Tank	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
241-BX-302B	Catch Tank	200-BP-6	SSTCP	B Plant	[3]	[3]
241-BX-302C	Catch Tank	200-BP-6	SSTCP	B Plant	[3]	[3]
241-C-301[7]	Catch Tank	200-PO-3	SSTCP	PUREX	[3]	RPP[6]
241-CX-70	Waste Handling	200-SO-1	RI	Semiworks	Ecology	TSD
241-CX-71	Neutralization	200-SO-1	RI	Semiworks	[3]	TSD[6]
241-CX-72	Experimental	200-SO-1	RI	Semiworks	[3]	TSD[6]
241-S-302A	Catch Tank	200-RO-2	WMP	S Plant	[3]	[3]
241-S-302B	Catch Tank	200-RO-4	WMP	S Plant	[3]	RPP[6]
241-SX-302	Catch Tank	200-RO-2	WMP	S Plant	[3]	[3]
241-T-301B[8]	Catch Tank	200-TP-6	SSTCP	T Plant	[3]	RPP[6]
241-T-361	Settling	200-TP-4	IRM/LFI[7]	T Plant	[3]	[3]
241-TX-302A	Catch Tank	200-TP-5	SSTCP	T Plant	[3]	RPP[6]

Table 3-1. Current Regulatory and Administrative Status of Miscellaneous Radioactive Waste Tanks. (Page 2 of 3)

Tank Number	Description	Operable Unit	Planned Action as identified in the AAMS	AAMS Report	Tri-Party Agreement Lead Agency	Tri-Party Agreement Unit Category
241-TX-302B	Catch Tank	200-TP-5	SSTCP	T Plant	[3]	[6]
241-TX-302BR	Catch Tank	200-TP-2	[9]	T Plant	[1,3]	RPP[1]
241-TX-302XB	Catch Tank	200-TP-5	[9]	T Plant	Ecology[1]	RPP[1,6]
241-TY-302A	Catch Tank	200-TP-5	SSTCP	T Plant	[3]	RPP[6]
241-TY-302B	Catch Tank	200-TP-5	SSTCP	T Plant	[3]	RPP[6]
241-U-361	Settling	200-UP-2	IRM/LFI	U Plant	[3]	CPP
241-Z-361	Settling	200-ZP-2	LFI/ERA/IRM	Z Plant	[3]	CPP
241-Z-8	Settling	200-ZP-2[10]	LFI/ERA/IRM	Z Plant	EPA[1]	CPP[1]
244-BXR Vault[11]						
244-BXR-001	Uranium Recovery	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
244-BXR-002	Uranium Recovery	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
244-BXR-003	Uranium Recovery	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
244-BXR-011	Uranium Recovery	200-BP-7	SSTCP	B Plant	[3]	RPP[6]
244-TXR Vault						
244-TXR-001	Uranium Recovery	200-TP-5	SSTCP	T Plant	Ecology[1]	RPP[1,6]
244-TXR-002	Uranium Recovery	200-TP-5	SSTCP	T Plant	Ecology[1]	RPP[1,6]
244-TXR-003	Uranium Recovery	200-TP-5	SSTCP	T Plant	Ecology[1]	RPP[1,6]
244-UR Vault						
244-UR-001	Uranium Recovery	200-UP-3	D & RCP	U Plant	[3]	RPP[6]
244-UR-002	Uranium Recovery	200-UP-3	D & RCP	U Plant	[3]	RPP[6]
244-UR-003	Uranium Recovery	200-UP-3	D & RCP	U Plant	[3]	RPP[6]
244-UR-004	Uranium Recovery	200-UP-3	D & RCP	U Plant	[3]	RPP[6]
270-E-1	Neutralization	200-BP-6	D & RCP	B Plant	[3]	[3]

Table 3-1. Current Regulatory and Administrative Status of Miscellaneous Radioactive Waste Tanks. (Page 3 of 3)

Tank Number	Description	Operable Unit	Planned Action as identified in the AAMS	AAMS Report	Tri-Party Agreement Lead Agency	Tri-Party Agreement Unit Category
270-W	Neutralization	200-UP-2	[9]	[9]	Ecology[1]	CPP[1]

D&RCP Decommissioning and RCRA Closure programs
SSTCP Single-Shell Tank Closure Program
WMP Waste Management Program
RARA Radiation Area Remedial Action
RI Remedial Investigation
RPP RCRA past-practice
CPP CERCLA past-practice
TSD RCRA treatment, storage and disposal

1 Facility not initially listed in the Tri-party Agreement, however the facility was included on 8/3/93, Change Number C-93-05 (Ecology et al. 1993b).

2 The AAMS reports deferred actions to the Waste Management Program in effect at the time the AAMS reports were being prepared but is now within the scope of Tank Waste Remediation System.

3 Facility listed in the Tri-Party Agreement, however, the lead agency or unit category is not identified.

4 The AAMS reported deferred actions to the Single-Shell Tank Closure Program in effect at the time the AAMS reports were being prepared but is now within the scope of both Tank Waste Remediation System and Environmental Restoration programs.

5 The B Plant AAMS states that this facility will be remediated as part of the Plant RI, however, Table 9-1 of the study indicates that RARA and D&RCRA Closure programs will be involved.

6 Currently identified or proposed for inclusion in the Tri-Party Agreement as a RCRA past practice unit or undesignated that would be changed to TSD category under changes to Milestone M-45-00 (Ecology et al. 1993c).

7 Also identified as 241-C-301C.

8 Also identified as 241-T-301.

9 These tanks are not discussed in the AAMS reports. Tank 241-TX-302BR is reported in Neilsen (1992) as a replacement tank for 241-TX-302B.

10 Approved change to the Tri-Party Aggreement, Change Number C-93-04, redesignation of source waste management units in 200-ZP-1 to 200-ZP-2, and designate, 200-ZF-1 as a groundwater operable unit (Ecology et al. 1993a).

11 Listed as a septic tank in the Tri-Party Agreement.

4.0 ASSESSMENT OF SAFETY HAZARDS

This chapter provides a preliminary assessment of the potential safety hazards associated with the miscellaneous tanks. A final safety assessment cannot be completed until radiological analysis or, at a minimum, a screening level evaluation is conducted (see Section 7.2). This section identifies the criteria associated with each safety issue and qualitative assessment of the probability of occurrence. Because of the uncertainty associated with the available data; risk and probability will be presented as high, moderate, or low. Table 4-1 presents the results of this assessment against the safety criteria discussed in this section. Rationale for the safety ratings are provided in Appendix A.

4.1 CHEMICAL SAFETY HAZARDS

This section provides a preliminary assessment of the safety hazards associated with the chemical components of the waste in the miscellaneous tanks. The following specific safety hazards are assessed:

- Hydrogen Buildup
- Ferrocyanide Explosion
- Organic Salt Reactivity
- Flammability of Tank Contents
- Emission of Vapors

Insufficient data are available to support conclusive analysis of these safety hazards; however, preliminary assessments are provided based on criteria for the safety issue, and data available to support the analysis.

Table 2-2 lists the single shell tanks on Hanford's "watch list." An association between these safety-issue tanks and the miscellaneous tanks is provided to identify where a potential safety concern may exist. This is most applicable to catch tanks and vault tanks. Other miscellaneous tanks covered in this report were not involved in the transfer of waste between tank farms and processing plants. These other tanks usually received waste from processing plants prior to disposal in cribs or wells.

4.1.1 Hydrogen Buildup

Background

Hydrogen generation, retention, and release create a potential for causing either a fire or explosion if a high enough concentration of hydrogen (and an oxidizer such as nitrous oxide) and ignition source are present. For the hydrogen to burn, its concentration must be above the lower flammability limit of 4% in air or of 3% in nitrous oxide (Babad 1992). Of the 177 single- and double-shell high level waste storage tanks on the Hanford Site, only 23 have been identified as having a potential to generate and release large enough quantities of hydrogen gas to pose an explosion hazard (see Table 2-2 for watch list tanks associated with miscellaneous tanks). Tank 241-SY-101 does exhibit cyclic gas release events (GREs). This tank vents accumulated gases at concentrations above 25% of the lower flammability limit over a period of minutes to hours every 100 - 140 days. Only two of the other 20 hydrogen tanks have indicated any evidence of cyclic GREs, although instrumentation for hydrogen and pressure measurements has not traditionally been installed on those tanks.

An extreme case of hydrogen generation is experienced when a hard salt-cake layer builds over sludge. Generated hydrogen gas remains trapped until sufficient quantity builds and that gas is forced through the salt cakes.

Laboratory studies have not been able to replicate the actual conditions and materials causing hydrogen gas generation; however, as described below, the combination of radioactive decay energy and hydrogen-containing compounds (water and organics) results in radiolysis of the hydrogen.

Hydrogen Buildup in Miscellaneous Tanks

Information on the sludge and supernatant composition in the 50 miscellaneous tanks suggests that there is very little potential for hydrogen generation to result in a GRE. This is due, in part, to the high ratio of void volume to waste volume. Also, it is suggested in an internal letter between Rockwell International employees (Appendix D, page D-3) that the waste concentration of radionuclides in 78% of the tanks needs to be greater than 0.03 Ci/l to reach a 4% lower flammability limit. The void volume to waste volume ratio issue applies only in cases where tanks are not ventilated, which is the case for all of the miscellaneous tanks which are isolated. Where tanks are ventilated, high rates of hydrogen generation are needed to cause hydrogen buildup.

Tanks 241-C-301, 241-T-301B, and 241-TX-302A are identified in a November 14, 1986 memo as candidates for hydrogen sampling (Appendix D, page D-3). Information received to date indicates that tanks 241-B-301, 241-B-361, 241-U-361, 241-T-361, 241-T-301B, 270-W, and 241-W-151-002 have a substantial volume of sludge or supernatant that might present a problem with void volume. These tanks have void volumes from about 33% to 0%, and the available information on radionuclide concentration indicates activity in the millicuries per liter range. The vault tanks all have void volumes of greater than 50%, with some of the vault tanks being listed as empty (241-WR vault). The expected radionuclide concentration is also in the range of microcuries per liter. The 241-CX-71 and 241-CX-72 tanks have sludge and supernatant radionuclide concentrations in the microcuries per liter range.

Based on the data presented within this report with respect to both tank void volumes and radionuclide concentration, hydrogen gas generation in the miscellaneous tanks occurs at very low levels. However, there is some uncertainty over the existing configuration of risers and lines associated with the miscellaneous tanks; i.e., it is conceivable that certain well-sealed risers could allow for elevated levels of hydrogen to collect and exceed 25% of the Lower Flammability Limit (LFL). Hydrogen buildup under such a scenario would not cause a major hazard (danger of tank rupture or major release of radionuclides in the event of fire or explosion) due to the limited quantities of hydrogen involved. It is conceivable that a safety hazard to personnel could exist when opening a riser on a tank that has been sealed for an extended period of time. Accordingly, safety precautions (non-sparking tools, grounding of components, etc.) should be taken in the vicinity of the miscellaneous tanks.

4.1.2 Ferrocyanide

Background

To accommodate a need for additional storage capacity during the 1950's, ferrocyanide scavenging processing was used to convert soluble radiocesium in aqueous wastes to an insoluble species that was then separated from the liquid, thus allowing additional aqueous waste to be sent to a soil column (crib) without exceeding the specifications for release of radionuclides. Several different scavenging processes were used, and a large quantity of cesium-rich waste exists with a variety of ferrocyanide compositions. This waste is in the single shell tanks (SSTs). Although ferrocyanides are stable in solution, an explosion risk exists at elevated temperatures in the presence of oxidizers like nitrates. Large quantities of nitrates are present in the SSTs. Studies have indicated the following general information:

1. Low tank temperatures and the lack of heat from radionuclide decay preclude potential ferrocyanide reactions. Wastes must be dry and above 250°C to pose any risk.

2. Ferrocyanide waste containing at least 22% water will preclude propagation of a ferrocyanide-nitrate reaction.

3. U and T plant wastes, representing about 80% of the waste inventory, are sufficiently diluted with inert material so that they are nonreactive when heated, even when dry. Ferrocyanide content must be above 8% to pose any risk and it is doubtful that such high concentrations could be attained in the miscellaneous tanks.

4. In-tank aging has occurred to significantly lower the fuel values (reactivity) to a level comparable with the U plant process wastes. C Tank Farm tanks C-109 and C-112 showed at least an order of magnitude reduction of fuel value in recent analyses.

5. Recent research has indicated that the perceived risk associated with ferrocyanide tanks has been overrated. Administrative actions to remove many ferrocyanide tanks from the watchlist are underway (Babad 1992, Cash et al. 1993).

Ferrocyanide in Miscellaneous Tanks

The 50 miscellaneous tanks are all believed to be at ambient temperature (55°F to 65°F) although they are not instrumented (Prosk and Smith 1986). Sludge moisture content is not known for all the tanks. From the available information, only small pockets of ferrocyanide/nitrates may exist in certain catch tanks or possibly one or two of the 241-WR Vault tanks. Estimated comparative risks are provided in Table 4-1 for the ferrocyanide issue. Several tanks may have received ferrocyanide waste; however, it is unlikely that sufficient waste was discharged to accumulate 1000 gmoles ferrocyanide, and moisture content is likely high enough and temperature is low enough in these tanks to preclude a significant risk.

4.1.3 Reactivity Due to Organic Salts

Reactivity due to organic salts is a safety issue identified for eight SSTs. Three parameters must be met by the tank water to pose a risk due to organic salts (Babad et al. 1993):

1) Total organic carbon (TOC) above 3%
2) Moisture level below 20%
3) Tank temperature above 85°C

If an exothermic reaction of the organic salts is sufficient to initiate combustion, an uncontrolled release of radionuclides to the environment might possibly occur. The available data do not allow any preliminary findings on this safety issue. The high sodium salt content of all the waste generating processes, the high radiological content of some of the tanks, and the previous stabilization activities with the removal of most of the liquid in some of the miscellaneous tanks mean that this safety issue is of concern.

4.1.4 Flammability

The presence of solvents, such as kerosene, indicates that flammability may be a real concern for future activities in tank farm remediation activities. In particular, activities associated with the 241-C-103 SST characterization have highlighted this concern. The tank was found to contain a liquid layer of organic material that presents the potential for combustion if an ignition source is provided (Hanlon 1993). With exception of empty tanks such as 241-CX-70, 241-S-302B, 241-TY-302B, many of the 241-WR vault tanks, and the neutralization tanks (which never received flammable solvents), all the rest of the miscellaneous tanks could conceivably have received enough flammable materials to present a definable flammability risk. However, a low risk is assumed because there is no documentation indicating disposal of organic solvents into the miscellaneous tanks.

4.1.5 Vapor Emissions

The chemical contents in both SSTs and DSTs at the Hanford Site have shown adequate volatility to require a proactive engineering approach to mitigation of potential employee exposure (Hanlon 1993). Specific gaseous emissions in the C, BX, and BY tank farms have been classified as noxious vapors or odors that exceed Occupational Safety and Health (OSHA), National Industrial Occupational Safety and Health (NIOSH), and American Conference of Governmental Industrial Hygienists (ACGIH) permissible exposure levels (PELs) or threshold limit values (TLVs). These releases have resulted in a concern for worker safety, and when work is accomplished at these tank farms, the workers are required to wear fresh air respirators (Babad 1992). Worker safety concerns are primarily a problem with passively ventilated tanks.

The vapors associated with the tanks at Hanford include both volatile organic and inorganic materials including:

- Light molecular weight organic compounds such as acetone and possibly carbon tetrachloride;

- High molecular weight organic compounds such as kerosene (normal paraffin hydrocarbons) and tributyl phosphate;
- Nitrous oxide and possibly other oxides of nitrogen;
- Allegedly, hydrogen cyanide and hydrogen sulfide;
- Ammonia

Each of these vapor emission issues has been identified for single shell tanks, and by extension, presents a potential safety issue associated with any occupational interaction with the miscellaneous tanks. Resolution of tank vapor issues is currently under consideration (Osborne 1992). Preliminary findings indicate several potential safety concerns associated with this issue:

- Flammable/explosive vapor is potentially associated with the high quantity of solvents used in the REDOX and PUREX processes. Some of these solvents may have reached miscellaneous tanks through waste transfers.
- Wastes routed to single and double shell tanks were treated with caustic to maintain a basic pH ($pH > 7.0$) in the tanks. Although operational protocols were designed to avoid acidic conditions within tanks by adjusting the pH to a level higher than 9.0, with the obvious exception of tanks meant for acidic waste handling, such as the vault tanks and neutralization tanks, no guarantee exists that these conditions did not arise in the miscellaneous tanks. If the pH of any of the miscellaneous tanks is less than 7.0, and a cyanide solution is present within the tank, then hydrogen cyanide gas could be present in high enough concentrations to present occupational risk during activities performed in the immediate proximity of the tanks. Both acids and ferrocyanides are known to have been present within the 241-WR vault.
- The volatile organic and ammonia concentration of the vapors within the miscellaneous tanks cannot be evaluated based on existing information; however, similarity with the SST waste indicates that this is likely a concern as respiratory protection has occasionally been required for work in the vicinity of the SSTs.

4.2 TANK/VAULT INTEGRITY

All of the catch tanks are constructed of carbon steel and the neutralization tanks are stainless steel. All were buried in the ground and for some period of their lifetime they went without cathodic corrosion protection. All are at least 40 years old and some are older. Welds will not have held up as well as the tanks themselves. Steel tanks are generally designed for a limited lifetime, thus, all catch tanks are considered to be of questionable integrity. While they have probably always contained liquid and solids with a basic pH, this is not certain. If some contents were acidic, there will have been corrosion on the inside of the tanks. For example, tank 241-TX-302BR sustained acid damage and was replaced by 241-TX-302B in the early 1950's. However, they are assigned a low probability of being a safety issue, because they have been isolated and stabilized.

Four of the settling tanks are of reinforced concrete and one is of uncertain construction. The concrete tanks may have held up better than the steel tanks but there is too much uncertainty to suggest that there is no possibility of a leak in any of these tanks.

Vault tanks are all in double containment, but there is no suggestion in the data which was available that the double containment was used to better guarantee that tank contents would not leak. There are instances where the vaults (which acted as secondary containment) apparently filled with waste materials. There is at least one historical incident where evidence of liquid intrusion into a vault is reported (Appendix D, page D-9). From the viewpoint of worker safety, this sort of double containment has no value. The vault tanks themselves are, like the catch tanks, questionable.

The hazard to personnel resulting from tank collapse is low because the tanks are buried. Heavy equipment should be restricted from areas immediately above and adjacent to the tanks in order to further minimize structural failure.

4.3 NUCLEAR SAFETY ISSUES

The purpose of this section is to identify the pertinent nuclear safety issues and to address these to the extent permitted by the technical information available for the 50 miscellaneous waste tanks.

Nuclear safety issues fall into two categories: (1) criticality safety issues, and (2) health physics and radiological protection issues. An example of a typical radiological protection issue is the consideration of potential radiation exposure that a worker may receive while in the vicinity of a tank. A typical criticality safety issue might address criticality of a process or operation due to a hypothetical accident condition, where the process or operation would otherwise remain subcritical under normal conditions.

4.3.1 Safety Issues Involving Criticality Safety

The issue concerning criticality safety of the miscellaneous tanks is the prevention of an inadvertent nuclear chain reaction in the tank waste. The potential for criticality depends upon a number of factors: (1) the amount and concentration of fissile isotopes present, (2) the amount of moderating material present, (3) the quantities and nuclear properties of other constituents present in terms of neutron absorption and neutron scattering, (4) the distribution of the constituents in the waste, and (5) the geometric shape of the waste.

A waste tank can be approximated by a conservative, idealized system. In this case, the physical system is an aqueous solution of ^{239}Pu reflected by an infinite thickness of water. The single-parameter limits for this system are as follows (Thomas 1978): 510 grams ^{239}Pu, an areal density of 0.25 grams per square centimeter, and a concentration of 7 grams ^{239}Pu per liter of solution. Should any one of these unconstrained limits be exceeded, constraints must be applied to the system to ensure subcriticality. Additional constraints may include consideration of other single-parameter limits or one or more of the following:

- limits on hydrogen-to-plutonium atomic ratios and plutonium concentrations,

- limits on minimum concentrations of materials that act as neutron absorbers,
- limits on nuclide concentrations of good neutron scatterers interspersed with fissile nuclides
- limits on system shape and dimensions.

For this assessment, the miscellaneous tanks of interest are the ones that contain fissile radionuclides of uranium and plutonium. For the 50 miscellaneous waste tanks, limited characterization data regarding the radionuclide content is available for 32 tanks. Evaluation of the limited waste characterization data for these tanks indicates that a majority of the miscellaneous tanks contain fissile radionuclides. A preliminary listing is provided in Table 4-2.

Adequate assessment of criticality safety relies extensively upon the availability of waste composition and waste form data. As mentioned earlier, these data are rather limited. This has placed a substantial limitation on the scoping assessment that can be performed to address the issue of criticality safety on a tank-by-tank basis.

Catch tanks collected drainage, spills leakage, line flushes, encasement drainage, and other miscellaneous liquids, such as rainwater that entered a diversion box. The catch tanks received effluent from the diversion boxes. The data sheets provided in Appendix A indicate the radionuclide content of the catch tanks. The fissile nuclide content appears to be well below the subcritical limits for our unconstrained system.

Preliminary findings indicate that the fissile nuclide content for the vault tanks is well below the subcritical limits for an unconstrained system. A 1977 Battelle study presented the criticality safety considerations for emptying the two tanks in the 231-W-151 vault (Davenport 1977). The study concluded that the two tanks could be emptied if the safety precautions were followed.

Settling tanks received alkaline or neutralized low salt, aqueous waste from the various processing plants and provided an opportunity for settling of suspended solids prior to the aqueous waste's overflow into a reverse well or cribs.

On the basis of waste characterization data for the 241-Z-361 tank, the 241-Z-361 tank is expected to contain between 35 and 76 kilograms of plutonium. (This estimate is based upon uncertainties in the tank floor areal density that range from 0.11 to 0.24 grams per square centimeter)(Carter and Brown 1976). Obviously, the estimated mass of plutonium present in the tank exceeds the unconstrained (single-parameter) limit, which is the minimum critical mass of plutonium necessary for criticality under the ideal conditions for geometric shape and waste composition. However, further evaluation revealed that other criteria for criticality in the waste (i.e., approaching idealized conditions) were absent even under accident conditions.

Plutonium concentration for the waste samples from tank 241-Z-361 is less than one gram plutonium per liter (Davenport et al. 1977). The second party review concluded that the potential for criticality was acceptably low given that the samples are representative of the plutonium concentration in the overall tank.

The experimental tank was used to study the characteristics of self-concentrating waste from the PUREX process. The potential for a criticality incident in tank 241-CX-72 has been evaluated and would not occur under credible circumstances. It is not recommended that the waste in this tank be exposed to water or to other moderating materials until sampling has confirmed the lack of criticality potential (Ludowise 1990).

Consideration of criticality safety for proposed actions involving pre-treatment and off-loading of waste will require further evaluation using adequate characterization data.

4.3.2 Safety Issues Involving Health Physics and Radiological Protection

Safety issues associated with health physics and radiological protection are concerned with materials emitting ionizing radiation and its effects upon personnel. From a radiological point of view, the miscellaneous tanks of interest are the ones that contain radionuclides. These are grouped into three categories according to the form of stored waste:

1) Tanks with sludge.
2) Tanks with supernatant.
3) Tanks with both sludge and supernatant.

A number of miscellaneous tanks for which characterization work has not been performed or documented are expected to contain radionuclides based upon their operating history. These include 241-WR-001 through 241-WR-005 and the 302 series catch tanks. The 302 series catch tanks received drainage from different diversion boxes and can therefore be expected to contain small amounts of various radionuclides. This is especially true of catch tank 240-S-302, which received waste from the 222-S laboratory where a wide variety of radionuclides were handled. In addition, the unplanned releases identified in Section 2.2 of this report provide an indication of tanks which received a high quantity of radioactive waste.

The range of radiological safety issues associated with normal operations (i.e. present state) is very limited. These can be addressed by a regular monitoring program to check and document radiation levels, where warranted, and post the contamination levels above grade, at the tank surface, in the vicinity of the tank or vault, or anywhere site workers may require access. The objective is to maintain personnel radiation exposure well below the regulatory dose limits. Controlled access may be required in areas where the radiation level is high enough to present the possibility for a worker to accumulate a yearly effective dose above the limits/administrative levels set forth in DOE's Radiological Control Manual (DOE 1992) and the WHC Radiation Protection (WHC 1988).

High radiation levels could potentially occur at vault 231-W-151, where ambient radiation levels of 10 mR/hr and 100 mR/hr have been measured at the hatch cover opening and the tank tops, respectively. Applying a nominal quality factor of 1, a worker could conceivably accumulate a dose equivalent of 2,000 mrem (milli-Rem) in one year (2000 hours) working at the hatch cover opening, or 20,000 mrem if working within the vault. 2,000 mrem is the Administrative Control Level established for all DOE activities, and 20,000 mrem is four times higher than the regulatory dose limit of 5,000 mrem per year for occupational workers.

The tanks have numerous piping connections to labs, diversion boxes, measuring instruments, and other tanks. Most of these, however, have been sealed off, and any releases through the remaining connections are likely to be insignificant. Such releases could only occur from tanks containing supernatant, which is subject to evaporation. Sludge waste could also be subject to such a scenario, but only if the waste is leachable and sufficient amounts of moisture can enter the tank through leaks or piping connections. In such cases, cesium is expected to be present in larger quantities in the supernatant since it is more soluble than the other radionuclides.

The potential for accidental releases not associated with transfer activities is also very limited assuming good tank integrity. The tanks are all below grade and some are protected by concrete vaults. Tornados, tornado-generated missiles, and other similar occurrences are therefore not likely hazards. Seismic qualification of these tanks has not been performed; however the tanks are in a low magnitude seismic zone, as defined in Hanford Plant Standard SDC 4.1, Civil-Arch Design Criteria, and are buried in relatively dry granular soils which would absorb most of the forces during a seismic event. Therefore, the potential for a seismic related failure is low. However, tanks which have experienced significant degradation due to corrosion may collapse during a seismic event. Any release associated with this event would be limited to surrounding soils and the hazard to personnel is very low.

Any waste removal or decontamination and disassembly operations will present significantly increased radiation exposure hazards. Waste transfer operations will have to guard against accidental spills of waste containing radionuclides and provide workers with adequate protection in case spills occur.

4.3.3 Heat Generation

Heat generation is of concern when high concentrations of radionuclides are present, chiefly ^{137}Cs and ^{90}Sr. At issue are concerns about the structural integrity of the tank shell and the concrete structure. With respect to both SSTs and DSTs, the temperature of concern is 148°C (300°F) which is the upper operating limit.

With the possible exception of the 241-CX-72 tank, all the miscellaneous tanks appear to be at ambient temperature. Radionuclide heating appears to be at equilibrium with the environment. Because the half-lives of both cesium and strontium are approximately 30 years, the accumulated waste in the various tanks has gone through about one half-life of decay. Heat reduction may also be attributed to nearly total decay of the very short-lived, but high heat-producing isotopes.

4.4 SAFETY ANALYSIS RESULTS

Based on the available data, potential safety issues have been estimated and are presented in Table 4-1. The available data to evaluate the tanks allowed only a qualitative assessment of tank contents. When the data was considered for each potential issue, it was found that more information was needed in almost every case before a well-defined assessment could be made.

The ranking of risk; low, moderate and high, is very subjective. Tanks which are empty and monitored for intrusion are considered to have no risk. Low risk has also been assigned to tanks which could conceivably have received a waste which would promulgate the safety issue where there is confidence that the quantity and/or concentration is sufficiently low to preclude an accident scenario. A moderate classification indicates that there is confidence that the primary conditions of a safety issue may be met; however, other criteria, such as temperature or moisture level, are unlikely. A high classification is provided for those tanks with documented process knowledge or sampling and analysis results which indicate that all conditions necessary for the safety category are present. These classifications are limited to monitoring and surveillance activities. Intrusive activities, such as sampling, will require hazard assessment and safety evaluation based on the planned activity and tank contents.

From the tabular data presented, it is possible to select a few tanks which have a higher potential for concern than the main body of tanks. This methodology could be used to establish a rough priority list for further evaluation of these tanks; however, it should be clear that a realistic evaluation of the safety of these tanks will require more data on tank contents and the processes occurring within the tanks.

Table 4-1. Potential Safety Issues. (Sheet 1 of 3)

Tank	Hydrogen Buildup	Ferrocyanide	Organic Salts	Flammability	Vapor Emissions	Tank Integrity	Criticality Safety	Radiological Hazard
241-A-302B	Low	Low	Moderate	Low	Low	Low	Low	Moderate
241-B-301	Low	Low	Moderate	Low	Low	Low	Low	Moderate
241-B-302B	Low	Low	Moderate	Low	Low	Low	Low	Low
241-BX-302A	Low	Low	Moderate	Low	Low	Low	Low	Low
241-BX-302B	Low	Low	Moderate	Low	Low	Low	Low	Low
241-BX-302C	Low	Low	Moderate	Low	Low	Low	Low	Low
241-C-301	Low	Low	Moderate	Low	Low	Low	Low	Moderate
240-S-302	Low	Low	Moderate	Low	Low	High	Low	Low
241-S-302A	Low	Low	Moderate	Low	Low	High	Low	Moderate
241-S-302B	None	None	None	None	None	None	None	None
241-SX-[illegible]	Low	Low	Moderate	Low	Low	Low	Low	Low
241-T-301B	Low	Low	Moderate	Low	Low	Low	Low	Moderate
241-TX-302A	Low	Low	Moderate	Low	Low	High	Low	Low
241-TX-302B	Low	Low	Moderate	Low	Low	Low[1]	Low	Moderate
241-TX-302-BR	Low	Low	Moderate	Low	Low	Low[1]	Low	Moderate
241-TX-302XB	Low	Low	Moderate	Low	Low	Low	Low	Low
241-TY-302A	Low	Low	Moderate	Low	Low	Low	Low	Low
241-TY-302B	None	None	None	None	None	None	None	None
241-CX-71	Moderate/High	Low	High	Low	High	Low	Low	High
241-CX-72	Low	None	Low	None	None	Low	Low	High

Table 4-1. Potential Safety Issues. (Sheet 2 of 3)

Tank	Hydrogen Buildup	Ferrocyanide	Organic Salts	Flammability	Vapor Emissions	Tank Integrity	Criticality Safety	Radiological Hazard
270-E-1	Low	Low	Moderate	Low	Low	High	Low	Low
270-W	Low	Low	Moderate	Low	Low	High	Low	Low
241-B-361	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	High
241-T-361	Moderate	Low	Moderate	Low	Moderate	Low	Moderate	High
241-U-361	Moderate	Low	Moderate	Low	Moderate	Low	Low	High
241-Z-8	Low	Low	Moderate	Low	Low	Low	Moderate	High
241-Z-361	Low	Low	Moderate	Low	Moderate	Low	Moderate	High
241-CX-70	None	None	None	None	None	None	None	None
244-BXR-011	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-BXR-001	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-BXR-002	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-BXR-003	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-TXR-001	Low	Low	Low	Low	Moderate	High	Low	Moderate
244-TXR-002	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-TXR-003	Low	Low	Low	Low	Moderate	Low	Low	Moderate
244-UR-001	Low	None	Low	Low	Low	Low/Moderate	Low	High
244-UR-002	Low	None	Low	Low	Low	Moderate/High	Low	High
244-UR-003	Low	None	Low	Low	Low	Moderate/High	Low	High
244-UR-004	None	None	None	None	Moderate	High	None	High
231-W-151-001	Low	None	Low	Low	Low	Low	Low	Low

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Centimeter

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 mm

1 2 3 4 5

Inches

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2 of 4

Table 4-1. Potential Safety Issues. (Sheet 3 of 3)

Tank	Hydrogen Buildup	Ferrocyanide	Organic Salts	Flammability	Vapor Emissions	Tank Integrity	Criticality Safety	Radiological Hazard
231-W-151-002	Low	None	Low	Low	Low	Low	Low	Moderate
241-WR-001	Low	Low	Low	Low	Low	High	Low	Low
241-WR-002	Low	Low	Low	Low	Low	Low	Low	Low
241-WR-003	Low	None	Low	Low	Low	High	Low	Low
241-WR-004	Low	None	Low	Low	Low	High	Low	Low
241-WR-005	Low	None	Low	Low	Low	Low	Low	Low
241-WR-006	Low	None	None	Low	Low	Low	Low	Low
241-WR-007	Low	None	Low	Low	Low	Low	Low	Low
241-WR-008	Low	None	Low	Low	Low	Low	Low	Low
241-WR-009	Low	None	Low	Low	Low	Low	Low	Low

Note:
[1]Tank 241-TX-302B replaced tank 241-TX-302BR because 241-TX-302BR was damaged by acid.

Table 4-2. Miscellaneous Waste Tanks Contaminated With Fissile Radionuclides.

TANK
Catch Tank 241-A-302B
Catch Tank 241-B-301
Catch Tank 241-B-302B
Catch Tank 241-BX-302A
Catch Tank 241-BX-302B
Catch Tank 241-BX-302C
Catch Tank 241-C-301
Catch Tank 240-S-302
Catch Tank 241-S-302A
Catch Tank 241-S-302B
Catch Tank 241-SX-302
Catch Tank 241-T-301B
Catch Tank 241-TX-302A
Catch Tank 241-TX-302XB
Catch Tank 241-TY-302A
Catch Tank 241-TY-302B
Catch Tank 241-TX-302B
Catch Tank 241-TX-302BR
Vault Tank 231-W-151-001
Vault Tank 231-W-151-002
Vault Tank 244-BXR-011
Vault Tank 244-BXR-002
Vault Tank 244-TXR-002
Vault Tank 244-UR-002
Settling Tank 241-B-361
Settling Tank 241-T-361
Settling Tank 241-U-361
Settling Tank 241-Z-361
Settling Tank 241-Z-8
Neutralization Tank 241-CX-71
Experimental Tank 241-CX-72

5.0 MONITORING AND CHARACTERIZATION CONSIDERATIONS

There are a number of physical constraints which should be considered prior to initiating any monitoring or characterization of the miscellaneous inactive underground radioactive waste tanks. The following sections summarize these considerations with regard to tank access, monitoring, and characterization.

5.1 TANK ACCESS CONSIDERATIONS

Tank access considerations can be grouped into external and internal issues. External issues include the nature and location of physical obstacles that may hinder or complicate access for monitoring and characterization purposes. Some tank access activities may be restricted due to administrative controls in the proximity of other hazards (e.g., vehical access prohibited, only non-sparking tools permitted or drilling and digging prohibited, etc.). Physical obstacles include nearby buildings, fences, tank riser layout, soil berms, utilities and vault covers. Based on a brief field reconnaissance, there are few obstacles that would hinder tank access. Eleven of the catch tanks are located within the fencing of their respective tank farms. There appear to be no physical obstacles within the tank farms or near these tanks to hinder tank access. Twelve tanks (5 catch tanks, 5 settling tanks, 241-CX-70, and 241-CX-71) are located within radiologically controlled areas that are marked by single chain fences around the tanks. Settling tank 241-T-361 does not have a fence around it. Tank 241-A-302B is located on a steep incline just outside of the eastern boundary fence of the A Tank Farm, which may cause problems for some sampling techniques. Two tanks are located within facility fences: 241-Z-361 at Z Plant and 240-S-302 at S Plant. Three tanks have buried risers: 270-E-1 and 241-TX-302BR have risers buried approximately 1 ft and 4 ft below grade, respectively, and 270-W is located beneath building 2715-UA. An enclosure has been built above tank 241-CX-72. The 244-BXR, 244-TXR, and 244-UR vaults are also located within tank farm fences; access to the 241-WR vault is unrestricted. All of the vaults are weather covered.

Internal tank access is currently prevented by blind flanges on the tank access risers and weather-proof covers on the vaults which were installed during the tank interim isolation projects of the early to mid 1980's. Typical examples of these mechanical barriers are shown in Figures 2-18 to 2-20. Removal and replacement of these barriers is a consideration for any potential tank access effort.

Tank access riser availability and diameter were reviewed as potential limiting factors in the ability to use various in-tank sampling methods which are summarized in Appendix C. This review was based on an examination of as-built drawings from Project B-231 and other isolation projects, tank design drawings, and a brief field reconnaissance (Table 5-1). A total of 25 tanks, mainly the catch tanks and settling tanks, have above-ground tank access risers. Access to these tanks is restricted by blind flanges on the access risers. These tanks all have at least two 4-inch diameter or larger access risers (Table 5-1). These risers should be sufficient to allow any of the sampling methods discussed in Appendix C to be used on these tanks. However, some risers may not be usable due to instrumentaiton located in the riser. The waste solids from one of these tanks, 241-CX-70, was sampled and analyzed in September 1991 (DOE-RL 1993d).

The 20 tanks and their associated sumps which are enclosed in the 244-BXR, 244-TXR, 244-UR, and 241-WR vaults are currently below grade and have been interim isolated with weather covers placed over the cement cover blocks as shown in Figure 2-19. The vault tanks and sumps appear to have 6-inch and/or 4-inch diameter access risers below grade. Access to the vault tank and sump risers may limit selection of potential sampling methods. Analytical data in Neilsen (1992) indicates that several of the vault tanks have been sampled in the past.

The 231-W-151 vault does not appear to have any dedicated sampling risers for tanks 001 or 002. The tanks are located inside the vault, with possibly only two 6-inch steam risers extending outside of the vault.

Five of the miscellaneous tanks have special access considerations. Tanks 241-CX-71 and 241-CX-72, which contain waste materials, were filled with grout in 1986 (Rymarz and Speer 1991, Neilsen 1992). A solids sample from tank 241-CX-71 was obtained in October 1990 (DOE-RL 1993d). The grout removal and sampling plans for tank 241-CX-72 have been abandoned and any sampling or cleanup of the tank has been deferred to the CERCLA operable unit activities (DOE-RL 1993d). The risers of neutralization tanks 270-E-1 and 270-W have been isolated approximately 1-foot below grade (Rymarz and Speer 1991, Neilsen 1992), and building 2715-UA has been built over neutralization tank 270-W (Reference drawing H-2-71678). The risers of catch tank 241-TX-302BR were cut a minimum of 4 feet below grade and either filled with sand or sealed when the tank was abandoned in 1954 (Reference-drawing H-2-2536).

5.2 TANK MONITORING CONSIDERATIONS

During isolation, all of the tank monitoring instruments were removed, with the exception of catch tank 241-TX-302B, which had a new manual reel tape installed on a 4-inch riser on July 16, 1993 (Hanlon 1994). Catch tank 241-A-302B, isolated during project B-138, has an instrument assembly (which appears to be broken) attached to a 4-inch riser. Four tanks: 241-A-302B, 241-S-302, 241-S-302A and 241-TX-302B, are currently monitored on a daily basis and the waste volumes are summarized in monthly reports (Hanlon 1994).

For liquid or sludge level monitoring of the catch tanks and settling tanks, the blind flanges would have to removed and monitoring instrumentation placed in the tanks. None of the tanks appear to have had associated dry wells for leak detection. Leak detection of the catch tanks and settling tanks was performed by monitoring liquid level measurements and the use of in-tank photographs. All of the vaults have been isolated with a weather cover and there are no tank risers above grade. To monitor any of the vaults, the weather cover would have to be removed and monitoring instruments placed in the tanks and sumps.

According to isolation records, two catch tanks, 241-S-302B and 241-TY-302B, were reported empty and would not need to be monitored. A third tank, 241-CX-70, has been emptied and air dried, and also would not need to be monitored. Two other tanks, 241-CX-71 and 241-CX-72, have been filled with grout. Tank 241-S-302A is also partially filled with grout.

5.3 TANK CHARACTERIZATION CONSIDERATIONS

This section focuses on issues concerning the nature of the materials in the tanks and possible characterization limitations of the miscellaneous tanks. Specific sampling methods for characterizing the liquid/sludge in the tanks are summarized in Appendix C. Although the best available data concerning the current volume of liquids and solids in the miscellaneous tanks is presented in this report, the accuracy of this information should be field verified prior to any intrusive characterization activity.

According to the isolation project records, the sludge found in the miscellaneous tanks varies from soft sludge to coarse gravel-like material, with many of the tanks containing sludge with a pudding-like consistency. Previous sampling programs involving the SSTs and DSTs have encountered problems when sampling sludge with a consistency of pudding. Sampling equipment that is able to sample pudding-like material is currently being tested by PNL. Testing is scheduled to be completed in December 1993 or January 1994. If the new techniques for sampling the sludge work well in the SSTs and DSTs, they should be able to be implemented during any sampling of the miscellaneous tanks.

A limiting factor for supernate liquid sampling is the amount of supernate left in the tanks during isolation. Isolation criteria called for leaving less than 400 gal or 4-inches of supernate in the tanks. Of the miscellaneous tanks that contain supernate, fifteen tanks and 4 sumps (Table 2-3) were isolated with less than 4-inches of supernate. The current technique for sampling supernate liquids is the drop bottle method (Appendix C). The limitation of this method is the drop bottle is 4-1/2 inches tall and was designed for liquid sampling with greater than 4-1/2 inches of liquid. For tanks with less than 4-inches of supernate liquid, a new or modified sampler will need to be used to adequately sample these liquids.

The core sample trucks, using either push core sampling or rotary core sampling, could be used to sample the liquid and sludge in the miscellaneous tanks. Currently the core sample trucks are dedicated to sampling the SSTs and DSTs. If the core sample trucks are utilized on the miscellaneous tanks, the SST and DST sample schedule may be impacted. Miscellaneous tank sampling may be delayed until the trucks are available, or additional sampling capacity may be needed.

Because the rotary core sampler is hydrostatically balanced with nitrogen gas during operation, two risers are needed to operate the sampler: one for the sampling assembly and the second for venting the balancing gases. Currently, the riser used for venting is either a 12-inch or 18-inch diameter riser. Several miscellaneous tanks may not have two useable risers; six tanks and all the vaults do not have any 12-inch risers. To use the rotary core sampling method on these tanks, the venting system may need to be modified to fit the smaller risers of the miscellaneous tanks.

Vapor sampling should not be a problem in the miscellaneous tanks, with the exception of the tanks that have buried risers, the grouted tanks, and some of the vault tanks. The majority of the tanks appear to have enough head space to allow sampling (Table 2-3), and many of the tanks have at least one 4-inch riser for sampling access.

The vaults, grouted tanks, and buried tanks all have special characterization considerations. As discussed in Section 5.1, all risers associated with the vaults were isolated below grade beneath cement cover blocks and weather covers. As with monitoring, any characterization activities will involved removing the weather cover on the vaults.

The 231-W-151 vault does not appear to have any dedicated sampling risers associated with either tank. A review of possible sampling risers will need to be conducted as part of any sampling plans. Sampling methods for the grout-filled 241-CX-72 tank were prepared (Griffin and Ludowise 1989), but sampling and decommissioning activities have been stopped and the tank has been deferred to the CERCLA operable unit activities (DOE-RL 1993d). Tank 241-CX-71 was sampled in 1990 (DOE-RL 1993d), but details of the sampling are not discussed. The three tanks with buried risers all have access considerations which may impact any sampling plans. The main riser on tank 270-W is buried approximately 18-inches below grade and is under a building. The risers of 270-E-1 and 241-TX-302BR are 1 ft and at least 4 ft below grade, respectively. The risers on 241-TX-302BR may also be sealed or filled with sand (Reference Drawing H-2-25-36).

Table 5-1. Miscellaneous Tank Riser Access Summary. (Page 1 of 3)

Tank Designation	Number and Diameter of Blind Risers for Access					Interim Isolation As-built Drawings	Comments
	3 in	4 in	6 in	12 in	Other (in)		
241-A-302B		2			1-8	H-2-71304	1-4"has broken tape
241-B-301		4		4		H-2-71646	
241-B-302B		2		1		H-2-71647	
241-BX-302A		2		1		H-2-71646	
241-BX-302B		2		1		H-2-71647	
241-BX-302C		2		1		H-2-71647	
241-C-301		4		4		H-2-71648	
240-S-302		2				H-2-71663	
241-S-302A		1		1		H-2-71650, H-2-71664	
241-S-302B		2		1		H-2-71650	12" under weather cov.
241-SX-302		2		1		H-2-71650	
241-T-301B		3		4		H-2-71652	
241-TX-302A		2		1		H-2-71652	
241-TX-302B		2		1		H-2-2536	1-4" has a manual tape
241-TX-302BR						H-2-71652	risers 4 ' below grade
241-TX-302XB		2		1		H-2-71652	
241-TY-302A		2		1		H-2-71652	
241-TY-302B		2		1		H-2-71652	
241-CX-72	1	1		2	1-2, 2-8		
241-CX-71				1	1->12		
270-E-1			1		1-40	H-2-71678	40" riser 1' below grade
270-W						H-2-32485	Tank under new bldg.
241-B-361		4		4		H-2-71677	
241-T-361		4		4		H-2-71676	
241-U-361		5		4		H-2-71676	
241-Z-8		2				H-2-71679	
241-Z-361	2		1		4-8, 2-36	H-2-71679	36"under weather cov.
241-CX-70		4		4	1-10, 1-42		
244-BXR-011			2			H-2-71655, H-2-71656	All Vault Risers Under
244-BXR-011 sump			2			H-2-71655, H-2-71656	Weather Cover
244-BXR-001		2	1			H-2-71655, H-2-71656	

Table 5-1. Miscellaneous Tank Riser Access Summary. (Page 2 of 3)

Tank Designation	Number and Diameter of Blind Risers for Access					Interim Isolation As-built Drawings	Comments
	3 in	4 in	6 in	12 in	Other (in)		
244-BXR-001 sump			2			H-2-71655, H-2-71656	
244-BXR-002			2			H-2-71655, H-2-71656	
244-BXR-002 sump			2			H-2-71655, H-2-71656	
244-BXR-003			2			H-2-71655, H-2-71656	
244-BXR-003 sump			2			H-2-71655, H-2-71656	
244-TXR-001		2	1			H-2-71661, H-2-71662	2-4" sampling, 6" spare
244-TXR-001 sump			2			H-2-71661, H-2-71662	
244-TXR-002			2			H-2-71661, H-2-71662	
244-TXR-002 sump			2			H-2-71661, H-2-71662	
244-TXR-003			2			H-2-71661, H-2-71662	
244-TXR-003 sump			2			H-2-71661, H-2-71662	
244-UR-001		2	1			H-2-71658, H-2-71659	2-4" sampling, 6" spare
244-UR-001 sump			2			H-2-71658, H-2-71659	
244-UR-002			2		1-2.5	H-2-71658, H-2-71659	
244-UR-002 sump			2		1-2.5	H-2-71658, H-2-71659	
244-UR-003			2		1-2.5	H-2-71658, H-2-71659	All Vault Risers Under
244-UR-003 sump			2		1-2.5	H-2-71658, H-2-71659	Weather Cover
244-UR-004			1			H-2-71658, H-2-71659	
231-W151-001							No sampling risers on
231-W151-002							design drawings
241-WR-001			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	All Vault Risers Under
241-WR-001 sump			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	Weather Cover
241-WR-002			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	
241-WR-002 sump			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	Tank & sump 001-005
241-WR-003			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	have a 2.5" sampling
241-WR-003 sump			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	riser & a spare 6" riser

Table 5-1. Miscellaneous Tank Riser Access Summary. (Page 3 of 3)

Tank Designation	Number and Diameter of Blind Risers for Access					Interim Isolation As-built Drawings	Comments
	3 in	4 in	6 in	12 in	Other (in)		
241-WR-004			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	
241-WR-004 sump			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	
241-WR-005			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	
241-WR-005 sump			1		1-2.5	H-2-71605, H-2-71667, H-2-71668, H-2-71669	
241-WR-006					2-1or1-1/8	H-2-71605, H-2-71667, H-2-71668, H-2-71669	2-1" sampling risers if
241-WR-006 sump						H-2-71605, H-2-71667, H-2-71668, H-2-71669	liquid level instruments
241-WR-007					2-1or1-1/8	H-2-71605, H-2-71667, H-2-71668, H-2-71669	removed when isolated;
241-WR-007 sump						H-2-71605, H-2-71667, H-2-71668, H-2-71669	1-1/8" risers if liquid
241-WR-008					2-1or1-1/8	H-2-71605, H-2-71667, H-2-71668, H-2-71669	level not removed
241-WR-008 sump						H-2-71605, H-2-71667, H-2-71668, H-2-71669	Drawings do not show
241-WR-009					2-1or1-1/8	H-2-71605, H-2-71667, H-2-71668, H-2-71669	sump risers for tanks
241-WR-009 sump						H-2-71605, H-2-71667, H-2-71668, H-2-71669	006-009

Note: Blanks indicate the criterion is not applicable.

6.0 TANK PRIORITIZATION

All of the miscellaneous tanks will eventually be fully remediated and closed. However, resource limitations dictate a need to prioritize and schedule characterization and remediation activities. The expected time until closure is completed raises concerns about the safety and environmental risk of these tanks prior to remediation. Tank monitoring and/or characterization are required to determine whether there are any safety issues that require action prior to tank closure.

This chapter develops a basis for prioritizing the miscellaneous tanks. The purpose of tank prioritization is to identify which of these tanks should have priority for action. Appropriate action for the tanks could include limited monitoring, screening level evaluation, complete characterization, partial waste removal, or complete remediation.

A preliminary prioritization for the miscellaneous tanks is presented in this chapter. However, currently available information is insufficient to reliably prioritize these tanks. Therefore, at least a minimum amount of data collection is necessary for all of the tanks. Data needs are discussed, and a program for further data collection is recommended in Chapter 7.0. Prioritization of these tanks for additional action should then be refined and revised based on the new information collected. Figure 6-1 provides a diagram of the decision process for characterization, prioritization, and remediation of the miscellaneous tanks.

6.1 BASIS FOR PRIORITIZATION

The primary concern for the miscellaneous tanks is the potential for safety or environmental problems. Prioritization due to the potential for problems can be based on known or suspected risk, or on potential high risk because of high uncertainty (i.e., lack of data). Absent an imminent safety hazard, however, characterization and closure of a tank should be scheduled to mesh with remediation of the surrounding area and/or associated facilities. Those tanks that do not warrant priority based on safety can be scheduled for action by balancing the resources required for characterization and closure of these tanks with other program needs and the availability of the resources. This will allow the most efficient use of resources and allow remediation of the miscellaneous tanks to be prioritized and integrated with other environmental restoration activities.

Therefore, the three criteria for prioritizing the miscellaneous tanks are (in order of importance):

1. Safety or environmental risk
2. Programmatic integration
3. Resources

These criteria are discussed in this section.

6.1.1 Current Risk

Human health and the environment must be protected prior to and during tank characterization and remediation. In general, the tanks presenting the greatest *relative* risk should be addressed first. Prioritization of miscellaneous tank closures relative to the SSTs, DSTs and other facilities is beyond the scope of this report, but is relevant to selecting immediate action for the tanks (see Sections 6.1.2 and 6.1.3). The type and magnitude of the risk are used in determining the appropriate action (e.g., monitoring or accelerated remediation).

The general concerns are:

- Worker risk, i.e., the safety of personnel working around the tanks. Worker safety for tank remediation involves different concerns, and is a separate issue to be addressed during tank characterization and selection of tank remediation alternatives.

- Public risk, i.e., the risk to both the general public and Hanford site personnel away from the tanks.

- Environmental risk, i.e., contamination of air, water or soil due to releases from the tanks.

In this context, it is important to define "risk" as the combination of the probability of an adverse event and the consequence of the event (probability times consequence). Therefore, both the probability and the consequence should be considered in prioritization. Mitigation of the primary event should be included in consideration of the risk. For example, the effects of a tank explosion could be mitigated to some extent if it occurred within a closed vault.

The general safety concerns for the miscellaneous tanks were discussed in Chapter 4 and can be summarized as follows:

- Risk of explosion, fire, or other sudden release. For these tanks, sudden release can be addressed in terms of the following potential causes:

    - hydrogen generation and build-up
    - ferrocyanide
    - reactivity due to organic salts
    - flammable organic compounds (vapor and liquid)
    - criticality (fissile radioactive isotopes)

- Risk of non-sudden release of radioactive/toxic gas to the atmosphere. This risk is a function of the integrity of tank isolation, the concentration of radioactive and toxic compounds in tank vapors, and the volume of tank waste that could serve as a continuing source of toxic vapors.

- Risk of leakage to soil or groundwater. This risk is a function of the integrity of the tank shell, the radioactivity and toxicity of any tank liquids, and the volume of liquid tank waste (including drainable interstitial liquid in sludges).

The risk of fire, explosion or other sudden release is clearly the greatest concern because it could cause the greatest damage and risk to the environment and human health. A non-sudden release (i.e., slow leak) of toxic gas would be mitigated by dilution in the air. However, it is a concern because it would not be contained and could pose a risk to public safety and workers in the vicinity of the tanks.

Historic leakage to soil or groundwater is obviously a concern in the long term, to be addressed during tank characterization and remediation. However, on-going leakage of liquids from the miscellaneous tanks is not believed to be of sufficient concern to serve as a basis for prioritization. This conclusion is based on the following:

- The potential for a problem is relatively low and consequences of a leak are expected to be minor. Because the tanks are inactive, and have been isolated and stabilized, there is only a small and finite quantity of waste that could leak.

- The potential contamination from an on-going leak is much smaller than existing, known contamination in the area of these tanks. Several of these tanks intentionally discharged contaminated liquid to nearby disposal cribs over a period of many years. It would not make sense to give priority for potential contamination from a miscellaneous tank leak over remediation of known contamination from waste disposal sites.

- Prioritization based on the other safety concerns considers many of the same parameters that affect risk due to leakage to soil or groundwater (e.g., waste volume and the radioactivity and toxicity of the waste).

- Soil and groundwater contamination from tank leakage should be integrated with other environmental restoration program activities addressing these problems at associated facilities in the 200 Area.

6.1.2 Programmatic Integration

Characterization and remediation of the miscellaneous tanks should be conducted with full consideration of other, related Hanford environmental restoration activities and integrated with these activities, where appropriate. This "programmatic integration" is desirable for the following reasons:

1. It allows more efficient allocation and use of limited resources.

2. It allows more cost-effective remediation (e.g., by combining operations).

3. It helps ensure that the remedial action for the miscellaneous tanks is compatible with remedial action in adjacent units.

The miscellaneous tanks were components of a complex system for chemical processing, waste treatment, and waste disposal. The tanks are closely associated with pipelines, valve pits, diversion boxes, and cribs and other disposal facilities. Closure of these tanks is just one part of the environmental restoration program for the overall system.

Settling tank 241-U-361 is an example of the need for programmatic integration. An LFI is underway and an IRM planned for the area encompassing the disposal cribs 216-U-1 and 216-U-2. However, the LFI as currently planned does not include any sampling near or within tank 241-U-361 (DOE-RL 1992b). Additional investigation is necessary to select an IRM suitable for both the cribs and the tank. For example, if a barrier is selected as the IRM for the cribs, the currently planned investigation would not indicate whether the barrier should be extended to cover the tank (e.g., to contain contaminated soil around the tank, if present). The consideration holds true even if other remedial actions (e.g., waste removal) are also used for the settling tank.

6.1.3 Resources

For tanks that do not pose an immediate and significant risk to human health and the environment (which is expected to include most, if not all, of the miscellaneous tanks), scheduling of tank remediation will depend heavily on the availability of resources. In the short term, action on the miscellaneous tanks is limited by the availability of resources for tank characterization, particularly sampling and analysis of tank wastes. At present, other tank characterization activities (i.e., the SSTs) are consuming the vast majority of these resources. In the longer term, remediation of the miscellaneous tanks will be constrained by the availability of treatment, storage, and disposal capacity for wastes and the demand for this capacity to address SST waste.

The availability of resources for tank characterization and remediation is more an issue to consider than a basis for prioritization. However, it can be a useful basis for prioritization within a grouping of tanks having the same (or similar) priority based on safety and programmatic integration. In this situation, the tanks that are less complex and provide easier access may require fewer resources to characterize or remediate, and could be addressed prior to more complex tanks.

Tank characterization and remediation requires a variety of resources, including the following limited resources:

- Sampling equipment for hard-to-obtain tank wastes, such as high activity sludges or bottom solids.
- Laboratory personnel and equipment (laboratory capacity) for analysis of radioactive wastes.
- Capacity for temporary storage of tank wastes (e.g., DSTs) until a final disposal system is available.
- Availability and capacity of treatment and disposal systems for high-level and transuranic tanks wastes (i.e., vitrification facility and geologic repository).

- Availability and capacity of treatment and disposal systems for low-level solids and sludges (i.e., vitrification facility and/or the Environmental Restoration Disposal Facility [ERDF]).

- Program management personnel.

Several programs have responsibility for remediation and closure of miscellaneous tanks. Closure activities must be integrated with and prioritized relative to the other responsibilities of these programs for allocation of resources.

The TWRS Program currently possess most of the capabilities for tank characterization. This program is conducting planning and evaluation of options for closure of SSTs that will be applicable or relevant to the miscellaneous tanks. However, TWRS resources are focused on the SSTs because of their priority. Therefore, resource allocation for miscellaneous tanks will be prioritized and scheduled in comparison with the priority for SSTs.

Similarly, the D&RCP and the ERRA may have the best capabilities and resources for addressing some of the miscellaneous tanks and related facilities (i.e., vaults or tanks with limited amounts of low activity waste). As with TWRS, these programs have other responsibilities and priorities competing with the miscellaneous tanks for resources.

Considering the priority given to SSTs for the same resources, it appears likely that the availability of resources will be a key factor in scheduling the characterization and remediation of the miscellaneous tanks, absent a demonstrated safety problem of similar magnitude to the SSTs.

6.2 CRITERIA AND APPROACH FOR PRIORITIZATION

As discussed in Section 6.1, the primary basis for prioritization is the potential for safety or environmental problems. Three categories have been established based on high, medium and low potential for safety or environmental problems:

1. High priority - tanks that require immediate action

2. Moderate priority - tanks which deserves priority but do not require immediate action

3. Low priority - tanks which do not warrant priority and can be characterized and remediated last.

The three general categories can be subdivided based on the programmatic integration and resource limitation criteria discussed in sections 6.1.2 and 6.1.3, respectively. In addition, the type of appropriate action, based both on the safety priority and these other factors can be useful in prioritizing tanks. Potential actions are discussed in Section 6.2.1. Section 6.2.2 describes the overall prioritization approach based on all these criteria.

6.2.1 Action Alternatives

At present, data on the miscellaneous tanks are insufficient to reliably prioritize the tanks. Therefore, at least a minimum amount of data collection is necessary for all of the tanks to resolve the safety issues (See Chapter 7.0). Once additional data are available, prioritization of action for the tanks can be refined. The following actions are possible:

- No monitoring necessary; schedule characterization and remediation as resources allow.
- Limited periodic monitoring necessary or advisable; schedule characterization and remediation as resources allow.
- Continuous or frequent monitoring necessary or advisable; accelerate characterization to resolve safety issues; schedule remediation as resources allow but be prepared to accelerate remediation if monitoring and characterization indicate safety problem.
- Perform immediate partial tank remediation (including necessary tank characterization) to address identified safety or environmental concerns, and then revise the priority and category of the tank to reflect the interim remedial action. An example of this action would be removal of tank contents. It is not believed that any of the miscellaneous tanks will require immediate remedial action, but the possibility cannot be eliminated at this time.
- Accelerate final tank remediation (including necessary tank characterization) either 1) to address identified safety or environmental risks, or 2) for efficient remediation based on programmatic integration (see Section 6.1.2). Choosing to accelerate remediation does not require selecting the specific tank remediation alternative (closure method), which is a separate decision.
- Collect additional data and reconsider priority and appropriate action.

6.2.2 Prioritization Categories

As previously discussed, tank prioritization has been developed using three categories:

- Category 1 - high priority; immediate action is required or advisable.
- Category 2 - moderate priority; immediate action needed, but priority remediation advisable as resources allow.
- Category 3 - low risk and consequent low priority for action.

Based on the additional criteria of programmatic integration, resource constraints and appropriate action, these three categories have been subdivided into the following eight categories:

- **Category 1A** - These tanks are considered to be high risk based on identified safety or environmental concerns, and accelerated remediation (partial or final, as appropriate) is necessary to address the problem. The scheduling of the remediation (degree of accelerated action) would depend on the degree of risk. If tank remediation is not to be immediate, then frequent monitoring would be necessary. Placing a miscellaneous tank in Category 1A implicitly indicates a risk similar to 241-SY-101 tank.

- **Category 1B** - These tanks have identified safety or environmental concerns, but routine monitoring could detect a problem and allow timely action (e.g., vapor monitoring for a flammable gas generation problem). Category 1B tanks should be remediated before lower-priority tanks, but the remediation can be scheduled based on available resources and programmatic integration. The immediate action on these tanks would be to establish a program of routine monitoring. Placing a miscellaneous tank in Category 1B implicitly indicates a risk similar to some of the watch list SSTs.

- **Category 1C** - Accelerated remediation is advisable to integrate with other environmental restoration activities (i.e., remediation of a miscellaneous tank as part of remediation of an operable unit). The actions and scheduling would match the needs of the other program(s) involved. Depending on the scheduling and estimated risk, some tank monitoring may be necessary.

- **Category 1D** - These tanks are estimated to have moderate risk, but there is high uncertainty in the estimate and the tanks therefore could be high risk. Additional tank characterization is needed to resolve key uncertainties. The tank would then be recategorized based on the new data.

- **Category 2A** - These tanks are estimated to have moderate risk, with low to moderate uncertainty in the estimate, and no need for priority based on programmatic integration has been identified. Tanks in this category should proceed with characterization and remediation to the extent that resources are available, but can wait (with periodic monitoring) on higher priority remediation projects. Periodic monitoring (less frequent than for Category 1) would be appropriate.

- **Category 2B** - These tanks are estimated to have low risk, but have high uncertainty in the estimate. Additional tank characterization is needed to resolve key uncertainties. The tank would then be recategorized based on the new data.

- **Category 3A** - These tanks are estimated to have low risk with low uncertainty in the estimate, but still contain waste. Characterization and remediation of Category 3 tanks can wait indefinitely, until all higher-priority tanks have been addressed. Little or no monitoring should be necessary for these tanks.

- **Category 3B** - These tanks are low risk with low uncertainty because they have been completely emptied of waste (not just pumped to minimum heel). The priority for characterization and remediation of Category 3B is lower than for Category 3A. However, tank closure is not complete. As with Category 3A, tank closure can wait until all other tanks are remediated. No monitoring is necessary for empty tanks.

Scheduling of remediation is also affected by the availability of treatment and disposal capacity. A capacity issue of particular significance for the miscellaneous tanks is whether their waste (typically small volumes) could be transferred to double-shell tanks for temporary storage to allow expedited and easier remediation.

6.3 PRELIMINARY PRIORITIZATION

A preliminary prioritization of the miscellaneous tanks has been performed, to the extent allowed by the available data, using the approach described in the preceding sections. This categorization is intended to provide some degree of relative priority for the miscellaneous tanks, but is not intended to be definitive. As already noted, screening-level investigation is needed on all of the miscellaneous tanks before a defensible prioritization can be performed.

The preliminary prioritization of the miscellaneous tanks is provided in Table 6-1. There are no *known* significant safety problems with the miscellaneous tanks at this time. Consequently, no tanks are identified in Category 1A or 1B. Evaluating programmatic integration is outside the scope of this report, so most tanks were not considered for Category 1C. Nevertheless, settling tank 241-U-361 has been identified as fitting this category. It is worth noting that excepting program integration, tank 241-U-361 would have been placed in Category 1D. A number of tanks have been prioritized as Category 1D due to the potential for a safety issue, high uncertainty in being able to discount the safety issue and high waste inventories and volumes.

The uncertainty in the information is too large to justify placing any tanks in Category 2A (moderate risk and uncertainty). All tanks with estimated low risk have been placed in Category 2B.

No tanks were identified for Category 3A because of the data uncertainty. It is expected that most of the Category 2B tanks could be placed in Category 3A following a well-planned screening investigation program (see Chapter 7.0). Three tanks are in Category 3B (empty): waste holding tank 241-CX-70 and catch tanks 241-S-302B and 241-TY-302B. Although many of the individual vault tanks are empty, they were not placed in Category 3B, unless the entire vault is empty, including sumps.

The following discussion summarizes priorities by tank type:

Settling Tanks

- 361 tanks are all Category 1D due to high inventories and volumes
- the W-151 and 241-Z-8 tanks are Category 2B due to lower volumes

Vault Tanks (4 vaults containing 20 tanks)

- Vaults tanks are all designated Category 2B

Catch Tanks
- 241-B-301 and 241-T-301B are Category 1D due to high waste volume
- 12 of the catch tanks are rated Category 2B
- 2 of the catch tanks are empty and rated Category 3B

Neutralization Tanks (3)
- 241-CX-71, 270-E-1 and 270-W are all rated category 2B

Experimental Tank 241-CX-72
- Category 2B

Waste Handling Tank 241-CX-70
- Empty and considered Category 3B

The settling tanks were all intended to separate and collect radioactive solids from waste liquid. The 361 settling tanks also have the highest waste volumes. This relatively large inventory of highly radioactive waste makes them, as a group, the highest priority miscellaneous tanks. The three tanks 231-W-151-001, 231-W-151-002, and 241-Z-8 have lower priority because of their lower waste volume.

The priority of vault tanks is based on their direct use in waste processing, the characteristics of the waste processed, the quantity of residual waste, the presence of liquid waste outside the tanks (e.g., in concrete vault sumps), and the number of tanks involved. All of the tanks within a given vault should be characterized and remediated together. It would not make sense to expose workers to vault radiation to only remediate selected tanks. In addition, the vaults themselves contain waste and require remediation. Each vault is considered a separate group and could be further prioritized based on estimated waste volume.

The catch tanks all received an ill-defined mixture of wastes from various processes and tank transfers, diluted by rainwater from diversion boxes and pipe encasements. They were all constructed of steel directly buried in soil, and have similar ages (37 to 45 years old). Sludges in these tanks could be similar to settling tank sludges, but is estimated to have less potential for any particular problem because of waste mixing and dilution. Catch tanks 241-B-301 and 241-T-301B have been categorized as 1D because of their high volume of sludge. Twelve of the catch tanks are categorized as 2B because of their low volume. The other two catch tanks are empty.

The neutralization tanks are given relatively low priority because they all contain limestone that contributes to stabilization of the waste and lessens the potential for safety and environmental problems. They all have stainless steel construction and expected low waste volume (not counting limestone or grout). Experimental tank 241-CX-72 is also categorized as 2B because it has been partially remediated by grouting.

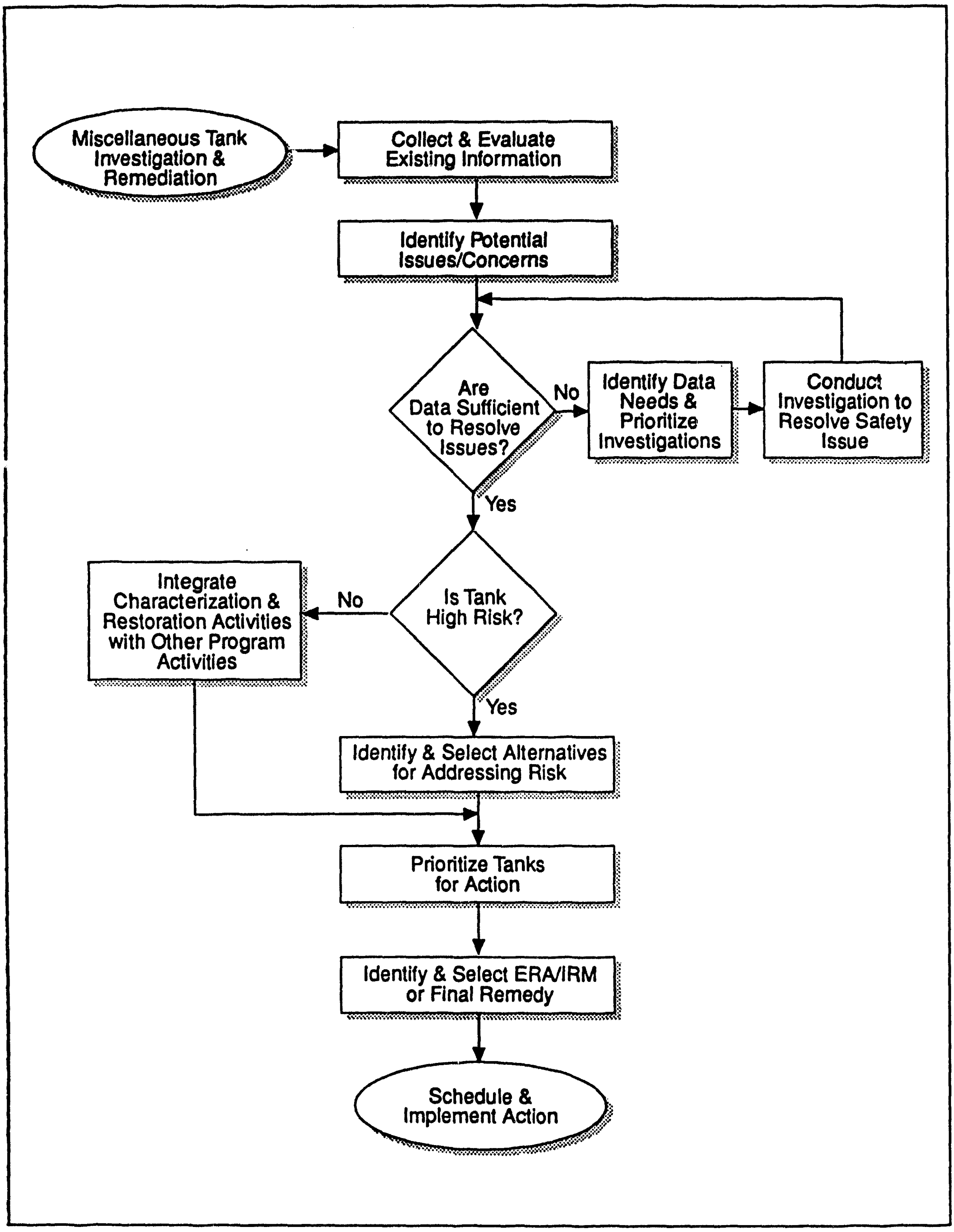

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Figure 6-1. Decision Process for Investigation and Remediation of Miscellaneous Tanks.

Table 6-1. Prioritization of the Miscellanous Tanks. (Sheet 1 of 3)

TANK	Priority Category [a]	Tank Type [b]	Relative Ranking on Safety Issues [c]								Sludge Volume (gal)	Liquid Volume (gal)	Total Volume (gal)	NOTES
			H2	FeCN	Org	Flam	Vap	Integ	Rad	Crit				
241-U-361	1C	S	M	L	M	L	M	L	H	L	27,700	100	27,800	Little or no liquid
241-T-361	1D	S	M	L	M	L	M	L	H	M	24,500	0	24,500	
241-B-361	1D	S	M	L	M	L	M	L	H	M	20,678	0	20,678	No pumpable liquids
241-Z-361	1D	S	L	L	M	L	M	L	H	M	20,000	200	20,200	Layered "mud-like" sludge
241-B-301	1D	C	L	L	M	L	L	L	M	L	21,660	590	22,250	
241-T-301B	1D	C	L	L	M	L	L	L	M	L	21,660	590	22,250	
241-WR-001	2B	V	L	L	L	L	L	H	L	L	-	-	12,000	Tank believed empty; est. 12,000 gal. in sump
241-WR-002	2B	V	L	L	L	L	L	L	L	L	-	-	35,000	Tank believed empty; est. 35,000 gal. in sump
241-WR-003	2B	V	L	N	L	L	L	H	L	L	-	-	0	Believed empty; unknown sump waste volume
241-WR-004	2B	V	L	N	L	L	L	H	L	L	-	-	0	Believed empty; unknown sump waste volume
241-WR-005	2B	V	L	N	L	L	L	L	L	L	-	-	-	Value unknown (may be empty)
241-WR-006	2B	V	L	N	N	L	L	L	L	L	-	-	min.	Minimum heel of thorium solution
241-WR-007	2B	V	L	N	L	L	L	L	L	L	-	-	0	Believed empty
241-WR-008	2B	V	L	N	L	L	L	L	L	L	-	-	0	Believed empty
241-WR-009	2B	V	L	N	L	L	L	L	L	L	0	23,000	23,000	Conflicting volume data (may be empty)
244-BXR-001	2B	V	L	L	L	L	M	L	M	L	7,200	0	7,200	Minimum sludge in sump
244-BXR-002	2B	V	L	L	L	L	M	L	M	L	1,800	380	2,180	Est. 280 gal. sludge in sump
244-BXR-003	2B	V	L	L	L	L	M	L	M	L	1,450	360	1,810	Est. 8,300 gal. soft sludge in sump

Table 6-1. Prioritization of the Miscellanous Tanks. (Sheet 2 of 3)

TANK	Priority Category [a]	Tank Type [b]	Relative Ranking on Safety Issues [c]								Sludge Volume (gal)	Liquid Volume (gal)	Total Volume (gal)	NOTES
			H2	FeCN	Org	Flam	Vap	Integ	Rad	Crit				
244-BXR-011	2B	V	L	L	L	L	M	L	M	L	7,000	100	7,100	Est. 4,200 gal. soft sludge in sump
244-TXR-001	2B	V	L	L	L	L	M	H	M	L	2,300	50	2,350	Minimum sludge in sump
244-TXR-002	2B	V	L	L	L	L	M	L	M	L	2,950	0	2,950	Minimum sludge in sump
244-TXR-003	2B	V	L	L	L	L	M	L	M	L	6,500	0	6,500	Minimum sludge in sump
244-UR-001	2B	V	L	N	L	L	L	L/M	H	L	1,850	390	2,240	Liquid and sludge in sump
244-UR-002	2B	V	L	N	L	L	L	M/H	H	L	2,300	570	2,870	Conflicting liquid level data (214 or 570 gal.)
244-UR-003	2B	V	L	N	L	L	L	M/H	H	L	1,570	0	1,570	Liquid and sludge in sump
244-UR-004	2B	V	N	N	N	N	M	H	H	N	min.	min.	min.	minimum heel
241-C-301	2B	C	L	M	M	L	L	L	M	L	9,000	1,470	10,470	
241-TX-302BR	2B	C	L	L	M	L	L	L	M	L	-	-	-	content unknown
241-S-302A	2B	C	L	L	M	L	L	H	M	L	-	-	5,130	Monitored. 2 ft grout over 1 ft sand
241-B-302B	2B	C	L	L	M	L	L	L	L	L	690	4,240	4,930	
241-A-302B	2B	C	L	L	M	L	L	L	L	L	-	-	3,600	Monitored.
241-TX-302A	2B	C	L	L	M	L	L	H	L	L	2,450	30	2,480	
240-S-302	2B	C	L	L	M	L	L	H	L	L	-	-	2,276	Monitored. Est. 100 gal. interstitial liquid
241-TX-302B	2B	C	L	L	M	L	L	L[1]	M	L	-	-	1,320	Monitored.
241-SX-302	2B	C	L	L	M	L	L	L	L	L	1,050	300	1,350	
241-BX-302B	2B	C	L	L	M	L	L	L	L	L	950	90	1,040	
241-BX-302C	2B	C	L	L	M	L	L	L	L	L	640	230	870	
241-BX-302A	2B	C	L	L	M	L	L	L	L	L	840	0	840	

Table 6-1. Prioritization of the Miscellanous Tanks. (Sheet 3 of 3)

TANK	Priority Category [a]	Tank Type [b]	Relative Ranking on Safety Issues [c]								Sludge Volume (gal)	Liquid Volume (gal)	Total Volume (gal)	NOTES
			H2	FeCN	Org	Flam	Vap	Integ	Rad	Crit				
241-TY-302A	2B	C	L	L	M	L	L	L	L	L	450	0	450	
241-TX-302XB	2B	C	L	L	M	L	L	L	L	L	110	250	360	
231-W-151-001	2B	S	L	N	L	L	L	L	L	L	0	1,430	1,430	
231-W-151-002	2B	S	L	N	L	L	L	L	M	L	10	950	960	
241-Z-8	2B	S	L	L	M	L	L	L	H	M	500	0	500	Liquid removed 10-19-74
241-CX-72	2B	E	L	N	L	N	N	L	H	L	650	0	650	Filled with grout over sludge
270-W	2B	N	L	L	M	L	L	H	L	L	-	-	-	contents unknown
270-E-1	2B	N	L	L	M	L	L	H	L	L	3,800	0	3,800	Possible 1,400 gal. interstitial liquid
241-CX-71	2B	N	M/ H	L	H	L	H	L	H	L	930	0	930	Grout over 4 ft limestone and 2.35 ft sludge
241-CX-70	3B	H	N	N	N	N	N	N	N	N	0	0	0	Flushed and emptied
241-S-302B	3B	C	N	N	N	N	N	N	N	N	0	0	0	Emptied
241-TY-302B	3B	C	N	N	N	N	N	N	N	N	0	0	0	Emptied

NOTES:

Volumes have been rounded to the nearest 10 gallons.
[1] Tank 241-TX-302B replaced tank 241-TX-302BR because 241-TX-302BR was damaged by acid.
- No Data
a. See text for explanation.
b. C = catch; E = experimental; N = neutralization; S = settling; V = vault.
c. Relative rankings: H = high; M = moderate; L = low; N = negligable.
d. Issue abbreviations:

H2	Hydrogen generation and buildup	Vap	Emission of radioactive or toxic vapors
FeCn	Ferrocyanide reactivity	Integ	Tank integrity
Org	Organic salt reactivity	Rad	Radioactivity
Flamm	Flammability	Crit	Criticality

7.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter summarizes the conclusions reached in the preceding chapters, and provide recommendations regarding the miscellaneous tanks.

7.1 CONCLUSIONS

7.1.1 Safety Concerns

The following conclusions apply to safety concerns:

- Based on currently available, limited data, there are no *known* significant safety problems with the miscellaneous tanks in their current state of isolation. However, the limited data is insufficient to eliminate the possibility that some of these tanks have the potential for significant safety problems.

- Although it appears unlikely that the safety issues for SSTs and DSTs are also a concern for the miscellaneous tanks, they cannot be ruled out at this time.

- A number of these tanks contain highly radioactive and/or toxic waste. It is necessary to employ standard Hanford-Site safety precautions and ALARA requirements for characterization, monitoring & remediation of the miscellaneous tanks.

7.1.2 Tank Prioritization

The following conclusions apply to tank prioritization:

- Currently available information on the miscellaneous tanks is insufficient to reliably and defensibly prioritize the tanks for remediation.

- The primary concern for the miscellaneous tanks is the potential for safety or environmental problems. Prioritization due to the potential for problems can be based on known or suspected risk, or on potential high risk because of high uncertainty (i.e., lack of data). Absent an imminent safety hazard, however, characterization and closure of a tank should be scheduled to mesh with remediation of the surrounding area and/or associated facilities. Finally, those tanks that do not warrant priority based on safety or programmatic integration can be scheduled for action by balancing the resources required for characterization and closure of these tanks with the availability of the resources. Therefore, the criteria for prioritizing the miscellaneous tanks are (in order of importance):

    1. Potential for safety or environmental problems (risk)

    2. Programmatic integration

3. Resources.

Eight categories for prioritizing tanks for action were developed in Chapter 6. Although additional data are required to resolve safety issues and determine appropriate actions for the tanks, a preliminary prioritization was conducted and is summarized in Table 6-1 and as follows:

- No tanks were placed in Categories 1A or 1B (identified need for immediate action based on safety).
- One tank, settling tank 241-U-361, was placed in Category 1C (priority action justified for programmatic integration). However, evaluating programmatic integration was outside the scope of this report, so it is likely that other tanks also belong in this category.
- Seven (7) tanks were placed in Category 1D based on high volume and the potential for safety concerns.
- No tanks were placed in Category 2A (moderate risk and uncertainty) because of the large uncertainty in the data.
- Thirty-nine (39) tanks were placed in Category 2B based on estimated low risk with significant uncertainty. It is expected that most of the Category 2B tanks could be placed in Category 3A following a well-planned screening investigation program.
- No tanks were identified for Category 3A (low risk, low uncertainty) because of data uncertainties.
- Three tanks were placed in Category 3B (empty): waste holding tank 241-CX-70 and catch tanks 241-S-302B and 241-TY-302B.

7.1.3 Currently Available Tank Data

The following conclusions apply to the availability and quality of data on the miscellaneous tanks:

- Currently available information on the miscellaneous tanks is insufficient for prioritizing the miscellaneous tanks, or for selecting and implementing appropriate remedial action.
- Further data collection is necessary to prioritize the miscellaneous tanks.
- Construction information, including "as-built" drawings for construction and isolation, are available for most miscellaneous tanks. However, there are discrepancies in some of the available information from different sources (even including location coordinates).

- Several miscellaneous tanks are identified leakers. Several other tanks have suspect integrity. The remainder are not known to have leaked, but are of an age (greater than 20 years) where leakage is very possible. However, on-going leakage from the tanks is not believed to pose a significant safety or environmental concern.

- Some data are available on waste volumes for all of the miscellaneous tanks. However, there are discrepancies in the data, and most of the measurements are old. Therefore, most of the waste volume measurements are considered to have low reliability. Waste volume measurements should be made for all of the tanks.

- The composition of wastes in the miscellaneous tanks is highly uncertain. Limited analytical data are available for some liquid wastes and sludges in these tanks. The mixture and variability of wastes handled in these tanks, particularly wastes associated with tank farm transfers, makes any estimation of waste composition unreliable.

7.1.4 Other Conclusions

The following additional conclusions are made:

- Tank characterization and remediation require a variety of resources, including the following limited resources:
  - Sampling equipment for hard-to-obtain tank wastes, such as high activity sludges or bottom solids.
  - Laboratory personnel and equipment (laboratory capacity) for analysis of radioactive wastes.
  - Capacity for temporary storage of tank wastes (e.g., DSTs) until a final disposal system is available.
  - Availability and capacity of treatment and disposal systems for high-level and transuranic tanks wastes (i.e., vitrification facility and geologic repository).
  - Availability and capacity of treatment and disposal systems for low-level solids and sludges (i.e., vitrification facility and the Environmental Restoration Disposal Facility [ERDF]).
  - Program management personnel.

- An issue to be resolved is whether small volumes of waste from the miscellaneous tanks could be transferred to DSTs for temporary storage to expedite remediation.

7.2 RECOMMENDATIONS

Based on the conclusions in Section 7.1, several recommendations are provided for subsequent actions with the miscellaneous tanks. The decision diagram in Figure 6-1 illustrates the process that should be followed. As indicated previously, existing information is inadequate to dismiss safety concerns and prioritize tanks for action, therefore, the primary recommendation is to collect additional data. A program of screening-level tank characterization would be a highly useful first step to resolve safety issues and prioritize the miscellaneous tanks for subsequent remedial activities. The data collection is necessary for all the miscellaneous tanks (including those believed to be empty) in order to prioritize tanks for further action. The following data would be relatively easy to collect from tanks that have above ground risers and would greatly enhance the reliability and defensibility of conclusions regarding safety concerns. However, the task is considerably more difficult for the vaults which have weather covers and are without above grade risers.

- Volume of liquid waste and sludge in tanks and vaults (i.e., vault sumps). Waste volume is a key factor in prioritizing the tanks and in estimating resource requirements for tank remediation (e.g., treatment and disposal capacity).

- Temperature in the vapor space of tanks and vaults. High temperature is required for ferrocyanide and organic salt safety issues to be a concern. If the tank is at ambient or only slightly above ambient temperature, then these issues can be eliminated for the tank. If the vapor temperature is above ambient, then waste temperature should be measured to ascertain whether localized temperature buildup could be a concern.

- Level of radioactivity. The degree of radioactivity is useful in evaluating safety issues, prioritizing the tanks, estimating worker safety requirements as part of resource planning, and preliminary evaluation of treatment and disposal requirements.

- Chemical analysis of tank vapor for toxic and flammable gases, including hydrogen. These data would be directly useful to evaluate the toxic vapor and flammability issues.

Following completion of the screening level evaluation, the tanks should be re-evaluated based on the information collected to determine whether there are any safety issues requiring accelerated action, or to otherwise plan future actions for the miscellaneous tanks. Additional tank characterization or remedial action should be accelerated for all tanks identified in Category 1.

Additional recommendations include the following:

- Include consideration of characterization and remediation for settling tank 241-U-361 in the LFI and IRM for the area encompassing disposal cribs 216-U-1 and 216-U-2 (see DOE-RL 1993a).

- Evaluate all of the remaining miscellaneous tanks for integrating with other environmental restoration activities to ensure remedial work is consistently and cost effectively implemented.

- Responsibility for the miscellaneous tanks is split between programs. These programs must be coordinated and agree on responsibilities for effective and efficient characterization and remediation of these tanks.

8.0 REFERENCES

Anderson, J.D., 1990, *History of the 200 Area Tank Farms*, WHC-MR- 0132, Westinghouse Hanford Company, Richland, Washington.

Babad, H., 1992, *Overview of Progress Made toward Resolving Priority One Safety Issues: Fiscal Year 1992*, WHC-EP-0606, Westinghouse Hanford Company, Richland, Washington.

Babad, H., C. DeFigh-Price, and J.C. Fulton, 1993, *Progress in Resolving High-Priority Hanford Site Radioactive Waste Storage Tank Safety Issues*, Submitted to Journal of Nuclear Safety.

Baldrige, K.F., 1959, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas 1959*, HW-60807, Hanford Laboratories Operation, Richland, Washington.

Baynes, P., 1993, *Tank Waste Remediation System Functions and Requirements*, Draft, DOE/RL-92-60, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Bell, N.E., 1984, *Guideline for Declaring Auxiliary Tanks Interim Stabilized*, Revision 0, SD-WM-TI-129 Rev. 0, Rockwell Hanford Operations, Richland, Washington.

Carter, R.D., and D.J. Brown, 1976, *Criticality Potential of 241-Z-361 Tank*, Memo to R.E. Isaacson, February 20, 1976, Atlantic Richfield Hanford Company, Richland, Washington.

Cash, R.J., H. Babad, and A.K. Postma, 1992, *Ferrocyanide Containing Tanks: A Study in Risk Evaluation*, WHC-SA-1405-FP, Westinghouse Hanford Company, Richland, Washington.

Davenport, L.C., 1977, *Criticality Safety Considerations for Emptying 231-W-141 Sump Tanks*, Letter to V.C. Asmund, Battelle Pacific Northwest Laboratories, Richland, Washington.

Davenport, L.C., W.J. Mikols, and C.L. Brown, 1977 March, *Second Party Criticality Safety Review of Settling Tank 241-Z-361*, Pacific Northwest Laboratory, Richland, Washington.

DiPietro, J.S., 1979, *Auxiliary Tanks Stabilization Plan*, Rockwell International, Internal Letter to R.A. Zinski, 60411-79-0047, Rockwell Hanford Operation, Richland, Washington.

DOE, 1992, *U.S. Department of Energy Radiological Control Manual*, DOE/EH-0256T, U.S. Department of Energy, Washington, D.C.

DOE-RL, 1989, *Single-Shell Tanks System Closure/Corrective Action Work Plan*, Draft A, DOE/RL-89-16 Draft A, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992a, *T Plant Source Aggregate Area Management Study Report*, DOE/RL-91-61 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992b, *U Plant Source Aggregate Area Management Study Report*, DOE/RL-91-52 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992c, *Z Plant Source Aggregate Area Management Study Report*, DOE/RL-91-58 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992d, *S Plant Aggregate Area Management Study Report*, DOE/RL-91-60 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992e, *Hanford Site Past-Practice Strategy*, DOE/RL-91-40, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993a, *200 West Groundwater Aggregate Area Management Study Report*, DOE/RL-92-16 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993b, *B Plant Source Aggregate Area Management Study Report*, DOE/RL-92-05 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993c, *PUREX Source Aggregate Area Management Study Report*, DOE/RL-92-04 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993d, *Semiworks Source Aggregate Area Management Study Report*, DOE/RL-92-18 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Droppo, J.G.Jr., J.W. Buck, J.S. Wilbur, D.L. Strenge, and M.D. Freshley, 1991, *Single-Shell Tank Constituent Rankings for Use in Preparing Waste Characterization Plans*, PNL-7572, Pacific Northwest Laboratory, Richland, Washington.

Ecology, EPA and DOE-RL, 1992, *Hanford Federal Facility Agreement and Consent Order*, 89-10 Rev. 2, Washington Department of Ecology, Olympia, Washington, U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1993a, *Hanford Federal Facility Agreement and Consent Order Change Requests C-93-04; Redesignation of the 200-ZP-1 and 200-ZP-2 Operable Units and Redefinition of the 200 West Area Groundwater Operable Units*, Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1993b, *Hanford Federal Facility Agreement and Consent Order Change Requests C-93-05: Miscellaneous Underground Tanks*, Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, EPA, and DOE-RL, 1993c, *Hanford Federal Facility Agreement and Consent Order Change Requests M-45-00; Complete Closure of all Single Shell Tank Farms*, Washington State Department of Ecology, Olympia, Washington; U.S. Environmental Protection Agency, Region X, Seattle, Washington, and U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Everette, S.E., J.A. Detamore, M.H. Raudenbush, and R.E. Thieme, 1988, *Comprehensive Implementation Plan for the DOE Defense Buried TRU-Contaminated Waste Program,* DOE/JIO-025, U.S. Department of Energy, Joint Integration Office, Albuquerque, New Mexico.

Gerber, M.S., 1991, *Historical Overview of Wastes Disposed to the Soil Column and to Tanks at the Hanford Site,* Westinghouse Hanford Company, Richland, Washington.

Griffin, T.E., and J.D. Ludowise, 1989, *Recommendations for the Sampling and Decommissioning of Tank 241-CX-72,* Revision 0, WHC- SD-DD-ES-008 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B.M., 1994, *Tank Farm Surveillance and Waste Status Summary Report for October 1993,* WHC-EP-0182-67, Westinghouse Hanford Company, Richland, Washington.

Hanlon, B.M., 1993, *Tank Farm Surveillance and Waste Status Summary Report for May 1993,* WHC-EP-0182-62, Westinghouse Hanford Company, Richland, Washington.

Harlow, D.G., 1974a, *Disposition and Isolation of BXR, TXR, and UR Vault Tanks,* Memo to J.A. Teal, Atlantic Richfield Hanford Company, Richland, Washington.

Harlow, D.G., 1974b, *Disposition and Isolation of Tanks 270-E-1, 241-CS-70, 241-CX-71, and 241-CX-72,* Memo to J.A. Teal, Atlantic Richfield Hanford Company, Richland, Washington.

Hill, R.C.P., and H. Babad, 1991, "High Organic Containing Tanks - Assessing the Hazard Potential", in *Environmental Remediation '91, "Cleaning up the Environment for the 21st Century"*, W. W. Willis, Editor, Proceedings of the ER'91 Conference at Pasco, Washington, September 8-11, 1991, U.S. Department of Energy, Office of Environmental Restoration.

Jensen, D.B., 1990, *Plutonium Finishing Plant Waste-Water Stream Specific Report, Addendum 8,* WHC-EP-0342, Addendum 8, Westinghouse Hanford Company, Richland, Washington.

LaSalle, F.R., and L.P. Morgan, 1990, *Engineering Study - Catch Tanks' Environmental Upgrades for Tank Farms,* WHC-SD- WM-ES-156 Revision 0, Westinghouse Hanford Company, Richland, Washington.

Lockrem, L.L., 1994, *Procedure for 242-A Vessel Vent Vapor Sampling,* LO-080-013, Rev. A-0, Westinghouse Hanford Company, Richland, Washington.

McVey, C.B., 1980, *Isolation of Auxiliary Tank Farm Facilities,* RHO-CD-977, Rockwell Hanford Operations, Richland, Washington.

Neilsen, E.H., 1992, *Miscellaneous Underground Radioactive Waste Tanks,* WHC-EP-0560, Westinghouse Hanford Company, Richland, Washington.

Osborne, J.W., 1992, *Program Plan for the Resolution of Tank Vapor Issues,* WHC-EP-0562, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Prosk, W., and D.A. Smith, 1986, *Single-Shell Tank Isolation Safety Analysis Report,* SD-WM-SAR-006, Rockwell Hanford Operations, Richland, Washington.

Rew, H.E., and A.M. Kion, 1990, *Management Requirements and Procedures,Management Standards,* WHC-CM-1-1 Level 1, Rev. 46, Westinghouse Hanford Company, Richland, Washington.

Ruppert, H.G., and K.R. Heid, 1954, *Summary of Liquid Radioactive Wastes Discharged to the Ground - 200 Areas, July 1952 through June 1954,* HW-33591, General Electric, Richland, Washington.

Rymarz, P.B., and D.R. Speer, 1991, *Summary of Radioactive Underground Tanks Managed by Hanford Restoration Operations,* WHC-SD-DD-TI-057 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Scheele, R.D., L.L. Burger, J.M. Tingey, and S.A. Bryan, 1991, "Ferrocyanide-Containing Waste Tanks: Ferrocyanide Chemistry and Reactivity", in *Environmental Remediation '91, "Cleaning up the Environment for the 21st Century",* W. W. Willis, Editor, Proceedings of the ER'91 Conference at Pasco, Washington, September 8-11, 1991, U.S. Department of Energy, Office of Environmental Restoration.

Stenner, R.D., K.H. Cramer, K.A. Higley, S.J. Jette, D.A. Lamar, T.J. McLaughlin, D.R. Sherwood, and N.E. Van Houten, 1988, *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford,* PNL-6456, Pacific Northwest Laboratory, Richland, Washington.

Subrahmanyam, V.B., 1989, *RadiologicalEvaluation of Hot Semiworks Waste Tank 241-CX-72,* Revision 0, WHC-SD-CP-TI-148, Revision 0, Westinghouse Hanford Company, Analytical Systems Laboratories, Chemical Processing Division, Richland, Washington.

Thomas, J.T., 1978, *Nuclear Safety Guide, TID-7016,* ORNL-NUREG/CSD-6, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Waite, J.L., 1991, *Tank Wastes Discharged Directly to the Soil at the Hanford Site,* WHC-MR-0227, Westinghouse Hanford Company, Richland, Washington.

Welty, R.K., 1988, *Waste Storage Tank Status and Leak Detection Criteria,* SD-WM-TI-356, v.1 and 2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1988, *Radiation Protection,* WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *Environmental Compliance Manual,* WHC-CM-7-5, Westinghouse Hanford Company, Richland, Washington.

Winters, W.I., L. Jensen, L.M. Sasaki, R.L. Weiss, J.F. Keller, A.J. Schmidt, and M.G. Woodruff, 1991, *Waste Characterization Plan For the Hanford Site Single-Shell Tanks,* WHC-EP-0210 Rev. 1, 2, and 3, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A

DATA SHEETS

CONTENTS

CONTENTS (cont.)

CONTENTS (cont.)

FIGURES

DATA SHEET
TANK 241-A-302B

Tank Category:	Catch	Coordinates:	N41250/W47345
Nominal Capacity:	13,500 gallons	Reference:	(Neilsen 1992), (DOE-RL 1993a) (Hanlon 1994)
Arrangement:	Horizontal		
Construction Material:	Steel	Total Waste Volume:	3,600 gallons
Reference Drawings:	H-2-57452, H-2-44501, sheet 69	(DOE-RL 1993a, Reports 3,240 gal. Total)	Current Status: Stabilized and Isolated

History of Operations

Tank 241-A-302B is a horizontally installed catch tank, 30 ft. by 8 ft. dia., with a nominal capacity of 13,500 gallons. This catch tank received waste spillage and leakage from the 241-A-151 and 241-A-152 PUREX diversion boxes, concrete encasements, and the pipe chase connecting the two encasements.

The tank was operated from 1956 to 1980 in support of PUREX operations. It was the subject of an Unusual Occurrence Report (Ruff 1990) in which the tank liquid level was reported to have been fluctuating through most of 1989. After investigation, the fluctuation was attributed to a measurement anomaly. Although the tank was removed from service in 1980, measured tank level from 1980 to 1986 varied from 13.25 inches to 32.75 inches. These changes were attributed to a manual type measuring device shorting out due to a faulty reel housing.

The tank was isolated by project B-138 and the isolation was approved in September, 1985. Although there was liquid remaining in the tank after isolation, the tank was evaluated and the conclusion from the evaluation was that the tank met stabilization criteria. It was declared stabilized in January, 1990.

No data was located from sampling of either the waste sludge or liquid in the tank. If process material leaked into the tank, the tank will be contaminated with PUREX process wastes which contain many chemicals and radionuclides. If there were no leaks or accidents, the tank may contain only dirt and water.

Suspected waste types in the tank could include any of the following (See Appendix B): P, IX, PSS, B, EVAP, HDRL, DSSF, NCPLX, CPLX, and CC.

Potential Safety Issues:

a) Hydrogen Buildup: Low risk because of large void volume (~75%).

b) Ferrocyanide: Low risk because of the small amount of material and relatively high liquid volume.

c) Organic Salts: Moderate risk - Temperature is not monitored but the liquid content indicates that high temperatures do not occur.

d) Flammability: Low risk because tank is out-of-service and isolated.

e) Vapor Emissions: Low risk because tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 40 years old and is subject to corrosion on the inside and the outside. This catch tank was the subject of an unusual occurrence report, however, further evaluation attributed the liquid level changes to the manual type measurements used (Neilsen 1992). Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - Tank content will very likely present a radiological hazard since it was associated with tank farms that received PUREX-generated wastes that contained high concentrations of fission products. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

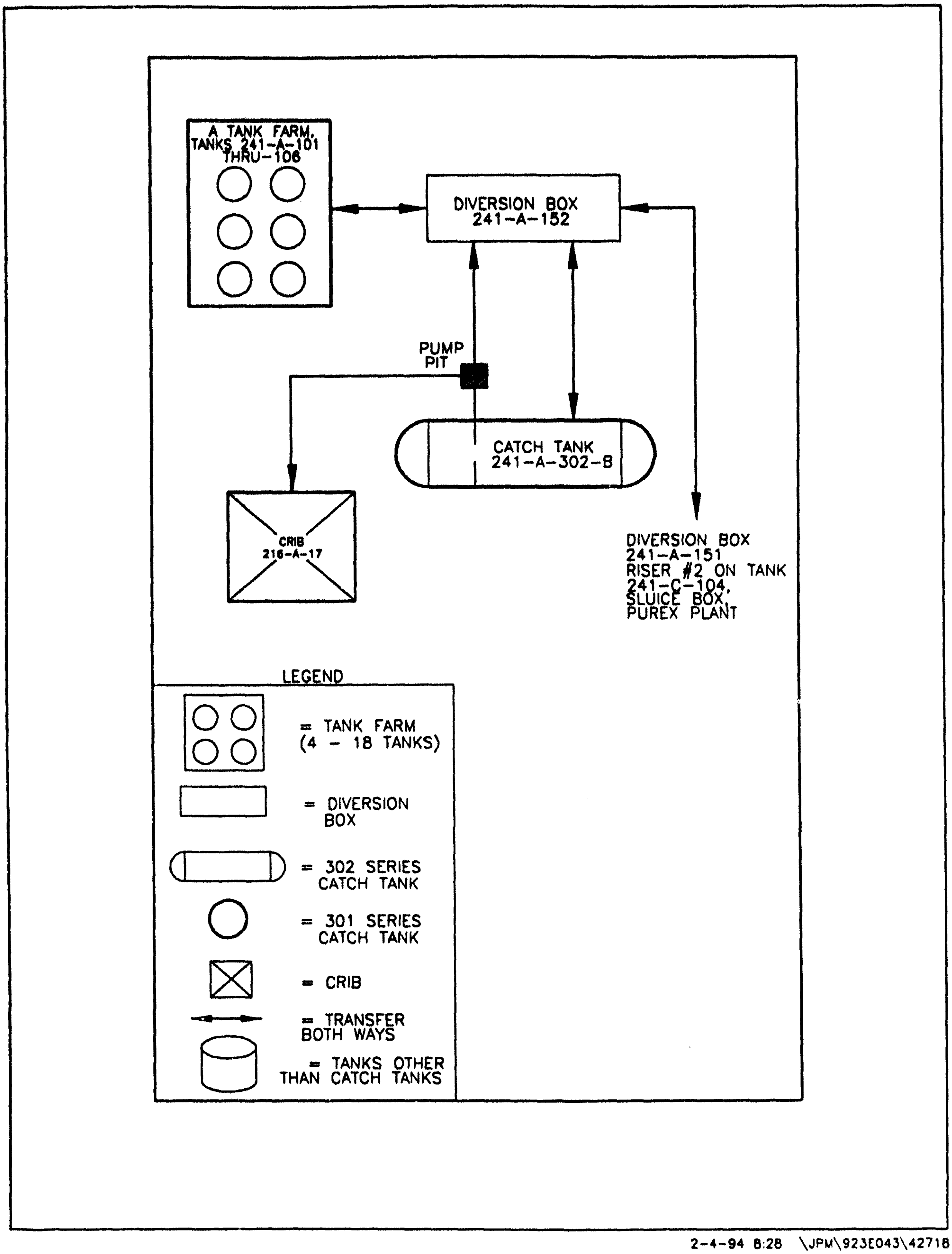

Figure A-1. Flow Diagram, Catch Tank 241-A-302B.

DATA SHEET
TANK 241-B-301

Tank Category:	Catch	Coordinates:	N45439/W52950
Nominal Capacity:	36,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993b)
Arrangement:	Vertical	Sludge Volume:	21,660 gallons
Construction Material:	Steel	Supernatant Volume:	590 gallons
Reference Drawings:	W-72903, H-2-44501 sheet 140	Current Status:	Isolated

Analytical Data for Tank 241-B-301 (Modified from Neilsen 1992)

Sample Number	8409T
Visual	Pale yellow, no solids
OTR, mR	25
pH	8.50
Pu, grams/gallon	$<6.58 \times 10^{-7}$
U, pounds, gallon	1.77×10^{-5}
^{134}Cs, μCi/gallon	88.64
^{137}Cs, μCi/gallon	1.14×10^{4}

Note: Adjusted for decay to April 1, 1992.

History of Operations

This is a vertical, flat-bottom, cylindrical tank measuring 15 ft. 6 in. long by 20 ft. in diameter which received drainage from four diversion boxes: 241-B-151, B-152, B-153 and B-154.

The tank was in operation from 1945 to 1984. No evidence was found of any unusual event relating to this tank during that period; although there was an incident in 1946 associated with diversion box 241-B-154. No waste volume information or analytical data was found from any time after 1974; although, according to further research (Appendix D, page D-19), it is known that samples were taken after that time. B Plant was in operation through the early 1980's, so data obtained before 1984 or 1985 will not be pertinent. A hand-written notation from Project B-231 paperwork was found which indicated a volume of 2695, probably gallons, in the tank.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 2C, 5-6, 224, EB, TBP, HLO, FP, CW, IC, OWW, BL, IX, BNW, DW, LW, N, R, EVAP, NCPLX.

Potential Safety Issues:

a) Hydrogen Buildup: Hydrogen generation is likely. Diffusion from the tank is also likely. As long as the tank is isolated, there should be no ignition source.

b) Ferrocyanide: Low risk

c) Organic Salts: Moderate risk because of waste processing.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emissions: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - Tank contents will very likely present a radiological hazard due to the quantity of sludge containing radionuclides. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

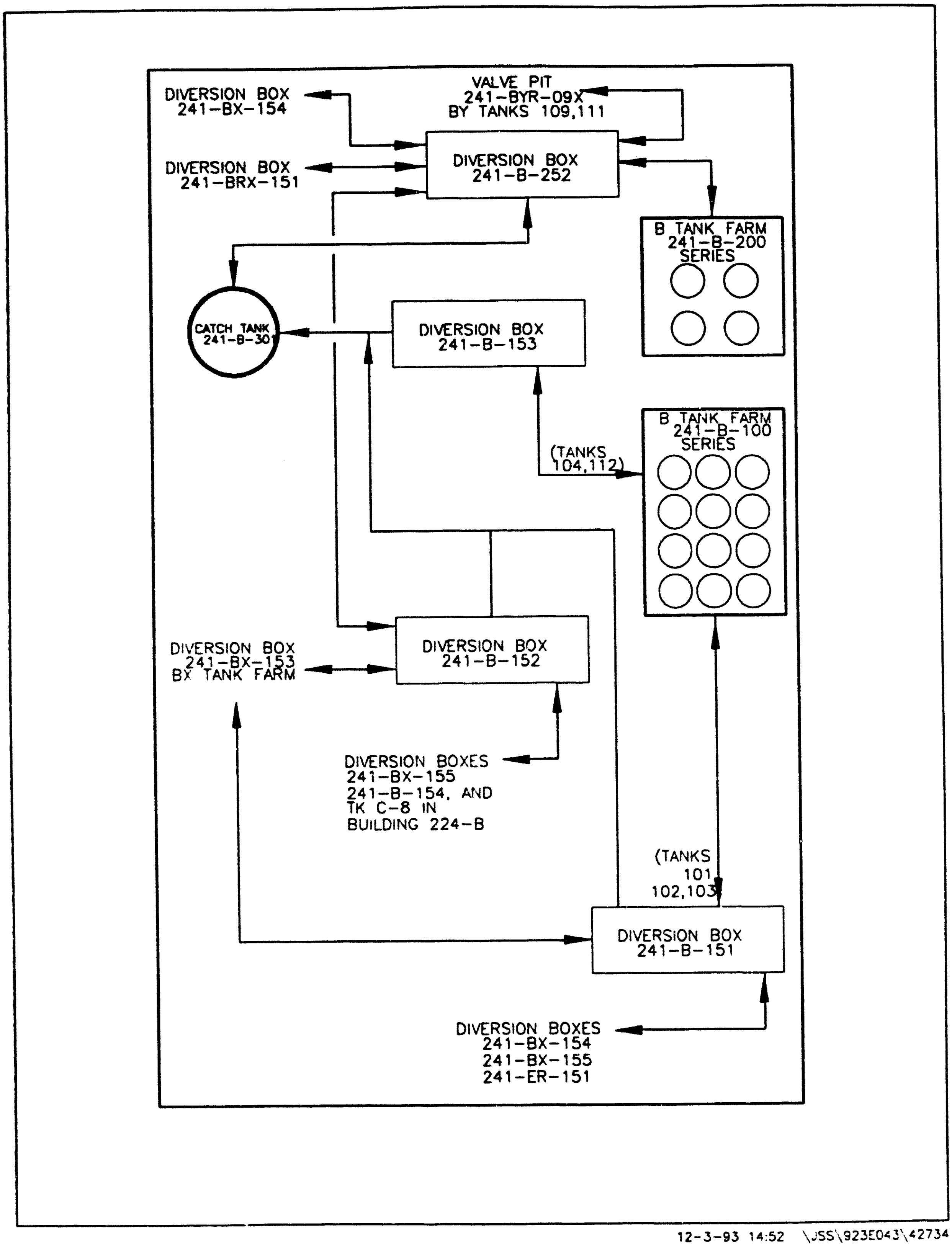

Figure A-2. Flow Diagram, Catch Tank 241-B-301.

DATA SHEET
TANK 241-B-302B

Tank Category:	Catch	Coordinates:	N42568/W52771
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993b)
Arrangement:	Horizontal	Sludge Volume:	690 gallons
Construction Material:	Steel	Supernatant Volume:	4,240 gallons
Reference Drawings:	W-77-092, H-2-44501, sheet 96	Current Status:	Stabilized and isolated

History of Operations:

The 241-B-302B catch tank is a cylindrical tank with a 9 ft. dia. and 35 ft. 9.5 in. length between rounded ends. The nominal capacity of this tank is 17,684 gallons.

The tank operated from 1945 to 1985. It was approved as interim stabilized on May 16, 1985. The stabilization evaluation form lists the solids level at 9 in. (taken in August 1984 by the manual tape method) and the liquid level measured at 35 in. (taken on May 10, 1985 by zip cord method). Using the calibration table for this series of tank (Bendixsen 1982), the solids volume is estimated at 690 gallons and the supernate is estimated at 4,240 gallons.

The supernate volume of 4,240 gallons is less than the 5,000 gallon minimum required for further action (i.e., pumping of liquid to tanker or overland to tank) according to Bell (1984). Therefore, no further action was required on 241-B-302B.

No evidence of any unusual events were found relating to this tank; however, there is an unplanned release associated with a nearby diversion box. The unplanned release UPR-200-E-77 was caused by work on a leaking jumper in the associated diversion box 241-B-154. The release occurred in 1946 and consisted of metal waste solution from B Plant processes. It was estimated that 1 Ci solution of fission products contaminated the ground surrounding the diversion box (DOE-RL 1993b).

Suspected waste types in the tank include any of the following B Plant waste types: B, BFSH, BL, BLEB, CF, DW, EB, IX, MW, SRS, IC, 3C, 5-6.

Potential Safety Issues

a) Hydrogen Buildup: As long as the tank is isolated, there should be no ignition source. There is low probability of risk.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Moderate risk - liquid volume high, but liquid may evaporate with time.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emission: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 50 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (<1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Tank contents present a relatively low radiological hazard due to the small volume of sludge present. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

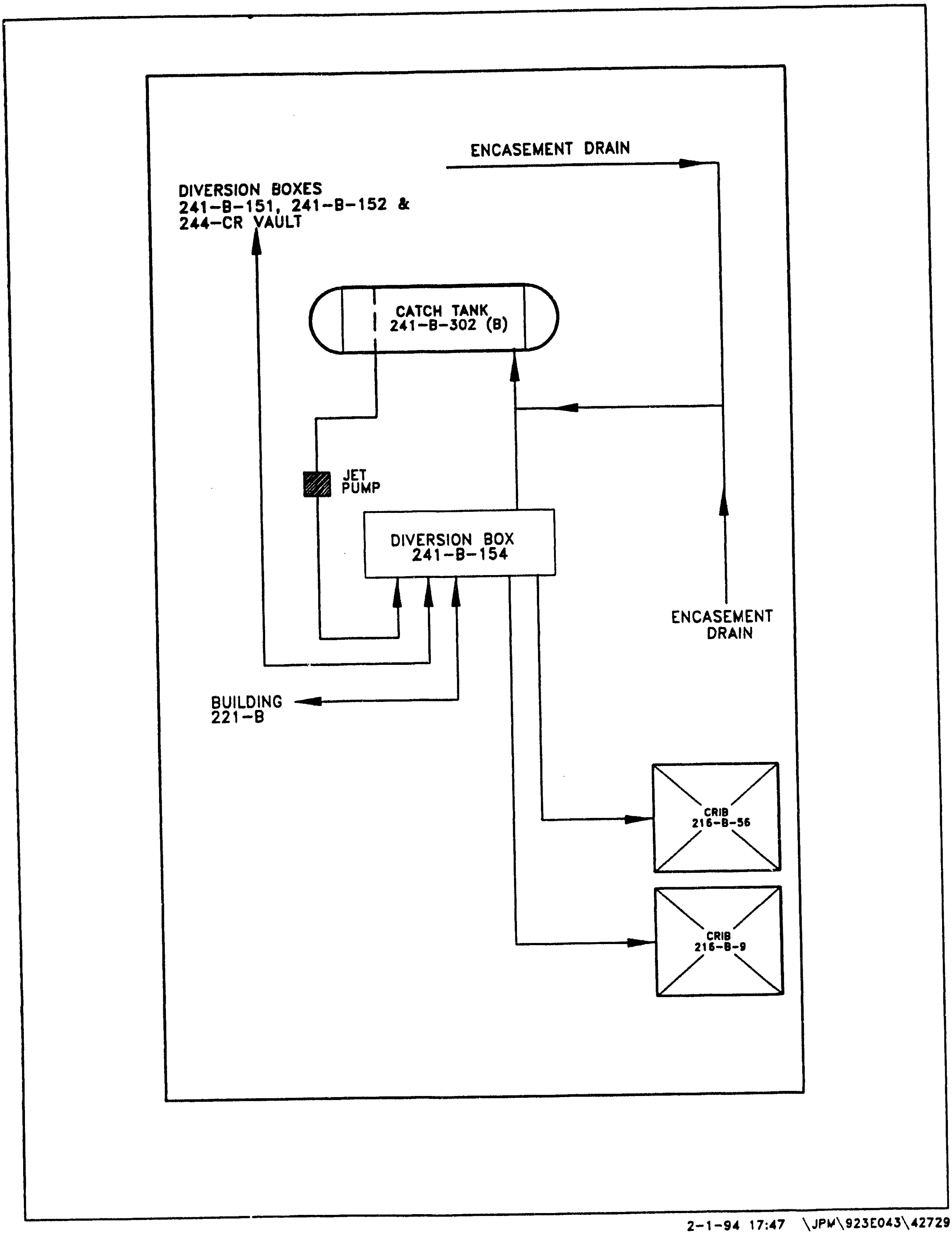

Figure A-3. Flow Diagram, Catch Tank 241-B-302B.

DATA SHEET
TANK 241-BX-302A

Tank Category:	Catch	Coordinates:	N45280/W53186
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993b)
Arrangement:	Horizontal	Sludge Volume:	835 gallons
Construction Material:	ASTM A70 flange grade steel	Supernatant Volume:	0 gallons
Reference Drawings:	W-2-618, H-2-44501, Sheet 140	Current Status:	Stabilized, isolated

History of Operations

Tank 241-BX-302A is a horizontally installed catch tank, 9 ft. in diameter by 36 ft. long between rounded ends. It received drainage from diversion boxes BR-152, BX-153, BYR-152 and BXR-152. The tank was operated from 1948 to 1985.

Analytical data from a 1979 sample is summarized below (WHC 1975-1985). Sample results represent values and activity at the time the results were published (1979) and are reported here only as an indicator of potential characteristics of the wastes managed. There were no unusual events recorded at this location.

Analyses of the Tank Farm Sample #7396, Tank 241-BX-302A:

pH	9.5	NO_2	1.46E-03 M	
Spg	0.98	NO_3	5.33E-03 M	
OH	<0.01 Molar (M)	PO_4	4.66E-03 M	
Al	<3.2E-04 M	SO_4	0.018 M	
Na	<0.08 M	CO_3	0.003 M	
F	<3E-04 M	Total Organic Carbon		0.043 g/L
Cl	3.84E-04 M	% H_2O >99%		
Cs^{137}	94.6 μCi/L (GEA)	VIS-OTR	Clear	0.005 rad/hr.
$Sr^{89/90}$	1.9E+02 μCi/L			
Pu^{147}	<11.2 μCi/L			
$Pu^{239/240}$	6.55E-08 g/L			

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, EB, TBP, CW, IX, OWW, BL, IWW, RIX, R, SIX, DW, BNW, LW, N, PL, EVAP, DSSF, NCDLX, CPLX.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk - No Data

d) Flammability: Low Risk - Isolated

e) Vapor Emission: Low Risk - No Liquid

f) Tank Integrity: Low Risk - The tank is 45 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Low Risk - Tank contents present a low radiological hazard due to the relatively small quantity of sludge containing moderate levels of radioactivity. Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

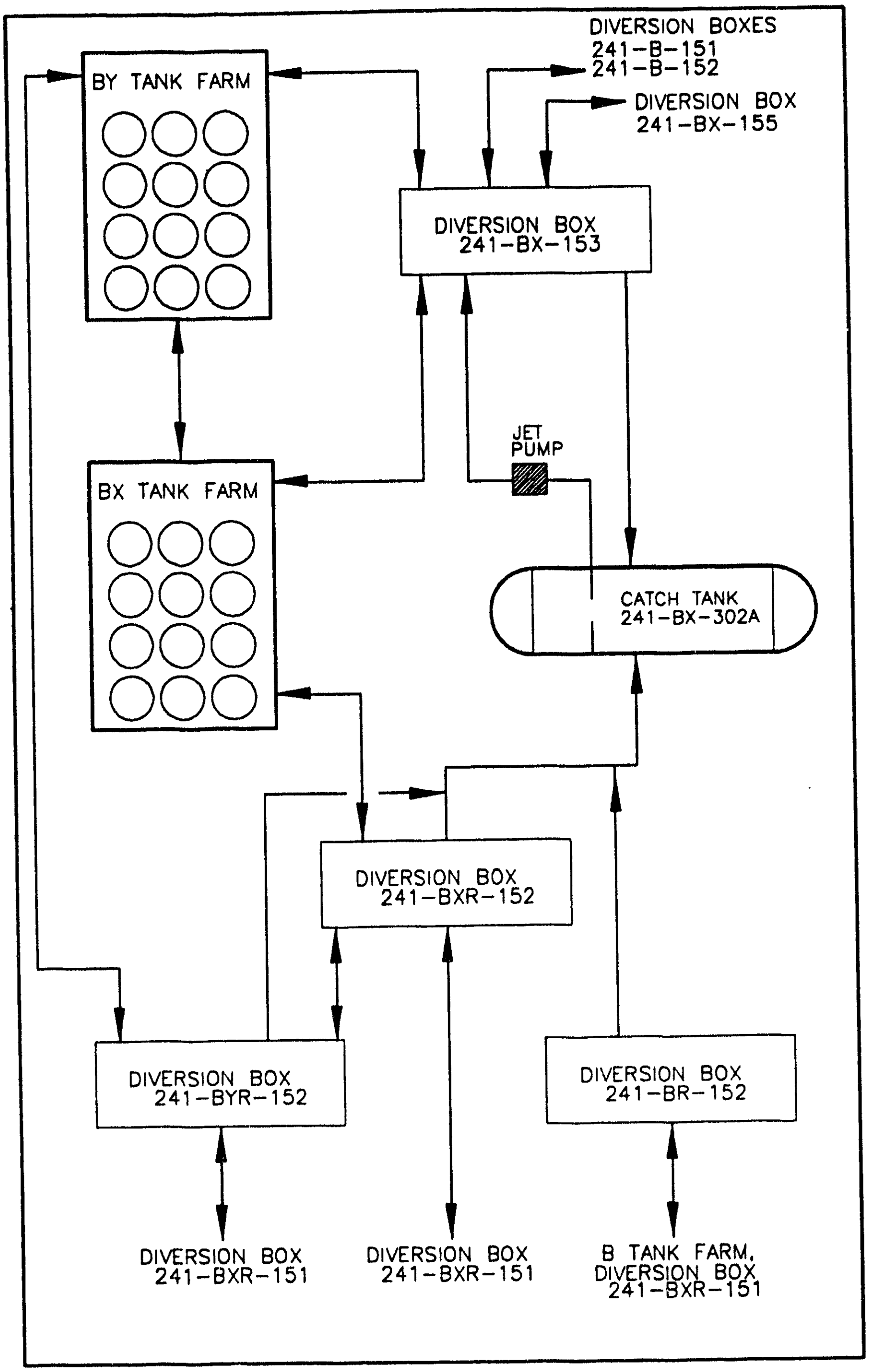

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Figure A-4. Flow Diagram, Catch Tank 241-BX-302A.

DATA SHEET
TANK 241-BX-302B

Tank Category:	Catch	Coordinates:	N42533/W53807
Nominal Capacity:	11,389 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993b)
Arrangement:	Horizontal	Sludge Volume:	950 gallons
Construction Material:	Steel	Supernatant Volume:	94 gallons
Reference Drawings:	H-2-636, H-2-44501, Sheet 97	Current Status:	Stabilized, isolated

History of Operations

Tank 241-BX-302B is installed horizontally and it is 10 ft. in diameter and 18 ft. long. It receives drainage from the BX-154 diversion box. The tank was built in 1946 and was in service from 1948 to 1985. It was isolated in 1985 with a solids level of 17.00 in. and a liquid level of 18.00 in.

No analytical data was found in the records and there were no unusual events recorded at this location.

Suspected waste types in the tank include any of the following B Plant waste types: B, BFSH, BL, BLEB, CF, DW, EB, IX, MW, SRS, 1C, 2C, 5-6.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk - No Data

d) Flammability: Low Risk - Isolated

e) Vapor Emission: Low Risk - No Liquid

f) Tank Integrity: Low Risk - The tank is 45 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical.

Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Tank contents present a low radiological hazard because of the anticipated moderate level of radioactivity contained in the limited sludge quantity. Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

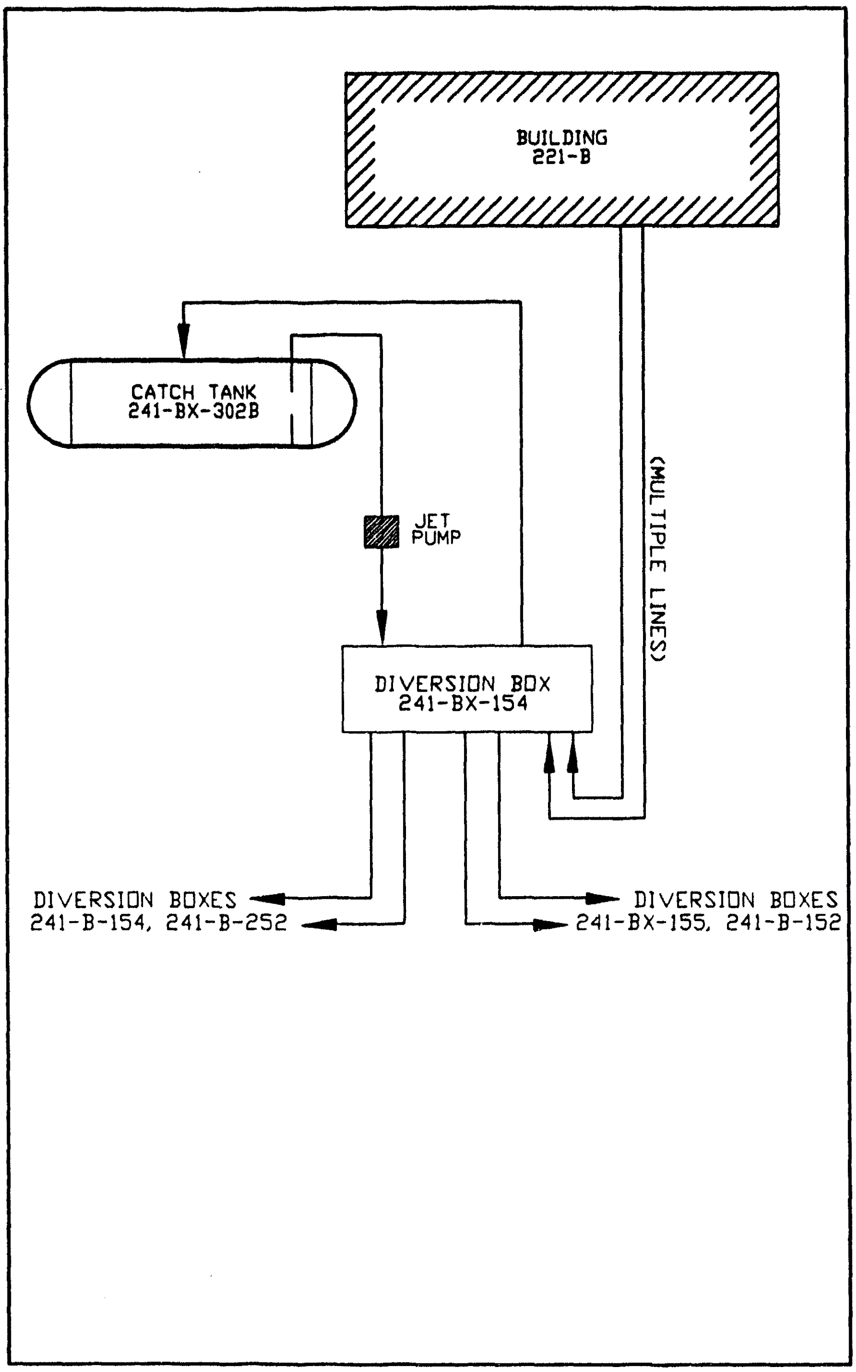

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Figure A-5. Flow Diagram, Catch Tank 241-BX-302B.

DATA SHEET
TANK 241-BX-302C

Tank Category:	Catch	Coordinates:	N44201/W53186
Nominal Capacity:	11,378 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993b)
Arrangement:	Horizontal	Sludge Volume:	635 gallons
Construction Material:	Steel	Supernatant Volume:	228 gallons
Reference Drawings:	H-2-635, H-2-44501, Sheet 118	Current Status:	Stabilized, Isolated

History of Operations

Tank 241-BX-302C is a horizontally installed, cylindrical tank, 10 ft. in diameter and 18 ft. between rounded ends. The nominal capacity of this tank is 11,378 gallons. This tank formerly received drainage from BX-155, now isolated. The catch tank is now isolated with a capped steam addition line and gaskets on three risers. Tank 241-BX-302C was in service from 1948 until 1985. It has been stabilized and isolated but is not currently being monitored. This unit was used for transfer of waste solutions from processing and decontamination operations.

No evidence of any unusual events were found relating to this tank; however, there is an unplanned release associated with diversion box 241-BX-155. This unplanned release (UPR-200-E-78) was caused by pressure testing of lines and jumpers. No date for the UPR has been identified. It is estimated that 10 Ci of fission products contaminated surrounding soil.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, EB, TBP, CS, IX, OWW, BL, IWW, RIX, R, SIX, DW, BNW, LW, N, PL, EVAP, DSSF, NCPLX, CPLX, 2C, 5-6, 224, HLO, FP.

Potential Safety Issues

a) Hydrogen Buildup: Low risk because of the large void volume.

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk - No Data

d) Flammability: Low Risk

e) Vapor Emission: Low Risk

f) Tank Integrity: Low Risk - The tank is 45 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Tank contents present a low radiological hazard due to the moderate level of radioactivity contained in the limited volume of waste present. Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

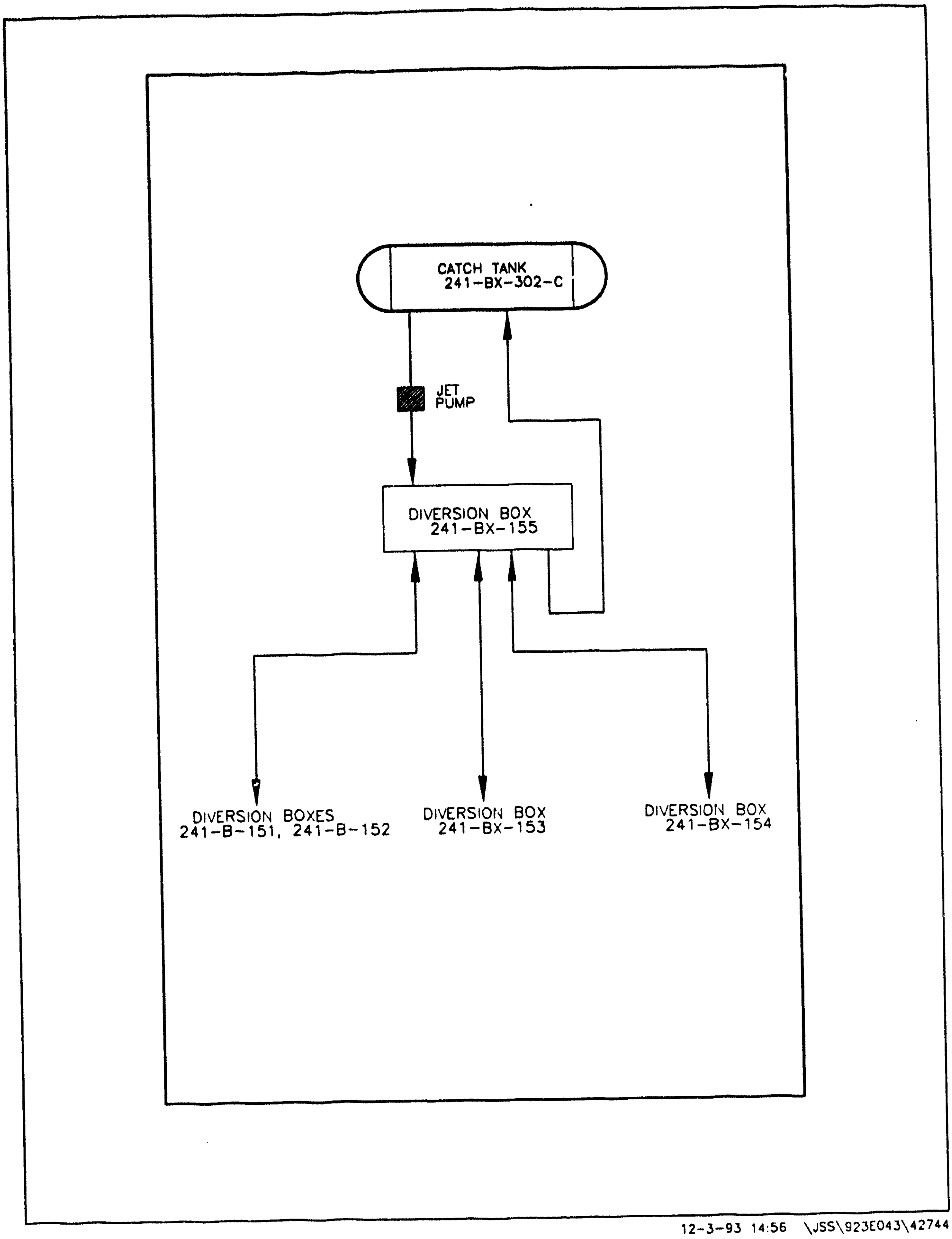

Figure A-6. Flow Diagram, Catch Tank 241-BX-302C.

DATA SHEET
TANK 241-C-301

Tank Category:	Catch	Coordinates:	N43160/W48480
Nominal Capacity:	36,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993a)
Arrangement:	Vertical	Sludge Volume:	9,016 gallons
Construction Material:	Steel	Supernatant Volume: DOE-RL (1993a), reports content of 31,900 gallons of 207-A Retention Basin Condensate	1,470 gallons
Reference	H-2-44501, sheet 92	Current Status:	Isolated

Analytical Data for Tank 241-C-301 (Modified from Neilsen 1992)

Sample Number	8410T
Visual	Clear, yellow, no solids
OTR, mR	130
pH	9.30
Pu, grams/gallon	$<6.58 \times 10^{-7}$
U, pounds/gallon	5.0×10^{-4}
Total β, μCi/gallon	1.7×10^{3}
^{134}Cs, μCi/gallon	1.47×10^{2}
^{137}Cs, μCi/gallon	2.55×10^{4}

Note: Adjusted for decay to April 1, 1992.

History of Operation

This is a vertical, flat-bottom, cylindrical tank with a 19 ft. height and a 20 ft. diameter which received drainage from diversion boxes 241-C-151, C-152, C-153, and C-252. These diversion boxes were associated with waste transfers to and from the C Tank Farm, which received wastes primarily from the B Plant and PUREX facilities and incidental wastes from C Plant facilities (Hot Semiworks).

C-Plant operated as a pilot plant from 1949 to 1983 in support of the REDOX process (1949 - 1954) and later the PUREX process (1954 - 1983). Consequently, wastes in tank 241-C-301 will probably contain material from a wide variety of processes varying considerably over time. Tank 241-C-301 is in a ferrocyanide waste transfer path, so it may have received some ferrocyanides.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, TBP, SSW, CW, OWW, HS, EB, P, FP, HLO, BNW, LW, N, PL, R, BL, IX, PSS, DW, RIX, EVAP, SRS, CPLX, NCPLX.

Potential Safety Issues

a) Hydrogen Buildup: Hydrogen generation is likely but so is diffusion from the tank. The tank is isolated so there is no ignition source.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Moderate risk because of low liquid volume.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emissions: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - Tank contents present a moderate radiological hazard due to the expected radioactivity levels and volume of sludge present. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

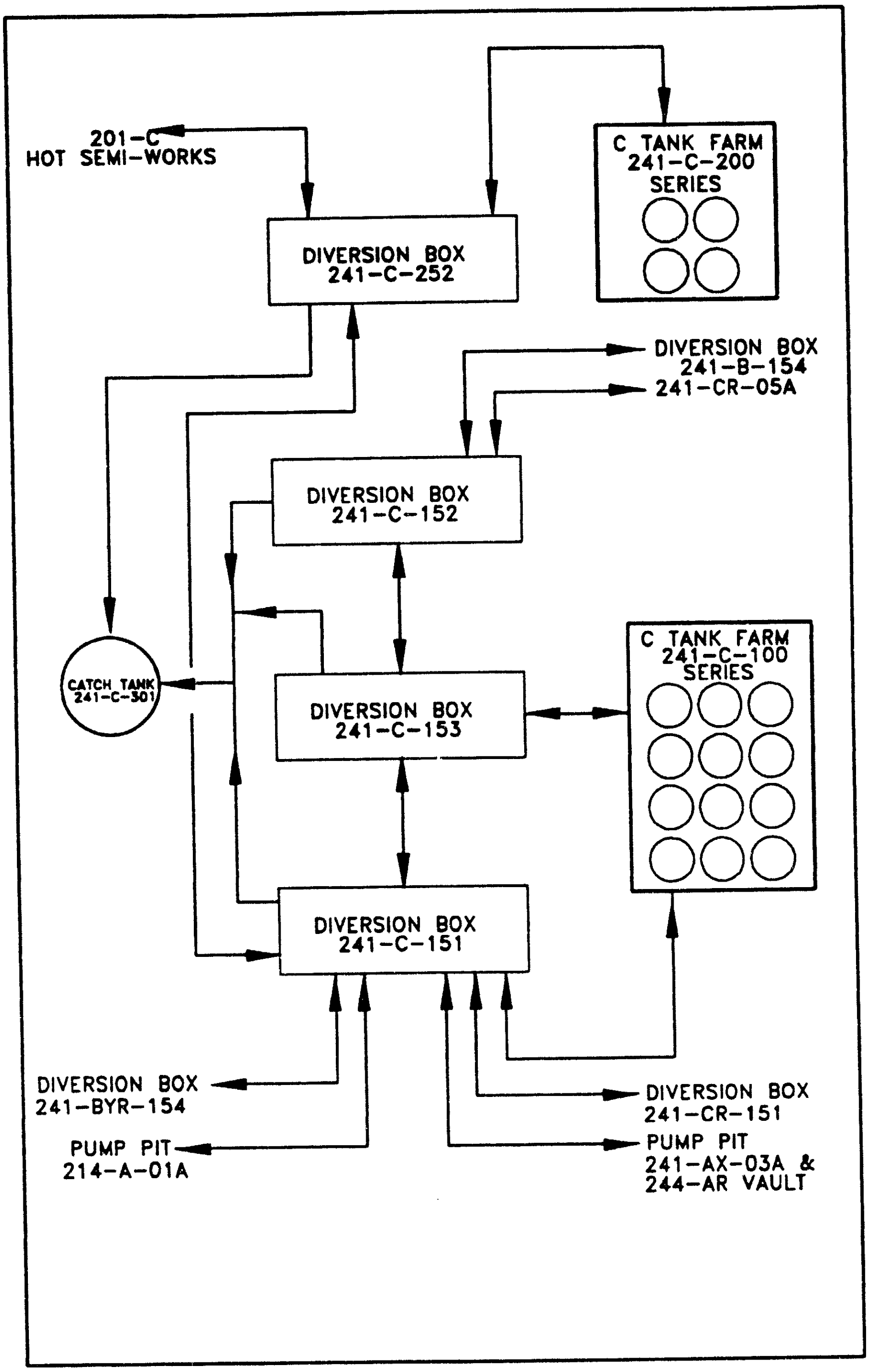

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Figure A-7. Flow Diagram, Catch Tank 241-C-301.

DATA SHEET
TANK 240-S-302

Tank Category:	Catch	Coordinates:	N34700/W73670 (DOE-RL 1992a)
Nominal Capacity:	17,684 gallons	Reference:	(Hanlon 1994)
Arrangement:	Horizontal	Total Waste Volume: DOE-RL (1992a), reports a content of 2,380 gallons of waste	2,276 gallons (100 gallons of interstitial liquid)
Construction Material:	Steel		
Reference Drawings:	H-2-5211, H-2-44511, sheet 28	Current Status:	Isolated Monitored

History of Operations

Catch tank 240-S-302 is a 9 ft. diameter by 36 ft. long, horizontal cylindrical tank having standard dished ends.

Although this tank leaks, the volume of sludge and supernatant should be close to the recorded volumes since most liquid has been pumped from the tank and it has been isolated.

The tank was in service throughout the period when S-Plant was operating or from 1950 to 1987 and functioned primarily to receive leakage, spillage, line flushes, and drainage associated with waste transfers through diversion box 240-S-151. These waste transfers were associated with the T and S Tank Farms, Building 202-S and certain cribs and sumps (see the attached flow diagram).

In 1977, evidence indicated that the tank was probably leaking. Again in 1985, data indicated a leak. Subsequent investigations resulted in a confirmation of its status as a leaker in April 1987.

Suspected waste types in the tank could include any of the following (See Appendix B): R, CW, EB, BNW, DW, N, B, BL, IX, LW, RIX, 224, TL, EVAP, HDRL, DSSF, NCPLX, PNF.

Potential Safety Issues

a) Hydrogen Buildup: The relatively small volume of waste in this tank will reduce the quantity of hydrogen gas which could be generated.

b) Ferrocyanide: There is a lower potential for ferrocyanide contamination in this tank than in many of the others.

c) Organic Salts: Moderate risk because of low liquid volume.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emissions: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: High Risk - This tank is a confirmed leaker.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (<1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

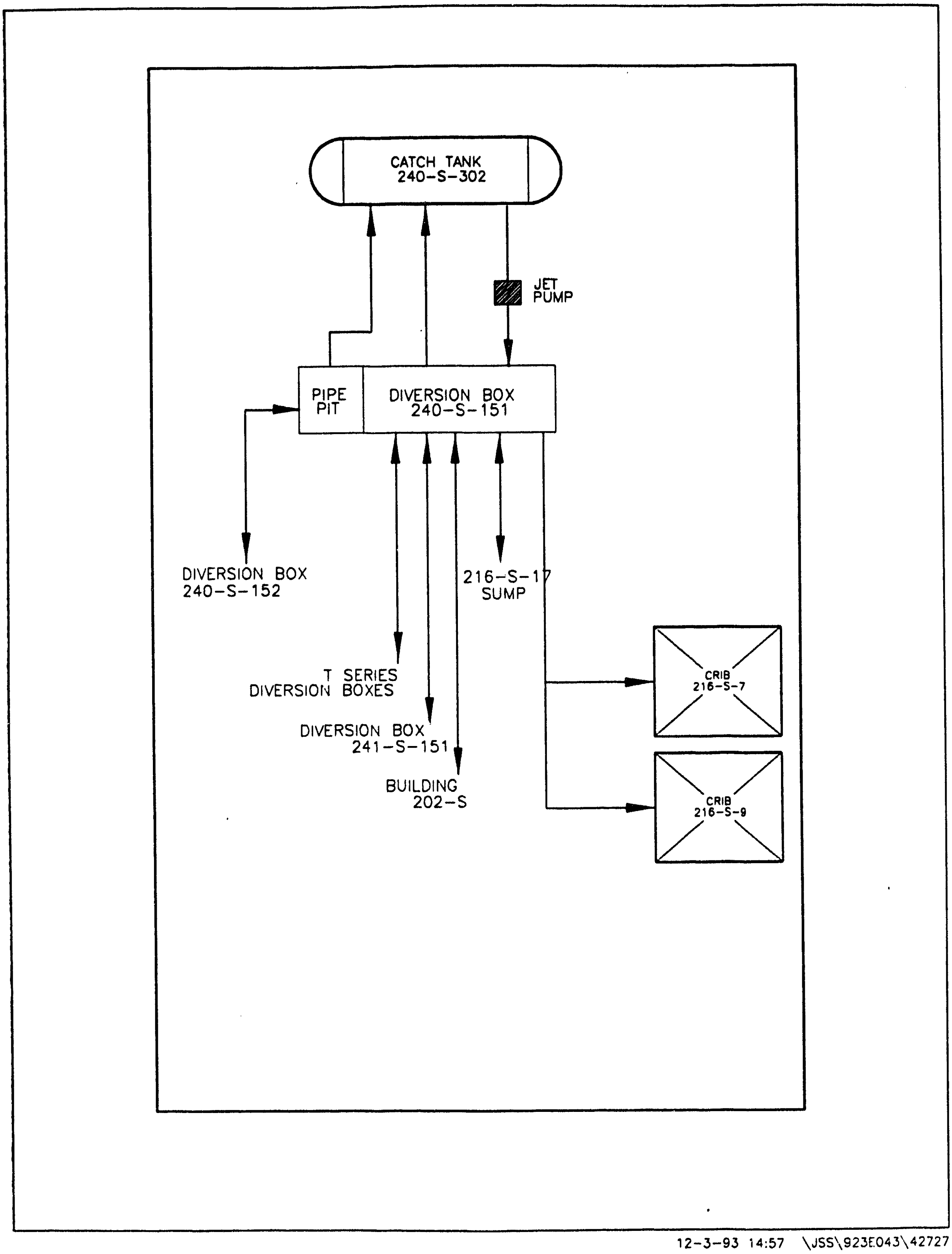

Figure A-8. Flow Diagram, Catch Tank 240-S-302.

DATA SHEET
TANK 241-S-302A

Tank Category:	Catch	Coordinates:	N35670/W75360 (DOE-RL 1992a)
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992), (Hanlon 1994), (DOE-RL 1992a)
Arrangement:	Horizontal	Total Waste Volume: DOE-RL (1992a), reports a content of 54 gallons of waste, and unspecified volume of grout	5,130 gallons
Construction Material:	Steel		
Reference Drawings:	H-2-1795, H-2-44571, sheet 38	Current Status:	Isolated

History of Operations

Tank 241-S-302A is a cylindrical tank, 35 ft. 9.5 in. in length, with a 8 ft. 10 7/8 in. diameter.

The tank was installed in 1949 in association with the 241-S-151 and 241-SX-151 diversion boxes, receiving spills, leakage, line flushes, and drainage associated with waste transfers through these diversion boxes and encasements. Wastes characteristic of the S, SX, and U Tank Farms, and the 222-S laboratory are expected to be present in the catch tank.

It was replaced in October of 1991 with tank 241-S-304 because it had been found to leak and efforts to repair it failed. The tank was in operation from 1949 to 1991. Sources of effluents to the tank have included the 222-S Laboratory, T Plant Decontamination Facility, Z Plant, and 102-SY and 244-TX tanks.

Liquid level fluctuations were observed in this tank from as early as 1977 until 1990 when it was determined that the tank was definitely leaking. An effort in early 1991 to seal the tank with grout was not successful and the tank was replaced later that year. The tank now contains grout and waste.

Suspected waste types in the tank could include any of the following (See Appendix B): R, CW, EB, BNW, DW, N, B, BL, IX, LW, RIX, 224, TL, EVAP, HDRL, DSSF, NCPLX, PNF.

Potential Safety Issues

a) Hydrogen Buildup: There is a leak in the tank. It is unlikely that hydrogen will accumulate.

b) Ferrocyanide: The sand and grout in this tank should lower the risk.

c) Organic Salts: Moderate Risk.

d) Flammability: Low risk because of grout.

e) Vapor Emissions: Low risk because of leak and grout.

f) Tank Integrity: High Risk - This tank is a confirmed leaker.

g) Criticality Safety: Low Risk - Grout reduces risk of hazard.

h) Radiological Hazard: Moderate Risk - Tank contents present a moderate radiological hazard due to high sludge content and the level of radioactivity present. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

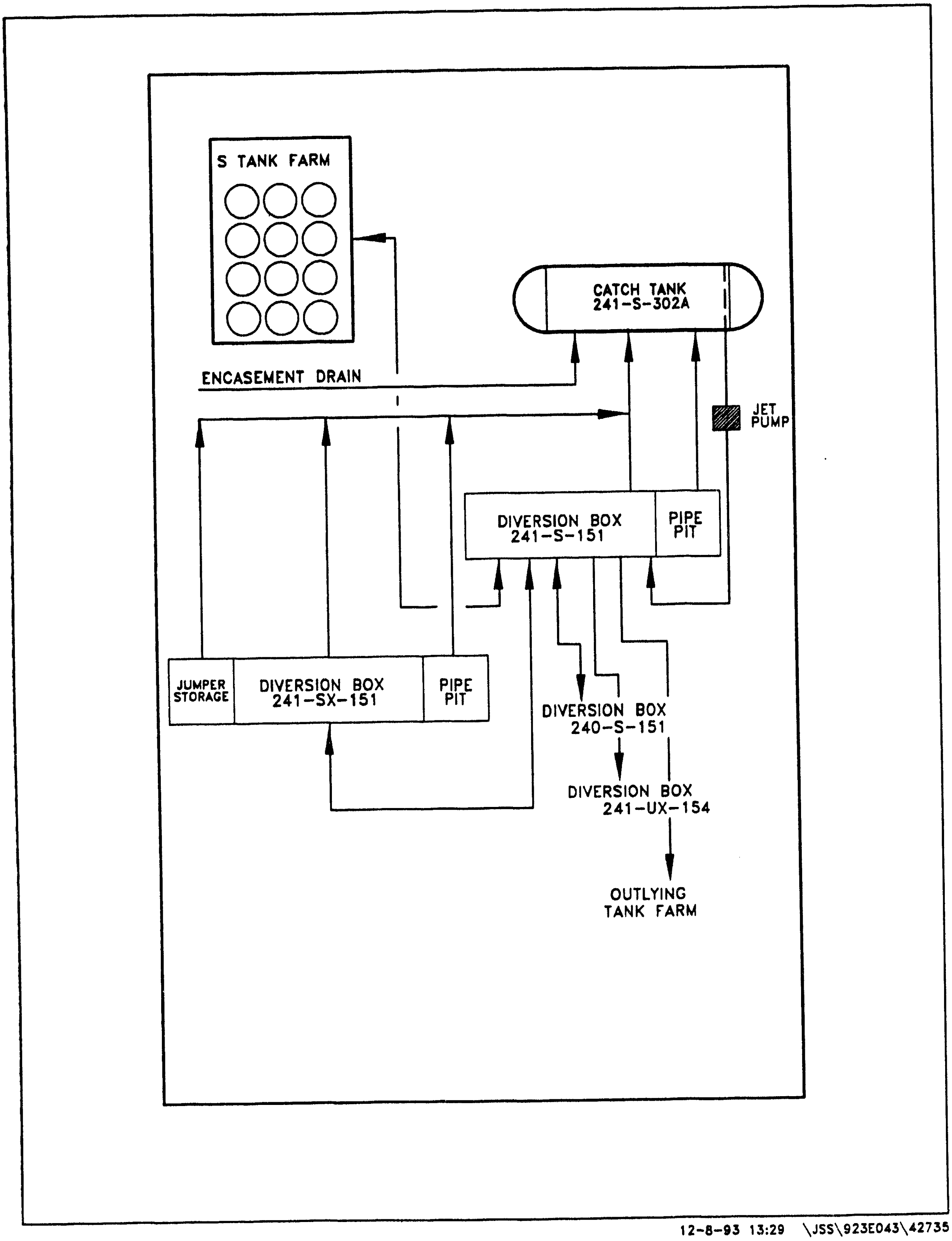

Figure A-9. Flow Diagram, Catch Tank 241-S-302A.

DATA SHEET
TANK 241-S-302B

Tank Category:	Catch	Coordinates:	N36265/W75540
Nominal Capacity:	14,314 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992a)
Arrangement:	Horizontal	Sludge Volume:	0 gallons
Construction Material:	Steel	Supernatant Volume: DOE-RL (1992a), reports a content of 3,240 gallons of waste.	0 gallons
Reference Drawings:	H-2-1820, H-2-44511, sheet 48	Current Status:	Isolated, Stabilized

History of Operations

Tank 241-S-302B is a horizontal, cylindrical tank, 9 ft. in diameter and 32 ft. 4 in. between rounded ends.

The tank operated from 1952 through 1985 in association with encasement drains for lines connecting the S Tank Farm and diversion box 241-S-151. As such, it historically is expected to have received the kinds of wastes found in the S Tank Farm.

The tank has since been isolated and stabilized, and the stabilization evaluation form states that the tank is now empty. A Waste Information Data System summary sheet from 1991 indicates the tank contains 3240 gallons of waste (DOE-RL 1992a). In 1993, tank contents are listed as unknown. It is considered highly likely that the tank is now empty.

Potential Safety Issues

Not Applicable. The tank is empty.

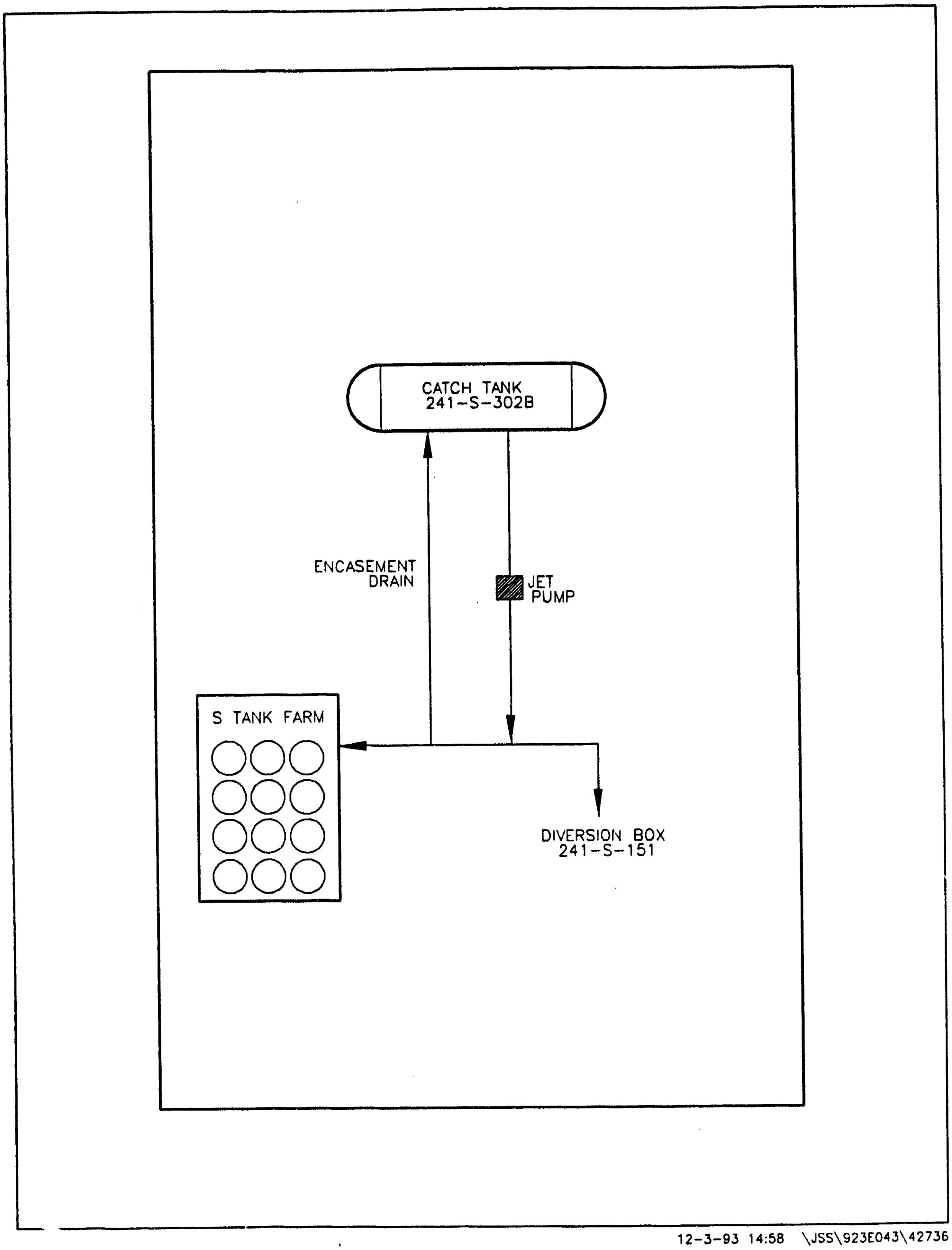

Figure A-10. Flow Diagram, Catch Tank 241-S-302 B.

DATA SHEET
TANK 241-SX-302

Tank Category:	Catch	Coordinates:	N35570/W75585
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992a)
Arrangement:	Horizontal	Sludge Volume:	1,050 gallons
Construction Material:	Steel	Supernatant Volume:	305 gallons
Reference Drawings:	H-2-39537, H-2-44511, sheet 38	Current Status:	Isolated

History of Operations

Tank 241-SX-302 is a horizontal, cylindrical tank, 9 ft. in diameter and 35 ft. 9.5 in. in length between rounded ends. The tank operated from 1954 to 1983. Drains to the catch tank originate from the 241-SX-151 diversion box, 241-SX-152 transfer box, the SX farm encasement and Line 456. All of these sources are isolated. The tank was stabilized at the end of 1984. Liquid and sludge values were obtained at that time.

Suspected waste types in the tank could include any of the following (See Appendix B): R, HLO, EB, CW, OWW, RIX, BNW, DW, LW, BL, IX, TL, B, EVAP, PL, PSS, 224, PNF, CPLX, DSSF, NCPLX.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk - As long as the tank is isolated, there should be no ignition source. There is low probability of risk.

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk - Liquid may evaporate with time.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emission: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Tank contents present a low radiological hazard because the moderate level of radioactivity is limited to a small volume of sludge. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

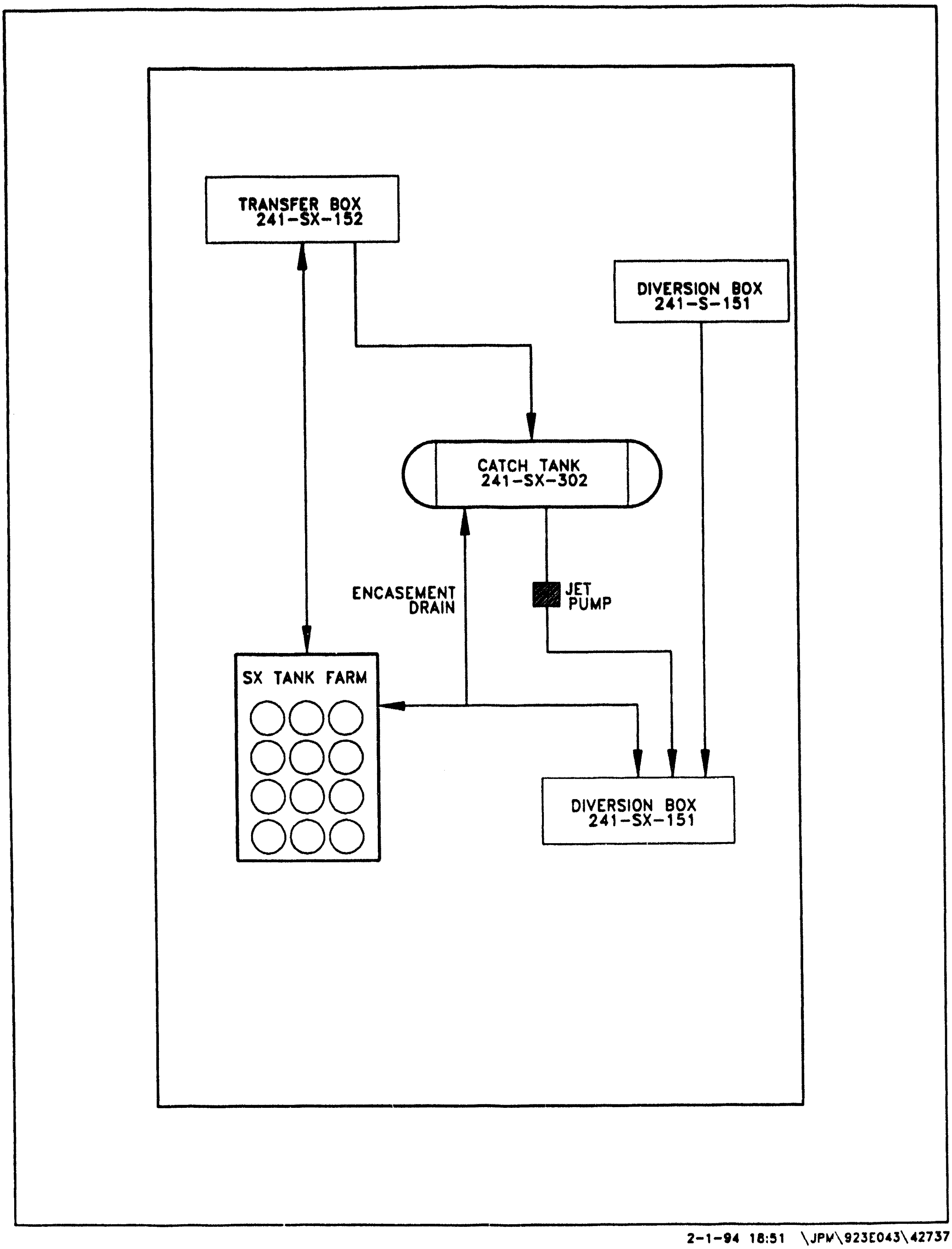

Figure A-11. Flow Diagram, Catch Tank 241-SX-302.

DATA SHEET
TANK 241-T-301B

Tank Category:	Catch	Coordinates:	N43232/W75837
Nominal Capacity:	36,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 199b)
Arrangement:	Vertical	Sludge Volume:	21,658 gallons
Construction Material:	Steel	Supernatant Volume:	588 gallons
Reference Drawings:	W-72903, H-2-44511, sheet 134	Current Status:	Stabilized, isolated

Analytical Data for Tank 241-T-301B (Modified from Neilsen 1992)

Sample Number	8497T
Visual	Clear, Yellow, no solids
OTR (mR)	50
pH	8.70
Pu, grams/gallon	$<6.58 \times 10^{-7}$
U, pounds/gallon	6.08×10^{-5}
Total β, μCi/gallon	3.04×10^{2}
^{134}Cs, μCi/gallon	13.47
^{137}Cs, μCi/gallon	1.6×10^{3}
^{106}Ru, μCi/gallon	5.94×10^{3}

Note: Activity has been adjusted for decay to April 1, 1992.

History of Operations

This is a vertical, flat bottom tank constructed of reinforced concrete, 20 ft. in diameter and 19 ft. high. The tank collected overflow from diversion boxes from 1944 to 1983, and served to collect spills, leaks, line flushes, and drainage associated with waste transfers in the vicinity of T Plant and the T Tank Farm (DOE-RL 1992b). T Plant operations included plutonium recovery, decontamination and experimental work so the tank may contain a wide variety of waste products. This catch tank may have received ferrocyanides as it is on a historical ferrocyanide transfer route.

The tank received drainage from four diversion boxes: 241-T-151, T-152, T-153 and T-252. All of these boxes have been sealed and isolated. Tank 241-T-301B was interim isolated in July 1985, and it is considered to be stabilized because it contains less than 5,000 gallons of supernate.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, 2C, TBP, 224, EB, CW, HLO, BNW, DW, BL, IX, R, RIX, EVAP, NCPLX.

Analytical data is available from 1974 but many changes in tank contents could have occurred between 1974 and 1985.

Potential Safety Issues

a) Hydrogen Buildup: Although the specific processes generating hydrogen in waste tanks are unknown, radioactive disintegration in any hydrogen containing medium will probably result in some generation of hydrogen gas. As long as the tank is isolated there should be no ignition source so the risk of fire or explosion should be low.

b) Ferrocyanide: Low Risk - Located on the ferrocyanide transfer route.

c) Organic Salts: Moderate risk because of lack of data.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emission: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is almost 50 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - The large sludge volume with anticipated significant concentrations of fission products represents a moderate radiological hazard. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

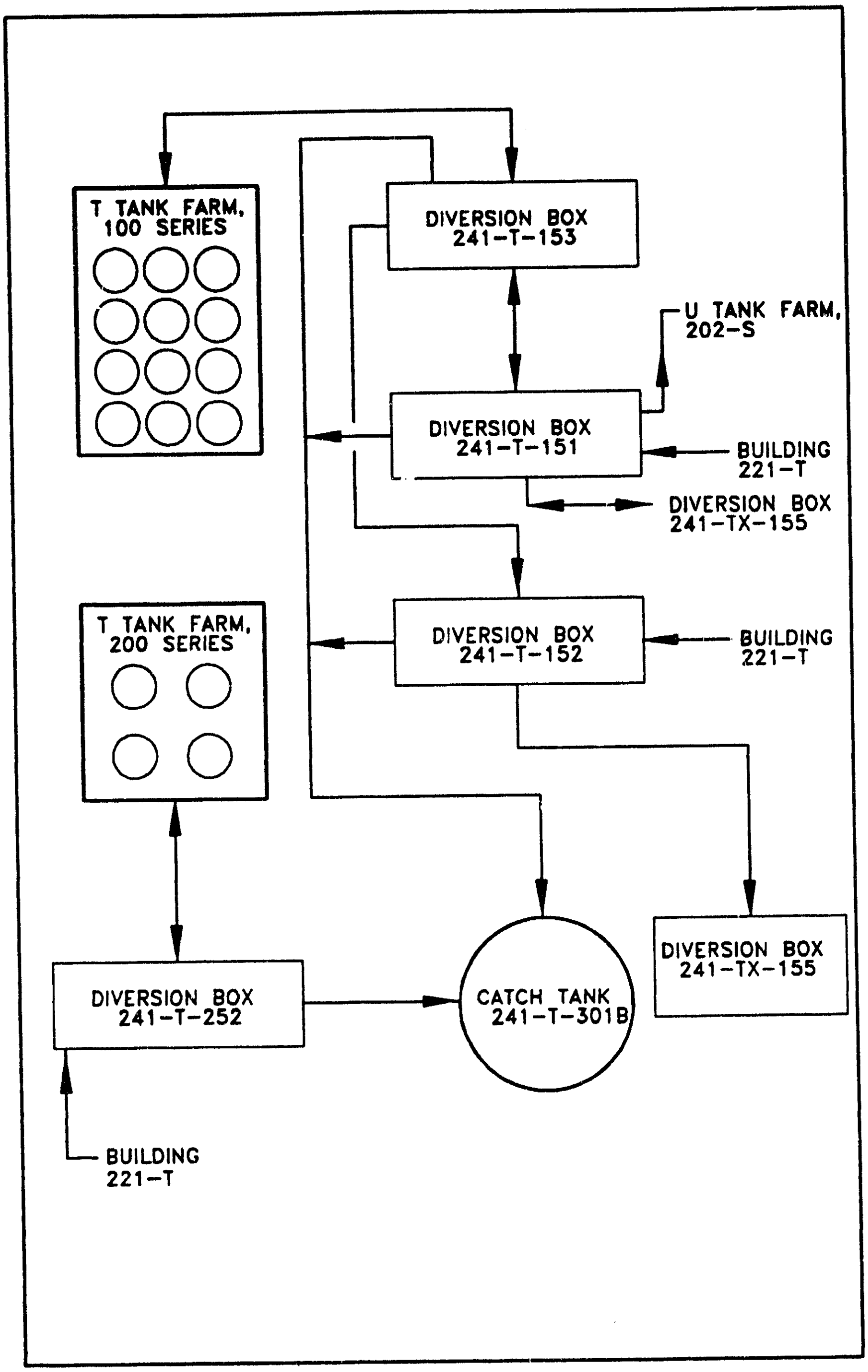

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Figure A-12. Flow Diagram, Catch Tank 241-T-301B.

DATA SHEET
TANK 241-TX-302A

Tank Category:	Catch	Coordinates:	N41570/W75640
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992b)
Arrangement:	Horizontal	Sludge Volume:	2,450 gallons
Construction Material:	Steel	Supernatant Volume:	30 gallons
Reference Drawings	H-2-828 H-2-44511, Sheet 110	Current Status:	Stabilized, isolated

History of Operations

Catch tank 241-TX-302A is a horizontal, cylindrical tank, 9 ft. in diameter and 35 ft. 9.5 in. between rounded ends. Nominal capacity of this tank is 17,684 gallons. This tank received drainage primarily from diversion box 241-TX-153, and associated encasements. The diversion box, catch tank, and encasement are all isolated. Isolation of 241-TX-302A includes gaskets on three risers and capping of the 1-inch steam addition riser.

This tank operated from 1949 to 1982. It was used to accept any spills, leaks, line flushes, and drainage of wastes from processing and decontamination operations (DOE-RL 1992b). Tank 241-TX-302A was approved as interim stabilized on December 4, 1984, and is both isolated and stabilized; however, it is not monitored. The stabilization evaluation form lists the solids level at 21.4 in. (measured in September, 1984 by doughnut method), and the liquid level at 21.5 in. (measured in September, 1984 by manual tape method). Using the calibration table for this tank series, the solids volume is estimated at 2,450 gallons; the supernate volume is estimated at less than 30 gallons. Due to the fact that the supernate volume is below the 400 gallon minimum for tank truck transfer and also below the 5,000 gallon minimum for overland transfer, no further actions were taken on this tank. The waste category is mixed and the type is liquid. This unit was used for transfer of waste solutions from processing and decontamination operations.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, TBP, EB, R, CW, OWW, RIX, SIX, IX, BL, BNW, DW, LW, N, PL, B, EVAP, CPLX, NCPLX, PNF. The following results of analysis of a sample from the 241-TX-302A tank was located in the 222-S Laboratory "Process Aides" files. The results are presented as reported on the 2/5/79, DSI for sample #7062 & T2137 (WHC 1975-1985):

GEA	1.270E+04	
VIS-OT	yellow Brn	2.00E-2 (10 mrad) RA0
Sol.	<10 (<2%)	
SpG	1.050	
OH~	(3.72E10-2 M)	

$^{89-90}Sr$	4.540E+02 μCi/gal
^{137}Cs	4.81E+01 μCi/gal
NO_2	(2.1×10^{-2} M)
NO_3	(1.29×10^{-1} M)

Potential Safety Issues

a) Hydrogen Buildup: Low risk because of the large void volume.

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk - No Data

d) Flammability: Low Risk

e) Vapor Emissions: Low Risk

f) Tank Integrity: High Risk - This tank leaks.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

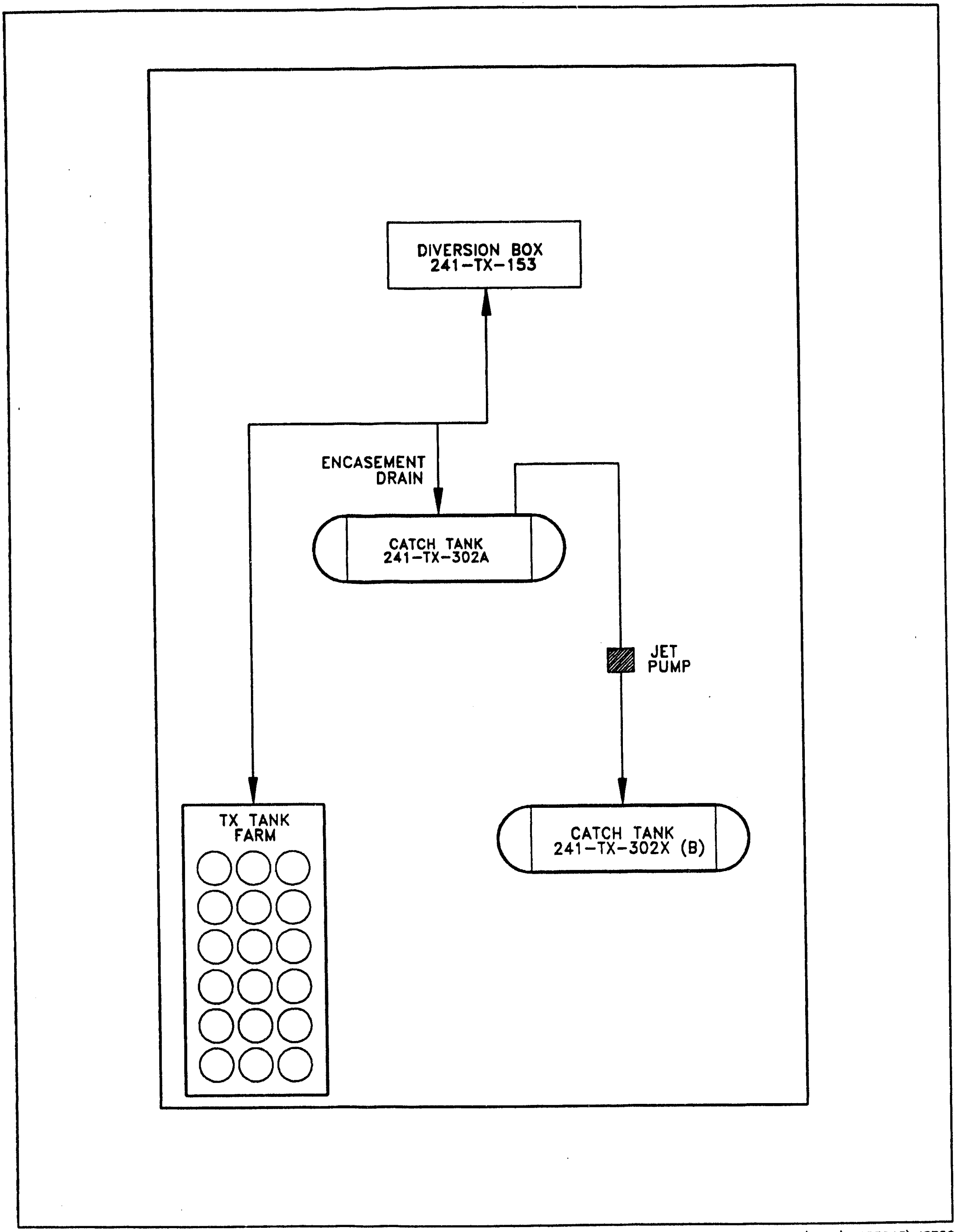

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Figure A-13. Flow Diagram, Catch Tanks 241-TX-302A, 241-TX-302XB.

DATA SHEET
TANK 241-TX-302BR

Tank Category:	Catch	Coordinates:	N41474/W74754
Nominal Capacity:	12,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992b)
Arrangement:	Horizontal	Sludge Volume:	No Data
Construction Material:	Steel	Supernatant Volume:	No Data
Reference Drawings	H-2-2536	Current Status:	Stabilized, isolated

History of Operations

241-TX-302BR was installed in the early 1950's to replace the original 241-TX-302B tank. These tanks were designed to receive drainage from diversion box 241-TX-155. However, the tank sustained acid damage and was replaced by 241-TX-302B about 1954. It was in operation from 1950 to 1954 and was isolated in 1954. Ferrocyanide may be present in this tank since it is on the ferrocyanide waste transfer route.

No analytical data was located for the waste in this tank.

An unplanned release, UPR-200-W-131, occurred in 1953 and resulted from leaky jumpers in diversion box 241-TX-155. An area 5 feet in diameter was contaminated around the diversion box (DOE-RL 1992b). The waste type involved was not identified; however, as the associated process mission was $BiPO_4$, the waste had to be either MW, 1C, or 2C. This release may impact tank 241-TX-302BR, as it is present in the vicinity of this diversion box.

Suspected waste types in the tank could include any of the following (See Appendix B): MW, 1C, 2C, TBP, 224, EB.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk

b) Ferrocyanide: Low Risk.

c) Organic Salts: Moderate Risk

d) Flammability: Low Risk

e) Vapor Emissions: Low Risk

f) Tank Integrity: This tank is a replacement for the original tank 241-TX-302B which was also damaged. The tank was taken out of service because it was damaged by acid. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - A moderate level of risk is assumed because of the waste volume present in the tank is unknown and that radiologically contaminated soils may be present in the vicinity of the tank. Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

*Note: Flow diagram provided with tank 241-TX-302B (page A-43).

DATA SHEET
TANK 241-TX-302B

Tank Category:	Catch	Coordinates:	N41474/W74754
Nominal Capacity:	17,684	Reference:	(Neilsen 1992), (Hanlon 1994)
Arrangement:	Horizontal	Total Waste Volume:	1,320 gallons
Construction Material:	Steel	Current Status:	Stabilized, isolated
Reference Drawings:	H-2-536, H-2-44511, Sheet 109		

History of Operations

Catch tank 241-TX-302B is a horizontal, cylindrical tank, 9 feet in diameter and 35 feet 9 inches between rounded ends. Nominal capacity of this tank is 17,684 gallons. This catch was installed in early 1954 as a replacement tank for 241-TX-302BR which was damaged by acid. This tank received drainage from diversion box 241-TX-155. Currently both tanks remain in original locations. Tank 241-TX-302B has been stabilized and isolated. Ferrocyanide may be present in this tank since it was on the ferrocyanide waste transfer route.

Unplanned release UPR-200-W-131 may impact this catch tank. See the data sheet for Tank 241-TX-302BR.

Suspected waste types in the tank include any of the following (See Appendix B): MW, R, CW, OWW, RIX, SIX, IX, BL, BNW, DW, LW, N, PL, B, EVAP, CPLX, NCPL, PNF, 1C, 2C, TBP, 224, EB, HLO.

The following analytical results from analysis of a sample from tank 241-TX-302B were found during a search of the 222-S Laboratory "Process Aids" files. The results are presented here just as recorded in the "Process Aids" files, Sample #T2138 reported 3/6/84 (WHC 1975-1985).

BRT yellow
<5% wt solids
0.025 rad (24 mR)
NO_2 $5.79x10^{-2}$ M
NO_3 $7.08x10^{-2}$ M
pH 9.95
OH~ $4.28x10^{-2}$ M

Potential Safety Issues

a) Hydrogen Buildup: Low risk because of the large void volume.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Moderate Risk

d) Flammability: Low risk because tank is out of service and isolated.

e) Vapor Emissions: Low risk because the tank is out of service and isolated.

f) Tank Integrity: Low Risk - No leak data in available records, however, this tank is a replacement for a tank that received acid damage.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239} Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239} Pu.

h) Radiological Hazard: Moderate Risk - This level of risk is assigned because of the possibility of contaminated soil present as a result of UPR-200-W-131.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

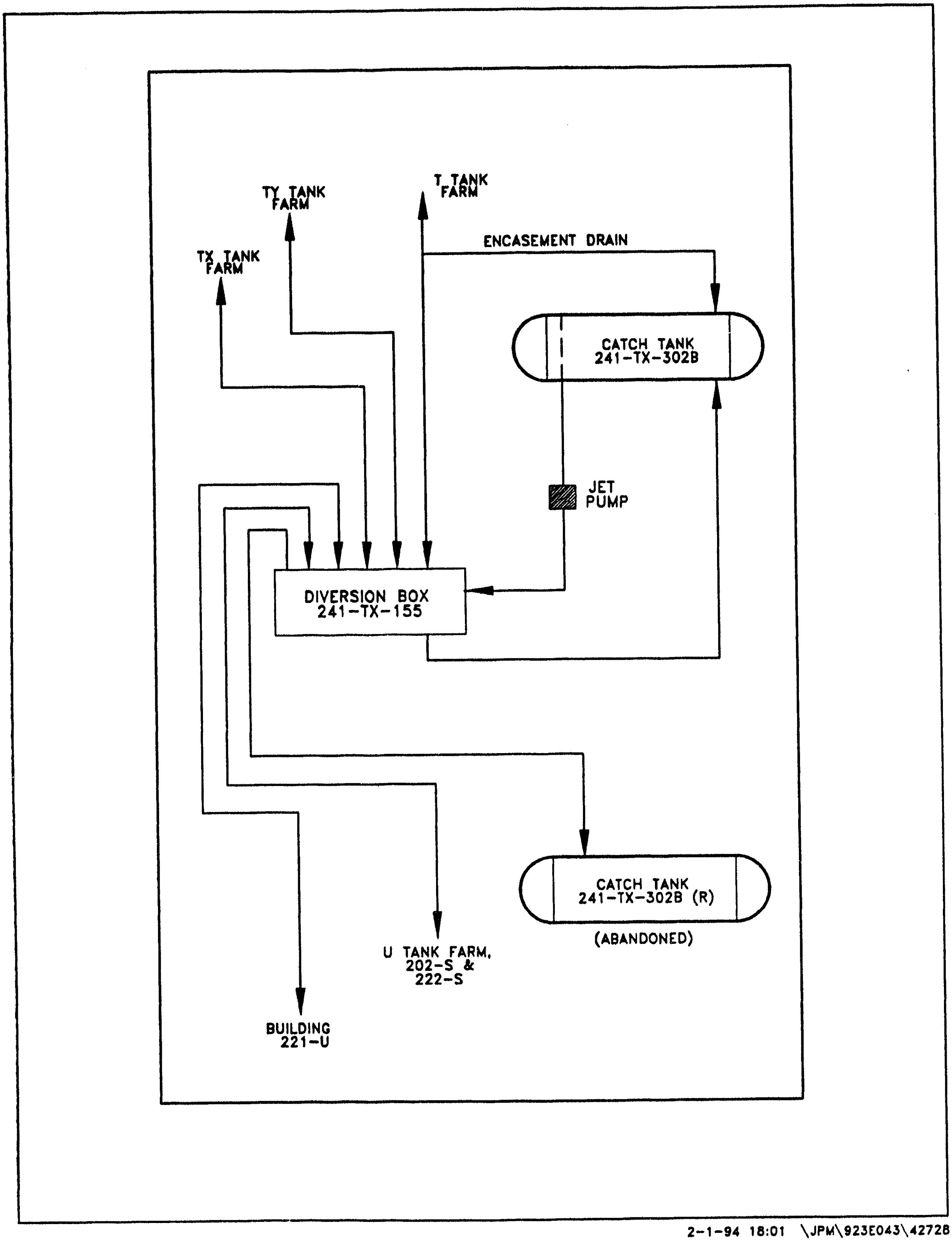

Figure A-14. Flow Diagram, Catch Tanks 241-TX-302B & 241-TX-302BR.

DATA SHEET
TANK 241-TX-302XB

Tank Category:	Catch	Coordinates:	N41623/W75679
Nominal Capacity:	14,314 gallons	Reference:	(Neilsen 1992)
Arrangement:	Horizontal	Sludge Volume:	108 gallons
Construction Material:	Steel	Supernate Volume:	245 gallons
Reference Drawings:	H-2-823, H-2-44511, Sheet 110	Current Status:	Stabilized, isolated

History of Operations

Catch tank 241-TX-302XB is a horizontal, cylindrical tank, 9 ft. in diameter and 28 ft. 10 in. between rounded ends. Nominal capacity of this tank is 14,314 gallons. This tank receives drainage from a concrete encasement originating at 244-TX-153. The diversion box, catch tank, and encasement are all isolated. Isolation of 241-TX-302XB includes gaskets on three risers and capping of the 1-inch steam addition riser. This catch tank has a current status of isolated and stabilized; however, it is not monitored. This tank received drainage indirectly from T Plant Operations and directly from waste transfers associated with the TX Tank Farm.

This tank was approved as interim stabilized on June 20, 1985, but the exact operating life of tank 241-TX-302B is unknown. It is suspected that operation began approximately in 1950. The stabilization evaluation form lists the solids level at 3 in. (measured in June, 1985 by doughnut method) and the liquid level at 6.5 in. (measured in June, 1985 by manual tape method). Using the calibration table for this tank series (Table 4-3, Bendixsen 1982), the solids volume is estimated at 108 gallons; the supernate volume is estimated at 245 gallons. Because the supernate volume is below the 400 gallons minimum for tank truck transfer and also below the 5,000 gallon minimum for overload transfer, no further actions were taken on this tank. This unit was used for transfer of waste solutions from processing and decontamination operations. This unit is not required to be monitored.

Suspected waste types in the tank could include any of the following (See Section 2.4.2.1): MW, 1C, TBP, EB, R, CW, OWW, RIX, SIX, IX, BL, BNW, DW, LW, N, PL, B, EVAP, CPLX, NCPLX, PNF.

Potential Safety Issues

a) Hydrogen Buildup: Low risk because of the large void volume.

b) Ferrocyanide: Low Risk

c) Organic Salts: Moderate Risk

d) Flammability: Low risk because tank is out of service and isolated.

e) Vapor Emissions: Low risk because the tank is out of service and isolated.

f) Tank Integrity: Low Risk - Tank age unknown. No leak data in available records.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (<1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Measurements are required to determine if the tank exterior presents a hazard.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

*Note: Flow diagram is provided with tank 241-TX-302A.

DATA SHEET
TANK 241-TY-302A

Tank Category:	Catch	Coordinates:	N42358/W75670
Nominal Capacity:	17,684 gallons	Reference:	(Neilsen 1992) (DOE-RL 199b)
Arrangement:	Horizontal	Sludge Volume:	450 gallons
Construction Material:	Steel	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-2233, H-2-44511, sheet 118	Current Status:	Stabilized, isolated

History of Operations

Tank 241-TY-302A is a horizontal, cylindrical vessel 9 ft. in diameter and 35 ft. 9.5 in. in length between rounded ends. It received drainage from diversion box 241-TY-153. The tank was considered to be stabilized and isolated after June, 1985 when procedures were completed and approved.

The tank was in service from 1953 to 1981. T Plant operations included plutonium recovery, decontamination, and experimental work so the tank may contain a wide variety of waste products from T Plant that were routed to the TY Tank Farm. The tank may contain ferrocyanide because it was on a ferrocyanide waste transfer path.

No analytical data has been located.

Suspected waste types in the tank could include any of the following (See Appendix B): TBP, EB, 1C, DW, R, CW, OWW, RIX, BL, EVAP, NCPLX.

Potential Safety Issues

a) Hydrogen Buildup: Although the specific processes generating hydrogen in waste tanks are unknown, radioactive disintegration in any hydrogen containing medium will probably result in some generation of hydrogen gas. As long as the tank is isolated there should be no ignition source so the risk of fire or explosion should be low.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Moderate risk because of lack of data.

d) Flammability: Low risk because the tank is out-of-service and isolated.

e) Vapor Emission: Low risk because the tank is out-of-service and isolated.

f) Tank Integrity: Low Risk - The tank is 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Only minimal quantities of waste are present. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

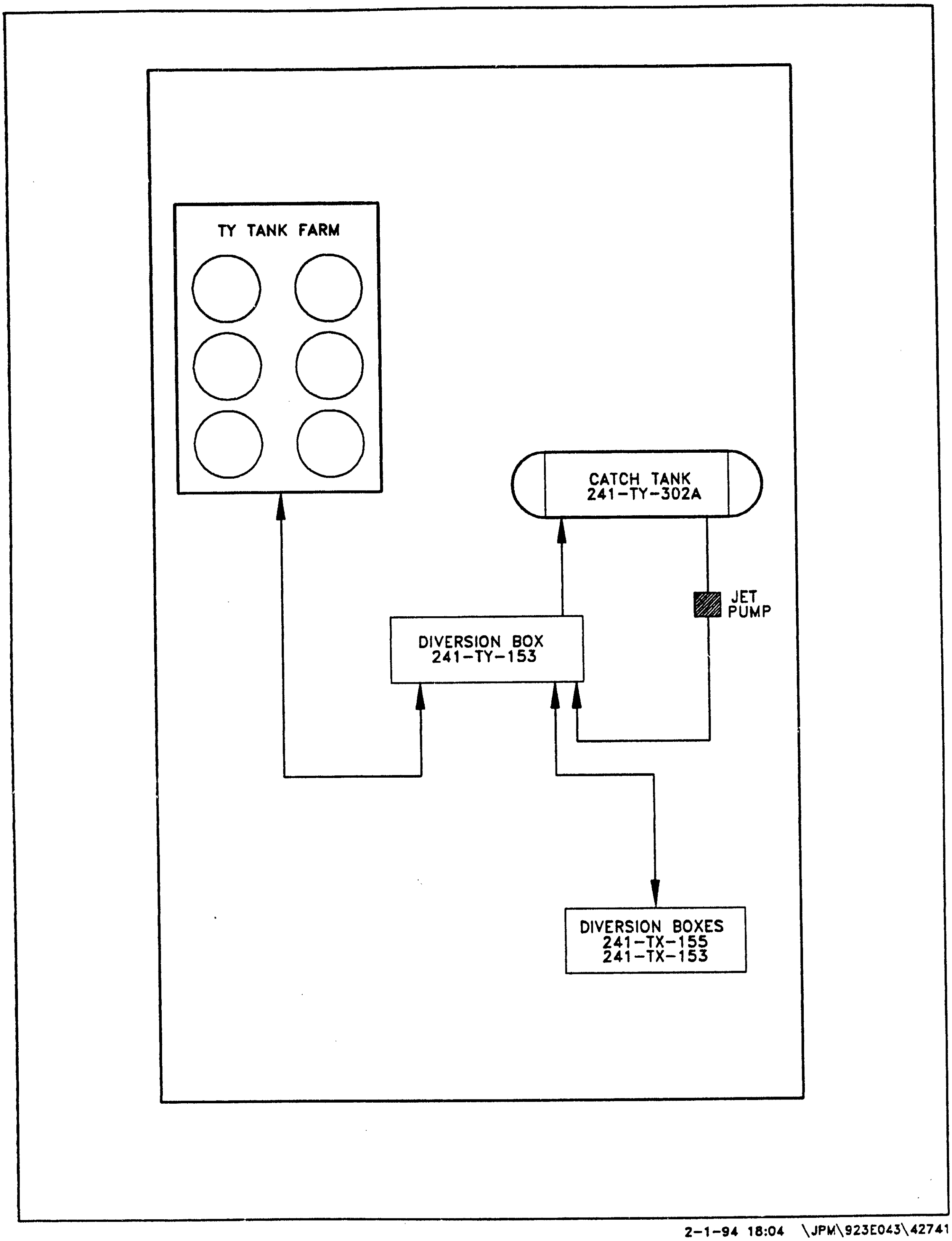

Figure A-15. Flow Diagram, Catch Tank 241-TY-302A.

DATA SHEET
TANK 241-TY-302B

Tank Category:	Catch	Coordinates:	N42608/W75715
Nominal Capacity:	14,314 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992b)
Arrangement:	Horizontal	Sludge Volume:	0 gallons
Construction Material:	Steel	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-2234, H-2-44511, sheet 126	Current Status:	Stabilized, isolated

History of Operations

Tank 241-TY-302B is a horizontal, cylindrical vessel 9 ft. in diameter and 32 ft. 4 in. in length between rounded ends. The tank receives drainage from a concrete encasement originating at diversion box 241-TY-153. Tank isolation and stabilization were approved in December, 1984.

The tank was in service from 1953 to 1981. T Plant operations included plutonium recovery, decontamination, and experimental work so the tank may have contained a wide variety of waste products that were routed from T Plant to the TY Tank Farm.

No analytical data has been located. Based on stabilization reports for solids and liquids measurements taken in August 1984, the tank is empty (Neilsen 1992).

Suspected waste types in the tank could include any of the following (See Appendix B): TBP, EB, 1C, DW, R, CS, OWW, RIX, BL, EVAP, NCPLX.

Potential Safety Issues

a) Hydrogen Buildup: No risk.

b) Ferrocyanide: No risk.

c) Organic Salts: No risk.

d) Flammability: No risk.

e) Vapor Emission: No risk.

f) Tank Integrity: No risk.

g) Criticality Safety: No risk.

h) Radiological Hazard: No risk.

i) Tank is empty. There was no evidence of heat generation causing a temperature rise.

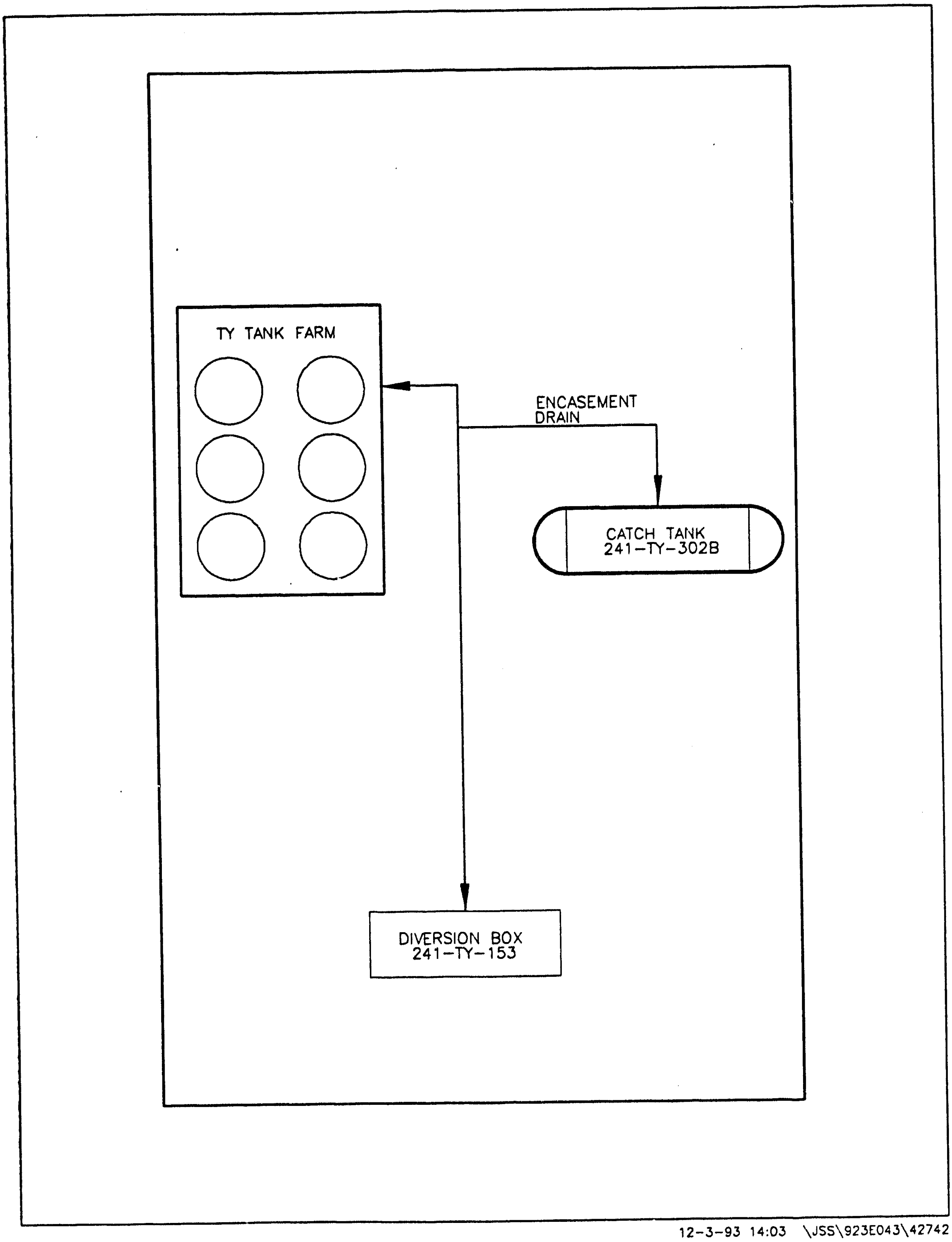

Figure A-16. Flow Diagram, Catch Tank 241-TY-302B.

DATA SHEET
TANK 270-E-1

Tank Category:	Neutralization	Coordinates:	N42600/W54400
Nominal Capacity:	4,185 gallons	Reference:	(Rymarz and Speer 1991)
Arrangement:	Vertical	Sludge Volume:	3,800 gallons
Construction Material:	Stainless Steel	Supernatant Volume:	None
Reference Drawings:	H-2-43116, H-2-44501, sheet 97	Current Status:	Isolated

History of Operations

Tank 270-E-1 is 9 ft. in diameter with a sloping bottom. The tank was originally constructed in the 1940's and was used in conjunction with the 221-U Building. The tank was moved, reworked, and put to use in 1952 to handle process condensate from 221-B Building. This evaporator condensate was an acidic waste and tank 270-E-1 functioned to neutralize this material. The tank contained a fixed limestone bed through which the condensate percolated, reacted, and overflowed to the 216-B-12 Crib.

Internal correspondence (Harlow 1974) indicates that the period of operation of tank 270-E-1 was from 1952 through 1957, which is consistent with the period of operation of the TBP process. The Aggregate Area Management Study (DOE-RL 1993b) states that the date of operation of the tank was from 1952 to 1970; however, examination of process drawings (H-2-44502, Sheet 22) indicates the inlet and outlet lines to tank 270-E-1 (alias 216-ER-1) were blanked off in the early 1960's and that any condensate from B Plant during later processing campaigns was sent either directly to crib 216-B-12 or its replacement, crib 216-B-62.

One unplanned release, UN-200-E-64, has been identified as potentially associated with this tank. The unplanned release was discovered in 1984 on the west side of the 216-B-64 basin with ^{137}Cs and ^{90}Sr contamination at up to 100,000 ct/min. It is not known whether the unplanned release is due to transfer line failure or tank failure; however, the contamination is known to be due to the type of waste routed to tank 270-E-1. Burrowing ants have been identified as responsible for spreading this contamination over a 2 acre area. In 1991, insecticide was applied to the known active ant mounds in the vicinity in an attempt to exterminate the ants. At this time no further ant activity has been observed.

In 1974 it was reported that the surface of the sludge in the tank was at 7.58 ft. and it was believed to be primarily limestone. There was no liquid visible at that time. Therefore, it should contain limestone, precipitated material from process condensates, and salts created from the reaction of limestone with the acids directed to this tank.

Potential Safety Issues

a) Hydrogen Buildup: Although the specific processes generating hydrogen in waste tanks are unknown, radioactive disintegration in any hydrogen containing medium will probably result in some generation of hydrogen gas. As long as the tank is isolated there should be no ignition source so the risk of fire or explosion should be low.

b) Ferrocyanide: Low Risk - There is no reason ferrocyanide would be introduced into this tank.

c) Organic Salts: Moderate Risk

d) Flammability: Low risk due to the large quantity of limestone and the nature of this process.

e) Vapor Emission: Low Risk - No liquids are observed in this tank so chemical reactions are minimized.

f) Tank Integrity: High risk of a leak because of unplanned release UN-200-E-64.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Tank content will very likely present a low radiological hazard. Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

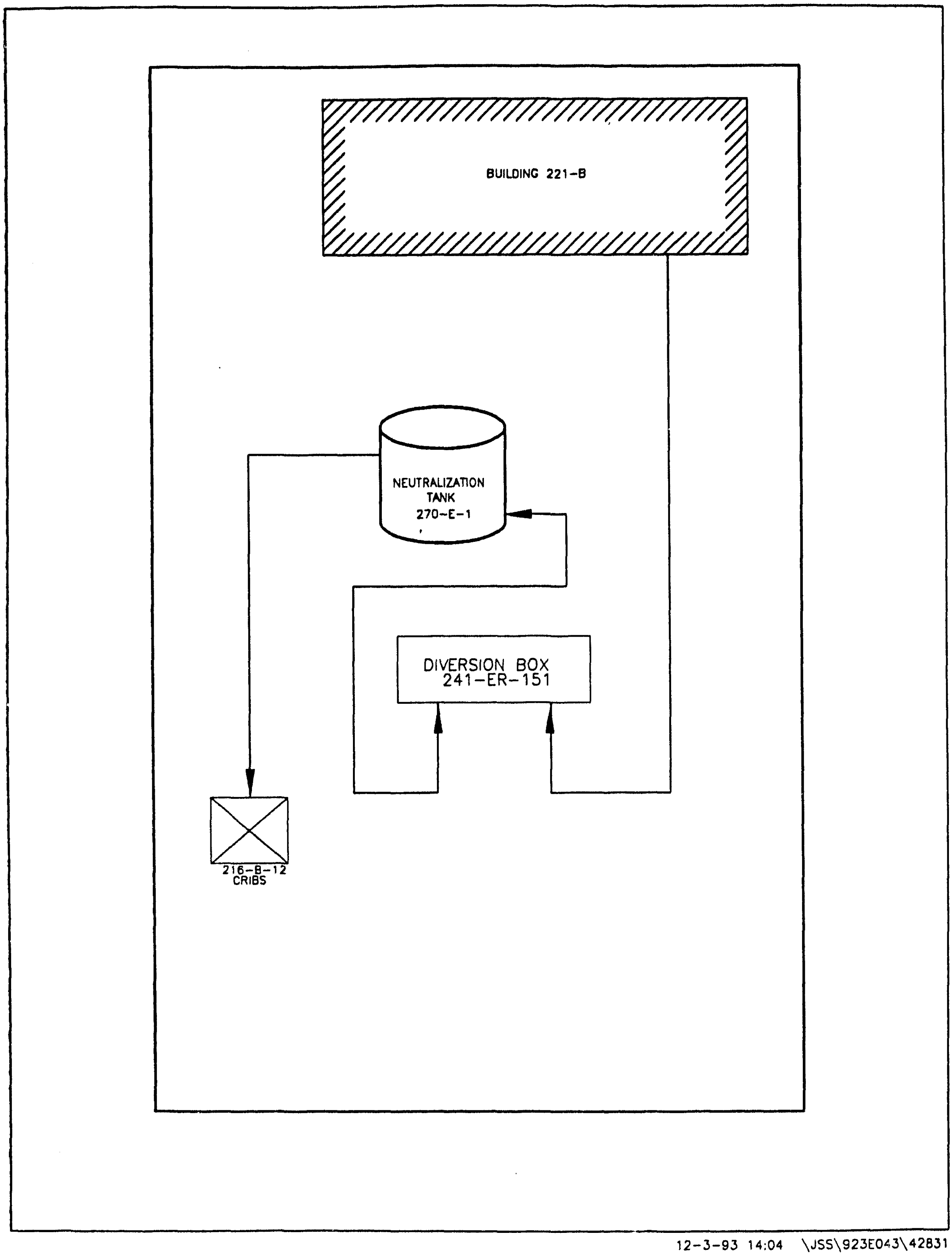

Figure A-17. Flow Diagram, Neutralization Tank 270-E-1.

DATA SHEET
TANK 270-W

Tank Category:	Neutralization	Coordinates:	N36042/W73100
Nominal Capacity:	3,780 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	No information
Construction Material:	Stainless Steel, concrete foundation	Supernatant Volume:	No information
Reference Drawings:	H-2-43116, H-2-44511, sheet 68	Current Status:	Isolated

History of Operations

Tank 270-W is a 9 ft. diameter, 9 ft. high, stainless steel cylindrical tank. The tank was filled with limestone and used to neutralize acidic 224-U process condensate flows when the UO_3 plant was in operation. The condensate resulted from the concentration of uranyl nitrate hexahydrates and was routed through the tank and finally released to the ground. One source indicates that the neutralized condensate flowed to the 216-U-8 Crib from 1952 to 1960 and to the 216-U-12 Crib from 1960 through 1970 (Neilsen 1992). However, other information suggests that as acidic waste from uranium recovery no longer emanated from U Plant after 1958, and since 224-U waste was not acidic, use of 270-W for neutralization after 1958 would not have been necessary, so the tank may have been bypassed years earlier than 1970. The tank was probably operated until about 1958 and inlet and outlet tubes were blanked off in 1970. A maintenance building, 2715-UA, was constructed directly above the tank. Visual inspection of the site noted that a cement slab has been poured over the area where the charging and vent risers should have been located (Harlow 1974).

Analyses of process condensate samples have revealed various chemical products. No analyses were found of the sludge or supernate in this tank, but in addition to limestone, it will likely contain precipitated products and salts created from the reaction of limestone and acid.

Potential Safety Issues

a) Hydrogen Buildup: Although the specific processes generating hydrogen in waste tanks are unknown, radioactive disintegration in any hydrogen containing medium will probably result in some generation of hydrogen gas. As long as the tank is isolated there should be no ignition source so the risk of fire or explosion should be low.

b) Ferrocyanide: Low Risk - There is no reason ferrocyanide would be introduced into this tank.

c) Organic Salts: Moderate Risk - No data.

d) Flammability: Low risk due to the large quantity of limestone and the nature of this process.

e) Vapor Emission: Low Risk - No liquids are observed in this tank so chemical reactions are minimized.

f) Tank Integrity: High Risk - The tank is over 40 yrs. old and has been subject to corrosion.

g) Criticality Safety: Low Risk - There are conditions under which a relatively small amount (< 1.0 kg) of properly moderated plutonium can go critical. Sampling would be required to determine the ^{239}Pu content of the tank. Tank function indicates that it should not contain a significant quantity of ^{239}Pu.

h) Radiological Hazard: Low Risk - Measurements are required to determine if the tank exterior presents a hazard.

i) There was no evidence of heat generation causing a temperature rise.

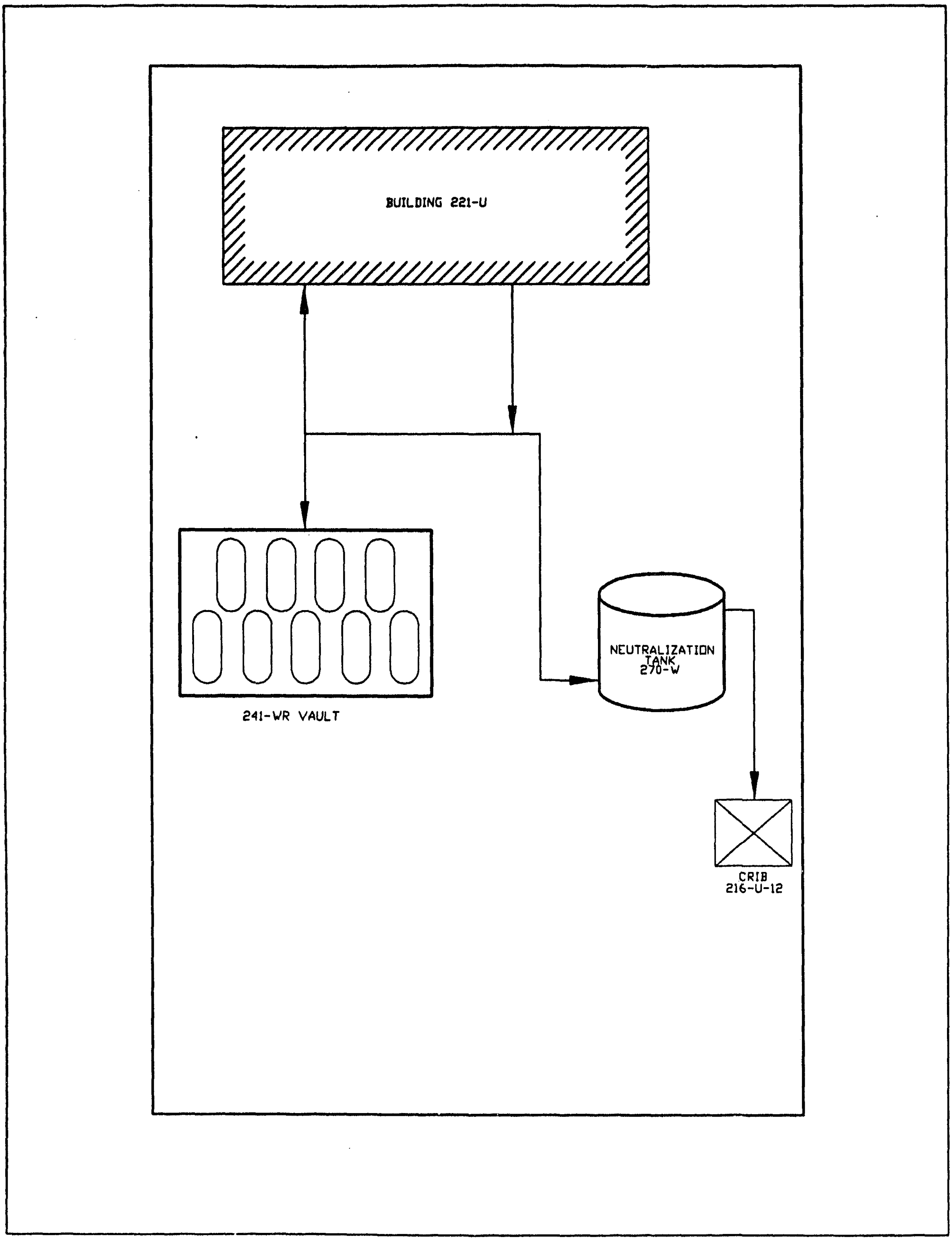

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Figure A-18. Flow Diagram, Neutralization Tank 270-W.

DATA SHEET
TANK 241-B-361

Tank Category:	Settling	Coordinates:	N43400/W52890
Nominal Capacity:	36,000 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1993b)
Arrangement:	Vertical	Sludge Volume:	20,678 gallons
Construction Material:	Unlined, reinforced concrete	Supernatant Volume:	None
Reference Drawings:	SK-2-4662, H-2-44501, sheet 107	Current Status:	Stabilized, Isolated (1985)

Period of Operation: 1945 - 1947

Analysis of a 1979 Sludge Sample (Smith 1980)
(activity level decayed to 1980)

COMPONENT	SOLIDS, wt%	LIQUIDS
Al^{+3}	<0.06	----
Bi^{+2}	10.3	8.05E-5 M
Fe^{+3}	1.3	2.0E-4 M
F^-	0.04	1.0E-2 M
La^{+3}	3.2	3.0E-4 M
Mg^{+2}	0.5	<9.0E-5 M
Mn^{+2}	3.0	<2.0E-5 M
$NaAl_2$	0.04	<4.05E-4 M
Na_2CO_3	----	1.90E-1 M
$NaNO_2$	----	3.0E-2 M
$NaNO_3$	----	2.4E-1 M
NaOH	----	1.0E-2 M
Na_3PO_4	----	4.05E-2 M
Na_2SO_4	----	<5.2E-5 M
Ni^{+2}	----	----
NO_3	2.0	----
PO_4^{-3}	3.4	----
SiO_4	0.4	2.0E-3 M
SO_4^{-2}	0.2	----
^{239}Pu	3.4 μCi/g	6.1E-7 μCi/ml
^{137}Cs	1.4 μci/g	2.5E-3 μCi/ml
$^{89-90}Sr$	23.0 μCi/g	3.1E-5 μCi/ml
$^{238}U^*$	1.1E-5 g/g	8.4E-6 g/ml

*All Valences
----Data not reported

Sample from 241-B-361
Settling Tank Sample #T4712
(WHC 1975-1985)

Appearance	Clear yellow w/brown solids
Radioactivity over top	0.005 Rad
Total β (liquid)	3.61 μCi/L
Spg	1.074
EDTA	$<2.7 \times 10^{-1}$
NO_2	3.99×10^{-2} M
NO_3	8.28×10^{-1} M
OH	2.55×10^{-1} M
pH	1.016×10^{1}
Solids by Volume	3.1%

Note: Radioactivity levels as reported on 4-3-84

Note: No pumpable liquids contained the tank.

Particle Density	-3.93 g/cm^3
Bulk Density	-1.29 g/cm^3
Moisture Content	-~72 wt%
Volume	-1.20 E^{+5} liter

DOE-RL (1993b), reports a sludge content of 32,000 gallons containing a total of 5.42 lb. plutonium.

History of Operation

The 241-B-361 settling tank is a cylindrical structure 20 ft. in diameter and 19 ft. high with a domed top, all constructed of unlined 6 in. reinforced concrete. The tank was in operation from April 1945 to September 1947, acting as a settling basin for low level, low salt, alkaline wastes originating from Cell 5 and 6 washing operations ($BiPO_4$ process) and additional waste from the 224-B concentration facility (low level concentrator condensate). After settling, supernatant in the tank was discharged to 216-B-5 reverse well.

Records indicate the tank was isolated in the early 1980's and was stabilized in 1985. A Stabilization Evaluation form dated 6-26-85 indicates that the tank currently contains 20,678 gal of sludge.

Potential Safety Issues

a) Hydrogen Buildup: Moderate Risk.

b) Ferrocyanides: Low Risk.

c) Organic Salts: Analytical results indicated high moisture content but this will dry out with time. Moderate Risk.

d) Flammability: Low risk. Moisture content, isolated, and stabilized.

e) Vapor Emission: Moderate risk. The sludge may trap vapors but vapors will be generated.

f) Tank Integrity: Low Risk - The tank is almost 50 years old and is subject to settling and ground stresses. Tank inspections would be required to determine tank integrity.

g) Criticality Safety: Moderate Risk - Although this tank may contain 2.4 Kg of plutonium, it appears well dispersed. This quantity of plutonium in this geometry appears to create moderate criticality hazard.

h) Radiological Hazard: High Risk.

i) Heat Generation: There is no evidence of heat generation causing temperature rise.

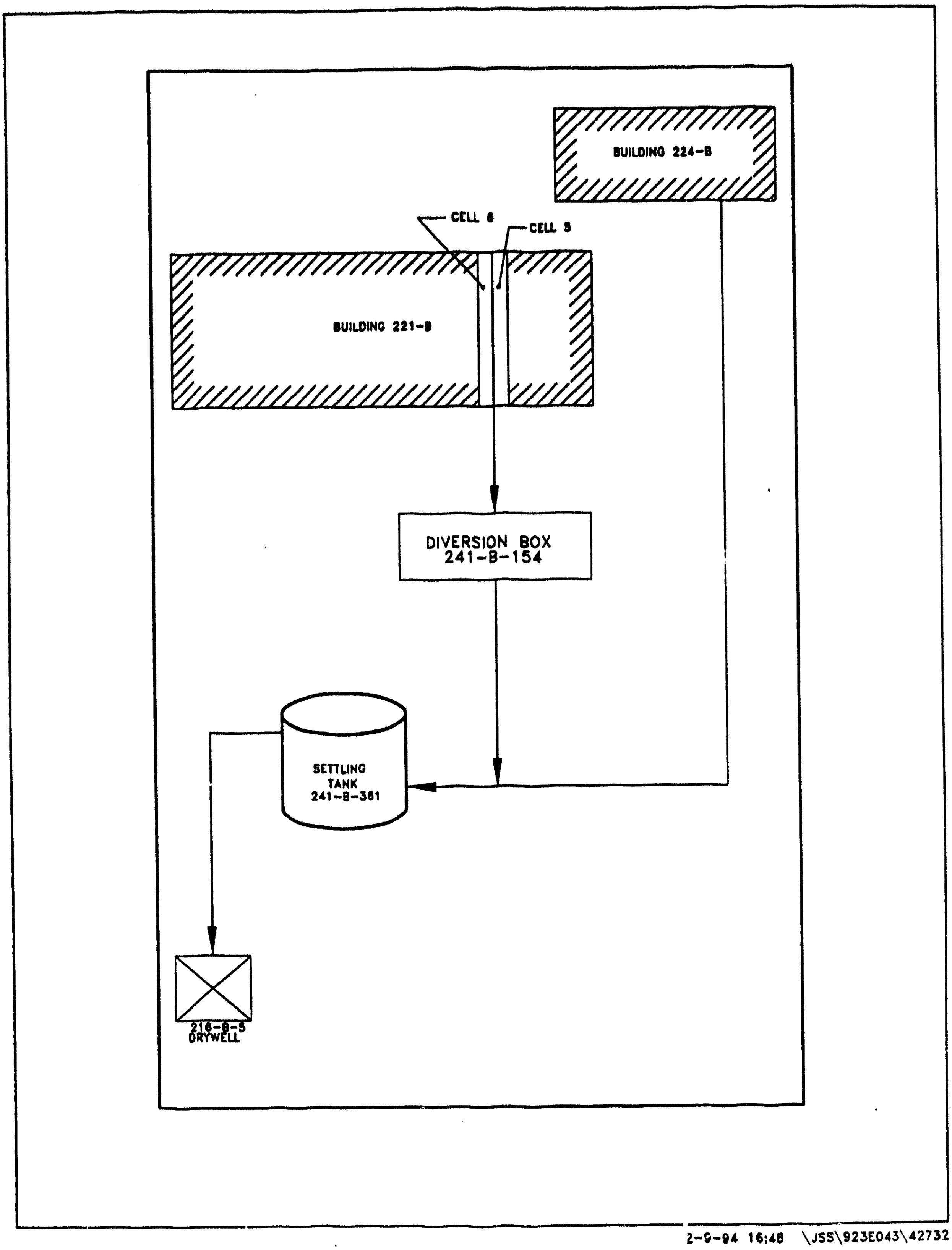

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Figure A-19. Flow Diagram, Settling Tank
Tank 241-B-361.

DATA SHEET
TANK 241-T-361

Tank Category:	Settling	Coordinates:	N43225/W74000
Nominal Capacity:	36,000 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1992b)
Arrangement:	Vertical	Sludge Volume:	24,500 gallons
Construction Material:	Unlined, reinforced concrete	Supernatant Volume:	0 gallons
Reference Drawings:	(Rymarz and Speer 1991)	Current Status:	Isolated, Stabilized (1985)

Period of Operation: Active use from 1944 - 1947; inactive use from 1948 to 1976.

Analysis of Sludge (Rymarz and Speer 1991)

Bulk Density	2.53 g/cc
Particle Density	3.91 g/cc
H_2O	61.3%
Al	<1.0%
Fe	2.0%
CO_3	0.9%
Ca	0.6%
NO_2	1.4%
NO_3	17.4%
SO_4	<1.0%
PO_4	1.0%
Ni	5.8%
Si	1.8%
Na	3.1%
Mg	0.2%
Mn	1.7%
Pu	$2.30 \cdot 10^{-5}$g/g
$^{89,90}Sr$	0.120 μCi/g
^{137}Cs	67.6 μCi/g

Note: Radioactivity levels as reported in 1977.

Analysis of Solution/Sludge
Sample No. 4713

Component	Result
Color	Clear yellow
% Solids	<2%
Rad over top	.004
T β liquid	4.00×10^1 μCi/L*
Specific Gravity	1.054
EDTA	Incomplete
$N0_2$	2.05×10^{-2} M
$N0_3$	2.93 M
OH	6.5×10^{-2} M
pH	12.54

Note: Radioactivity as reported on 4-3-85. *Unit of measure not reported, however, μCi/L were typically used during this time period.
Reference: (WHC 1975-1985)

DOE-RL (1992b) reports 4.4 lb of plutonium (15,500 Ci beta/gamma) in the 28,000 gallons of sludge. Also, this source indicates that all of the following contaminants are in the waste: transuranics, fission products, uranium, heavy metals, volatiles, and semivolatiles.

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History of Operations

The 241-T-361 settling tank is a cylindrical vessel constructed of 6 in. reinforced concrete that is 20 ft. in diameter and 19 ft. high with a domed top. Tank 241-T-361 was in active use following commencement of $BiPO_4$ operations at T Plant (late 1944). The tank functioned in the context of $BiPO_4$ process waste handling at T Plant as 241-B-361 functioned at B Plant (see data sheet for 241-B-361). In the waste flow configuration at that time, low level, low salt alkaline wastes from 221-T and 224-T were routed to tank 241-T-361, which in turn discharged to the 216-T-3 reverse well and the 216-T-6 cribs (see M-2904-W, Sheet 1). Specifically, tank 241-T-361 discharged to 216-T-3 reverse well 1.13 X 10^7 liters during the period 6/45 - 8/46 and then the tank discharged to 216-T-6 crib 4.5 X 10^7 liters during the period 8/46 - 10/47. The cribs and reverse well were out of service by October 1947 (Maxfield 1979). The lines formerly connected to tank 241-T-361 from T Plant were rerouted to diversion box 241-T-152 and from there, wastes would be sent to the 241-T Tank Farms. There are no other possible discharge paths from tank 241-T-361 except to the cribs and reverse well mentioned above (see H-2-44512, Sheet 39). Consequently, use of tank 241-T-361 must have ended in October 1947 when its associated cribs and well were all taken out of service permanently. A Stabilization Evaluation form dated 7-10-85 indicates that the tank currently contains 24,500 gal of waste.

The unit was isolated and stabilized in 1985. No unplanned releases are reported for this unit.

Potential Safety Issues

a) Hydrogen Buildup: Moderate Risk.

b) Ferrocyanides: Studies indicate that T Plant wastes are sufficiently diluted with inert material that they are non-reactive when heated. Low Risk.

c) Organic Salts: Moderate Risk.

d) Flammability: Low Risk. Moisture content is high and tank is isolated and stabilized.

e) Vapor Emission: Moderate Risk. The sludge may trap vapors but vapors will be generated.

f) Tank Integrity: Low Risk. The tank is about 50 years old and is subject to settling and ground stresses. Tank inspections would be required to determine tank integrity.

g) Criticality Safety: Sample indicated very low level of Plutonium; however, the tank may not be homogeneous. Moderate Risk.

h) Radiological Hazard: High Risk.

i) Heat Generation: There is no evidence of heat generation causing temperature rise.

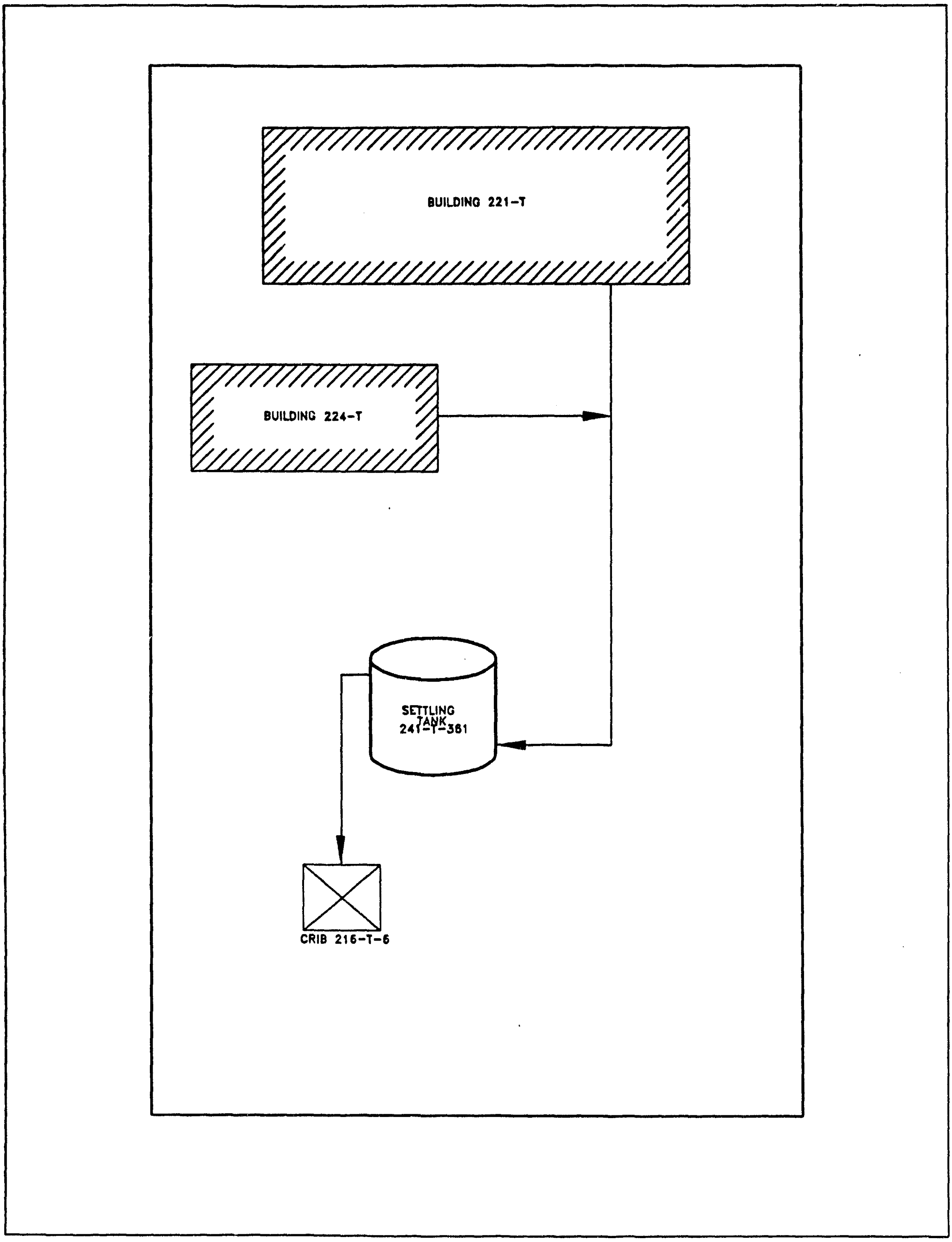

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Figure A-20. Flow Diagram, Settling Tank 241-T-361.

DATA SHEET
TANK 241-U-361

Tank Category:	Settling	Coordinates:	N37830/W74160
Nominal Capacity:	36,000 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	27,734 gallons [DOE-RL (1992c) reports a sludge content of 27,500 gallons.]
Construction Material:	Unlined, reinforced concrete	Supernatant Volume:	98
Reference Drawings:	SK-2-4661, H-2-44511, sheet 61	Current Status:	Isolated

Period of Operation: 1951 - 1967

Analysis of Sludge (April 1976)
(Rymarz and Speer 1991)

Bulk Density	1.49 g/cc
Particle Density	5.97 g/cc
H_2O	65.6%
Al_2O_3	2.4%
Na_2CO_3	<1.0%
FeOH	2.9%
$NaNO_2$	<1.0%
$NaNO_3$	27.2%
Mg	0.06%
Mn	0.6%
Na_2SO_4	1.3%
Na_3PO_4	<1.0%
Ni	0.5%
SiO_2	0.3%
Na	4.4%
U	0.133 μCi/g
Pu	9.97 X 10^{-7} μCi/g
^{89,90}Sr	4.9 μCi/g
^{137}Cs	8.8 μCi/g

Note: Radioactivity levels as reported in 1976.

Solution/Slude Sample No. 4711

Color	Clear Yellow
Percent Solids	<2%
Radioactivity over sample	.006
Total β liquid	1.83×10^{-3} μCi/L*
SpG	1.013
EDTA	incomplete
$N0_2^-$	4.73×10^{-3} molarity
$N0_3^-$	3.18 molarity
OH^-	6.82 molarity
pH	7.17

Note: Radioactivity level as reported on 4-3-85. *No units reported, however, μCi/L were typically used during this time period.

Reference: (WHC 1975-1985)

DOE-RL (1992c) reports an estimated 2,125 Ci beta/gamma in this tank, and reports that known contaminants include transuranics, fission products, uranium, inorganics, and semi-volatile organics (kerosene, TBP). Suspected contaminants include heavy metals and volatile organics.

History of Operations

Tank 241-U-361 is a cylindrical concrete vessel with 6 in. reinforced concrete walls, 20 ft. in diameter and 19 ft. high with a domed top. Waste from the uranium recovery process in the 221-U building and decontamination wastes from the 224-U building passed through this tank where solids settled out on its way to cribs 216-U-1 and 216-U-2. The tank was in service from 1951 through 1967. (Early records suggest 1951 - 1957.) The following provides the history of operations for this settling tank (DOE-RL 1992c):

Process	Facility	Period of Operation
Cell Drainage Tank 5-6	221-U	1952 - 1957
UO_3 Conversion Waste	224-U	1957 (1 Month)
276-U Solvent Scrubbing	276-U	1957 (1 Month concurrent with UO_3 conversion waste)
UO_3 Equipment Decontamination	224-U	1957 - 1967

It has been reported that a relatively large amount of cesium was processed through this tank. Associated cribs contain large amounts of plutonium. It was stabilized in 1985 when it was pumped down to a residual liquid volume of 98 gallons. Records indicate that one outlet line may remain open (Armstrong 1968, Owens and Sabin 1984, and McVey 1980).

Although analytical data is from a report written in 1991, the tank was sampled and the data was obtained in 1976.

This tank is associated with one unplanned release numbered UN-200-W-19. According to the U Plant AAMS (DOE-RL 1992c and Baldridge 1959) reports the release as follows:

> "Organic wastes and cell drainage from the TBP and UO_3 plants overflowed to the ground by way of the tank and crib vents in the spring of 1953. Ground contamination up to 11.5 rads/h at three inches was found over an area of approximately 50 ft^2. Decontamination was attempted and the area was then backfilled, delimited with a wooden fence, and posted with radiation zone signs."

Potential Safety Issues

a) Hydrogen Buildup: Moderate Risk.

b) Ferrocyanides: Studies indicate that U Plant wastes are sufficiently diluted with inert material that they are non-reactive when heated. Low Risk.

c) Organic Salts: Moderate Risk.

d) Flammability: Low Risk. Moisture content is high and the tank is isolated and stabilized.

e) Vapor Emission: Moderate Risk. The sludge may trap vapors but vapors will be generated.

f) Tank Integrity: Low Risk. The tank is about 40 years old and is subject to settling and ground stresses. Tank inspections would be required to determine tank integrity.

g) Criticality Safety: Sample indicated very low level of Plutonium; however, the tank may not be homogeneous. Records indicate Plutonium level is high in the 216-U-2 crib. Low Risk.

h) Radiological Hazard: High Risk.

i) Heat Generation: There is no evidence of heat generation causing temperature rise.

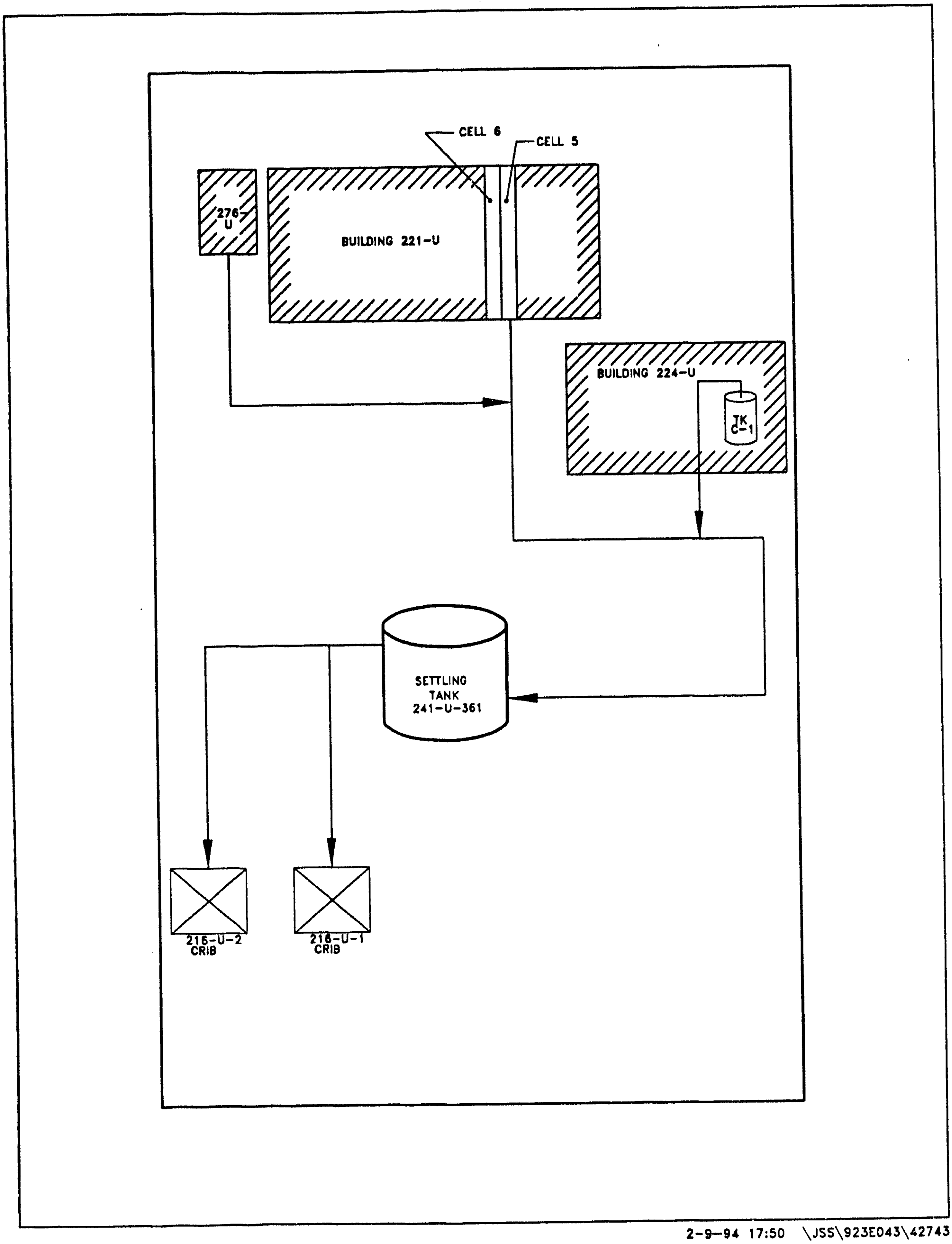

Figure A-21. Flow Diagram, Settling Tank 241-U-361.

DATA SHEET
TANK 241-Z-361

Tank Category:	Settling	Coordinates:	N39500/W76600
Nominal Capacity:	40,500 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1992d)
Arrangement:	Vertical	Sludge Volume:	20,000 gallons
Construction Material:	12" concrete walls, lined with 3/8" steel	Supernatant Volume:	200 gallons
Reference Drawings:	H-2-18460	Current Status:	Isolated and Stabilized

Period of Operation: 1949 - 1976

DOE-RL (1992d), reports that the tank received wastes from PFP (234-5Z Building), PRF (236-Z Building), and the 242-Z Building, containing a total of 65 to 165 pounds of plutonium, some unknown fraction of which has been retained in the tank sludge. PRP, PRF, and Americium Recovery (242-Z) wastes contained the following chemical and radiochemical constituents:

CHEMICAL	RADIONUCLIDES
Nitrate	Pu
Fluoride	Transuranics (including 241 Am)
Sodium	Alpha Emitters
Sulfate	
Phosphate	
CCl4	
TBP	
DBBP	
Ion Exchange Resin	

History of Operations

The 241-Z-361 settling tank is a rectangular, concrete vessel with inner dimensions of 26 ft. by 13 ft. and a height varying from 17 to 18 ft. due to a sloping bottom. The walls are 12 in. thick concrete lined with 3/8 in. steel. It served as a settling tank for liquid wastes routed to the 216-Z-1A tile field and the 216-Z-1, 216-Z-2, 216-Z-3, 216-Z-12, and 216-Z-18 cribs from the 234-5Z building, 236-Z building and the 242-Z building. Tank 241-Z-361 was in service from 1949 to 1976.

Records indicate that all lines into and out of the tank were blanked off in 1973 and supernate was pumped from the tank in 1975 to a residual 200 gallons.

The tank is believed to contain between 30 and 75 kg of plutonium with a most probable value of 26.8 kg. Extensive investigations have been conducted to assure tank contents do not constitute a criticality hazard. Most analytical sampling has been directed to that purpose.

According to a March 10, 1979 Atlantic Richfield Hanford Company letter (Appendix D, page D-7) sludge from tank 241-Z-361 was characterized as follows (radioactivity levels as reported in 1979):

241-Z-361 Core Sample Analysis:

Analysis of:

Component	Section #3 Result	Section #5 Result
Volume % Solids	*45.6	21.8
Pu Concentration g/L in solids	0.20	0.72
Pu Concentration g/L in sludge	0.097	0.157

*Not completely dry after four days.

Emission Spec. Analyses of Section 4 (ppm)

Component	Result	Component	Result
Al	60,000	Mo	300
B	10	Na	50,000
Be	10	Nb	160
Bi	50	Ni	2,000
Cd	50	Pb	200
Co	1,000	Si	5,000
Cr	800	Sa	20
Cu	2,500	Ta	400
Fe	40,000	Ti	150
Fa	80	V	200
K	3,000	W	400
Mg	19,000	An	5,000
Mn	400	Zr	160

Section No. 2 Run by HEDL

Component	Result
C Wt. %	2.08
S Wt. %	0.081
Cl ppm	310
N ppm	7,500

Section No. 4 Run by HEDL

Component	Result
C Wt. %	0.57
S Wt. %	0.045
Cl ppm	180
N ppm	1,500

Section No. 6 Run by HEDL

C Wt. %	1.17
S Wt. %	0.056
Cl ppm	280
N ppm	3,000

Potential Safety Issues

a) Hydrogen Buildup: Low Risk

b) Ferrocyanides: No reason to use ferrocyanides at Z Plant. Low Risk.

c) Organic Salts: Moderate Risk - No Data.

d) Flammability: Low Risk. Moisture content is high and tank is isolated and stabilized.

e) Vapor Emission: Moderate Risk. The sludge may trap vapors but vapors will be generated.

f) Tank Integrity: The tank is about 45 years old but thick walls and double containment should provide a high level of safety. Tank inspections would be required to assure tank integrity. Low Risk.

g) Criticality Safety: High plutonium content. In spite of extensive analysis some risk continues to exist. Moderate Risk.

h) Radiological Hazard: High Risk.

i) Heat Generation: There is no evidence of heat generation causing temperature rise.

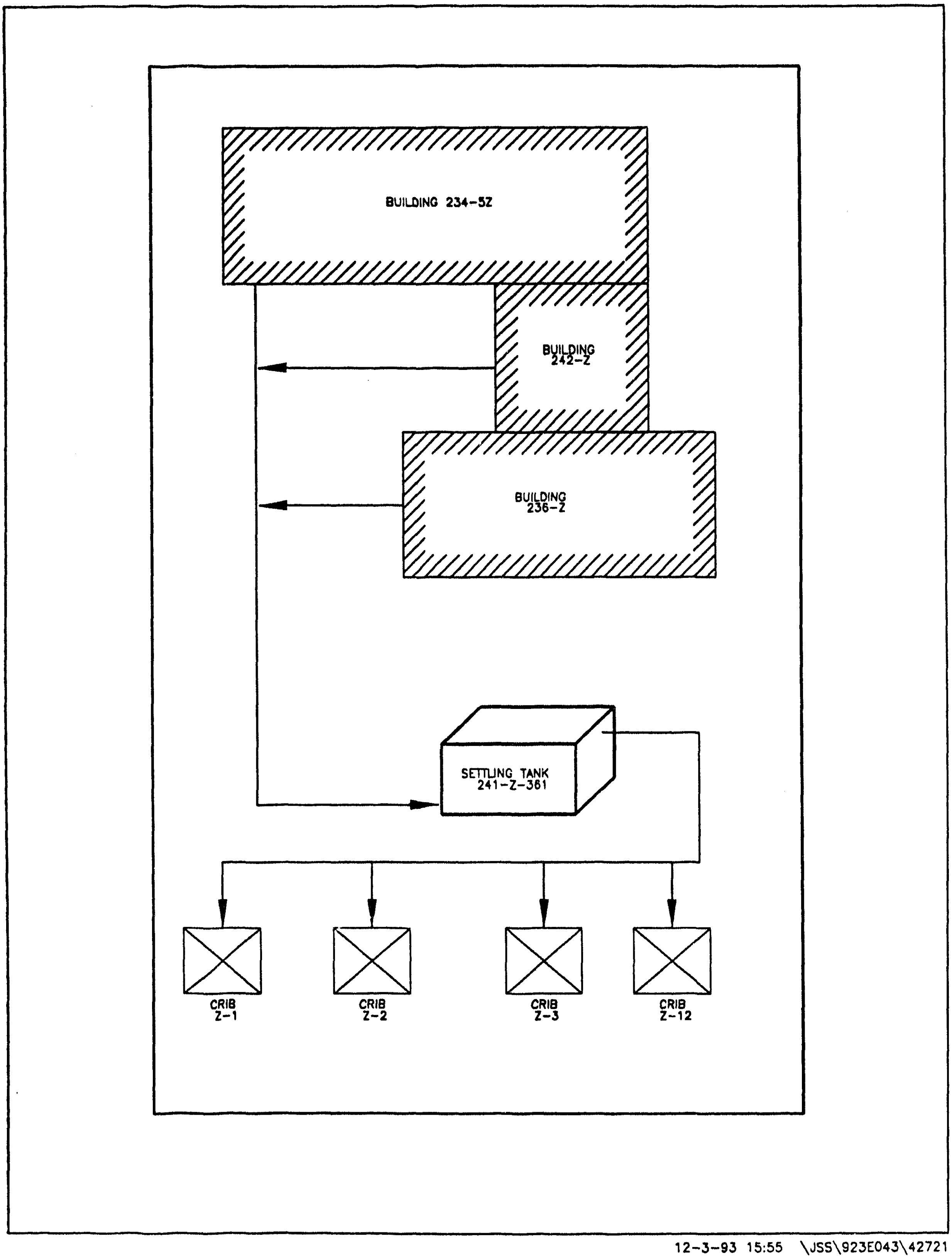

Figure A-22. Flow Diagram, Settling Tank 241-Z-361.

DATA SHEET
TANK 241-Z-8

Tank Category:	Settling	Coordinates:	N40000/W76290
Nominal Capacity:	15,435 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1992d)
Arrangement:	Horizontal	Sludge Volume:	500 gallons
Construction Material:	Steel or wrought 5/16"	Supernatant Volume:	0 gallons (the 7,650 gallons of supernatant reported in DOE-RL (1992d), have been pumped).
Reference Drawings:	H-2-16653, H-2-44511, sheet 95	Current Status:	Isolated and Stabilized

Period of Operation: 1955 - 1962

Probable Plutonium Inventory of Tank 241-Z-8 Based on Analytical Results of April and May 1974 Samples (Rymarz and Speer 1991)

Volume	Plutonium (grams/liter)	Plutonium (grams)
500 gal. (sludge)	0.004	8
	0.25	475
	0.76 *	1444 *

* Maximum plutonium 1600 grams
Liquid pH = 6
Liquid SpG - 1.034

Note: Radioactivity levels do not account for any decay that has occurred since 1974.

The Z Plant AAMS (DOE-RL 1992d) reports a sodium hydroxide content of 1000 kg (this is probably for the contents previous to the supernatant pumping). Also, it is reported that 241-Z-8 received RECUPLEX process waste, which contains nitrates, fluorides and phosphates.

History of Operations

Tank 241-Z-8 is a horizontal, cylindrical vessel 8 ft. in diameter and 40 ft. long. This settling tank received waste from the RECUPLEX facility (backflush of feed filters for the RECUPLEX process) from 1955 to 1962. Overflow from the tank went to 216-Z-8 french drain.

One analysis of four samples indicated a plutonium content between 8 and 1444 grams. A second sample indicated 38 grams. Both samples were analyzed in 1974 although results have been recorded in more recent documents.

No unplanned releases were identified for this tank.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk

b) Ferrocyanides: No reason to use ferrocyanides at Z Plant. Low Risk.

c) Organic Salts: Moderate Risk - No Data.

d) Flammability: Low Risk. Moisture content is high and tank is isolated and stabilized.

e) Vapor Emission: Low Risk. The sludge may trap vapors but vapors will be generated.

f) Tank Integrity: Low Risk - The tank is almost 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: Possible high plutonium content. Moderate Risk.

h) Radiological Hazard: High Risk.

i) Heat Generation: There is no evidence of heat generation causing temperature rise.

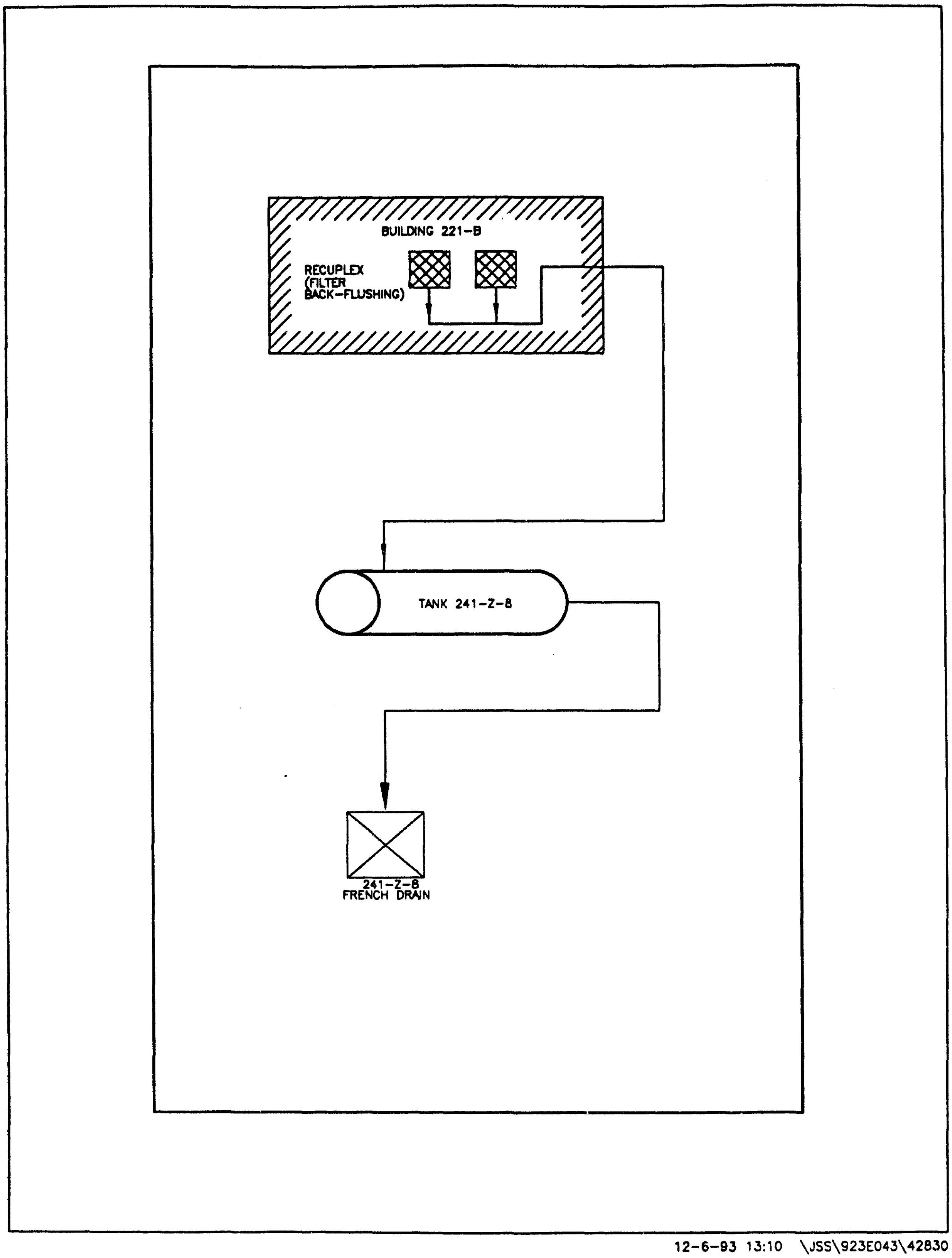

Figure A-23. Flow Diagram, Tank 241-Z-8 (silica gel settling tank).

DATA SHEET
TANK 231-W-151-001

Tank Category:	Settling	Coordinates:	N40800/W76596
Nominal Capacity:	4,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992d)
Arrangement:	Vertical	Sludge Values:	None
Construction Material:	Stainless Steel	Supernatant Volume:	1,430 gallons
Reference Drawings:	H-2-1224, H-2-44511, Sheet 103	Current Status:	

Period of Operations: 1948 - Not later than 1974

History of Operations

The 231-W-151 vault tanks were installed to receive drainage from about 75 floor drains in Building 231-Z. Apparently, drainage was received into tank 231-W-151-002 which overflowed into tank 231-W-151-001, which in turn overflowed to crib 216-Z-7. Solids in the floor drainage would settle out leaving sludge and sediment in the bottom of the tanks, particularly tank 231-W-151-002, being the first tank in the series. Plutonium finishing was conducted in building 231-Z; any wastes or chemicals generated or used in this process may have conceivably been introduced to the 231-W-151 vault tanks. The exact date of discontinuance of use of the vault is not known; however, it is known that by 1974 the inlet lines to the tanks, including tank 231-W-151-001, had been blanked off.

On May 9, 1974, a water sample was taken from tank 231-W-151-001. At the time of sampling, there were not enough solids in the bottom of the tank to retrieve a sample of this material. Analysis results were as follows (Neilsen 1992):

Parameter	Value	Total Content
pH	7.15	7.15
Total Alpha	2.9×10^{-3} µCi/L	15.7 µCi
Total Beta	66 ** µCi/L	0.36 Ci **
^{137}Cs	3.1×10^{-2} µCi/L	0.002 Ci
^{89}Sr, ^{90}Sr	8.5 µCi/L	0.045 Ci
Uranium	2.3×10^{-5} g/L	0.13 g

* Values adjusted to 04/01/92

** Total Beta is approximately 50% lower because of decay.These results indicate that

Tank 231-W-151-001 contained only about 0.001g of plutonium at that time.

Potential Safety Issues

a) Hydrogen Buildup: Minimal risk since very little radioactive material and organic material is present.

b) Ferrocyanide: No risk since little or no ferrocyanides are present and tank contains mostly water.

c) Organic Salts: Low risk since available evidence does not suggest the presence of these compounds.

d) Flammability: Low Risk - Some inflammable materials (hydrocarbons) may be present but no ignition source exists.

e) Vapor Emissions: Low Risk - Some solvents may have found their way into the tanks but it is expected that these have overflowed to the crib if they were ever present.

f) Tank Integrity: No evidence of leaks was reported at the time of liquid sampling in 1974. Nature of wastes in the tank is not corrosive; however, extended life of tanks suggests at least low risk of leakage.

g) Criticality Safety: Low Risk - The low level of risk is based upon 1) only low levels of plutonium were detected in the liquid and 2) there is minimal sludge present in the tank.

h) Radiological Hazard: Low risk as only traces of radionuclides are present.

i) Heat Generation: Low Risk (No Data)

*Flow diagram shown on page A-79.

DATA SHEET
TANK 231-W-151-002

Tank Category:	Settling	Coordinates:	N40800/W76596
Nominal Capacity:	950 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992d)
Arrangement:	Vertical	Sludge Values:	12 gallons
Construction Material:	Stainless Steel	Supernatant Volume:	955 gallons
Reference Drawings:	H-2-1224, H-2-44511, Sheet 103	Current Status:	

Period of Operations: 1948 - Not later than 1974

History of Operations

The 231-W-151 vault tanks were installed to receive drainage from about 75 floor drains in Building 231-Z. Apparently, drainage was received into tank 231-W-151-002 which overflowed into tank 231-W-151-001, which in turn overflowed to crib 216-Z-7. Solids in the floor drainage would settle out leaving sludge and sediment in the bottom of the tanks, particularly tank 231-W-151-002, being the first tank in the series. Plutonium finishing was conducted in building 231-Z; any wastes or chemicals generated or used in this process may have conceivably been introduced to the 231-W-151 vault tanks. The exact date of discontinuance of use of the vault is not known; however, it is known that by 1974 the inlet lines to the tanks, including tank 231-W-151-001, had been blanked off.

On May 9, 1974, a water sample was taken from tank 231-W-151-002. Analysis results were as follows [adjusted to April 1, 1992 (Neilsen 1992)]:

Parameter	Aqueous Value	Solid Value	Total Content
pH	7.15		
^{137}Cs	1.7 X 10^{-3} μCi/L	3.0 X 10^{-4} μCi/L	6 μCi
Sr	0.7 X 10^{-2} μCi/L	<3.9 X 10^{-4} μCi/L	<25 μCi
U	1.0 X 10^{-5} g/L	<2.0 X 10^{-6} g/L	<0.04 g
$^{239/240}Pu$	Not reported	101 μCi/g	14.1 Ci
^{238}Pu	Not reported	2.1 μCi/g	0.3 Ci
^{241}Am	Not reported	6.4 μCi/g	0.9 Ci

These results indicate a content of 228g of plutonium in the sludge in tank 231-W-151-002 and less than 0.001g in the supernatant.

Potential Safety Issues

a) Hydrogen Buildup: Low risk since sludge content is limited to 12 gallons which has potential to generate only small amounts of hydrogen. Hydrogen could diffuse out of the tank and 231-W-151 vault readily.

b) Ferrocyanide: No risk since little or no ferrocyanides are present and tank contains large amounts of water.

c) Organic Salts: Low risk since available evidence does not suggest the presence of these compounds.

d) Flammability: Low Risk - Some inflammable materials (hydrocarbons) may be present but no ignition source exists.

e) Vapor Emissions: Low Risk - Some solvents may have found their way into the tanks but it is expected that these have overflowed to the crib if they were ever present.

f) Tank Integrity: No evidence of leaks was reported at the time of liquid sampling in 1974. Nature of wastes in the tank is not corrosive; however, extended life of tanks suggests at least low risk of leakage.

g) Criticality Safety: Low Risk - Insufficient plutonium is present to pose a hazard.

h) Radiological Hazard: The sludge in tank 231-W-151-002, containing greater than 15 Ci of transuranics, represents a moderate handling hazard.

i) Heat Generation: Low Risk - Lack of data and suspected lack of heat generation exist.

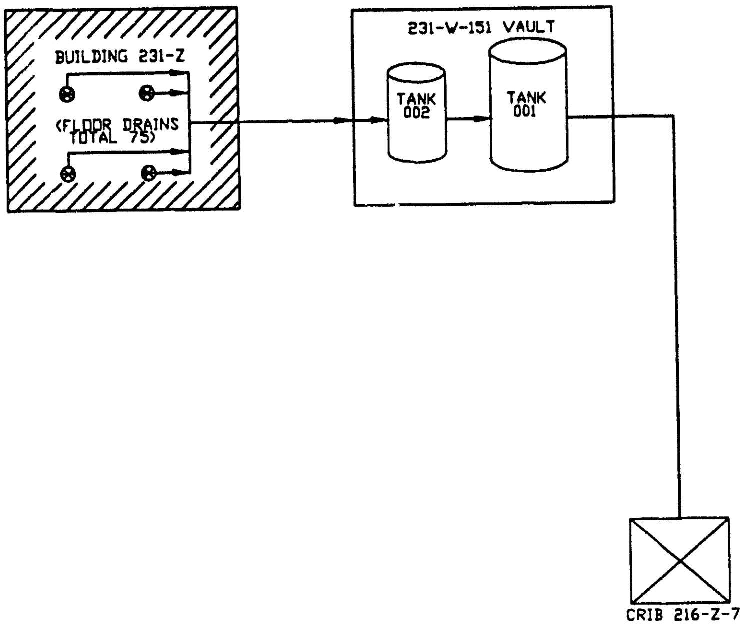

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Figure A-24. Flow Diagram, Vault Settling Tanks 231-W-151.

DATA SHEET
TANK 241-CX-70

Tank Integrity:	Waste Holding	Coordinates:	N42100/W50200
Nominal Capacity:	30,000 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1993c)
Arrangement:	Vertical	Sludge Volumes:	None (empty)
Construction Material:	12" concrete walls (bottom varies from 0.8 to 2 ft. in thickness) lined with 1/4" stainless steel plate	Supernatant Volume:	None (empty)
Reference Drawings	H-2-4319, H-2-44501, sheet 82	Current Status:	Monitoring system is present to detect leakage into the tank; tank is inspected monthly.

History of Operation:

Tank 241-CX-70 is a cylindrical concrete structure, 20 ft. in diameter and 15 ft. high, constructed with 12 in. thick concrete walls and top and a bottom 2 ft. thick at the edges tapering to 9 in. in the center. It is lined with 1/4 in. stainless steel. The tank was used to hold high level process waste from the REDOX process at the 201-C Facility before the waste was sent to a nearby tank farm. It was used from 1952 through 1957 (Rymarz and Speer 1991).

Decommissioning work began on this tank in 1984. In 1987 and 1988 a large amount of the waste was removed from the tank by sluicing and sent to the tank farms. Golder communication (Appendix D, page D-1) states that the tank is now completely empty and that it is sealed up and monitored monthly.

There were no unplanned releases identified as associated with this tank.

Potential Safety Issues:

Not Applicable. Tank is empty.

*Flow diagram on page A-85.

DATA SHEET
TANK 241-CX-71

Tank Category:	Neutralization	Coordinates:	N42110/W50190
Nominal Capacity:	1,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1993c)
Arrangement:	Vertical	Sludge Volume:	930 gallons
Construction Material:	Stainless Steel, Concrete Foundation	Supernatant Volume:	
Reference Drawings	H-2-44501, sheet 82	Current Status:	Tank is inspected monthly.

History of Operations

Tank 241-CX-71 is a vertical cylinder, 6.85 ft. high with a 5 ft. diameter. The tank was in service from 1952 to 1957. It was used for neutralization of acidic 201-C process condensate and coil and condensate cooling water from the 201-C Building. The tank may also have received process condensates from REDOX and PUREX pilot plant operations, decontamination flushes, and hot shop sink waste (DOE-RL 1993c). Neutralized effluent from the tank was originally directed to the 216-C-1 crib and was later sent to the 216-C-5 crib. Additional limestone could be added through a large central riser pipe as dissolution of the limestone bed occurred.

Analytical data is available from 1990 which shows significant quantities of many chemical constituents and relatively low levels of radioactive contaminants (see Appendix B). High levels of radioactivity were reportedly detected in soils overlying the tank in 1991.

The tank was reported to be isolated in 1979 but there does not appear to be any documentation to support this assertion. The upper section of the tank was filled with grout in 1986.

No unplanned releases have been documented for this tank (DOE-RL 1993c).

Potential Safety Issues

a) Hydrogen Buildup: Very little void volume and a lot of chemicals and low levels of radioactive materials. There would seem to be significant risk of hydrogen buildup in this tank - moderate to high.

b) Ferrocyanide: Cyanides are present but not in quantities expected to result in an explosion. Low Risk.

c) Organic Salts: Organic compounds were found in the tank and organic salts are likely to exist there also. High Risk.

d) Flammability: The tank is out-of-service and the contents are covered with grout, so there should be no risk.

e) Vapor Emission: High risk that there would be vapor emissions if the tank is not isolated or if it were opened.

f) Tank Integrity: Low Risk - The tank is 40 years old and is subject to corrosion on the inside and the outside. Tank inspections and knowledge of the constituents would be required to determine tank integrity.

g) Criticality Safety: The plutonium content of this tank appears to be very low. Low risk.

h) Radiological Hazard: There is a hazard due to radioactive materials in the tank and from contaminated soil above the tank. High risk.

i) There was no evidence of heat generation causing a temperature rise.

DATA SHEET
TANK 241-CX-72

Tank Category:	Experimental	Coordinates:	N42058/W50072
Nominal Capacity:	2,300 gallons	Reference:	(Rymarz and Speer 1991) (DOE-RL 1993c)
Arrangement:	Vertical	Solids Volume:	653 gallons (2300 gallons including grout)
Construction Material:	Steel	Supernatant Volume:	None
Reference Drawings:	H-2-2554, H-2-44501, sheet 82	Current Status:	Sampling or cleanup of the tank has been deferred to the CERCLA operable unit activities; tank is inspected monthly.

<u>History of Operations</u>

Records indicate that tank 241-CX-72 received process waste exclusively from pilot studies of PUREX process, for terminal storage. Fluids, some containing fluorine compounds, from the decontamination of the operational areas at the Semiworks following the PUREX study may also have gone into this tank. Studies of waste self-concentration, as well as the investigations of bumping phenomenon in waste tanks, were conducted in the tank (Subrahmanyam 1989).

Tank 241-CX-72 is a vertical cylindrical vessel, made of 3/8-inch carbon steel, the tank measures 40 inches in diameter and 35.6 feet in length. The tank is enclosed in a 6 foot diameter caisson made of 1/2-inch carbon steel with a 12-inch concrete reinforced base. In addition to two 8-inch risers, a 3-inch dry well is located at the periphery of the tank. Records indicate that this tank was in operation for less than one year.

Analytical data is available from 1974 showing a sludge quantity of 73.5-inches and a liquid quantity of 1-inch. The amount of waste was recorded at different levels during the next few years and the data is difficult to interpret. There have been a number of efforts to explain discrepant data.

In 1986 it was decided the tank was empty and it was filled with grout. In 1988 an agitator rod from the paddle system was found to have been accidentally pulled approximately 15 feet out of the tank. The rod was determined to be contaminated. Due to the levels of contamination on the equipment a further study of the tank was initiated.

Three smears from the "hot" end of the agitator rod were reported to contain, respectively, alpha activities of 2000, 7000, 8000 disintegrations per minute(dpm). Gamma activities of 2.64E3, 4.46E3, and 5.81E3 pCi in each of the three smears with a beta/gamma ratio of 25:1 (Subrahmanyam 1989).

Radiological characterization investigations were conducted. Based upon these investigations radiation dose rate and neutron flux measurements strongly suggest the presence of a minimum 10-foot layer of radioactivity at the tank bottom The activity layer is dry and contains little, if any, hydrogenous materials to thermalize the neutrons generated within the contents of the tank. Based on an objective evaluation of all pertinent data, it is concluded that the activity layer at the bottom of the tank contains fission product activities mixed with a most probable 150 to 200 grams of fissile isotope, Pu-239 (Subrahmanyam 1989).

There are no unplanned releases associated with this tank (DOE-RL 1993c).

Potential Safety Issues

a) Hydrogen Buildup: There should be a low risk of hydrogen buildup.

b) Ferrocyanide: No risk - This tank was not in service when they were used.

c) Organic Salts: Low risk because minimal organic salts present.

d) Flammability: No risk because of grout cover.

e) Vapor Emission: No risk because of grout cover.

f) Tank Integrity: Low risk.

g) Criticality Safety: Low risk - The plutonium quantity is estimated at 200 grams maximum which is below a critical mass quantity.

h) Radiological Hazard: Neutron measurements have shown that there is a high risk condition in this tank.

i) Heat Generation: High risk - Heat is being generated in this tank which may cause unexpected chemical reactions.

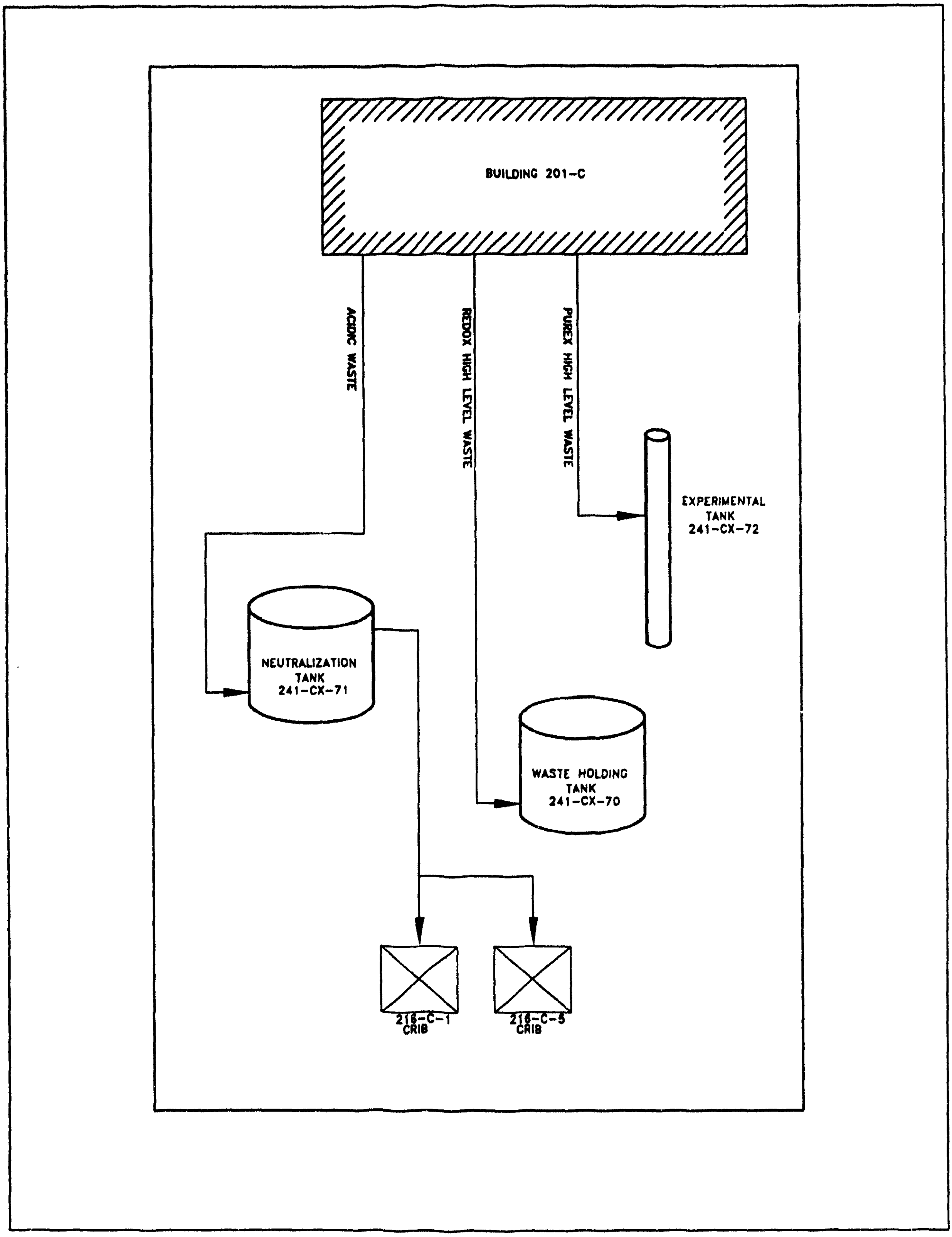

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Figure A-25. Flow Diagram, Tanks 241-CX-70, 241-CX-71, 241-CX-72.

DATA SHEET
TANK 244-BXR-001

Tank Category:	Cylindrical	Coordinates:	N45201/W53531
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	7,215 gallons
Dimensions:	20 ft. Tall X 20 ft. Dia.		
Construction Material:	1/4" Carbon Steel	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-71655, H-2-44501, Sheet 129	Current Status:	Isolated

Period of Operations: 1951 - 1957

History of Operations

Tank 244-BXR-001 is located in an individual cell inside of the BXR vault. The concrete cell contains a sump with a capacity of 45 gallons. Each cell within the vault is separated from the adjacent cell by a 2 ft. thick concrete wall.

When in service, the tank was used as a slurry accumulation tank receiving a maximum of 13,720 gallons/day of metal waste slurry from tanks in the BX and BY Tank Farms. The attached flow diagram shows the destination of slurries pumped out of tank 244-BXR-001.

The vault containing tank 244-BXR-001 was isolated as a single system in 1985. Isolation was accomplished by cutting and capping pipes and ducts outside of the vault, sealing a conduit trench, and installing a weather cover over the vault at grade level. Separate samples were collected from the 244-BXR-001 tank and sump during 1984 and analyzed. The results for the tank sample, as recorded in the 1984 Rockwell International internal letter are reported below (WHC 1975-1985).

Analysis of a 1984 Liquid Sample

Component	Result	Component	Result
OH^- (M)	*	Total Alpha (μCi/L)	13.30**
NO_2^- (M)	0.147	Total Beta (μCi/L)	1.93×10^4**
NO_3^- (M)	0.332	Gamma Energy Analysis (Cs-137, μCi/L)	1.01×10^4**
pH	9.91		

*Unable to run hydroxide analysis because pH is too low.
**Activity level as reported in 1984.

Potential Safety Issues

a) Hydrogen Buildup: Hydrogen may exist in sealed risers. Safety precautions are recommended when opening a riser. Low Risk.

b) Ferrocyanide: Low Risk.

c) Organic Salt: Small amounts of organics exist in tank 244-BXR-001; however, low tank temperature will not support initiation of an organic salt reaction. Low Risk.

d) Flammability: Feed material to this tank originated in the BX and BY Tank Farms. Since the tanks feeding tank 244-BXR-001 are not considered to contain flammable gases, it is assumed that 244-BXR-001 does not contain flammable material. Low Risk.

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined. Hence, toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: There is no information available on the present condition of the tank. Low Risk.

g) Criticality Safety: Sufficient sample information is not available to make a determination on criticality safety. However, the feed tanks to 244-BXR-001 received only waste from various chemical processes. It is reasonable to conclude that a sufficient concentration of fissionable material does not exist in tank 244-BXR-001 for a fission event to occur. Low Risk.

h) Radiological Hazards: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There is no evidence to indicate heat generation by chemical reaction or fission product activity. Low Risk.

DATA SHEET
TANK 244-BXR-002

Tank Category:	Cylindrical	Coordinates:	N45201/W53531
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	1,805 gallons
Dimensions:	12 ft. Tall X 14 ft. Dia.		
Construction Material:	1/4" Type 347 stainless steel	Supernatant Volume:	380 gallons
Reference Drawings:	H-2-71655, H-2-44501, Sheet 129	Current Status:	Isolated

Period of Operations: 1951 - 1957

<u>History of Operations</u>

Tank 244-BXR-002 is located in an individual cell inside of the BXR vault. The concrete cell contains a sump with a capacity of 45 gallons. The sump may contain ferrocyanide discharged from the 241-BXR-151 diversion box. The box is on the ferrocyanide waste transfer route. Each cell within the vault is separated from the adjacent cell by a 2 ft. thick concrete wall.

Tank 244-BXR-002 contains in-tank cooling coils. The coils were capable of transferring 1,202,000 BTU/hr of heat out of the tank. When in service, the tank was used as a blend tank. Under normal conditions a slurry stream was brought in from tank 244-BXR-001 and mixed with nitric acid. It received a maximum of 14,230 gallons/day from tank 244-BXR-001 and a maximum of 7,800 gallons/day nitric acid. The solutions were then pumped to tank 244-BXR-011.

The 244-BXR vault containing tank 244-BXR-022 was isolated as a single system in 1985. Isolation was accomplished by cutting and capping pipes and ducts outside of the vault, sealing a conduit trench, and providing a weather seal over the vault cover blocks at grade level. A Rockwell International internal letter presents the analytical results for tank 244-BXR-002 samples collected in 1978 (Rockwell International 1974). Samples were also collected in 1984 from the 244-BXR-002 tank and sump. The analytical results for the tank sample, as reported in the Rockwell International internal letter dated June 11, 1984 are presented below (WHC 1975-1985).

<u>Analysis of a 1984 Liquid Sample No. R9879 (Activity Levels as Reported in 1984)</u>

Component	Results	Component	Results
NO_2 (m)	0.0515	Total Alpha (μCi/L)	0.393
OH (m)	*	Total Beta (μCi/L)	1.53×10^3
NO_3 (m)	0.173	Gamma Energy Analysis (cesium-137, μCi/L)	5.19×10^2
pH	9.55		

Volume % of Solids** Tr

*Too low to measure
**Visual estimation

Potential Safety Issues

a) Hydrogen Buildup: Hydrogen may exist in sealed risers. Safety precautions are recommended when opening a riser. Low Risk.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Low Risk - Organic salts may exist in tank 244-BXR-002; however, low tank temperature will not support initiation of an organic salt reaction.

d) Flammability: Feed material to this tank originated in tanks in the BX, BY and B tank farms. Since the tanks feeding the 244-BXR-002 tank are not considered to contain flammable gases, it is assumed that 244-BXR-002 does not contain flammable material. Low Risk.

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: There is no information available on the present condition of the tank. Low Risk.

g) Criticality Safety: Sufficient sample information is not available to make a determination on criticality safety. However, the feed tanks to BXR-02 received only waste fr[illegible] various chemical processes. It is reasonable to conclude that a sufficient concentra[illegible] of fissionable material does not exist in Tank BXR-02 for a fission event to occur. [illegible] Risk.

h) Radiological Hazards: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There is no evidence to indicate heat generation by chemical reaction of fission product activity. Low Risk.

DATA SHEET
TANK 244-BXR-003

Tank Category:	Cylindrical	Coordinates:	N45201/W53531
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	1,449 gallons
Dimensions:	12 ft. Tall X 14 ft. Dia.		
Construction Material:	Type 347 stainless steel 1/4"	Supernatant Volume:	356 gallons
Reference Drawings:	H-2-71655, H-2-44501, Sheet 129	Current Status:	Isolated
Period of Operations:	1951 - 1957		

History of Operations

Tank 244-BXR-003 is located in an individual cell inside of the BXR Vault. The concrete cell contains a sump with a capacity of 45 gallons. Each cell within the vault is separated from the adjacent cell by a 2 ft. thick concrete wall.

Tank 244-BXR-003 was configured and used identically to tank 244-BXR-002. The tanks were used as a pair in waste blending operations.

The 244-BXR vault containing tank 244-BXR-003 was isolated as a single system in 1985. Isolation was accomplished by cutting and capping pipes and ducts outside of the vault, sealing a conduit trench, and providing a weather seal over the vault cover blocks at grade level. The tank and vault sump were sampled in 1984 as part of the isolation project. The analytical results for the tank samples are presented below, as reported in a Rockwell International internal letter dated May 8, 1984 (WHC 1975-1985).

Analysis of a 1984 Liquid Sample No. R9881 (Activity Levels as Reported in 1984)

Component	Results	Component	Results
OH (m)	*	Total Alpha (μCi/L)	0.93
N02 (m)	0.0145	Total Beta (μCi/L)	8.99×10^4
N03 (m)	0.627	Gamma Energy Analysis	6.03×10^3
pH	10.10		

*Unable to run hydroxide analysis because pH is too low.

Potential Safety Issues

a) Hydrogen Buildup: Hydrogen may exist in sealed risers. Safety precautions are recommended when opening a riser. Low Risk.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Organic salts may exist in tank 244-BXR-003; however, low tank temperature will not support initiation of an organic salt reaction. Low Risk.

d) Flammability: Feed material to this tank originated in the BX, BY and B tank farms. Since the tanks feeding the 244-BXR-003 tank are not considered to contain flammable gases, it is assumed that 244-BXR-003 does not contain flammable material. Low Risk.

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: There is no information available on the present condition of the tank. Low Risk.

g) Criticality Safety: Sufficient sample information is not available to make a determination on criticality safety. However, the feed tanks to 244-BXR-003 received only waste from various chemical processes. It is reasonable to conclude that a sufficient concentration of fissionable material does not exist in tank 244-BXR-003 for a fission event to occur. Low Risk.

h) Radiological Hazards: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There is no evidence to indicate heat generation by chemical reaction of fission product activity. Low Risk.

DATA SHEET
TANK 244-BXR-011

Tank Category:	Cylindrical	Coordinates:	N45201/W53531
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992)
Dimensions:	20 ft. Tall X 20 ft. Dia.		
Arrangement:	Vertical	Sludge Volume:	7,020 gallons
Construction Material:	Type 347 stainless steel, 1/4"	Supernatant Volume:	98 gallons
Reference Drawings:	Project B-231 RHC-CD-977 H-2-21655, H-2-44501, Sheet 129	Current Status:	Isolated

Period of Operation: 1951 - 1956

History of Operations

Tank 244-BXR-011 is located in an individual cell inside of the 244-BXR vault. The concrete cell contains a sump with a capacity of 45 gallons. Each cell within the vault is separated from the adjacent cell by a 2 ft. thick concrete wall.

When in service, the tank was used as a pump tank for the Uranium Recovery operations. It received approximately 27,200 gallons per day of acid solutions from tanks 244-BXR-002 and 244-BXR-003. The solutions were pumped from 244-BXR-011 to 241-ER-151 diversion station and from there to U Plant for uranium recovery. According to a December 4, 1978, Rockwell International internal letter, tank 244-BXR-011 solids were sampled and analyzed (WHC 1975-1985). The analytical results as reported in 1978 are as follows:

Analysis of Tank 244-BXR-011 Solids Sample No. 1628 (Activity Levels as Reported in 1978)

Components	Water Soluble	Acid (Fusion)
Al*	0.06%	2.3%
Bi^{3+}	NR	
$CO^{2}_{3}{}^{-}$	2.2%	
CrO^{-}_{4}	NR	
Cl*	NR	
F*	0.006%	
Fe*	0.003%	0.95
Hg*	NR	
K+	NR	

Components	Water Soluble	Acid (Fusion)
La^{3+}	NR	
^{106}Rh	NR	0.278 µCi/g
^{125}Sb	NR	0.964 µCi/g
$N0^{-}_{2}$	1.5%	
$N0^{-}_{3}$	3.3%	4.0%
Na+	10.8%	
OH-	<0.6%	
$P0^{3}_{4}$-	0.003%	2.3%
$S0^{2}_{4}$-	<1.0%	<1.0%
$Si0^{2}_{2}$-	0.03%	5.0%
U*	1.56×10^{-4} g/g	9.34×10^{-4} g/g
Pu*	2.80×10^{-9} g/g	3.75×10^{-7} g/g
Am*	$<2.10 \times 10^{-11}$ g/g	3.18×10^{-8} g/g
$89+90Sr^{2+}$	0.54 µCi/g	85.5 µCi/g
^{137}Cs+	11.1 µCi/g	23.0 µCi/g
^{155}Eu*	NR	11.03 µCi/g
TOC	1.69 g/l	
Ce	11.1 µCi/g	0.114 µCi/g
Water Solubility	18.0 %	
Bulk Density	0.564 g/cc	
Percent Water	66.0	

*All oxidation states
NR - Analysis not requested

The 244-BXR vault containing tank 244-BXR-011 was isolated as a single system in 1985. Isolation was accomplished by cutting and capping pipes and ducts outside of the vault, sealing a conduit trench, and providing a weather seal over the vault cover blocks at grade level.

The literature indicates that the wall of the tank is buckled. Occurrence report 79-70 describes the condition of the tank. The tank failure was due to an overpressure condition on the exterior of the tank from a higher than allowed liquid level in the cell.

Potential Safety Issues:

a) Hydrogen Buildup: Hydrogen may exist in sealed risers. Safety precautions are recommended when opening a riser. Low Risk.

b) Ferrocyanide: Low Risk.

c) Organic Salts: Organic salts may exist in tank 244-BXR-011; however, low tank temperature will not support initiation of an organic salt reaction. Low Risk.

d) Flammability: Feed material to this tank originated in tanks in the BX, BY and B tank farms. Since the tanks feeding the 244-BXR-011 tank are not considered to contain flammable gases, it is assumed that 244-BXR-011 does not contain flammable material. Low Risk.

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: As discussed previously, the tank has buckled. There is no additional information available to make a determination on the integrity of the tank. Low Risk.

g) Criticality Safety: Sufficient sample information is not available to make a determination on criticality safety. However, the feed tanks to 244-BXR-011 received only waste from various chemical processes. It is reasonable to conclude that a sufficient concentration of fissionable material does not exist in tank 244-BXR-011 for a fission event to occur. Low Risk.

h) Radiological Hazards: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There is no evidence to indicate heat generation by chemical reaction or fission product activity. Low Risk.

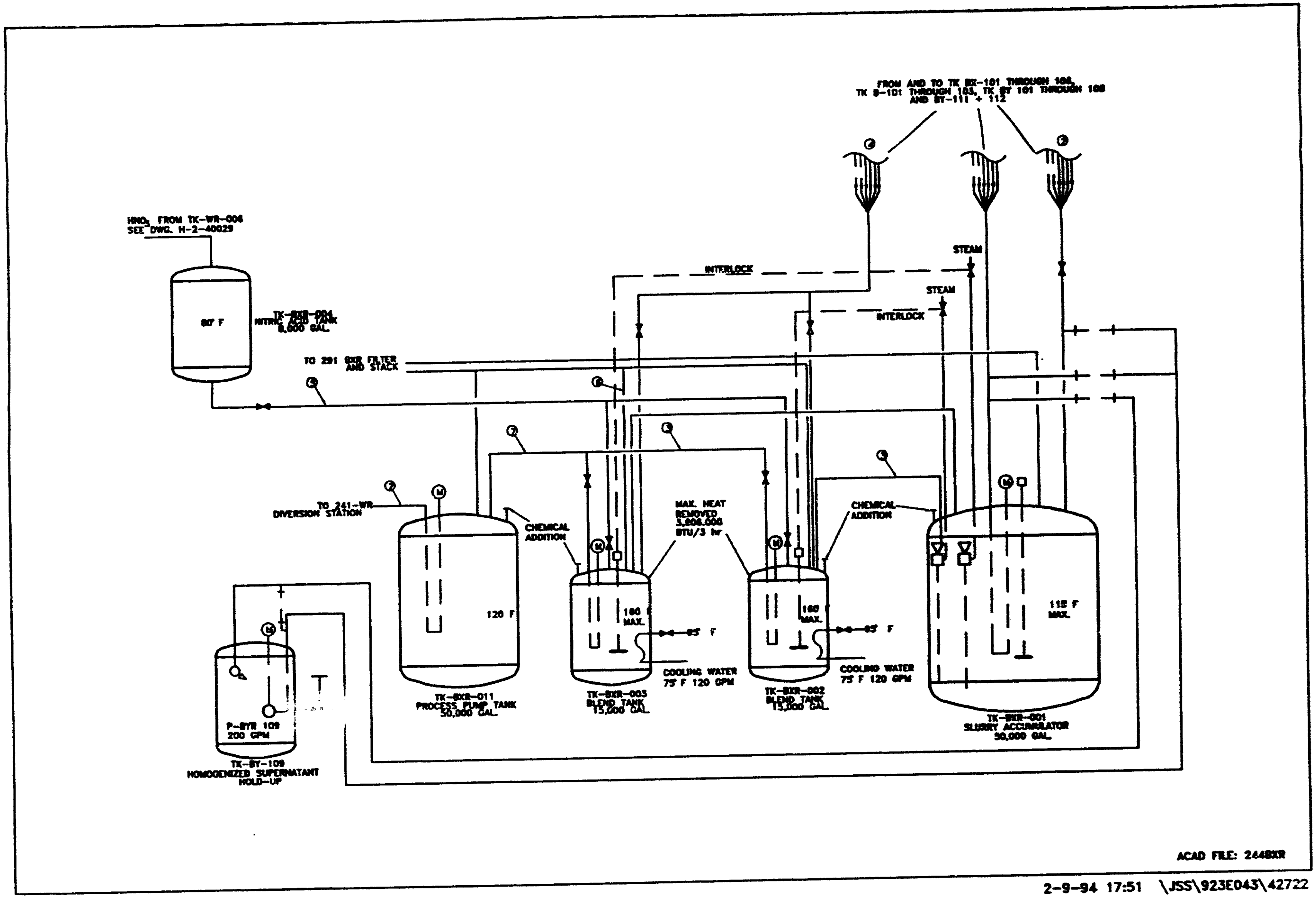

Figure A-26. Flow Diagram, 244-BXR Vault Tanks.

DATA SHEET
TANK 244-TXR-001

Tank Category:	Vault	Coordinates:	N41475/W75795
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	2,291 gallons
Construction Material:	Steel plate, 1/4"	Supernatant Volume:	49 gallons
Reference Drawings:	H-2-42300, H-2-44511, Sheet 110	Current Status:	Isolated

History of Operations

Tank 244-TXR-001 is a vertical cylindrical tank, 20 ft. in diameter and 20 ft. tall with dished ends. The tank was in service from 1951 to 1956, during which time it received $BiPO_4$ metal waste from three tanks in T Tank Farm (101, 102, 103) and six tanks in the TX Tank Farm (103, 104, 105, 106, 107, 108). It was used as an accumulator tank and the waste slurry was pumped from this tank to 244-TXR-002 and/or 244-TXR-003 acidification and blending. The purpose and functioning of 244-TXR-001 were the same as 244-BXR-001 (see data sheet for this tank). The tank was stabilized in November, 1984 and it probably was isolated earlier. Records have been located which discuss isolation plans.

A Rockwell International internal letter dated May 8, 1984 (WHC 1975-1985) reports the analytical results for samples collected from the 244-TXR-001 tank and also samples from the associated sump. The tank sample results (R9885), as reported in 1984 are presented below:

Analyses of Liquid from the 244-TXR-001 Tank (Activity Levels as Reported in 1984)

Component	Result
OH-	*
$N0_2$-	0.108
$N0_3$	0.443
Total Alpha (μCi/L)	1.05
Total Beta (μCi/L)	4.51×10^3
Gamma Energy Analysis (Cs-137, μCi/L)	4.49×10^3
pH	9.52

*Sample pH too low to run hydroxide analysis

Hanford Occurrence Report 79-68 relates to this tank and it concludes that the tank is of "questionable integrity."

Potential Safety Issues

a) Hydrogen Buildup: Low Risk - Large Void Volume

b) Ferrocyanide: Low Risk.

c) Organic Salts: Low Risk

d) Flammability: Low Risk

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: High Risk - Questionable as per UOR-79-68.

g) Criticality Safety: Low Risk - Significant amounts of plutonium were never introduced into this tank.

h) Radiological Hazard: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

DATA SHEET
TANK 244-TXR-002

Tank Category:	Vault	Coordinates:	N41475/W75795
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	2,945 gallons
Construction Material:	Type 347 stainless steel, 1/4"	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-42300, H-2-44511, Sheet 110	Current Status:	Isolated

Period of Operations: 1951 - 1956

History of Operations

Tank 244-TXR-002 is a cylindrical vertical vessel, 14 ft. in diameter by 12 ft. high with disked ends. The tank was in service from 1951 to 1956. Waste slurry was transferred to the tank from 244-TXR-001, nitric acid was added to dissolve uranium oxide, and the resulting solution was pumped to U Plant as the feedstock for the uranium recovery (TBP) process. The purpose and functioning of 244-TXR-002 were the same as 244-BXR-002. The tank was stabilized in November, 1984 and it probably was isolated earlier. Records have been located which discuss isolation plans.

The results of chemical analysis for a liquid sample from the 244-TXR-002 tank received at the 222-S laboratory on July 31, 1975 are presented below (Neilsen 1992). The radioactivity levels were not adjusted to account for radioactive decay that has occurred since 1975. Also presented below are estimated radionuclide inventory for the 244-TXR-002 tank as excerpted from Neilsen (1992).

Chemical and Radionuclide Analyses of Supernatant (Activity Levels as Reported in 1975)

Item	Value
Appearance	Brown
Solids:	<1%
pH	12.3
SpG	1.05 g/cc
OH	490 mg/L
Al	630 mg/L
Na	19,400 mg/L
NO_2	410 mg/L
NO_3	82,500 mg/L
PO_4	460 mg/L
Cl	1,100 mg/L
F	20 mg/L
CO_3	380 mg/L
Radiation Level	1.5 rad/h
Pu	0.72 μg/L
^{134}Cs	100 μCi/L
^{137}Cs	22,000 μCi/L
^{89}Sr, ^{90}Sr	10 μCi/L

Estimated Radionuclide Inventory of Tank 244-TXR-002 (Nielsen 1992)

Radionuclide	Amount
Pu	8.1 mg
^{89}Sr, ^{90}Sr	0.08 Ci
^{134}Cs	0.8 Ci
^{137}Cs	169.2 Ci

Note: Values decay corrected to April 1992.

Potential Safety Issues

a) Hydrogen Buildup: Low Risk - Large Void Volume

b) Ferrocyanide: Low Risk.

c) Organic Salts: Low Risk

d) Flammability: Low Risk

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: Low Risk - Questionable as per UOR-79-68.

g) Criticality Safety: Low Risk - Significant amounts of plutonium were never introduced into this tank.

h) Radiological Hazard: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

DATA SHEET
TANK 244-TXR-003

Tank Category:	Vault	Coordinates:	N41475/W75795
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992)
Arrangement:	Vertical	Sludge Volume:	6,460 gallons
Construction Material:	Type 347 stainless steel, 1/4"	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-42300, H-2-44511, Sheet 110	Current Status:	Isolated

Period of Operations: 1951 - 1956

Content: Similar to analysis for 244-TXR-002.

History of Operations

Tank 244-TXR-003 i cylindrical vertica ssel, 14 ft. in diameter by 12 ft. high with dished ends. The tank was in service from 51 to 1956. Waste slurry was transferred to the tank from 244-TXR-001. nitric acid was added to dissolve uranium oxide, and the resulting solution was pumped to U Plant as the feedstock for the uranium recovery (TBP) process. Tank 244-TXR-003 and 244-TXR-002 were essentially identical in size and function and were probably used in concert to facilitate waste blending operations. [The Data Sheet for the 244-TXR-002 tank summarizes tank data presented by Neilsen (1992)]. The tank was stabilized in November, 1984 and it probably was isolated earlier. Records have been located which discuss isolation plans.

Potential Safety Issues

a) Hydr n Buildup: Low Risk - Large Void Volume

b) Ferrocyanide: Low Risk.

c) Organic Salts: Low Risk

d) Flammability: Low Risk

e) Vapor Emission: Feed material to this tank originated in tanks that contained constituents that may produce toxic vapors when combined, hence toxic vapors may be present in the tank. Moderate Risk.

f) Tank Integrity: Low Risk - Questionable as per UOR-79-68.

g) Criticality Safety: Low Risk - Significant amounts of plutonium were never introduced into this tank.

h) Radiological Hazard: This tank contains several long-lived radionuclides in the sludge. A survey of the tank exterior is required to determine the actual hazard. Moderate Risk.

i) Heat Generation: There was no evidence of heat generation causing a temperature rise.

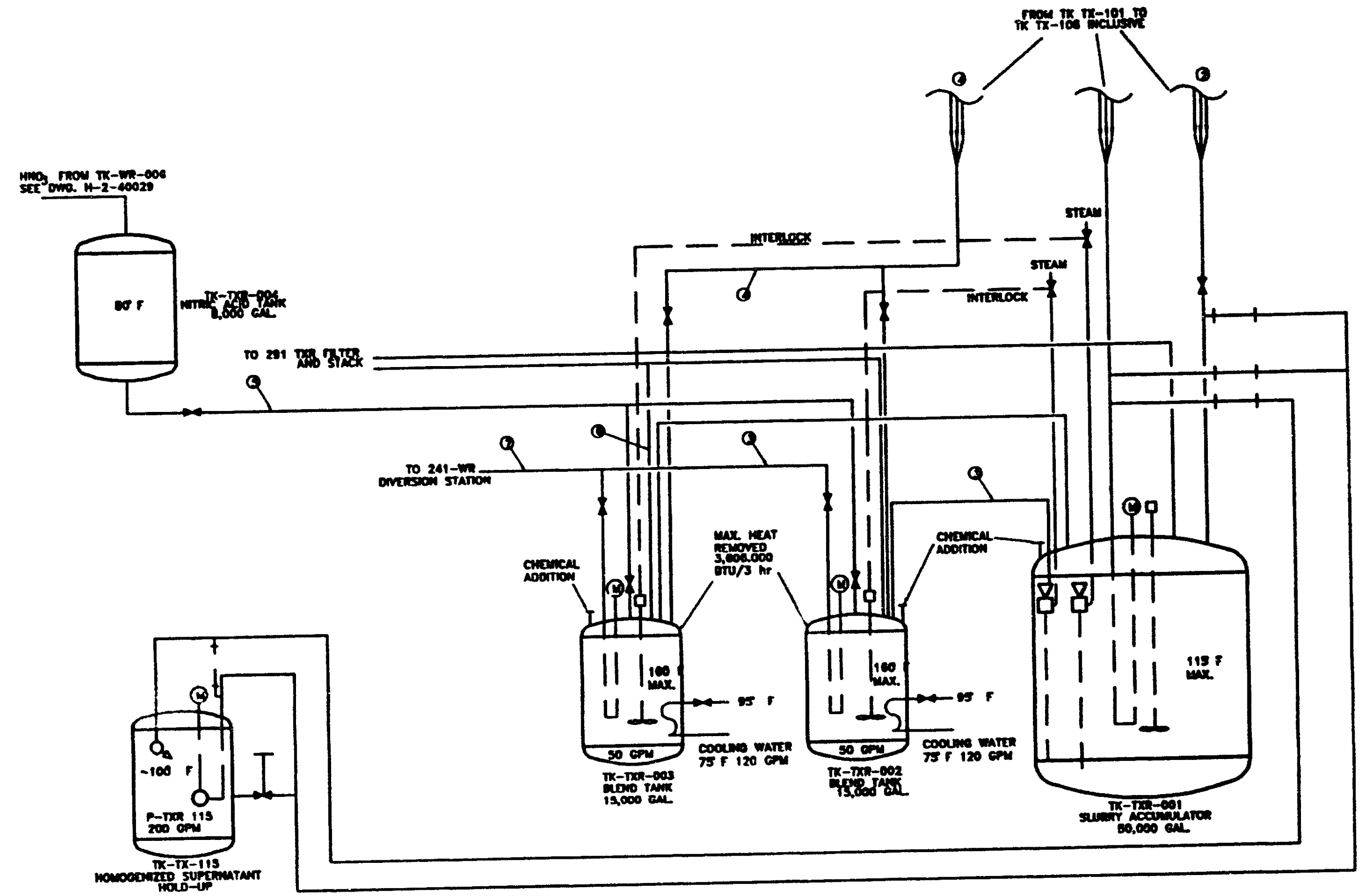

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Figure A-27. Flow Diagram, 244-TXR Vault Tanks.

DATA SHEET
TANK 244-UR-001

Tank Category:	Vault	Coordinates:	N38390/W75750
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	1,852 gallons
Construction Material:	Steel Plate, 1/4"	Supernatant Volume:	390 gallons
Reference Drawings:	H-2-40218, H-2-44511, Sheet 70	Current Status:	Isolated, Stabilized

Period of Operations: 1952 - 1956

Out of Service Date: 1957

History of Operations

The 244-UR vault was constructed in 1951 for use in conjunction with uranium recovery processing conducted in U Plant (221-U). The function of the vault included reception of uranium-bearing waste slurries from tanks U-101, 102, 103, and 107 in the 244-U Tank Farm, which at that time contained neutralized metal waste generated by the original $BiPO_4$ process. The vault was used for subsequent blending, pH adjustment (acidification) and conditioning of this waste as feed material for the TBP uranium extraction process in the U Plant Canyon. The flow diagram accompanying this data sheet depicts the four tanks in the 244-UR vault in terms of their historical process function.

Tank 244-UR-001 was used as a slurry accumulator tank (compare 244-BXR vault tank 244-UR-001 and 244-TXR vault tank 244-UR-001). As such, it was used as the collection point for waste slurries sluice-mined from the U Tank Farm. The accumulated wastes were pumped from tank 244-UR-001 to other tanks in the vault for further conditioning (see data sheets for tanks 244-UR-002 and 244-UR-003).

The UR Vault was used until 1956 and was taken out of regular service in 1957. Apparently, the vault tanks were not used after this time and the entire vault was interim stabilized in 1985.

Presumably, some wastes (sludges & liquids) were left in the tanks of the 244-UR vault at the close of active vault use in the 1950's as records from the 70's and early 80's report varying amounts of wastes in the tanks and tank pits/sumps. Apparently, intrusion of water (precipitation) from the ground surface above the vault contributed to the varying amounts of liquid found in the tank pits during this period. The records associated with the tank isolation project of the mid 80's provide the most reliable current estimates of tank and tank pit waste volumes. These estimates are provided in the header of the data sheet.

According to the U Plant Source Aggregate Area Management Study Report (DOE-RL 1992c), one unplanned release has been identified for this vault. This unplanned release (UPR-200-W-24) occurred in 1953 and was the result of a violent chemical reaction in the 244-UR-002 blending tank involving metal waste supernate. The contaminated area was backfilled and stabilized; however, the vault lies in a low area and water runoff has spread contamination beyond the immediate vault area. Employee descriptions of the area surrounding the tank, as described in the U Plant AAMS (DOE-RL 1992c) indicate that the soils surrounding the vault were covered with "yellowcake" (uranium oxide). Radiation readings of 500 to 1,000 ct/min were observed. This contaminated area was stabilized by laying sheets of lead over the soils and covering the lead sheets with clean soil. The U Plant AAMS noted that the employee's descriptions cannot be verified (DOE-RL 1992c).

Limited analytical data on the contents of tank 244-UR-001 are available from a 1977 ARHCO employee memorandum (Walker 1977) (Radioactivity levels are reported in 1977).

pH	7.5
Radiation Level	25 mrad/hr
SpG	1.0
^{137}Cs	1.8 X 10^3 μCi/gal
U	2.0 X 10^{-3} g/gal
Total Beta	3.2 X 10^3 μCi/gal
Total Alpha	1.2 X 10^{-1} μCi/gal

Also, limited information on the contents of the 244-UR-001 sump were reported in Walker (1977) and are presented below (radioactivity levels as reported in 1977):

pH	8.6
Radiation Level	30 mrad/hr
^{137}Cs	1.7 X 10^3 μCi/gal
Total Beta	2.4 X 10^3 μCi/gal
Total Alpha	5.5 X 10^{-2} μCi/gal

<u>Potential Safety Issues</u>

a) Hydrogen Buildup: Low risk since total waste volume in the tank and sump is limited to about 5,000 gallons of dilute liquid waste. Any hydrogen generated should readily diffuse out of the tank and vault.

b) Ferrocyanide: No risk since little or no ferrocyanides are present and the tank contains mostly water.

c) Organic Salts: Tributyl phosphate-containing wastes were present in this tank, so some amount of organic salts is probably present. However, it is expected that this represents a low risk as the wastes are dilute.

d) Flammability: Low risk as little or no flammable material and no ignition sources are present.

e) Vapor Emission: Low risk because present waste content is not expected to contain significant amounts of volatile material.

f) Tank Integrity: No evidence of leaks emerged in the 1970's. Present waste content is not strongly corrosive, yet design life of the tank has been exceeded; consequently, there is low to moderate risk of tank leakage.

g) Criticality Safety: Low risk (traces of plutonium only).

h) Radiological Hazard: High risk because UPR-200-W-24 resulted in contamination of soils surrounding the vault. Background readings in the vault are in the 1 - 50 mrem range.

i) Heat Generation: Low Risk - No Data

DATA SHEET
TANK 244-UR-002

Tank Category:	Vault	Coordinates:	N38390/W75750
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	2,304 gallons
Construction Material:	Type 347, stainless steel, 1/4"	Supernatant Volume:	214 or 570 gallons (Conflicting Data)
Reference Drawings:	H-2-40218, H-2-44511, Sheet 70	Current Status:	Isolated, stabilized

Period of Operations: 1952 - 1976 (?)

History of Operations

The 244-UR vault was constructed in 1951 for use in conjunction with uranium recovery processing conducted in U Plant (221-U). The function of the vault included reception of uranium-bearing waste slurries from tanks U-101, 102, 103, and 107 in the 244-U Tank Farm, which at that time contained neutralized metal waste generated by the original $BiPO_4$ process. The vault was used for subsequent blending, pH adjustment (acidification) and conditioning of this waste as feed material for the TBP uranium extraction process in the U Plant Canyon. The flow diagram accompanying this data sheet depicts the four tanks in the 244-UR vault in terms of their historical process function.

Tank 244-UR-002 and tank 244-UR-003 were essentially identical tanks used for blending, temperature adjustment, acidification, and venting of wastes received from tank 244-UR-001 of the vault. (Compare tanks 244-UR-002 and 244-UR-003 of the BXR and TXR vaults that were the same in function as these two tanks.) Nitric acid used in this conditioning was received from 244-UR Tank 004 into tanks 244-UR-002 and 244-UR-003.

The UR vault was used until 1956 and was taken out of regular service in 1957. Apparently, the vault tanks were not used after this time and the entire vault was interim stabilized in 1985.

Presumably, some wastes (sludges & liquids) were left in the tanks of the 244-UR vault at the close of active vault use in the 1950's as records from the 70's and early 80's report varying amounts of wastes in the tanks and tank pits/sumps. Apparently, intrusion of water (precipitation) from the ground surface above the vault contributed to the varying amounts of liquid found in the tank pits during this period. The records associated with the tank isolation project of the mid 80's provide the most reliable current estimates of tank and tank pit waste volumes. These estimates are provided in the header of the data sheet.

According to the U Plant Source Aggregate Area Management Study Report (DOE-RL 1992c), one unplanned release has been identified for this vault. This unplanned release (UPR-200-W-24) occurred in 1953 and was the result of a violent chemical reaction in the 244-UR-002 blending tank involving metal waste supernate. The contaminated area was backfilled and stabilized; however, the vault lies in a low area and water runoff has spread contamination beyond the immediate vault area. Employee descriptions of the area surrounding the tank, as described in the U Plant AAMS indicate that the soils surrounding the vault were covered with "yellowcake" (uranium oxide) (DOE-RL 1992c). Radiation readings of 500 to 1,000 ct/min were observed. This contaminated area was stabilized by laying sheets of lead over the soils and covering the lead sheets with clean soil. The U Plant AAMS noted that the employee's descriptions cannot be verified.

A sample of liquid was obtained from cell 2 of the 244-UR vault in 1974 (Sample T-9505) and analyzed (Neilsen 1992). The results as reported in 1974 were as follows:

Visual Appearance:	Yellow, No Solids
Radiation Level	1 mrad/hr
pH	9.1
Al	$<1.30 \times 10^{-3}$ molar
Na	7.32×10^{-2} molar
NO_2	6.45×10^{-4} molar
NO_3	3.06×10^{-2} molar
Pu	$<5.34 \times 10^{-6}$ g/gal
PO_4	$<3.56 \times 10^{-3}$ molar
F	4.14×10^{-5} molar
CO_3	3.25×10^{-2} molar
^{137}Cs	6.70×10^{2} μCi/gal
$^{89,90}Sr$	21.5 μCi/gal
Water	99.95%
SpG	1.01

Although the memo indicates that the sample was from tank 244-UR-002, it is suspected that the sample is actually of the liquid in the pit or sump since the June 7, 1977 ARHCO internal memo (Walker 1977) gives limited analytical results for tank 244-UR-002 and sump contents as follows (Activity levels as reported in 1977):

Tank		Sump	
pH	0.7	pH	9.0
Radiation Level	50 mrad/hr	Radiation Level	10
SpG	1.03	^{137}Cs	1.8×10^{2} μCi/gal
^{137}Cs	3.3 μCi/gal	Total Beta	2.5×10^{2} μCi/gal
Total Beta	5.0×10^{3} μCi/gal	Total Alpha	3.8×10^{-1} μCi/gal
Total Alpha	1.4 μCi/gal		

Potential Safety Issues

a) Hydrogen Buildup: Low risk since total waste volume in the tank and sump is limited to about 3,000 gallons of dilute liquid waste. Any hydrogen generated should readily diffuse out of the tank and vault.

b) Ferrocyanide: No risk since little or no ferrocyanides are present and the tank contains mostly water.

c) Organic Salts: Tributyl phosphate-containing wastes were present in this tank, so some amount of organic salts is probably present. However, it is expected that this represents a low risk as the wastes are dilute.

d) Flammability: Low risk as little or no flammable material and no ignition sources are present.

e) Vapor Emission: Low risk because present waste content is not expected to contain significant amounts of volatile material.

f) Tank Integrity: No evidence of leaks emerged in the 1970's. Present waste content is moderately corrosive and design life of the tank has been exceeded; consequently, there is moderate to high risk of tank leakage.

g) Criticality Safety: Low risk (traces of plutonium only).

h) Radiological Hazard: High Risk. Although background readings in the vault are in the 1 -50 mrem range, unplanned release UPR-200-W-24 resulted in contaminated soil surrounding the vault.

i) Heat Generation: Low Risk - No Data

DATA SHEET
TANK 244-UR-003

Tank Category:	Vault	Coordinates:	N38390/W75750
Nominal Capacity:	15,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	1,568 gallons
Construction Material:	Type 347, stainless steel, 1/4"	Supernatant Volume:	0 gallons
Reference Drawings:	H-2-40218, H-2-44511, Sheet 70	Current Status:	Isolated, stabilized

Period of Operations: 1952 - 1976 (?)

History of Operations

The 244-UR vault was constructed in 1951 for use in conjunction with uranium recovery processing conducted in U Plant (221-U). The function of the vault included reception of uranium-bearing waste slurries from tanks U-101, 102, 103, and 107 in the 244-U Tank Farm, which at that time contained neutralized metal waste generated by the original $BiPO_4$ process. The vault was used for subsequent blending, pH adjustment (acidification) and conditioning of this waste as feed material for the TBP uranium extraction process in the U Plant Canyon. The flow diagram accompanying this data sheet depicts the four tanks in the 244-UR vault in terms of their historical process function.

Tank 244-UR-002 and tank 244-UR-003 were essentially identical tanks used for blending, temperature adjustment, acidification, and venting of wastes received from tank 001 of the vault. (Compare tanks 244-UR-002 and 244-UR-003 of the BXR and TXR vaults that were the same in function as these two tanks.) Nitric acid used in this conditioning was received from 244-UR-004 into tanks 244-UR-002 and 244-UR-003.

The UR Vault was used until 1956 and was taken out of regular service in 1957. Apparently, the vault tanks were not used after this time and the entire vault was interim stabilized in 1985.

Presumably, some wastes (sludges & liquids) were left in the tanks of the 244-UR Vault at the close of active vault use in the 1950's as records from the 70's and early 80's report varying amounts of wastes in the tanks and tank pits/sumps. Apparently, intrusion of water (precipitation) from the ground surface above the vault contributed to the varying amounts of liquid found in the tank pits during this period. The records associated with the tank isolation project of the mid 80's provide the most reliable current estimates of tank and tank pit waste volumes. These estimates are provided in the header of the data sheet.

According to the U Plant Source Aggregate Area Management Study Report (DOE-RL 1992c), one unplanned release has been identified for this vault. This unplanned release (UPR-200-W-24) occurred in 1953 and was the result of a violent chemical reaction in the 244-UR-002 blending tank involving metal waste supernate. The contaminated area was backfilled and stabilized; however, the vault lies in a low area and water runoff has spread contamination beyond the immediate vault area. Employee descriptions of the area surrounding the tank, as described in the U Plant AAMS (DOE-RL 1992c) indicate that the soils surrounding the vault were covered with "yellowcake" (uranium oxide). Radiation readings of 500 to 1,000 ct/min were observed. This contaminated area was stabilized by laying sheets of lead over the soils and covering the lead sheets with clean soil. The U Plant AAMS noted that the employee's descriptions cannot be verified.

The June 7, 1977 ARHCO internal memo (Walker 1977) reports the following analytical results for liquids in tank 244-UR-003 and Sump as follows (activity as reported in 1977):

Tank 244-UR-003		244-UR-003 Sump	
Parameter	Value	Parameter	Value
pH	2.0	pH	1.5
Radiation Level	50 mrad/hr	Radiation Level	10
$^{89,90}Sr$	3.7×10^{3} µCi/gal	Total Beta	6.3×10^{2} µCi/gal
^{137}Cs	9.5×10^{2} µCi/gal	Total Alpha	1.7×10^{-1} µCi/gal
U	2.1×10^{-4} g/gal		
Total Beta	1.1×10^{4} µCi/gal		
Total Alpha	6.7×10^{-2} µCi/gal		

Potential Safety Issues

a) Hydrogen Buildup: Low risk since total waste volume in the tank and sump is limited to about 3,000 gallons of dilute liquid waste. Any hydrogen generated should readily diffuse out of the tank and vault.

b) Ferrocyanide: No risk since little or no ferrocyanides are present and the tank contains mostly water.

c) Organic Salts: Tributyl phosphate-containing wastes were present in this tank, so some amount of organic salts is probably present. However, it is expected that this represents a low risk as the wastes are dilute.

d) Flammability: Low risk as little or no flammable material and no ignition sources are present.

e) Vapor Emission: Low risk because present waste content is not expected to contain significant amounts of volatile material.

f) Tank Integrity: No evidence of leaks emerged in the 1970's. Present waste content is moderately corrosive and design life of the tank has been exceeded; consequently, there is moderate to high risk of tank leakage.

g) Criticality Safety: Low risk (traces of plutonium only).

h) Radiological Hazard: High risk since UPR-200-W-24 resulted in contamination of the soils surrounding the vault. Background readings in the vault are in the 1 - 50 mrem range.

i) Heat Generation: Low Risk - No Data

DATA SHEET
TANK 244-UR-004

Tank Category:	Vault	Coordinates:	N38390/W75750
Nominal Capacity:	8,230 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Empty
Construction Material:	Type 347, stainless steel, 11 gauge	Supernatant Volume:	Empty
Reference Drawings:	H-2-40218, H-2-44511, Sheet 70	Current Status:	Isolated

Period of Operations: 1952 - 1976 (?)

History of Operations

The 244-UR vault was constructed in 1951 for use in conjunction with uranium recovery processing conducted in U Plant (221-U). The function of the vault included reception of uranium-bearing waste slurries from tanks U-101, 102, 103, and 107 in the 244-U tank farm, which at that time contained neutralized metal waste generated by the original $BiPO_4$ process. The vault was used for subsequent blending, pH adjustment (acidification) and conditioning of this waste as feed material for the TBP uranium extraction process in the U Plant Canyon. The flow diagram accompanying this data sheet depicts the four tanks in the 244-UR vault in terms of their historical process function.

Tank 244-UR-004 provided temporary storage for 60% nitric acid used in the waste conditioning and treatment performed in tanks 244-UR-002 and 244-UR-003 of the vault. It did not contain radioactive material and has not been used an any other capacity. Consequently, it is suspected that any residual liquid in the tank consists of non-radioactive acidic waste.

The UR vault was used until 1956 and was taken out of regular service in 1957. Apparently, the vault tanks were not used after this time and the entire vault was interim stabilized in 1985.

Presumably, some wastes (sludges & liquids) were left in the tanks of the 244-UR vault at the close of active vault use in the 1950's as records from the 70's and early 80's report varying amounts of wastes in the tanks and tank pits/sumps. Apparently, intrusion of water (precipitation) from the ground surface above the vault contributed to the varying amounts of liquid found in the tank pits during this period. The records associated with the tank isolation project of the mid 80's provide the most reliable current estimates of tank and tank pit waste volumes. These estimates are provided in the header of the data sheet.

According to the U Plant Source Aggregate Area Management Study Report (DOE-RL 1992c), one unplanned release has been identified for this vault. This unplanned release (UPR-200-W-24) occurred in 1953 and was the result of a violent chemical reaction in the 244-UR-002 blending tank involving metal waste supernate. The contaminated area was backfilled and stabilized; however, the vault lies in a low area and water runoff has spread contamination beyond the immediate vault area. Employee descriptions of the area surrounding the tank, as described in the U Plant AAMS (DOE-RL 1992c) indicate that the soils surrounding the vault were covered with "yellowcake" (uranium oxide). Radiation readings of 500 to 1,000 ct/min were observed. This contaminated area was stabilized by laying sheets of lead over the soils and covering the lead sheets with clean soil. The U Plant AAMS noted that the employee's descriptions cannot be verified (DOE-RL 1992c).

Potential Safety Issues

a) Hydrogen Buildup: No risk since the tank was used only to store nitric acid; no mechanism for hydrogen generation is present.

b) Ferrocyanide: No risk as no ferrocyanides are present in the tank.

c) Organic Salts: No risk since no organic salts were ever contained in the tank.

d) Flammability: No risk since no flammable materials are present.

e) Vapor Emission: Moderate risk as nitric acid residue is probably present which can liberate nitrogen acids.

f) Tank Integrity: No evidence of leaks emerged in the 1970's. Any residual waste would be highly corrosive and design life of the tank has been exceeded; consequently, there is high risk of tank leakage.

g) Criticality Safety: No Risk

h) Radiological Hazard: High risk since UPR-200-W-24 resulted in contamination of the surrounding soils. Background readings in the vault are low

i) Heat Generation: Low Risk - Lack of mechanism for heat generation.

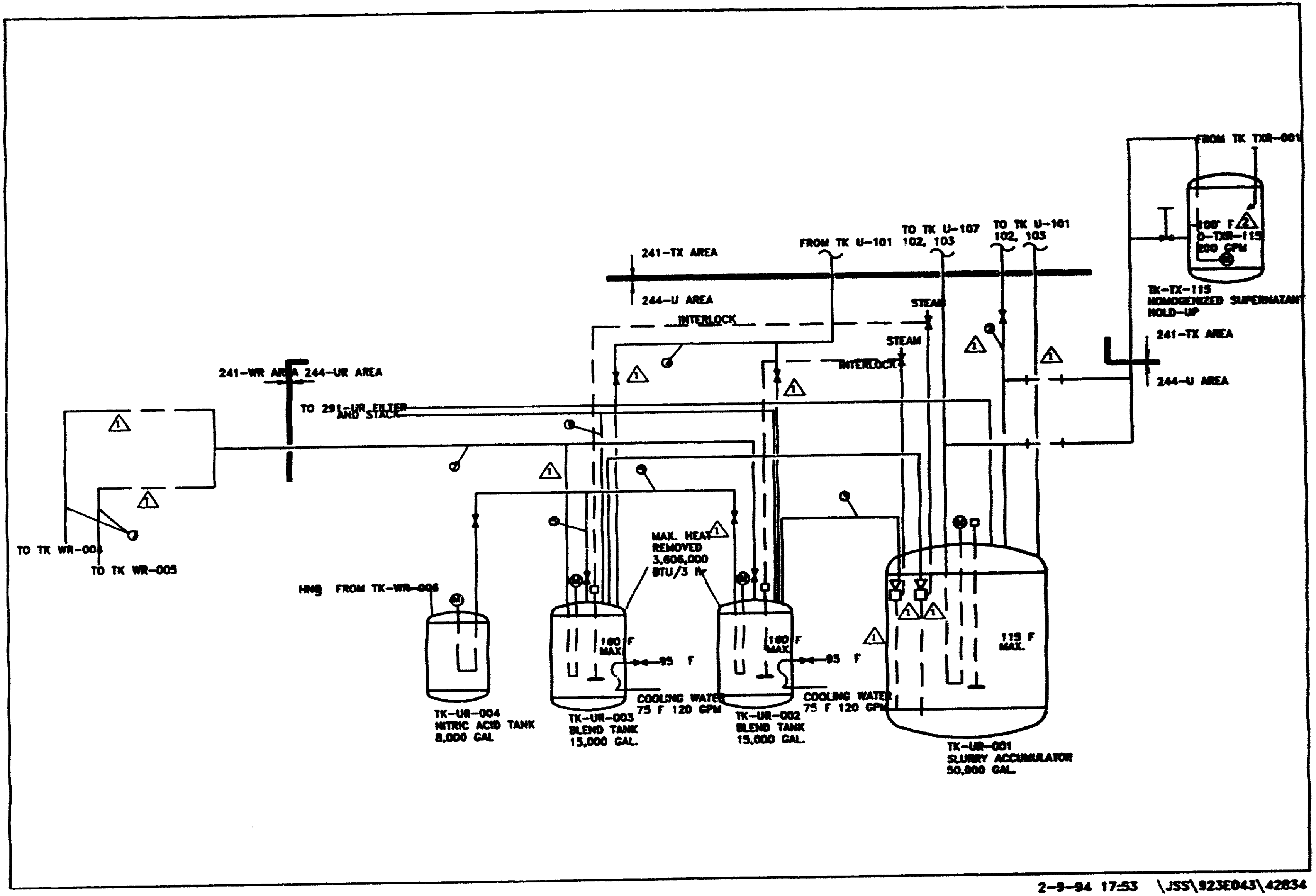

Figure A-28. Flow Diagram, 244-UR Vault Tanks.

DATA SHEET
241-WR VAULT SUMMARY

Tank Category: Vault   Coordinates: N38850/W72850

Period of Operation: 1952 - 1976

History of Operations

The 241-WR vault (also known as the 244-WR Diversion Station and the Thorium Vault) was constructed in 1951 - 1952 for use in conjunction with uranium and thorium recovery processing conducted in U Plant (221-U). The function of the vault included reception of uranium and thorium-bearing waste slurries from tank farms (neutralized metal waste generated by the original $BiPO_4$ process), subsequent blending, pH adjustment (acidification), and conditioning of this waste as feed material for the TBP uranium extraction process in the U Plant Canyon. Also, water generated in the TBP extraction process, as well as 291-U stack condensate and UO_3 evaporator condensate, were received by the vault and subsequently sent to tank farms. The flow diagram accompanying this data sheet depicts all nine tanks in the 241-WR vault in the context of their historical function.

The next use of the 241-WR vault was as a storage repository for 60% thorium nitrate solution; only the original cold side tanks 006, 007, 008, and 009 were designated for this service. It was during this period of use that seepage of liquids through cracks in the wall separating the hot and cold sides of the vault was observed. Ultimately, the thorium nitrate solution in these tanks was removed and the last flushes of these tanks were transferred to underground storage tanks in 1980. Above ground structures, entry ports and vents have been removed and a weather proof cover placed over the vault. However, a completed Stabilization Evaluation form documenting isolation and stabilization has not been located.

Individual data sheets have been prepared for each of the vault tanks that present tank specific historical information.

Potential Safety Issues

The following potential safety issues are generally applicable to the vault and individual tanks, unless specifically identified on the individual tank data sheet.

a) Hydrogen Buildup: As the tank is essentially empty and the sump contains water with low levels of radionuclide contamination, hydrogen generation above more than trace levels is not likely. Any traces of hydrogen generated are expected to diffuse rapidly out of the porous walls and cover of the vault. Low Risk.

b) Ferrocyanides: No Risk - All tanks should be ranked as no risk, except 241-WR-001 and 241-WR-002 which are ranked low risk since minimal quantities of ferrocyanides are expected.

c) Organic Salts: Tributyl phosphate-containing wastes were once present in this tank. However, the tank is now empty and the only TBP or other organic salts now present would be in very dilute form in the liquid in the sump. Low Risk.

d) Flammability: Low risk because the vault is out-of-service and isolated. Also, minimal inflammable material is present.

e) Vapor Emission: Low risk because the vault is out-of-service and isolated.

f) Tank Integrity: Low risk.

g) Criticality Safety: Low risk because of low levels of fissile material.

h) Radiological Hazard: A background radiation reading taken in 1981 in the various tank 241-WR tank pits. The data are presented in the data sheets for individual tanks.

i) Heat Generation: There is no evidence of heat generation anywhere in the 241-WR Vault.

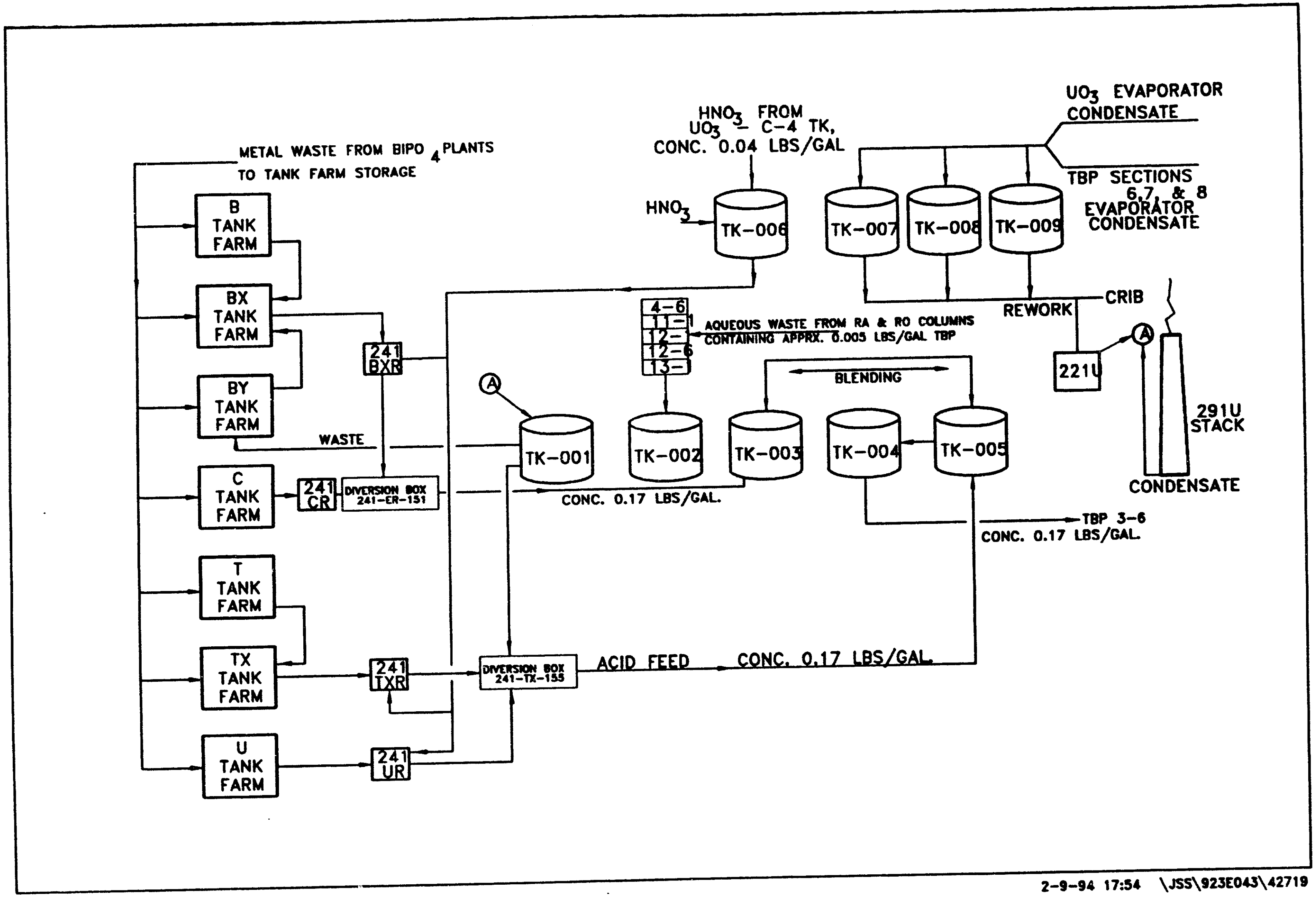

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Figure A-29. 241 WR Vault Process Flow Diagram (1952-1957).

DATA SHEET
TANK 241-WR-001

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, H-2-71667, H-2-71668, H-2-71669,	Current Status:	Isolated

Period of Operation: 1952 - 1976

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-001 was apparently used as a waste pump tank, which received neutralized process waste effluent from 221-U, as well as drainage from the 291-U stack. Effluent from tank 241-WR-001 was routed to tank farms. Refer to the accompanying flow diagram for a depiction of these waste flows. During the thorium storage period (after 1958), tank 241-WR-001 was inactive. A 1965 ISOCHEM memo that lists the then current volumes of liquids in tanks 241-WR-001 - 005 and their sumps mentions that tank 241-WR-001 was collapsed during TBP operation and would not hold liquid. Additional research indicates that in the early 1980's tank 241-WR-001 was probably empty (consistent with the 1965 observation), but that the surrounding pit or sump contained approximately 14,000 gallons of liquid (probably mildly contaminated water).

At least one sample of the 241-WR-001 sump liquid has been taken and analyzed according to Rockwell employees (Appendix D, page D-17); the results were as follows (activity levels are as reported in 1983):

Component	Value
Total Beta (μCi/L)	612
Total Alpha (μCi/L)	2.09×10^{-2}
Cs^{137} (μCi/L)	1.50
Sr^{90} (μCi/L)	187
Pu (g/L)	1.18×10^{-6}
U (g/L)	2.66×10^{-4}
Th (g/L)	$<2.7 \times 10^{-4}$
NO_2 (molar)	0.0198
NO_3 (molar)	0.286
pH	7.73
SpG	0.991

Ferrocyanide may also be present.

Potential Safety Issues

Radiological Hazard: A background radiation reading taken in 1981 in the tank 241-WR-001 pit was 30 mrem. This represents a low radiological hazard.

Tank Integrity: High Risk - The tank was reported to have failed 30 years ago.

Ferrocyanides: Low Risk - Minimal quantities may be present.

DATA SHEET
TANK 241-WR-002

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-002 was used to receive TBP bearing wastes from reverse osmosis columns used in the uranium recovery process conducted at U Plant. Accumulated wastes were sent from tank 241-WR-002 to the tank farms. Apparently, no other use of this tank existed, so residual liquid (if any) in the tank is expected to be similar to the TBP wastes in question (concentration of 0.005 lb TBP/gallon).

An undocumented contamination incident reportedly occurred in the early 1960's when a tank overflowed and filled its cell (DOE-RL 1992c). When the tank was subsequently pumped out, it floated loose from its base, rupturing its lines, jumpers and mechanical connections. A significant cleanup effort was required to return the facility to service. Documentation of this spill is limited to the above information.

Additional correspondence indicates that in the early 1980's, tank 241-WR-002 was empty but that the surrounding pit or sump contained approximately 35,000 gallons of liquid. If the tank had been floating at the time of measurement in 1981, it is more likely that the pit contained 70,000 gallons of liquid at this time.

A sample labeled "002-WR-Vault" was analyzed in 1983, according to Rockwell employees (Appendix D, page D-17); presumably, this sample was taken from liquid in the 241-WR-002 sump. The results as reported in 1983 were as follows:

Component	Concentration
Total Beta (μCi/L)	77.6
Total Alpha (μCi/L)	$< 3.26 \times 10^{-3}$
Cs^{137} (μCi/L)	5.27
Sr^{90} (μCi/L)	57.3
Pu (g/L)	7.22×10^{-7}
U (g/L)	3.14×10^{-3}
Th (g/L)	$< 2.7 \times 10^{-4}$
NO_2 (molar)	8.96×10^{-5}
NO_3 (molar)	0.114

pH	8.75
SpG	0.983

Ferrocyanides may also be present.

Potential Safety Issues

Radiological Hazard: A background radiation reading taken in 1981 in the tank 241-WR-002 pit was 5 mrem. This represents a low radiological hazard.

Ferrocyanides: Low Risk - Minimal quantities may be present.

DATA SHEET
TANK 241-WR-003

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-003 was used to receive uranium and thorium-bearing wastes from tank farms. Tanks 241-WR-003 and 241-WR-005 were used in conjunction in blending and acidifying steps before pumping the treated wastes in tank 241-WR-004, from which the treated wastes were sent as feed stocks to the TBP process. See the process flow diagram for the 241-WR vault.

Apparently tank 241-WR-003 was not used after 1958. In 1965, it was reported that during pumping of the sump, tank 241-WR-003 leaked to the sump until the sump was pumped down to approximately 4 1/2 ft. In 1981, measurements of liquid levels in tank 241-WR-003 were taken, at which time the tank was reported to be empty and the sump was reported to contain 6 1/2" of water. At the present time, it is likely that tank 241-WR-003 remains empty though liquid levels in the sump may have changed.

Potential Safety Issues:

Tank Integrity: The tank has been reported to have leaked; therefore, may pose a high risk.

Radiological Hazard: A background reading taken in 1981 in the tank 241-WR-003 pit was 5 mrem. This represents a low radiological hazard.

DATA SHEET
TANK 241-WR-004

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated

Period of Operation: 1952 - 1976

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-004 was used as a collection tank for acidified and blended uranium-bearing wastes. The wastes were sent directly from tank 241-WR-004 to 221-U for processing. After 1958, tank 241-WR-004 was not used.

A 1965 memo mentions that tank 241-WR-004 was observed to have leaked during a pump-out of the 004 sump. This suggests that the tank is incapable of containing residual waste and this was confirmed by 1981 measurements of liquid levels in the tank and sump. The tank was observed to be empty and the sump was reported to contain 3 1/2" of water.

Potential Safety Issues

Radiological Hazard: A background radiation reading taken in 1981 in the tank 241-WR-004 pit was 1 mrem. This represents a low radiological hazard.

Tank Integrity: High Risk - The tank has been reported to have leaked.

DATA SHEET
TANK 241-WR-005

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-005 was used in the blending and acidifying of uranium and thorium-bearing wastes received from tank farms. It was used in conjunction with tank 241-WR-003 for these operations. Tank 241-WR-005 represented the main point of reception of acid from tank 241-WR-006, which was the main acid storage tank in the 241-WR vault. Apparently, tank 241-WR-005 was not used after 1958. According to uncovered documents, there is no indication that tank 241-WR-005 leaks, and a 1981 observation indicated that both tank 241-WR-005 and its sump are empty.

Potential Safety Issues

Radiological Hazard: A background radiation reading taken in 1981 in the tank 241-WR-005 pit was 10 mrem. This represents a low radiological hazard.

DATA SHEET
TANK 241-WR-006

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-006 was used to store and pump recovered or recycled 60% nitric acid from UO_3 Plant. The acid in this tank was used to acidify the wastes treated in tanks 241-WR-003, 241-WR-004, and 241-WR-005. After 1958, tank 241-WR-006 was used for storage of 60% thorium nitrate solution as described above.

Certain evidence suggests that tank 241-WR-006, along with the other cold side tanks, is presently dry and fairly clean except for some residual thorium nitrate contamination (alpha). Apparently, a sample of liquid from tank 241-WR-006 was taken about 1980 and analyzed. Results as presented at the time of analysis were as follows (WHC 1975-1985):

Parameter	Serial No. T-2754	Serial No. T-2753
SpG	1.0071	1.00705
Total Beta	4.32×10^{-2} µCi/L	6.13×10^{-2} µCi/L
pH	12.3	12.3
Th	1.9×10^{-3} g/L	9.44×10^{-4} g/L
U^{233}	$<5 \times 10^{-5}$ g/L	$<5 \times 10^{-5}$ g/L

DATA SHEET
TANK 241-WR-007

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-007 was used to receive 221-U evaporator condensate. The collected condensate was either discharged to cribs or recycled to Building 221-U. After 1958, tank 241-WR-007 was used for storage of 60% thorium nitrate solution.

Available evidence suggests that tank 241-WR-007, along with the other cold side tanks, is presently dry and fairly clean except for some residual thorium nitrate contamination (alpha).

Apparently, a sample of liquid from tank 241-WR-007 was taken about 1980 and analyzed. Results at the time of analysis were (WHC 1975-1985):

	Serial No. T-2755	Serial No. T-2756
SpG	1.0071	1.0071
Total Beta	5.43×10^{-2} μCi/L	$<3.86 \times 10^{-4}$ g/L
pH	12.3	12.3
Th	5.9×10^{-4} g/L	6.0×10^{-4} g/L
U^{233}	$<5 \times 10^{-5}$ g/L	$<5 \times 10^{-5}$ g/L

DATA SHEET
TANK 241-WR-008

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	Minimal
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-008 was used to receive 221-U evaporator condensate. The collected condensate was either discharged to cribs or recycled to Building 221-U. After 1958, tank 241-WR-008 was used for storage of 60% thorium nitrate solution.

Available evidence suggests that tank 241-WR-008, along with the other cold side tanks, is presently dry and fairly clean except for some residual thorium nitrate contamination (alpha).

DATA SHEET
TANK 241-WR-009

Tank Category:	Vault	Coordinates:	N38850/W72850
Nominal Capacity:	50,000 gallons	Reference:	(Neilsen 1992) (DOE-RL 1992c)
Arrangement:	Vertical	Sludge Volume:	Minimal
Construction Material:	Type 347 stainless steel	Supernatant Volume:	23,000 gallons
Reference Drawings:	H-2-40061, H-2-44511, sheet 75	Current Status:	Isolated
Period of Operation:	1952 - 1976		

History of Operations (Please refer to the 241-WR Vault Summary Sheet for general vault history)

During the period 1952 - 1958, tank 241-WR-009 was used to receive 221-U evaporator condensate. The collected condensate was either discharged to cribs or recycled to Building 221-U. After 1958, tank 241-WR-009 was used for storage of 60% thorium nitrate solution.

Some evidence suggests that tank 241-WR-009, along with the other cold side tanks, is presently dry and fairly clean except for some residual thorium nitrate contamination (alpha). However, another source reports a liquid content of 23,000 gallons in tank 241-WR-009 (Di Pietro 1979).

Armstrong, D.A., 1978, *Conceptual Design Report Isolation of Auxiliary Tanks and Vaults, Project B-223, Line Item JM-78-18-a*, RHO-CD-559-1, Rockwell Hanford Operations, Richland, Washington.

Baldridge, K.F., 1959, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas - 1959*, HW-60807, General Electric Corporation, Richland, Washington.

Bell, N.E., 1984, *Guideline for Declaring Auxiliary Tanks Interim Stabilized*, Revision 0, SD-WM-TI-129 Rev. 0, Rockwell Hanford Operations, Richland, Washington.

Bendixsen, R.B., 1982, *Tank Farm Catch Tanks - Calibration Tables*, Rev. 0, SD-RE-TI-057, Rockwell Hanford Operations, Richland, Washington.

Di Pietro, J.S., 1979, "Auxiliary Tanks Stabilization Plan," Rockwell International Internal Letter to R. A. Zinsli, 60411-79-0047, Rockwell Hanford Operations, Richland, Washington.

DOE-RL, 1992a, *S Plant Aggregate Area Management Study Report*, DOE/RL-91-60 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1992b, *T Plant Source Aggregate Area Management Study Report*, DOE/RL-91-61 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1992c, *U Plant Source Aggregate Area Management Study Report*, DOE/RL-91-52 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1992d, *Z Plant Source Aggregate Area Management Study Report*, DOE/RL-91-58 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1993a, *PUREX Source Aggregate Area Management Study Report*, DOE/RL-92-04 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1993b, *B Plant Source Aggregate Area Management Study Report*, DOE/RL-92-05 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

DOE-RL, 1993c, *Semiworks Source Aggregate Area Management Study Report*, DOE/RL-92-18 Rev. 0, U.S. Department of Energy, Richland Office Operations, Richland, Washington.

Hanlon, B.M., 1994, *Tank Farm Surveillance and Waste Status Summary Report for October 1993*, WHC-EP-0182-67, Westinghouse Hanford Company, Richland, Washington.

Harlow, D.G., 1974, "Disposition and Isolation of Tanks 270-E-1, 241-CS-70, 241-CX-71, and 241-CX-72, Memo to J.A. Teal, Atlantic Richfield Hanford Company, Richland, Washington.

Maxfield, H.L., 1979, *Handbook - 200 Areas Waste Sites*, RHO-CD- 673, Rockwell Hanford Operations, Richland, Washington.

McVey, C.B., 1980, *Isolation of Auxiliary Tank Farm Facilities*, RHO-CD-977, Rockwell Hanford Operations, Richland, Washington.

Neilsen, E.H., 1992, *Miscellaneous Underground Radioactive Waste Tanks*, WHC-EP-0560, Westinghouse Hanford Company, Richland, Washington.

Owens, K.W., and J.C. Sabin, 1984, *Long Range Decommissioning Plan for Rockwell Hanford Operations Surplus Facilities Management Program*, RHO-WM-PL-10, Rockwell Hanford Operations, Richland, Washington.

Rockwell International, 1978, *Analysis of tank Farm Samples, Tank 002-BXR,* letter from manager, Special Analysis to S. Buckingham, Rockwell International, Richland, Washington.

Ruff, W.G., 1990, *Unusual Occurrence Report,* Westinghouse Hanford Company, Richland, Washington.

Rymarz, P.B., and D.R. Speer, 1991, *Summary of Radioactive Underground Tanks Managed by Hanford Restoration Operations*, Revision 0, WHC-SD-DD-TI-057 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Smith, R.M., 1980, *216-B-5 Reverse Well Characterization Study,* RHC-ST-37, Rockwell Hanford Operations, Richland, Washington.

Subrahmanyam, V.B., 1989, *Radiological Evaluation of Hot Semiworks Waste Tank 241-CX-72,* Revision 0, WHC-SD-CP-TI-148, Revision 0, Westinghouse Hanford Company, Analytical Systems Laboratories, Chemical Processing Division, Richland, Washington.

Walker, C.M., 1977, "Isolation Criteria for `Auxiliary´ Tanks," Memo to W.C. Schmidt, Atlantic Richfield Company, Richland, Washington.

WHC, 1975-1985, *Process Aids: Compilation of Technical Letters by Process Development Group,* WHC-IP-0711, Westinghouse Hanford Company, Richland, Washington.

APPENDIX B

WASTE GENERATING PROCESSES

CONTENTS

TABLES:

CONTENTS (Cont.)

TABLES (cont):

This appendix provides a description of the waste processing and tank farm operations at the Hanford Site, as these activities apply to the 50 miscellaneous tanks. This appendix includes a discussion of the various processes and waste streams, a breakdown, by facility, of the waste streams and periods of operation, and an expanded description of the tank farm and waste management activities which impact the composition of waste in the tanks. This appendix is intended to provide details as to the characteristics of the waste which are suspected as being in the miscellaneous tanks.

B.1 PROCESS WASTE STREAMS

Processing activities at the Hanford Site began in 1944 to provide special nuclear materials. Over the 50 year history of the site a variety of processing missions and activities have been performed including nuclear reactor operations, fuel fabrication, production of specialized isotopes in the Fast Flux Test Facility, and chemical processing operations. The key mission at the Hanford Site from 1943 through the late 1980's was the separation of plutonium from irradiated nuclear fuel rods for the nations nuclear weapons program. This mission was pursued for four decades using three distinct separations processes and was supported by a variety of pilot plant, laboratory, and purification processes. These activities all resulted in the generation of waste.

The generation of large quantities of waste materials required a well-coordinated waste management program. As part of this waste management program, tanks were constructed underground to store the highly radioactive waste produced in the separations and support processes. Where the waste contained lower radiation levels, waste was often discharged to underground gravel beds called cribs. In most instances, during the transfer of waste from the processing facilities to waste management units, a miscellaneous tank was involved. As described in this report, these tanks included catch tanks for leaks and spills from diversion boxes, tanks filled with limestone to provide neutralization, tanks constructed to allow settling of solids prior to disposal, and tanks to provide pre-treatment of waste prior to processing in facilities.

In an effort to determine the potential safety and environmental hazards associated with each of the 50 miscellaneous tanks it is necessary to obtain characterization information on each of the tanks. Since many of the potential safety hazards would be realized only during intrusive activities (i.e., sampling and analysis), this report attempts to characterize the contents of the miscellaneous tanks using process knowledge. This appendix provides information associated with each waste generating activity to support process knowledge characterization.

B.1.1 200 AREA PROCESSES

The 200 Areas provided the chemical processing plants for Hanford's missions from 1943 through the late 1980's. The primary processing and waste management facilities in the 200 Areas, which are of interest to this study, include:

A Plant (PUREX Separations)
B Plant ($BiPO_4$ Separations, Waste Management)
C Plant (Semi-works/Pilot Plant for REDOX, PUREX and B Plant Waste Fractionization)

S Plant (202-S/REDOX Process, 222-S Laboratory)
T Plant ($BiPO_4$ Separations, Decontamination, R & D)
U Plant (Uranium Recovery)
Z Plant (Putonium Finishing)
Tank Farms (Single Shell Tanks and Double Shell Tanks)
Evaporators (Waste Concentration)
Vaults (244 Series/Pretreatment and Interim Storage)

Table B-1 provides a list of the process waste generated at Hanford which were discharged to the single shell tanks and the acronym designation of each waste type. These acronyms are used in Appendix A.

B.1.2 SEPARATIONS, RECOVERY, AND PURIFICATION PROCESS

Separation of plutonium from irradiated nuclear fuel was the primary mission of the Hanford Site. Three distinct processes were used for separations. These processes, and their associated facilities, were:

- Bismuth Phosphate Process ($BiPO_4$) - B Plant and T Plant
- Reduction-Oxidation (REDOX) Process - S Plant (202-S)
- Plutonium-Uranium Extraction (PUREX) Process - A Plant

In addition to these three specific separations processes, a variety of other processes were used at the site. These processes include uranium recovery at U Plant, plutonium purification at Z Plant, pilot plant operations at C Plant for REDOX and PUREX processes, and cesium recovery using ferrocyanide.

These processes accounted for a significant quantity of the waste sent to the tank farms. In addition, the processes required a significant variety of inorganic and organic chemicals to meet the process purification requirements. Table B-2 provides a list of the chemicals discharged to waste management units (tank farms and soil column) from the separations and recovery processes. This table is indicative of only the primary separations and recovery process chemicals. Additional chemicals are specified in tables throughout this appendix (see Section B.2) for each of the operating facilities. These plant-specific lists provide a more comprehensive listing for the miscellaneous tanks associated with a particular plant.

In evaluating miscellaneous tanks, this list can be considered to be inclusive of all isotopes and chemicals which may be present. However, it is highly desirable to narrow this list significantly. This can be done if a specific waste stream is known as the only process associated with a particular tank. This is simple with tanks such as the 244-BXR vault; however, catch tanks may very well require a process knowledge characterization consisting of nothing more than the list provided in Table B-2.

B.2 CHEMICAL PROCESSING FACILITIES

The chemical processing facilities in the 200 East and West areas generated the significant portion of waste which was received in the miscellaneous tanks. This section of the appendix provides a description of the waste-processing activities performed at the plants and the radionuclides and chemicals generated by the plants. The purpose of this section is to provide a basis for preliminary characterization of miscellaneous tanks, such that priorities for remedial activities can be established.

B.2.1 B PLANT

The B Plant facilities are located in the 200 East Area and have provided a number of chemical processing support missions for the Hanford Site. The primary B Plant facility (221-B) has processing cells which contain chemical processing equipment such as tanks, chemical reactors, filters, ion-exchange columns, and pumps. These cells are heavily shielded with concrete and were constructed with processing of nuclear materials as the key function. The ability to change the equipment in the cells has made B Plant, and its sister plants - T Plant and U Plant, ideal for a wide variety of missions.

B Plant's waste streams were discharged to tank farms, cribs, ditches or injection wells. The primary disposal method for high-level waste streams was the B, BX, BY and C tank farms during the SST operations and the DSTs in the 1980's and 1990's. Low-level waste from concentrator operations was sent through miscellaneous tanks to cribs while waste streams which were not intended to be contaminated with radioactive materials, such as the chemical sewer and steam condensate, were discharged to trenches on the northwest side of the plant.

Table B-3 provides a list of the chemicals and radionuclides used or generated at B Plant facilities. As shown on Table B-3, B Plant used greatest number of the chemicals of all of the operating plants. This is due to B Plant's various missions over the years from plutonium separation to waste fractionation to cesium purification. As such, the chemicals discharged from B Plant, and potentially discharged to miscellaneous tanks, are the most difficult to define. In addition to the varied missions, B Plant received waste after processing had been performed in PUREX and REDOX and was subject to receipt of all of the chemicals used in those facilities.

Waste streams generated by the bismuth phosphate process (MW, 1C, 2C, CW) are discussed below since these waste streams are of interest to the miscellaneous tanks. No data is available on other waste streams since they either had a highly variable composition, were discharged in low enough quantities to be considered not applicable to this report, or the data was not available.

Bismuth Phosphate Process

The earliest process used for plutonium recovery from irradiated uranium fuel was the bismuth phosphate ($BiPO_4$) process. The $BiPO_4$ operations were a batch process, involving repeated precipitation, centrifugation and dissolution in a carrier-precipitation chemical separation scheme. Four distinct types of wastes were produced by the $BiPO_4$ process: 1) metal waste (MW), 2) coating waste (CW), 3) first cycle decontamination waste (1C), and 4) second cycle decontamination waste (2C), (Welty 1988, Winters et al., 1991, Gerber 1991).

Metal waste generated by plutonium extraction from dissolved fuel elements was basic (pH > 7.0), and contained a high quantity of uranium, thus the term metal waste. The waste stream contained 1.0% (by mass) of plutonium and high concentration (>2 M) of sodium salts (Waite 1991).

Coating waste was the result of the nuclear fuel rod cladding (aluminum metal) removal. The primary components of the CW removal were sodium salts, aluminum salts, plutonium (0.4%) and uranium (0.4%) (Waite 1991).

First-cycle and second-cycle waste were generated from a plutonium purification process (Gerber 1991). These wastes contained a variety of sodium, ammonium, and iron salts; however, in relation to the metal waste and coating waste, they contained relatively dilute concentrations of contaminants. These two waste processes, as noted above, were primarily purification steps in the $BiPO_4$ process. Both of the waste streams had a plutonium concentration of up to 1% by mass (Welty 1988). The 2C waste stream contained a high quantity of $BiPO_4$ as a final purification step.

Waste Fractionation Process

The waste fractionation process was operated from 1968 to 1978 (Gerber 1991) to separate strontium and cesium from waste in a variety of tank farms. The primary purpose of this mission was to reduce ^{137}Cs and ^{90}Sr content, thereby reducing the heat generation and high radioactivity of the waste. The process allowed cesium to be separated and purified through an ion exchange process and encapsulated for use in the medical sterilization and food irradiation processes. Strontium was removed from the waste using chelating agents such as citrate, ethylenediaminetetraacetic acid (EDTA), and hydroxylethyl-ethylenediaminetetraacetic acid (HEDTA). The waste stream generated by this process were discharged to the B, BX, and BY tank farms in the 1960's and early 1970's and to the double shell tanks in the later 1970's. This process is of interest to this study due to the significant use of organic materials in the facility and subsequently discharged to tank farms. A discussion of the use of organic materials at the Hanford site is provided in a later sub-section of this appendix.

B.2.2 T PLANT

T Plant was constructed and operated identically to B Plant through the plutonium separations operations from 1943 through 1956. After 1956, T Plant became a decontamination and experimental facility only and very little waste was transferred to the tank farms. The waste that was transferred was very dilute due to the nature of decontamination operations (washing and flushing). A list of the chemicals and radionuclides used and/or generated at T Plant is provided in Table B-4.

B.2.3 U PLANT

U Plant was constructed, identical to T and B Plants, in 1944 to support the $BiPO_4$ process; however, B Plant and T Plant provided sufficient processing capacity and U Plant was never used for plutonium separations. The facility began operations as a uranium recovery plant in 1952 and operated as such until 1958 (DOE-RL 1992a). A list of the chemicals and radionuclides used at U Plant is shown in Table B-5.

The operation of U Plant involved several facilities. A description of the operations of these facilities, and their associated periods of operation are discussed in the following sections. These facilities include (DOE-RL 1992a):

Facility	Process	Period of Operation
221-U Building	Uranium Recovery Process	1952-1958
224-U Building	UO_3 Conversion Process	1952-1955
	PUREX Support (UO_3 Conversion)	1952-TBD
276-U Building	Solvent Treatment	1952-1958

The 221-U facility received acidified bismuth phosphate metal waste from the 244-BXR, 244-TXR, 244-UR, and 241-WR vaults and uranium was extracted. The process separated the uranium into an organic phase (tributyl phosphate in a kerosene diluent) which was then stripped using nitric acid (DOE-RL 1992a). The separated uranium was routed to the 224-U facility for conversion to UO_3. The solvent was transferred to the 276-U building for sulfate scrubbing and recycled to 221-U for further processing.

According to the U Plant Source Aggregate Area Management Study Report (DOE-RL 1992a), the uranium recovery process waste stream included fission products with a high radioactivity level, low organic content, bismuth phosphate, nitrate salts, and neutralized acid waste. The operation of the UO_3 conversion process generated an acidic to neutral process waste containing nitrates, low organic level, and low radioactivity level. The solvent treatment process generated a high organic content waste stream with a low salt content, acidic to neutral pH, and an intermediate radioactivity level. The waste streams sent to tank farms were, in all cases, made alkaline (Anderson 1990).

B.2.4 Z PLANT

Z Plant, also referred to as the plutonium finishing plant, consists of numerous facilities which supported the purification of the plutonium extracted by the three separations process ($BiPO_4$, REDOX, and PUREX). The various facilities and processes associated with Z Plant operations, particularly where interaction with the miscellaneous tanks is identified, is provided below. The associated dates of construction/operational start up are provided; however operating durations are deferred to the description of the specific processes performed within the facilities. The reference for this history of operation is the Z Plant Source Aggregate Area Management Study Report (DOE-RL 1992b). A list of the chemicals and radionuclides used/generated from Z plant facilities is provided in Table B-6.

	Process	Period of Operation
234-5Z	Primary Plutonium Finishing Facility (PFP)	1949-TBD
231-Z	Plutonium Isolation Facility (PIF)	1945-TBD

236-Z	Plutonium Recovery Facility (PRF) Process	TBD
242-Z	Americium Recovery Process	1964-TBD

RECUPLEX PROCESS

This process used solvent extraction technology to remove plutonium from PFP waste streams based on the formation of an organic-plutonium complex which is preferentially soluble in an organic solvent. This waste stream was discharged directly to the 241-Z-8 settling tank, also referred to as the silica gel waste settling tank (DOE-RL 1992b). Waste liquids were discharged from the 241-Z-8 settling tank to the 216-Z-8 french drain. No records were identified for the disposal history of spent silica gel from the 241-Z-8 tank; however, available information suggests that the tank has never been pumped out. A reported 3.5 lb of Pu were present in the tank as of 1974 (DOE-RL 1992b). The use of this tank was discontinued in April 1962 (DOE-RL 1992b).

PLUTONIUM RECLAMATION FACILITY

The PRF replaced the RECUPLEX process line in 1962. The PRF utilized a similar process to the RECUPLEX process, utilizing a carbon tetrachloride/tributyl phosphate extraction process. The primary waste streams generated by the PRF included spent aqueous solutions, spent organic wastes, and non-contact wastewater. These waste streams were routed to the soil column via the 241-Z-361 settling tank.

PLUTONIUM FINISHING PLANT

Operation of this facility, the 234-5Z plant, included the use of three successive process lines to convert plutonium nitrate to plutonium metal. These process lines, and associated operational periods are (DOE-RL 1992b):

Process	Periods of Operation
RG-RB Line	1949-1953
Remote Mechanical Line A	1953-1979
Remote Mechanical Line C	1960-1973 and 1985-1988.

Each of these process lines created waste streams which contained detectable quantities of plutonium and other TRU elements (Jensen 1990). Specifically, this waste stream was acidic and corrosive (pH 2), high in salts, and low in organic content. The waste is reported to be high in nitrates in the form of nitric acid, aluminum nitrate, magnesium nitrate, ferric nitrate, and calcium nitrate. Other components include metal ions, aluminum fluoride, potassium hydroxide, potassium fluoride, chromium, and lead (DOE-RL 1992b).

Analytical Laboratory/231-W-151 Settling Tanks

The Z Plant analytical and development laboratories are currently housed in the 234-5Z building; however, historically, analytical and development laboratories are also reported to have been housed in the 231-Z Building (Stenner et al. 1988). The laboratory provides analytical services for PFP activities. Laboratory process waste, from 75 floor drains, was routed through the 231-W-151 settling tanks (Neilsen 1992). The two 241-W-151 tanks (Tk-001, Tk-002) were used for collection of liquids from the floor drains from the Z Plant laboratory (plutonium processing). Both tanks in the vault drained to the 216-Z-7 Crib (Neilsen 1992) No treatment activities are known to have occurred within these tanks. Chemical and radionuclide analyses are available for samples from these tanks; see the data sheets for these tanks.

B.2.5 S PLANT

The S Plant facilities began operation in 1951 with a reduction-oxidation process (REDOX) in the 202-S facility to replace the $BiPO_4$ process. The REDOX process was the first process designed to recover both plutonium and uranium (Gerber 1991). Plant operations at the 202-S plant were discontinued in 1967 and the REDOX process was replaced with the PUREX process. A list of the chemicals and radionuclides used/generated at 202-S is provided in Table B-7.

The 222-S analytical laboratory began operations in 1951 and provides high-level and low-level chemical/radiological analytical services for the 200 Areas. The laboratory is still in operation. Table B-8 provides a partial list of chemicals used at the 222-S complex.

In addition to these two primary facilities, a number of other support facilities associated with the REDOX process and the analytical laboratory are included with the S Plant area. These facilities include the 203-S and 204-S tank farms, used for storage of uranyl nitrate hexahydrate; the 205-S Silica Gel House, used for chemical make-up, uranyl nitrate hexahydrate sampling, a waste neutralizer tank, and two silica gel adsorption columns to remove zirconium and niobium from uranyl nitrate hexahydrate solution; and the 233-S Plutonium Concentration Facility, used as a final purification facility for plutonium product until 1963 and as a concentration (by evaporation) facility for plutonium and neptunium nitrate solutions from 1963 to 1967 (DOE-RL 1992c).

B.2.6 PUREX FACILITY

The plutonium/uranium extraction (PUREX) process began operation in 1956 in the 202A facility and operated until 1972. A second operating mission was performed from 1983 until final shutdown in 1992. This process was the last of the plutonium separation processes at the Hanford site. The main purpose of the facility was to extract plutonium, uranium, and neptunium from irradiated fuel rods discharged from defense production reactors located in the 100 Area (Gerber 1991). The PUREX chemical separation process is based on dissolving the decladded fuel rods in nitric acid, extracting the nuclear materials through a solvent extraction process, purifying the nuclear materials in an ion exchange process, and shipping the product to PFP for final purification. The waste streams associated with PUREX operations include process condensate, cooling water, steam condensate, chemical sewer, and ammonia scrubber distillate. The waste stream of interest, with respect to this miscellaneous tank evaluation, is the PUREX process condensate waste stream. The PUREX process condensate waste stream has a widely varying composition (DOE-RL 1993a). Constituents which could be within this waste stream include very high levels of radioactive materials (fission products such as Cs and Sr); organic compounds (tributyl phosphate, normal paraffin hydrocarbons, and trace quantities of butanol, butylaldehyde, acetone, methyl ethyl ketone); nitrates; and hydroxides (DOE-RL 1993a). Table B-9 provides a list of the chemicals and radionuclides used/generated at PUREX facilities.

B.2.7 SEMIWORKS (C PLANT) FACILITY

The C Plant facilities were originally constructed in 1949 to provide pilot plant activities in support of the REDOX process and was converted to a pilot plant for PUREX in 1954. The primary facility is the 201-C process building. The facility waste streams similar to the REDOX and PUREX process waste streams. The facility ceased operation and decommissioning was initiated in 1983 (DOE-RL 1993b). Table B-10 provides a partial list of chemicals used in the C Plant complex.

B.3 WASTE MANAGEMENT OPERATIONS

The Hanford Site performed several waste management operations which affected the composition of the waste in the tank farms and subsequently in the miscellaneous tanks. These activities make a direct correlation of waste processing mission to miscellaneous tank composition difficult, especially with respect to the catch tanks. This section of the appendix provides data on the specific waste management operations as it relates to the miscellaneous tanks. Tables are provided to document those characteristics known for each waste management activity, if available.

The waste management activities which are addressed in this section include:

- Single Shell Tank Operations
- Waste Concentration

In addition to the waste management activities, the use of organic chemicals at the Hanford site is of significant interest to this study due to the numerous safety criteria associated with organic materials including:

- Organic Salt Flammability
- Flammability of Solvents
- Toxic Vapor Emissions

To support the development of safety analysis with respect to these three safety criteria, a sub-section on organic chemical use is provided.

B.3.1 SINGLE SHELL TANK OPERATIONS

Single shell tanks were used at Hanford from 1943 until 1980. During the 1960's and 1970's it was determined that SSTs did not provide the long term storage capability needed to protect and the environment and double shell tanks were constructed as the preferred method of active waste management facilities.

The key indicator of waste composition of the catch tanks can be argued to be the SSTs since the catch tanks were connected to diversion boxes associated with the SSTs. As such, the waste types in the SSTs should be similar to the waste types contained within the associated catch tanks (with the understanding that the catch tanks collected rainwater, snowmelt, dust, etc. during time periods when the tank was connected to a diversion box and that only leaks and spills entered the diversion boxes).

Table B-11 provides a list of the single shell tank farms and the periods of active waste transfers. This table is intended to provide a correlation for future catch tank studies which will attempt to use process knowledge methods for initial characterization to identify hazards.

B.3.2 EVAPORATOR/CONCENTRATION PROCESSES

The use of waste concentration was necessary at the Hanford site to minimize the volume of waste stored in the SSTs and DSTs. Evaporation activities continue to be operated at Hanford for this reason. In addition to volume reduction, evaporation causes the waste to be concentrated since most of the radionuclides are contained within the evaporator bottoms, or the concentrate. The steam generated by an evaporation operation can be condensed and either treated and disposed or sent to a low level disposal facility (tank farm). During SST operations, the LLW was sent to cribs.

To achieve evaporation, two methods were used: The In-Tank Heating Method and the Evaporator Method. In-tank heating was conducted by the in-tank solidifaction (ITS) units. ITS #1 started on March 19, 1965, and ITS #2 started on february 17, 1968. On August 24, 1971, ITS #1 was converted to be a cooler. Both units were shut down on June 30, 1974 (Anderson 1990).

In 1952, two evaporator systems, 242-B and 242-T, were installed operated for about four years. The 242-T evaporator processed 1C and TBP waste with a volume reduction of 82.1% and 35.5% respectively. The 242-B unit evaporated 1C waste with a volume reduction rate of 80.9% and recovered about 8.7M liters (2.3M gallons) of TBP waste (volume reduction rate not reported; however, assumed to be similar to that for 242-T) (Anderson 1990). The 242-B evaporator was never reactivated, however, the 242-T evaporator was reactivated in 1965 and was eventually shutdown in 1976.

Many different processes contributed waste streams, hence, several distinct evaporator bottom types were produced. For example, only bottoms from the evaporation of bismuth phosphate, TBP, and B Plant waste fractionation waste, and the ITS units of the BY tank farm were stored in the 200E area tanks. Although current available information indicates the tanks receiving evaporator bottoms (see Table B-11), it is not possible to determine the type of evaporator bottoms received (Anderson 1990).

B.3.3 ORGANIC CHEMICALS

The use of organic chemicals is described in Section 2. This appendix provides a tabular representation of the chemicals used, by plant, to provide a correlation of organic materials with tank farms and miscellaneous tanks. Tables B-12 through B-30 provides these tables.

B.4 REFERENCES

Anderson, J.D., 1990, *History of the 200 Area Tank Farms*, WHC-MR- 0132, Westinghouse Hanford Company, Richland, Washington.

DOE-RL, 1992a, *U Plant Source Aggregate Area Management Study Report*, DOE/RL-91-52 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992b, *Z Plant Source Aggregate Area Management Study Report*, DOE/RL-91-58 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992c, *S Plant Aggregate Area Management Study Report*, DOE/RL-91-60 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1992d, *T Plant Source Aggregate Area Management Study Report*, DOE/RL-91-61 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993a, *PUREX Source Aggregate Area Management Study Report*, DOE/RL-92-04 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993b, *Semiworks Source Aggregate Area Management Study Report*, DOE/RL-92-18 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 1993c, *B Plant Source Aggregate Area Management Study Report*, DOE/RL-92-05 Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Gerber, M.S., 1991, *Historical Overview of Wastes Disposed to the Soil Column and to Tanks at the Hanford Site*, Westinghouse Hanford Company, Richland, Washington.

Jensen, D.B., 1990, *Plutonium Finishing Plant Waste-Water Stream Specific Report, Addendum 8*, WHC-EP-0342, Addendum 8, Westinghouse Hanford Company, Richland, Washington.

Neilsen, E.H., 1992, *Miscellaneous Underground Radioactive Waste Tanks*, WHC-EP-0560, Westinghouse Hanford Company, Richland, Washington.

Stenner, R.D., K.H. Cramer, K.A. Higley, S.J. Jette, D.A. Lamar, T.J. McLaughlin, D.R. Sherwood, and N.E. Van Houten, 1988, *Hazard Ranking System Evaluation of CERCLA Inactive Waste Sites at Hanford*, PNL-6456, Pacific Northwest Laboratory, Richland, Washington.

Waite, J.L., 1991, *Tank Wastes Discharged Directly to the Soil at the Hanford Site*, WHC-MR-0227, Westinghouse Hanford Company, Richland, Washington.

Welty, R.K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, SD-WM-TI-356, v.1 and 2, Westinghouse Hanford Company, Richland, Washington.

Winters, W.I., L. Jensen, L.M. Sasaki, R.L. Weiss, J.F. Keller, A.J. Schmidt, and M.G. Woodruff, 1991, *Waste Characterization Plan For the Hanford Site Single-Shell Tanks*, WHC-EP-0210 Rev. 1, 2, and 3, Westinghouse Hanford Company, Richland, Washington.

Table B-1. Process Waste Streams Discharged to Single Shell Tanks.

Waste Designation	Definition
B	B Plant High-Level Waste
BFSH	B Plant Flush
BL	B Plant Low-Level Waste
BNW	Battelle Pacific Northwest Laboratories Waste
CARB	Carbonated Waste
CCPL, CC	Complexant Concentrate
CF	Cesium Feed
CPLX	Complexed Waste
CWP, CW	PUREX Coating Waste
CWR	REDOX Coating Waste
DSSF	Double-shell slurry feed
DW	Decontamination Waste
EB	Evaporator Bottoms
EVAP	Evaporator Feed
FP	Fission Product Waste
HDRL	Hanford Defense Residual Liquid
HLO	Hanford Laboratory Operations
HS	Hot Semiworks
IX	Ion Exchange Waste
LW	Laboratory Waste
MW	Metal Waste
N	N Reactor Waste
NCPL	Noncomplexed waste
OWW	Organic Wash Waste
P, IWW	PUREX High-Level waste
PNF	Partial Neutralized Waste
PSS	PUREX Sludge Supernate
R	REDOX High-Level Waste
RESD	Residual Evaporator Waste
RIX	REDOX Ion Exchange Waste
RSN	REDOX Supernatant Waste
SIX	PUREX Ion Exchange Waste
SRS	Strontium Sludge Waste
SSW	Strontium Semi-works Waste
TBP	Tri-butyl Phosphate Waste
1C	First Cycle Waste
2C	Second Cycle Waste
224	224-U Waste
5-6	Cell 5 and 6 Waste

Table B-2. Chemicals Used or Produced in Separation/Recovery Processes.

RADIONUCLIDES (all isotopes assumed unless specified)	INORGANIC CHEMICALS	ORGANIC CHEMICALS
Actinium		
Americum	Aluminum	Acetic Acid
Antimony	Aluminum nitrate nonahydrate	Dibutyl butyl phosphonate
Astitine	Aluminum nitrate	Formaldehyde
Barium	Ammonium Flouride	Hydroxyacetic acid
Beryllium	Ammonium nitrate	Normal paraffin hydrocarbon
Bismuth	Beryllium	Oxalic acid
Carbon - 14	Cadmium nitrate	Sugar
Cerium	Ferric nitrate	Tartaric acid
Cesium	Ferrous sulfamate	Tributyl phospate
Cobalt	Hydrazine	Trichloroethane
Curium	Hydroxylamine nitrate	Tri-n-dodecylamine
Europium	Iron	
Fancium	Lead nitrate	
Iodine - 129	Mercuric nitrate	
Lead	Nickel nitrate	
Manganese - 54	Nitric acid	
Neptunium	Phoporic acid	
Nickel	Potassium flouride	
Niobium	Potassium hydroxide	
Palladium	Potassium permanganate	
Plutonium	Silicon	
Polonium	Silver nitrate	
Potassium	Sodium carbonate	
Promethium	Sodium ferrocyanide	
Protactinium	Sodium flouride	
Radium	Sodium hydroxide	
Ruthenium	Sodium nitrate	
Samarium	Sodium nitrite	
Selenium	Sodium sulfacte	
Strontium - 90	Sodium thiosulfate	
Technetium	Sufamic acid	
Thallium	Sulfuric acid	
Thorium	Zirconium	
Tin		
Tritium		
Uranium		
Yttrium		
Zinc - 65		
Zirconium		Source: DOE-RL 1993a

Table B-3. Chemicals Used or Produced at B Plant Facilities.

RADIONUCLIDES (all isotopes unless specified)	RADIONUCLIDES (Cont)	INORGANIC CHEMICALS (Cont)	INORGANIC CHEMICALS (cont.)	ORGANIC CHEMICALS
	Thorium	Carbonate	Niobium	1-Butanol
Actinium	Tin - 126	Ceric flouride	Nitrate	1-Butanone
Americum	Tritium	Ceric iodate	Nitric Acid	2-Butanone
Antimony	Uranium	Ceric nitrate	Nitrite	Acetone
Astitine	Yttrium	Ceric sulfate	Periodic acid	Acetic acid
Barium	Zinc - 65	Cesium carbonate	Phosphoric acid	Butanoic acid
Bismuth	Zirconium	Cesium chloride	Phophotungistic acid	Butyl alcohol
Carbon - 14		Chloride	Plutonium fluoride	Butylated hydroxy
Cerium	INORGANIC	Chromium	Plutonium nitrate	toluene
Cesium	CHEMICALS	Ferric cyanide	Plutonium peroxide	Carbon tetrachloride
Cobalt		Ferric nitrate	Potassium	Chloroform
Curium	Alkaline liquids	Ferrous sulfamate	Potassium carbonate	Citric acid
Europium	Aluminum	Ferrous sulfate	Potassium	Decane
Fancium	Aluminum nitrate	Flouride	ferrocyanide	Dis2-Ethyl hexyl
Iodine - 129	nonahydrate	Hydrochloric acid	Potassium fluoride	phosphoric acid
Iron - 59	Aluminum nitrate	Hydrofluoric acid	Potassium hydroxide	Dibutyl phosphonate
Lanthanum - 140	Ammonia Ammonium	Hydrogen fluoride	Potassium oxalate	Dichloromethane
Lead	flouride	Hydrogen peroxide	Potassium	Ethanol
Manganese - 54	Ammonium	Hydroiodic acid	permanganate	EDTA
Neptunium	hydroxide	Hydroxide	Pu-Lanthanum	Halogenated
Nickel	Ammonium ion	Hydroxylamine	fluoride	hydrocarbons
Niobium	Ammonium nitrate	hydrochloride	Pu-Lanthanum oxide	Hydroxyacetic acid
Palladium	Ammonium oxalate	Iron	Rubidium	Kerosene
Plutonium	Ammonium	Lanthanum flouride	Silica	Methyl ethyl ketone
Polonium	silicofluoride	Lanthanum hydroxide	Silicon	Molybdate-citrate
Potassium - 40	Ammonium sulfate	Lanthanum nitrate	Silver	Monobutyl
Praeseodymium -	Arsenic	Lanthanum-	Silver nitrate	phosphate
144	Barium	neodynium nitrate	Sodium	Normal paraffin
Promethium	Barium nitrate	Lead	Sodium salts	hydrocarbon
Protactinium	Beryllium	Lead nitrate	Sulfamic acid	Proponal
Radium	Bismuth	Lithium	Sulfate	Thenolytrifluoro-
Rhodium	Bismuth nitrate	Magnesium	Sulfuric acid	acetate
Ruthenium	Bismuth phosphate	Magnesium carbonate	Tin	Toluene
Samarium	Boric acid	Magnesium nitrate	Titanium	Tributyl phospate
Selenium	Cadmium	Manganexe	Uranium oxide	Trichloroethane
Silver - 100m	Cadmium nitrate	Mercuric nitrate	Uranyl nitrate	Trichloromethane
Sodium - 22	Calcium	Mercury	hexahydrate	Trisodium hydroxyl-
Strontium	Calcium carbonate	Nickel	Yttrium	ethyl Ethylene-
Technetium	Calcium chloride	Nickel nitrate	Zeolon	diamine triacetate
Tellerium - 129	Chromium nitrate	Phosphorous	Zinc	(HEDTA)
Thallium	Chromous sulfate	pentoxide	Zirconium	
	Copper		Zirconyl nitrate	
	Cyanide			
	Carbon dioxide			

Source: DOE-RL 1993c

Table B-4. Chemicals Used or Produced in T Plant Processes

RADIONUCLIDES (all isotopes assumed unless specified)	RADIONUCLIDES (Cont.)	INORGANIC CHEMICALS (Cont.)
	Uranium	Oxalic acid
Actinium	Yttrium	Phosphate
Americium	Zinc-65	Phosphoric acid
Antimony	Zirconium	Potassium
Astitine-217		Sodium hydroxide
Barium	INORGANIC CHEMICALS	Potassium ferrocyanide
Bismuth		Potassium hydroxide
Carbon-14	Aluminum	Potassium permanganate
Cerium	Ammonium ion	Silica
Cesium	Ammonium nitrate	Silicon
Cobalt	Ammonium sulfate	Silver
Curium	Arsenic	Sodium
Europium	Barium	Sodium bismuthate
Francium	Bismuth	Sodium carbonate
Iodine-129	Bismuth phosphate	Sodium dichromate
Iron-59	Boric acid	Sodium iodine
Lanthanum-140	Boron	Sodium nitrate
Lead	Cadmium	Sodium nitrite
Manganese-54	Calcium	Sodium thiosulfate
Neptunium	Carbonate	Sulfamic acid
Nickel	Ceric nitrate	Sulfate
Niobium	Cerium	Sulfuric acid
Palladium-107	Chloride	Thorium
Plutonium	Chromium	Tin
Polonium	Copper	Titanium
Potassium-40	Cyanide	Uranium
Praseodymium-144	Ferric cyanide	Uranium oxide
Promethium-147	Ferrous sulfate	Uranyl nitrate hexahydrate
Protactinium	Fluoride	
Radium	Hydrogen fluoride	Zinc
Rhodium	Hydrogen peroxide	Zirconyl nitrate
Ruthenium	Hydroxide	
Samarium-151	Iron	ORGANIC CHEMICALS
Selenium-79	Lanthanum nitrate	
Silver-110m	Lead	Butyl alcohol
Sodium-22	Lithium	Chloroform
Strontium	Magnesium	Decane
Technetium-99	Nickel	Dibutyl phosphate
Tellurium-129	Nickel sulfate	Halogenated hydrocarbons
Thallium-207	Nitrate	Kerosene
Thorium	Nitric acid	Methyl ethyl ketone
Tin-126	Nitrite	Monobutyl phosphate
Tritium		Paraffin hydrocarbons
		Tributyl phosphate
		Trichloroethane

Source: DOE-RL 1992d

Table B-5. Chemicals Used or Produced in U Plant Processes.

RADIONUCLIDES (all isotopes assumed unless specified)	INORGANIC CHEMICALS	INORGANIC CHEMICALS (Cont.)
	Aluminum	Sulfuric acid
Actinium	Ammonium ion	Thorium
Americium	Ammonium nitrate	Tin
Antimony	Arsenic	Titanium
Astitine-217	Barium	Uranium oxide
Barium	Bismuth	Uranium
Bismuth	Bismuth phosphate	Uranyl nitrate hexahydrate
Carbon-14	Boron	Vanadium
Cerium	Cadmium	Zinc
Cesium	Calcium	Zirconium oxide
Cobalt	Carbonate	
Curium	Cerium	**ORGANIC CHEMICALS**
Europium	Chloride	
Francium	Chromium	Acetone
Iodine-129	Copper	Ammonium
Iron-59	Cyanide	Butyl alcohol
Lead	Ferric Cyanide	Carbon tetrachloride
Manganese-54	Fluoride	Chloroform
Neptunium	Hydroxide	Citrate
Nickel	Iron	Ethylene diamine
Niobium	Lanthanum	tetraacetate (EDTA)
Palladium-107	Lead	Glycolate
Plutonium	Lithium	Kerosene
Polonium	Magnesium	Methylene chloride
Potassium-40	Manganese	MIBX ("Hexone")
Protactinium	Mercury	N-(2-hydroxyethyl)
Radium	Nickel	ethylenediaminetriacetate
Ruthenium	Nitrate	(HEDTA)
Samarium-151	Nitric acid	Oxalate
Selenium-79	Nitrite	Paraffin hydrocarbons
Silver-110m	Phosphate	Toluene
Sodium-22	Phosphoric acid	Tributyl phosphate
Strontium	Potassium	Trichloroethane
Technetium-99	Selenium	Other degradation products
Thallium-207	Silica	
Thorium	Silicon	
Tin-126	Silver	
Tritium	Sodium	
Uranium	Sodium hydroxide	Source: DOE-RL 1992a
Yttrium-90	Strontium	
Zinc-65	Sulfamic acid	
Zirconium	Sulfate	

Table B-6. Chemicals Used or Produced in Z Plant Processes.

RADIONUCLIDES
(all isotopes assumed unless specified)

Silver
Aluminum
Americium
Antimony
Gold-195
Barium-133
Beryllium
Carbon-14
Calcium-45
Cadmium-109
Cerium
Chlorine-36
Curium
Cobalt
Chromium-51
Cesium
Einsteinium-254
Europium
Iron
Gadolinium-153
Germanium-68
Tritium
Iodine
Potassium-40
Krypton-85
Manganese-54
Molybdium-93
Sodium-22
Diabium
Nickel
Neptunium-237
Phosphorous-32
Protactinium-231
Lead
Promethium-147
Polonium-210
Plutonium
Radon
Rubidium-86
Rhenium-187
Ruthenium
S[illegible]r-35
S[illegible]ium-46
S[illegible]ium

RADIONUCLIDES (Cont.)

Samarium-151
Tin
Strontium
Tantanium-182
Technitinium-99
Tellurium
Titanium-204
Thorium
Thulinium-170
Uranium
Vanadium-49
Yttrium
Zinc-65
Zirconium-95

INORGANIC CHEMICALS

Aluminum
Asbestos
Beryllium
Aluminum fluoride
Aluminum nitrate
Cadmium
Calcium nitrate
Chro[illegible]
Copp[illegible]
Copp[illegible]e
Ferric nitrate
Fluoride
Lead
Magnesium nitrate
Mercury
Mercury - amalgamated
Nitrate
Nitric acid
Potassium
Chloride
Potassium nitrate
Silver
Slaked lime
Sodium
S[illegible]m chloride
S[illegible]m diuranate
S[illegible]m fluoride
[illegible]m hydroxide
[illegible]m Nitrate

INORGANIC CHEMICALS (Cont.)

Sulfate
Sulfuric acid
Uranium hexafluoride
Zirconium

ORGANIC CHEMICALS

Acetonitrile
Butyl acetate
Carbon Tetrachloride
Creosote
Cyclohexane
Cyclohexanone
DDCP
Dibutyl butyl phosphonate
Dibutyl phosphate
Ethanol
Ethanolamine
Ethylene glycol
Freon II
Blycerine
Hexane
Hexanol
Isopropanol
Kerosene
Methanol
Naphthylamine tritium
Normal paraffins
Oil
Paint thinner
Perchloroethylene
Polychlorinated biphenyls
Polyurethane
Pseudocumene
Tar
Tetrahydrofuran
Toluene
Tributyl phosphate
Trichloroethene
Trioctyl phosphine
Vinyl chloride
Xylenes

Source: DOE-RL 1992b

Table B-7. Chemicals Used or Produced in S Plant Processes.

RADIONUCLIDES
(all isotopes assumed unless specified)

Aluminum-28
Americium-241
Antimony
Barium
Beryllium
Cadmium-109
Calcium-45
Carbon-14
Cerium-141
Cesium
Chlorine-36
Chromium-51
Cobalt
Curium-243
Einsteinium-254
Europium
Gadolinium-153
Germanium-68
Iodine
Iron-55
Krypton-85
Lead
Manganese-54
Molybdenum-93
Niobium
Nickel
Phosphorus-32
Plutonium
Potassium-40
Polonium-210
Promethium-147
Protactinium-231
Radium-228
Rhenium-187
Rhodium-106
Rubidium-86
Ruthenium
Scandium-46
Selenium-75
Silver
Sodium-22
Sulfur-35
Tin
Tritium

RADIONUCLIDES (Cont.)

Strontium
Tantalum-182
Technetium-99
Tellurium
Thallium
Uranium
Vanadium-49
Yttrium
Zinc-65
Zirconium-95

INORGANIC CHEMICALS

Aluminum
Aluminum nitrate
Aluminum oxide
Ammonia
Ammonium fluoride
Ammonium hydroxide
Ammonium nitrate
Ammonium oxalate
Boron
Boric acid
Cadmium
Ceric ammonium nitrate
Ceric sulfate
Chromic nitrate
Copper
Ferrous ammonium sulfate
Ferrous sulfamate
Ferrous sulfate
Hydrazine
Hydrochloric acid
Hydrofluoric acid
Hydrogen
Hydroxylamine
Hydrochloride
Iron
Lead nitrate
Magnesium
Manganese dioxide
Mercuric nitrate
Mercuric thiocyanate
Mercury
Nitric Acid

INORGANIC CHEMICALS (Cont.)

Nitrogen dioxide
Oxalic acid
Periodic acid
Potassium dichromate
Potassium fluoride
Potassium oxalate
Potassium permanganate
Silicon
Silicon dioxide
Silver nitrate
Sodium aluminate
Sodium bismuthate
Sodium carbonate
Sodium dichromate
Sodium metasilicate
Sodium nitrate
Sodium nitrite
Sulfamic acid
Tetrabromoethane
Titanium chloride
Xenon
Zinc

ORGANIC CHEMICALS

Acetone
Bromonaphalene
Di2-ethyl hexyl phosphoric acid
Hydroxyquinoline
Methyl isobutyl carbinal
Methyl isopropyl diketone
Mineral oil
Normal paraffin
hydrocarbon
O-phenanthroline
Propane
S-diphenyl carbazide
Tetraphenyl boron
Thenoyltrifluoroacetone
Tributyl phosphate
Tri-iso-octylamine
Tri-n-octylamine
Xylene

Source: DOE-RL 1992c

Table B-8. Partial List of Chemicals Used in 222-S Laboratory Processes.

Acetone	Normal paraffin hydrocarbon
Aluminum nitrate nonahydrate	O-phenanthroline
Ammonium hydroxide	Potassium fluoride
Ammonium oxalate	Potassium oxalate
Bromonaphthalene	Potassium permanganate
Butylated hydroxytoluene	S-diphenyl carbazide
Ceric sulfate	Sodium dichromate
Di2-ethyl hexyl phosphoric acid	Sodium fluoride
Ferrous sulfamate	Sodium dyroxide
Ferrous sulfate	Sodium nitrite
Hydrazine	Sulfate
Hydrochloric acid	Sulfuric acid
Hydroxylamine hydrochloride	Tetrabromoethane
Hydroxyquinoline	Tetraphenyl boron
Lead nitrate	Thenoyltrifuoroacetone
Mercuric thiocyanate	Tributyl phosphate
Methyl ethyl ketone	Trichloro methane
Methyl isobutyl ketone	Titanium chloride
Mineral oil	Tri-iso-octylamine
Nitrate	Tri-n-octylamine
Nitric acid	Vanadium
	Xylene
	Zinc amalgam

Source: DOE-RL 1992c

Table B-9. Chemicals Used or Produced in Purex Processes.

RADIONUCLIDES (all isotopes assumed unless specified)	INORGANIC CHEMICALS	INORGANIC CHEMICALS (Cont.)
	Aluminum	Potassium hydroxide
Actinium	Aluminum nitrate	Potassium permanganate
Americium	Ammonium carbonate	Selenium
Antimony	Ammonium fluoride	Selenium tetroxide
Astitine-217	Ammonium nitrate	Silicon trioxide
Barium	Arsenic	Silver
Beryllium-7	Barium	Silver nitrate
Bismuth	Beryllium	Sodium
Carbon-14	Bismuth	Sodium carbonate
Cerium	Bismuth phosphate	Sodium dichromate
Cesium	Boron	Sodium nitrate
Cobalt	Cadmium	Sodium nitrite
Curium	Cadmium nitrate	Sodium thiosulfate
Europium	Calcium	Strontium
Francium	Carbonate	Sulfamic acid
Iodine-129	Cerium	Sulfate
Lead	Chloride	Sulfuric acid
Manganese-54	Chromium	Tin
Neptunium	Copper	Tungsten tetroxide
Nickel	Cyanide	Uranium
Niobium-93m	Ferric cyanide	Vanadium
Palladium-107	Ferric nitrate	Zinc
Plutonium	Ferrous sulfamate	Zirconium oxide
Polonium	Fluoride	
Potassium-40	Gold	ORGANIC CHEMICALS
Promethium-147	Hydrazine	
Protactinium	Hydrogen peroxide	Acetone
Radium	Hydroxide	Chloroform
Ruthenium	Hydroxylamine nitrate	Citrate
Samarium-151	Iron	Ethylene diamine tetraacetate
Selenium-79	Lanthanum	(EDTA)
Strontium-90	Lead	Gylcolate
Technetium-99	Magnesium	Methylene chloride
Thallium	Manganese	N-(2-hydroxyethyl)
Thorium	Mercury	ethylenediaminetriacetate
Tin	Nickel	(HEDTA)
Tritium	Nitrate	Oxalate
Uranium	Nitric acid	Oxalic acid
Yttrium-90	Nitrite	Paraffin hydrocarbons
Zinc-65	Phosphate	Sugar (sucrose)
Zirconium	Potassium	Tartaric acid
	Potassium fluoride	Toluene
Source: DOE-RL 1993a		Tributyl phosphate
		Other degradation products

Table B-10. Partial List of Chemicals Used in Semi-Works Processes.

Acetic acid Aluminum sulfate Aluminum nitrate nonahydrate (ANN) Ammonium fluoride Ammonium nitrate Calcium nitrate Caustic tartrate (CT) Chromium nitrate Citric acid Di-2-ethylehexyl phosphoric acid Ethylenediamine tetraacetate (EDTA) Ferric nitrate Manganese oxide Nickel nitrate Nitric acid Nitric ferrous ammonium sulfate Nitrilotriacetic acid (NTA) Nonylphenoxy polyethroxy ethanol Normal paraffin hydrocarbon (NPH) Oxalic acid Pentasodium diethylene Triamine penta acetate Permanganate caustic Phosphoric acid Potassium bicarbonate Potassium permanganate Potassium persulfate Shell spray base Shell E-2342 Silver nitrate Sodium acetate Sodium aluminate Sodium carbonate Sodium dichromatic Sodium hexametaphosphate Sodium fluoride Sodium hydroxide Sodium nitrate Sodium nitrite	Sodium persulfate Sodium phosphate Sodium silicate Sodium sulfate Sodium sulfide Soltrol-170 Sugar Sulfamic acid Sulfuric acid Tartaric acid Tetrasodium ethylene diamine-tetra acetate (EDTA) Tributyl phosphate (TBP) Trisodium hydroxyethyl ethylene-diamine triacetate (HEDTA) Trisodium phosphate Turco 4128A Zirconium oxide Note: Radionuclides will be the same as for REDOX and PUREX Source: DOE-RL 1993b

Table B-11. Single Shell Tank Operations - Period of Active Waste Transfers. (Sheet 1 of 2)

TANK FARM	WASTE	DURATION	TANK FARM	WASTE	DURATION
A TANK FARM	P	1956-1975	BX TANK FARM	MW	1948-1956
	IX	1970-1976		1C	1948-1968
	PSS	1970-1976		EB	1954-1976
	B	1973-1976		TBP	1956-1968
	EVAP	1976-1978		CW	1962-1975
	HDRL	1978		IX	1967-1976
	DSSF	1978-1980		OWW	1968-1972
	NCPLX	1978-1980		BL	1968-1976
	CPLX	1979-1980		IWW	1970
	CC	1980		RIX	1970-1972
B TANK FARM	MW	1945-1953		R	1971-1972
	2C	1945-1956		SIX	1971-1972
	5-6	1952-1963		DW	1973-1974
	224	1952-1974		BNW	1973-1975
	EB	1952-1976		LW	1973-1975
	TBP	1953-1969		N	1973-1975
	HLO	1959-1968		PL	1973-1975
	FP	1963-1968		EVAP	1976-1977
	CW	1963-1976		DSSF	1978-1980
	1C	1965-1969		NCPLX	1978-1980
	OWW	1969		CPLX	1979-1980
	BL	1969-1976	C TANK FARM	MW	1946-1955
	IX	1969-1976		1C	1946-1969
	BNW	1973-1976		TBP	1952-1969
	DW	1973-1976		SSW	1955-1956 & 1968-1977
	LW	1973-1976		CW & OWW	1956-1976
	N	1973-1976		HS	1957-1968
	R	1973-1976		EB & P	1957-1976
	EVAP	1976-1978		FP	1962-1963
	NCPLX	1978-1980		HLO	1967-1968
BY TANK FARM	MW	1950-1955		BNW & LW	1968-1976
	1C	1950-1956 & 1961-1964		N & PL	1968-1976
	TBP	1952-1968		R	1970
	P	1957-1965		BL	1970-1975
	CW	1957-1970		IX	1970-1976
	OWW	1957-1970		PSS	1970-1976
	IX	1968-1970		DW	1973-1976
	EB	1968-1976		RIX	1975
	EVAP	1976-1977		EVAP & SRS	1976-1977
	NCPLX	1978-1980		CPLX &	1978-1980

Table B-11. Single Shell Tank Operations - Period of Active Waste Transfers. (Sheet 2 of 2)

TANK FARM	WASTE	DURATION
S TANK FARM	R	1952-1973
	CW	1957-1974
	EB	1968-1976
	BNW	1973-1974
	DW & N	1973-1974
	B & BL	1974
	IX & RIX	1974
	LW & 224	1974
	TL	1975-1976
	EVAP	1976-1977
	HDRL	1978
	DSSF,	1978-1980
SX TANK FARM	R	1954-1975
	HLO	1967
	EB	1967-1976
	CW, OWW,	1971-1975
	BNW, DW	1975
	BL, IX, &	1975-1976
	B, EVAP,	1976
	PNF	1978-1980
	CPLX	1979-1980
	DSSF &	1980
T TANK FARM	MW	1945-1957
	1C	1945-1969
	2C	1945-1975
	TBP	1952-1976
	CW	1955-1976
	224	1952-1976
	EVAP	1976-1977
	EB	1953-1964 & 1972-
	HLO	1967-1978
	R, RIX, IX &	1972-1976
	NCPLX	1978-1980
	BNW	1968-1972 & 1975-
TX TANK FARM	MW	1949-1957
	1C	1949-1974
	TBP & EB	1952-1976
	CW	1966-1968 & 1971-
	R	1957-1974
	OWW & RIX	1971-1976
	BNW, DW,	1975
	IX	1972-1974
	BL	1972-1976
	CPLX,	1978-1980
	B	1975-1976
	EVAP	1976-1977
TY TANK FARM	TBP	1953-1974
	EB	1953-1976
	1C	1954-1968
	DW	1961-1967
	R	1967-1974
	CW	1968-1969
	OWW	1968-1976
	RIX	1970-1976
	BL	1972-1976
	EVAP	1976-1978
	NCPLX	1978-1980

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1 2 3 4 5

Inches

4 of 4

Table B-12. PUREX Plant (A Plant): Fuel Reprocessing (200 East Area)(1955-1972).

Compound Name	Formula	Comments
Dibutyl Butyl Phosphonate	$CH_3(CH_2)_3PO_3[CH_3(CH_2)_3]_2$	
Dowex 21 K/Amberlite XE-270 (IX Resin)	Polystyrene DVB with Trimethyl Ammonia	Product name
Formaldehyde (Solution)	CH_2O	
Hydrazine	H_2NNH2H_2O	
Hydroxylamine Nitrate	NH_2OHHNO_3	
Ionac A-580/Permutit SK (IX Resin)	Polyvinyl Puridine with Methyl Groups	Product name
Normal Paraffin Hydrocarbon	$C_{10}H_{22}$ to $C_{14}H_{30}$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Shell E-2342	Naphthalene and Paraffins	Product name
Soltrol-170	$C_{10}H_{22}$ to $C_{16}H_{34}$	Product name
Sugar	$C_{12}H_{22}O_{11}$	
Tartaric Acid	$C_2H_2(OHCOOH)_2$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Trichloroethane	CH_3CHCl_3	Equipment degreasing
Tri-n-dodecylamine	$[CH_3(CH_2)_{11}]_3N$	

Table B-13. PUREX Plant (A Plant): Analytical Laboratory (200 East Area)(1955-1972).

Compound Name	Formula	Comments
Acetone	$CH_3C_2OH_3$	
Carbon Tetrachloride	CCl_4	
Hydroxylamine Hydrochloride	NH_2OHHCl	
Isopropyl Alcohol	C_3H_7OH	
Thenoyltrifluoroacetone	$(CH)_3SCOCH_2$ $COCF_3$	

Table B-14. PUREX Plant (A Plant): Fission Product Recovery (200 East Area)(1960-1966).

Compound Name	Formula	Comments
Acetic Acid	CH_3CO_2H	
Hydroxyacetic Acid	CH_3OCOOH	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Tartaric Acid	$C_2H_2(OHCOOH)_2$	

Table B-15. B Plant: Fuel Reprocessing (200 East Area)(1945-1952).

Compound Name	Formula	Comments
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Trichloroethane	CH_3CHCl_3	Equipment degreasing

Table B-16. B Plant: Strontium Recovery and Waste Fractionization (200 East Area)(1965-1976).

Compound Name	Formula	Comments
Citric Acid	$C_3H_4OH(COOH)_3$	
Di2-Ethyl Hexyl Phosphoric Acid	$C_{16}H_{34}O_2POOH$	
Duolite ARC-359 (IX Resin)	Sulfonated Phenolic	Product name
Hydroxyacetic Acid	CH_3OCOOH	
Normal Paraffin Hydrocarbon	$C_{10}H_{22}$ to $C_{14}H_{30}$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Sodium Gluconate	$(CHOH)_4CO_2HCH_2$ ONa	
Sugar	$C_{12}H_{22}O_{11}$	
Tartaric Acid	$C_2H_2(OHCOOH)_2$	
Tetrasodium Ethylene Diamine-Tetra Acetate (EDTA)	$N_2C_2H_4(C_2H_2O_2Na)_4$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Trichloroethane	CH_3CHCl_3	Equipment degreasing
Trisodium Hydroxyethyl Ethylene-Diamine Triacetate (HEDTA)	$N_2C_2H_4(C_2H_2O_2Na)_3$ (C_2H_4OH)	
Zeolite AW-500 (IX Resin)	$Al_2(SiO_5)_2(OH)_2$	Product name

Table B-17. B Plant: Waste Encapsulation (200 East Area)(1974-1976).

Compound Name	Formula	Comments
Acetone	$CH_3C_2OH_3$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Trichloroethane	CH_3CCl_3	

Table B-18. Semiworks Pilot Plant (200 East Area)(1955-1967.

Compound Name	Formula	Comments
Acetic Acid	CH_3CO_2H	
Citric Acid	$C_3H_4OH(COOH)_2$	
Di2-Ethyl Hexyl Phosphoric Acid	$C_{16}H_{34}O_2POOH$	
Glycolic Acid	$HOCH_2CO_2H$	
Hydrazine	$H_2NNH_2H_2O$	
Hydroxyacetic Acid	CH_3OCOOH	
Nitrilotriacetic Acid (NTA)	$N(CH_2COOH)_3$	
Normal Paraffin Hydrocarbon	$C_{10}H_{22}$ to $C_{14}H_{30}$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Pentasodium Diethylene Triamine Penta Acetate (DTPA)	$N_3(CH_2)_4(COONa)_5$	
Shell Spray Base	$C_{10}H_{22}$ to $C_{16}H_{34}$	Product name
Shell E-2342	Naphthalene and Paraffins	Product name
Soltrol-170	$C_{10}H_{22}$ to $C_{16}H_{34}$	Product name
Sugar	$C_{12}H_{22}O_{11}$	
Tartaric Acid	$C_2H_2(OHCOOH)_2$	
Tetrasodium Ethylene Diamine-Tetra Acetate (EDTA)	$N_2C_2H_4(C_2H_2O_2Na)_4$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Trisodium Hydroxyethyl Ethylene-Diamine Triacetate (HEDTA)	$N_2C_2H_4(C_2H_2O_2Na)_3$ (C_2H_4OH)	

Table B-19. REDOX Plant (S Plant): Fuel Reprocessing (200 West Area) (1951-1967).

Compound Name	Formula	Comments
Hydrazine	$H_2NNH_2H_2O$	
Normal Paraffin Hydrocarbon	$C_{10}H_{22}$ to $C_{14}H_{30}$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	

Table B-20. REDOX Plant (S Plant): Analytical Laboratory (200 West Area) (1951-1976).

Compound Name	Formula	Comments
Acetone	$CH_3C_2OH_3$	
Di2-Ethyl Hexyl Phosphoric Acid	$C_{16}H_{34}POOH$	
Hydrazine	$H_2NNH_2H_2O$	
Hydroxylamine Hydrochloride	NH_2OHHCl	
Hydroxyquinoline	C_9H_6NOH	
Methyl Ethyl Ketone	$CH_3COC_2H_5$	
Methyl Isobutyl Ketone	$CH_3COC_4H_9$	
Mineral Oil	Light Hydrocarbons	
Normal Paraffin Hydrocarbon	$C_{10}H_{22}$ to $C_{14}H_{30}$	
O-phenanthroline	$C_{12}H_8N_2$	
S-diphenyl Carbazide	$(C_6H_5NHHN)_2CO$	
Shell Spray Base	$C_{10}H_{22}$ to $C_{16}H_{34}$	Product name
Tetrabromoethane	$(CHBr_2)_2$	
Tetraphenyl Boron	$(C_6H_5)_4B$	
Thenoyltrifluroacetone	$(CH)_3SCOCH_2$ $COCF_3$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Tri-iso-octylamine	$[(CH_3)_2CH(CH_2)_5]_3N$	
Tri-n-octylamine	$[CH_3(CH_2)_7]_3N$	
Xylene	$C_6H_4(CH_3)_2$	

Table B-21. T Plant: Fuel Reprocessing (200 West Area) (1944-1956).

Compound Name	Formula	Comments
Oxalic Acid	$HO_2CCO_2H2H_{20}$	
Trichloroethane	CH_3CHCl_3	Equipment degreasing

Table B-22. 221-T Plant: Equipment Decontamination (220 West Area) (1964-1980).

Compound Name	Formula	Comments
Acetone	$CH_3C_2OH_3$	
Jasco Paint Stripper	Methylene Chloride, CH_3OH	Product name
Kerosene	$C_{10}H_{22}$ to $C_{16}H_{34}$	
Trichloroethane	CH_3CCl_3	
Turco (Fabrifilm)	Toluene, Butanol, Isopropanol, Acetone	Product name
Turco 2822	Methlene Chloride, Acetic Acid	Product name
Turco 4501 A	KOH, Hydroxydiamine Compounds	
Turco 4518	$HO_2CCO_2H2H_2O$, Sodium Dodecyl Benzene Sulfonate	
Turco 4521	$(NH_4)_2C_2O_4$, $HO_2CCO_2H2H_2O$, Sodium Dodecyl Benzene Sulfonate	
Turco T-5561	2-Butoxyethol, Dioctyl Phtalate, Morpholine, Mineral Oil	Product name
Turco T-5589	Isopropanol, NH_4OH	Product name
Turco Alkaline (Rust Remover)	NaOH, Kerosene	Product name
Turco Deseal Zit 2	Methylene Chloride, Acidic Acid	Product name
West Lode Degreaser	Aromatic Compounds	Product name

Table B-23. U Plant: Uranium Recovery and In-Plant Scavenging (200 West Area) (1952-1958).

Compound Name	Formula	Comments
Shell Spray Base	$C_{10}H_{22}$ to $C_{16}H_{34}$	Product name
Shell E-2342	Naphthalene and Paraffins	Product name
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Trichloroethane	CH_3CHCl_3	Equipment degreasing

Table B-24. U Plant: Analytical Laboratory (200 West Area) (1952-1958).

Compound Name	Formula	Comments
Carbon Tetrachloride	CCl_4	
Ethanol	C_2H_5OH	
Ethyl Ether	$(CH_3CH_2)_2O$	
Oxalic Acid	$HO_2CCO_2H2H_20$	

Table B-25. Plutonium Finishing Plant (Z Plant): Plutonium Conversion to Oxide (200 West Area) (1973-1976).

Compound Name	Formula	Comments
Oxalic Acid	$HO_2CCO_2H2H_2O$	

Table B-26. Plutonium Finishing Plant (Z Plant): Plutonium Reclamation and Waste Treatment (200 West Area) (1973-1976).

Compound Name	Formula	Comments
Carbon Tetrachloride	CCl_4	
Dibutyl Butyl Phosphonate	$CH_3(CH_2)_3PO_3[CH_3(CH_2)_3]_2$	
Dodecane	$CH_3(CH_2)_{10}CH_3$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	

Table B-27. Plutonium Finishing Plant (Z Plant): Analytical Laboratory (200 West Area) (1973-1976).

Compound Name	Formula	Comments
Acetic Acid	CH_3CO_2H	
Acetone	$CH_3C_2H_3O$	
Alizarin Yellow	$C_{14}H_8O_4$	
Bromocresol Purple	C_7H_6OHBr	
Carbon Tetrachloride	CCl_4	
Dibutyl Phosphate	$(n\text{-}C_4H_9)_2HPO_4$	
Hydrazine	$N_2H_4H_2O$	
Methanol	CH_3OH	
Napthylamine	$C_{10}H_9N$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Thenoyltrifluoracetone	$(CH)_3SCOCH_2COCF_3$	
Thymolphthalein	$C_{28}H_{30}O_4$	
Toluene	$C_6H_5CH_3$	
Tributyl Phosphate	$(C_4H_9)_3PO_4$	
Tri-Iso-Octylamine	$C_{24}H_{51}N$	
Tris (hydroxymethyl) Amino Methane	$(CH_2OH)_3CNH_2$	
Xylene	$C_6H_4(CH_3)_2$	

Table B-28. Tank Farms (200 Areas): Equipment Decontamination and Waste Evaporation/Solidification (1944-1980).

Compound Name	Formula	Comments
Acetic Acid	CH_3CO_2H	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Pentasodium Diethylene Triamine Penta Acetate (DTPA)	$N_3(CH_2)_4(COONa)_5$	
Tartaric Acid	$C_2H_2(OHCOOH)_2$	
Turco Deseal Zit 2	Methylene Chloride Acetic Acid	Product name

Table B-29. Tank Farms (200 Areas): Waste Scavenging and Sludge Sluicing/Dissolution (1952-1976).

Compound Name	Formula	Comments
American Cyanamid S 4058 Floc	Hydrocarbon	Product name

Table B-30. Building 242 (200 East Area): Irradiation Rupture Prototype Loop (1959-1967).

Compound Name	Formula	Comments
Citric Acid	$C_3H_4OH(COOH)_3$	
Oxalic Acid	$HO_2CCO_2H2H_2O$	
Trisodium Hydroxyethyl Ethylene-Diamine Triacetate (HEDTA)	$N_2C_2H_4(C_2H_2O_2Na)_3$ (C_2H_4OH)	

APPENDIX C

POTENTIAL MONITORING AND CHARACTERIZATION METHODS AND TECHNIQUES

CONTENTS

FIGURES:

C1.0 POTENTIAL MONITORING AND CHARACTERIZATION METHODS

Potential tank monitoring and characterization methods that may be applicable for use at the miscellaneous inactive radioactive waste tanks are described below.

C1.1 LEAK DETECTION MONITORING

Leak detection monitoring methods can be divided into in-tank methods and monitoring of adjacent drywells. Because there are no drywells adjacent to any of the miscellaneous tanks, any potential leak detection monitoring is limited to using in-tank methods.

When the miscellaneous tanks were interim isolated (Section 2.3), most had the liquid level measuring devices removed, supernatant level reduced to 4 inches or less and blind flanges installed on the above ground tank risers. This typical tank status limits any future monitoring to using in-tank manual methods, unless there is a need to utilize more sophisticated, automated systems on selected tanks.

Manual in-tank monitoring methods include using a manual tape, Food Instruments Corporation (FIC) gauge, or hand-held conductivity probe (zip cord) to measure surface liquid levels and solids levels. The manual tape and FIC gauge are typically mounted on top of a riser. The manual tape uses a 3-ft-long spool piece to attach the tape reel to the riser (Farley and Grigsby 1992). The manual tape is a steel measuring tape (similar to those found in hardware stores) with a plummet attached to one end; the tape is normally left hanging inside of the tank. Containment at the manual tape reel/tank riser interface is provided by a set of neoprene gasket seals that the steel tape slides between. When not in use, the seals can be tightened against the tape with a thumb screw/slider assembly (Farley and Grigsby 1991).

The hand-held conductivity probe (zip cord) is a portable measuring device (Figure C-1). It consists of two 3/8-inch diameter steel rods approximately 1 foot long which are encased in a rubber sheath and held in place and separated by room temperature vulcanizing silicone cement (Farley and Grigsby 1992). The steel rod probes are connected to a Volt Ohm meter (VOM) by a graduated two-conductor insulated cord.

The steel tape and plummet of the FIC and manual tape systems, and the steel rod probe of the hand-held conductivity probe are lowered through the tank access riser until the surface of the liquid waste is contacted. The FIC gauge performs automatically and is typically interfaced with the Computer Automated Surveillance System (CASS). The manual tape is lowered by means of a hand crank. The liquid surface level is established when the conductivity probe or plummet contacts moisture. The FIC liquid level is read from a counter, and the manual tape or conductivity probe liquid level is read directly from the calibrated tape or cord. The surface liquid level to be measured must be located directly below the access riser containing the FIC or manual tape system (Klem 1988). Utilizing tank-specific elevation and construction dimensions, the level of the liquid or solid surface from the bottom of the tank is recorded.

The FIC gauge and manual tape systems and the conductivity probe are also used to measure a single-point solids-surface level. As above, the solids-surface level is established when either the FIC gauge or the conductivity probe contacts moisture. In the past, several automated FIC gauges have completely unwound their tapes and become contaminated when they were unable to contact moisture. The single-point measurement of the solids-surface level is valid only for flat surfaces. Tank personnel using the manual tape system may sense when the plummet touches the exposed or submerged solids level by grasping the tape and feeling for the solids contact. A donut- or pancake-shaped plummet is substituted for the standard conical plummet to improve measurement of the solids level (Klem 1988).

The initial liquid level readings are used to establish a baseline for each tank being monitored. Because the accuracy of these manual methods is about $\pm$0.25 inch, a decrease of 0.5 inch is required to be reported for corrective action (Appendix D, page D-11).

Interstitial liquid levels (ILLs) can be measured through liquid observation wells (LOWs), which are fiberglass-reinforced epoxy-polyester or steel drywells inserted to within 6 inches of the waste tank bottom. Monitoring is accomplished using the computer-equipped drywell panel truck and, typically, neutron or gamma probes (Klem 1988). Because none of the miscellaneous inactive tanks currently have any LOWs, they would need to be installed before this monitoring method could be utilized.

Numerous improved tank surveillance methods are discussed by Klem (1988). These methods include improved in-tank photography and optical radar for measuring liquids and solids levels, and development of geophysical probes to measure ILLs in the LOWs.

C1.2 TANK INTEGRITY ASSESSMENT TECHNIQUES

This section provides a description of the available techniques to determine tank integrity and focuses on determination of tank integrity for both occupational safety and environmental protection.

To determine the integrity of an underground tank there are numerous technologies available, many of which require personnel entry. Due to the high radiation levels likely in most, if not all the miscellaneous tanks, it is a primary assumption that personnel entry will not be allowed. Remote techniques include:

- Liquid Level Monitoring (Environmental Protection)
- Remote Camera (Environmental Protection and Occupational Safety)
- Remote Ultrasound (Environmental Protection and Occupational Safety)

Liquid level monitoring is currently performed on four of the miscellaneous tanks; however, most are not monitored at all (see Section 2.3). Liquid level monitoring is generally performed using manual tape techniques. This type of monitoring is easily implemented on tanks which have access through above ground risers; however, tanks which have been sealed through interim isolation or are in vaults would be more difficult to access using this technique.

Cameras operated by remote control are a viable option for inspecting the internal integrity of the tank. This technique is implemented by suspending a camera into the tank vapor space and either videotaping or taking pictures of the internal wall surfaces. The conventional camera systems need 12-inch diameter entry ports; however, a technique has been developed for use of cameras which can be suspended through 6-inch risers. Photographs taken with this camera package are of good quality and allow investigators to collect a good amount of qualitative data for integrity assessment (Klem 1988).

Another promising technique is the use of remote ultrasound equipment to determine wall thickness. This technique involves the use of ultrasonic testing devices which emit sound waves and provide wall thickness measurements based on the characteristics of the return sound wave. The technique is commonly employed for above ground tank inspections; however, using the same remote control and robotics technologies available for cameras, ultrasonic testing could also be conducted on underground tanks.

C1.3 WASTE CHARACTERIZATION TECHNIQUES

Waste characterization is accomplished by physically sampling and analyzing the waste materials. Waste characterization techniques currently being used at the SSTs are, for the most part, directly applicable to characterizing wastes in the miscellaneous tanks. This section focuses on the physical sampling methods that could be used to characterize the miscellaneous tanks. These methods include tank vapor sampling of gases and several techniques for sampling of tank liquids and solids. Laboratory analytical characterization techniques being used for the SST waste samples (Klem et al. 1990, Winters et al. 1991) would be directly applicable to miscellaneous tank waste samples, so these methods will not be discussed here.

C1.3.1 Vapor Sampling

A tank vapor sampling method is described in WHC (1994). This procedure is specific to the 242-A Evaporator vessel, but could likely be adapted for use in the miscellaneous tanks. The sampling device is an assembly of two six-inch stainless steel sorbent tubes connected in series, a 0.1 liter per minute gas flow controller, a vacuum gauge, a valve, and a six liter Summa canister (Figure C-2). The sorbent tubes are filled with a commercial absorbent material (a T0-2 Method absorbent) which traps organic compounds, but allows water vapor to pass. The Summa canister serves both as the device pump and the final collection stage (WHC 1994). It is likely that this system could be utilized for vapor sampling in the miscellaneous tanks with little or no modifications.

C1.3.2 Drop Bottle Sampling

The only method currently used to obtain samples of tank supernatant liquids is the drop bottle ("bottle on a string") method. This simple and effective method utilizes a stoppered and weighted glass sample bottle attached to the end of a stainless steel wire or string (Figure C-3). The bottle is manually lowered through the tank access riser until the top of the bottle is beneath the surface liquid level. A short, quick, upward pull on the wire or string removes the stopper and allows the liquid to fill the sample bottle, which is then carefully raised to the surface. The sample is packed and transported to the laboratory for processing. Details of the sampling procedures may be found in Plant Operating Procedure (Ross 1992) and Halgren (1991).

This method can sample surface liquids and very soft solids (Klem 1988) at different depths beneath the liquid surface. Because the 100 ml sample bottle is 4-1/2 inches high, this method is limited to obtaining samples from surface liquid layers that are greater than 4-1/2 inches thick. This sampling method would need to be modified, or a new method employed to obtain samples from thin (less than 4-1/2 inch) surface liquid layers, which are probably typical of many of the miscellaneous tanks (Table 2-3).

C1.3.3 Sludge Weight Samplers

Two types of sludge weight samplers may be used to obtain grab samples of soft sludges (Van Vleet 1991). The first is a six-tube sampler and the second is an inverted cone sampler. Details of the operating procedures may be found in WHC (1991a) and a detailed description of the samplers may be found in Marusich (1991). The two sludge weight samplers are shown in Figures C-4 and C-5. A sludge weight sampler used to obtain samples of hard salt/salt cake is discussed in Johnson (1991).

C1.3.4 Auger Sampling

The auger sampler is a manually operated, type 304 stainless steel screw-type auger which uses a type 304 stainless steel guide tube (2.1-inch inside diameter) that extends from the top of the riser to the waste surface. Details of the operating procedures may be found in WHC (1991b) and a detailed description of the auger sampler assembly components, installation, use and removal may be found in Van Vleet (1991). Figure C-6 shows a schematic of the complete guide tube assembly, which weighs approximately 50 kg (110 lbs) (Van Vleet 1991). The guide tube can be installed in a 4-inch or larger riser either manually or with a crane.

After installation and positioning of the guide tube assembly, the auger sampler assembly is then installed, either manually or with a crane, through the guide tube. Figure C-7 shows a schematic of the complete auger sampler assembly, which weights approximately 32 kg (70 lbs) (Van Vleet 1991). Figure C-8 shows the details of the auger bit.

Sampling is performed by manually turning the auger rods and bit into the waste material and then retrieving the auger bit into the retrieval container. This method is limited to retrieving one 12-inch long waste sample from a minimum 4-inch diameter riser. Although this sampling method has difficulty in sampling wet sludges, it is ideally suited to sampling crusts and thin (< 12 inch) solid layers on the bottom of a tank.

C1.3.5 Push Core Sampling

A specially designed, intrinsically safe core sample truck is used to obtain full depth core samples of tank liquids, sludges or solids in 19-inch segments (Van Vleet 1991). The core sample truck has a rotary platform mounted on the rear of the truck. Two sets of equipment are mounted on the perimeter of the rotary platform. One set is the shielded sample receiver unit that functions to place empty samplers into, and to remove full samplers from the drill string. The other set of equipment is the drill unit that functions to push the drill string and stainless steel sampler into the material being sampled. Figure C-9 shows a schematic of the core sample truck, and Figures C-10 and C-11 show additional sampling equipment details. A detailed description of the sampling procedure can be found in Marusich (1991).

This sampling method is limited to obtaining supernatant liquids and sludges. It has difficulty with sampling hard salt/salt cake (Klem 1988) and with obtaining undisturbed samples of interstitial liquid layers. In addition, when obtaining samples from greater than 38 inches in depth, this system requires use of a hydrostatic balancing fluid, which has lead to sample contamination in some instances.

C1.3.6 Rotary Core Sampling

Based on the experience gained from using the push core sample truck system, a second specially designed core sample truck is used to obtain full depth core samples of tank liquids, sludges or solids. This sample truck is similar to the system shown in Figures C-9 to C-11. This improved sample truck can be used in either push core mode to sample liquids and sludges or in rotary core mode to sample hard salt cake. The rotary core sampler is balanced with nitrogen gas, which does not contaminate the sample.

This system uses 2.457-inch outside-diameter nickel-plated rods and a 2-3/8-inch outside diameter core bit. The system has successfully been used through 12-inch and 4-inch diameter tank access risers. It may be possible to sample through 3-inch diameter risers if there are no safety issues associated with the smaller riser diameter. The system requires two risers during operation. One riser is used for the rotary sampling tools and the second riser is used for exhausting/filtering the balancing gas. The exhaust/filter riser is either a 12- or 18-inch diameter riser. The system was used until 1991 and then shut down for modifications. The modifications are scheduled to be completed by March 31, 1994. The rotary sampling truck is fully dedicated to sampling SSTs and DSTs.

C2.0 REFERENCES

Farley, W.G., and J.M. Grigsby, 1991, *Safety Assessment for Gas Sampling all Ferrocyanide Tanks*, Revision 2, WHC-SD-WM-SAD-009 Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Halgren, D., 1991, *Double-shell Tank Waste Analysis Plan,* WHC-SD-WM-EV-053, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Johnson, G.D., 1991, *Program Plan for Evaluation and Remediation of the Generation and Release of Flammable Gases in Hanford Site Waste Tanks*, WHC-EP-0416, Westinghouse Hanford Company, Richland, Washington.

Klem, M.J., 1988, *Technology Program Plan for Improved Surveillance of Underground Waste Tanks*, SD-WM-TPP- 039 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Klem, M.J., C.E. Golberg, R.D. Gibby, K.A. Giese, F.A. Ruck, J.C. Sonnichsen, D.D. Wanner, N.R. Wing, K.A. Woodworth, and J.F. Fletcher, 1990, *Single-Shell Tank Systems Technical Support Program Plan*, WHC-EP-0288, Westinghouse Hanford Company, Richland, Washington.

Marusich, R.M., 1991, *Push Mode Core Sampling Safety Assessment in Tank 101-SY*, WHC-SD-WM-SAD-008, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

Marusich, R.M., D.C. Deere and R.J. Van Vleet, 1991, *Safety Assessment for Window B Activities in Tank 101-SY*, WHC-SD-WM-SAD-003, Rev. 3, Westinghouse Hanford Company, Richland, Washington.

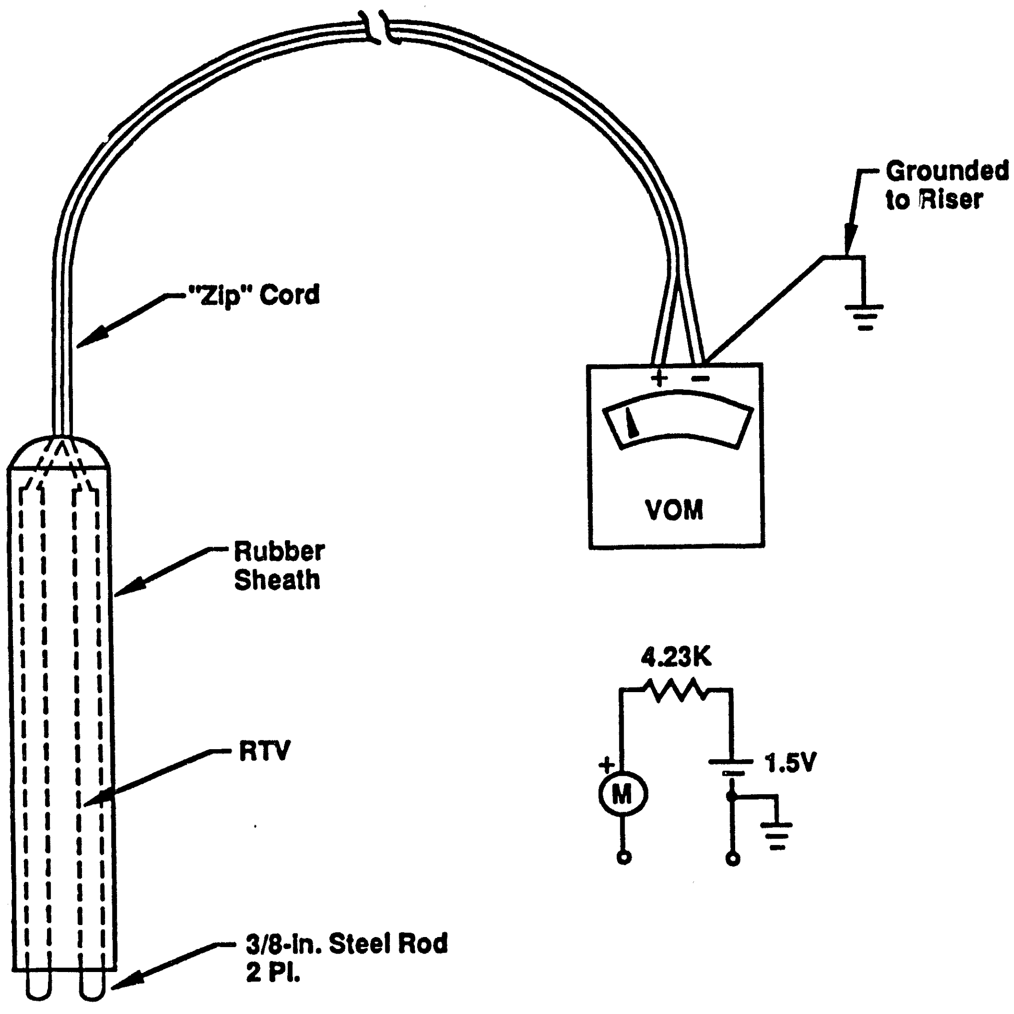
Ross, L.E., 1992, *Sample Non-Aging Waste Storage Tanks*, POP-TO-080-30, Westinghouse Hanford Company, Richland, Washington.

Van Vleet, R.J., 1991, *Safety Assessment for Penetrometer Testing and Auger Sampling in Tanks that Generate Flammable Gases*, WHC- SD-SAD-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991a, *Sludge Weight Crust Sampling from 241-SY-101*, TFPE-YP- 0060, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991b, *Auger Samples from 241-BY-104*, TFPE-YP-0080, Westinghouse Hanford Company, Richland, Washington.

Winters, W.I., L. Jensen, L.M. Sasaki, R.L. Weiss, J.F. Keller, A.J. Schmidt, and M.G. Woodruff, 1991, *Waste Characterization Plan For the Hanford Site Single-Shell Tanks*, WHC-EP-0210 Rev. 1, 2, and 3, Westinghouse Hanford Company, Richland, Washington.



Source: Farley and Grigsby (1991)

Figure C-1. Conductivity Probe Level Measuring Device.

JFP\M111293-B5

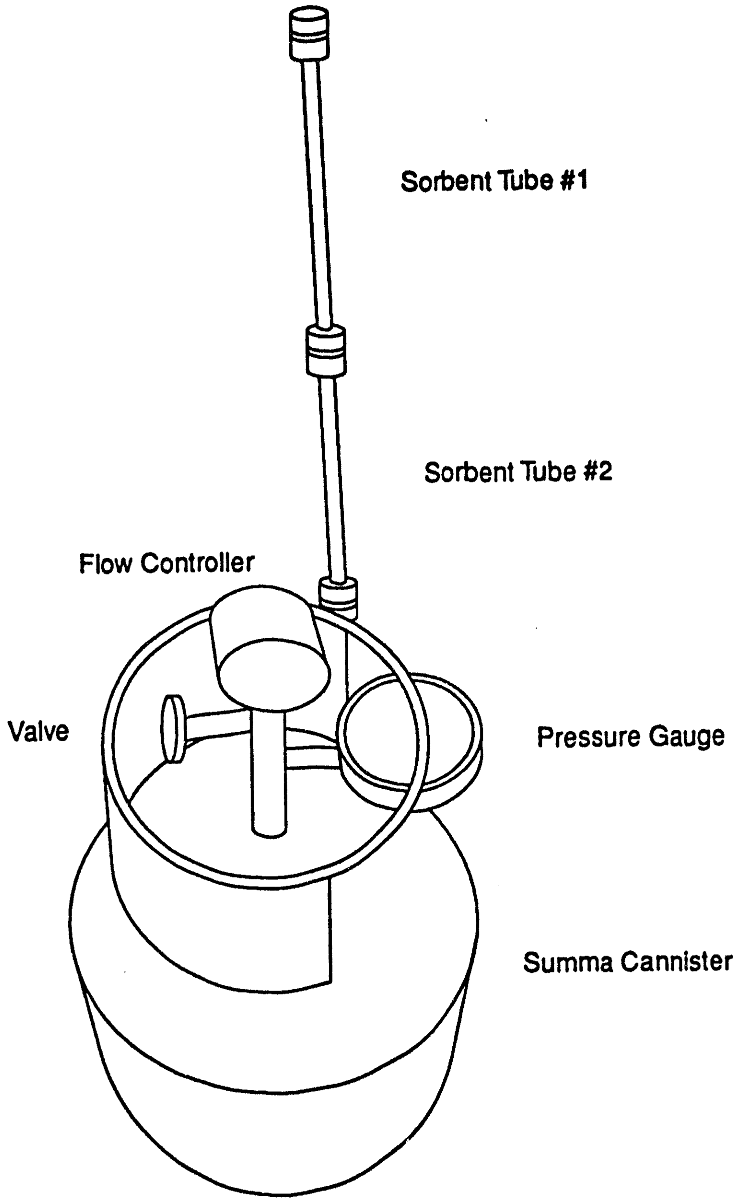


Figure C-2. Vapor Sampling Device.

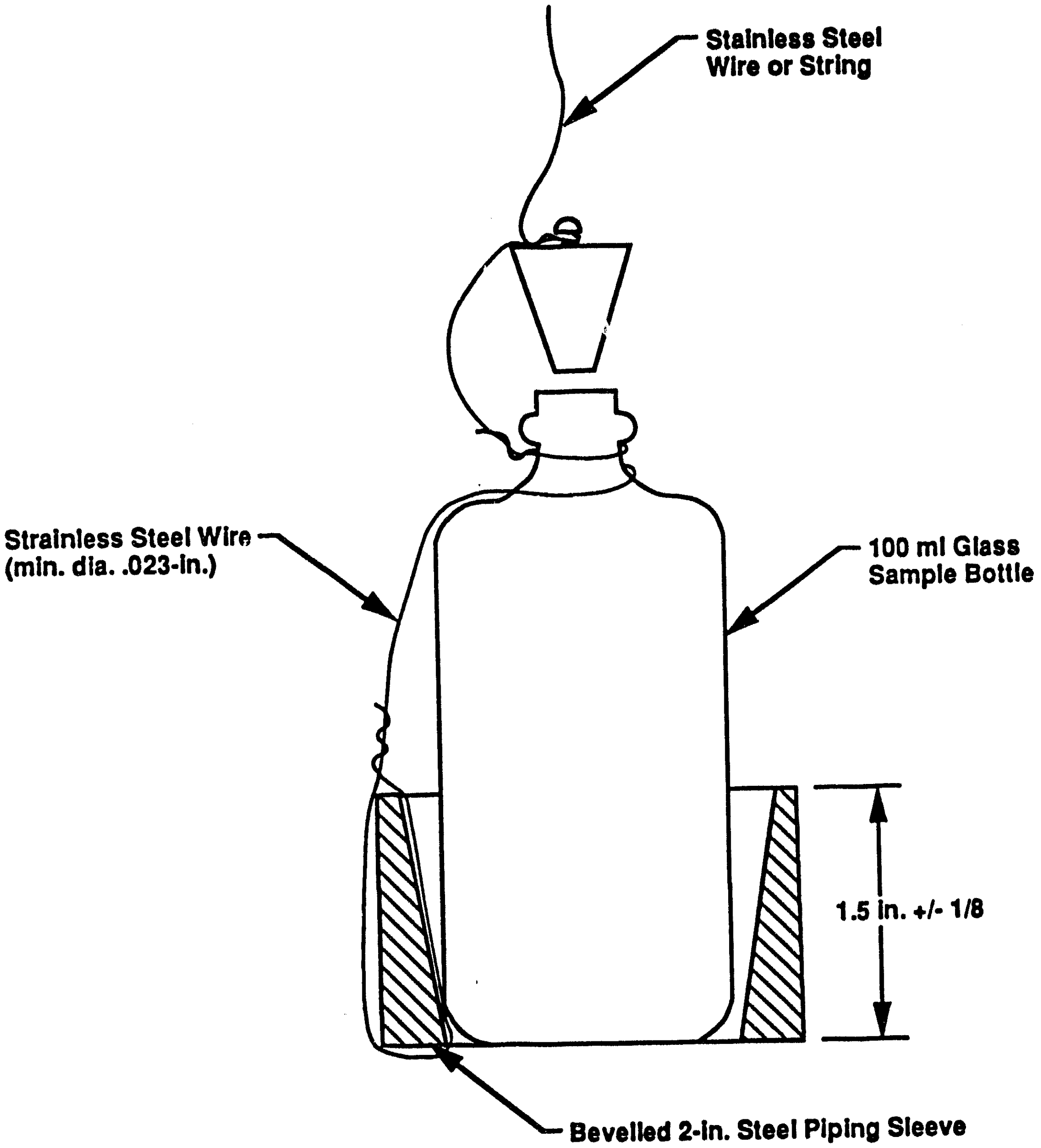
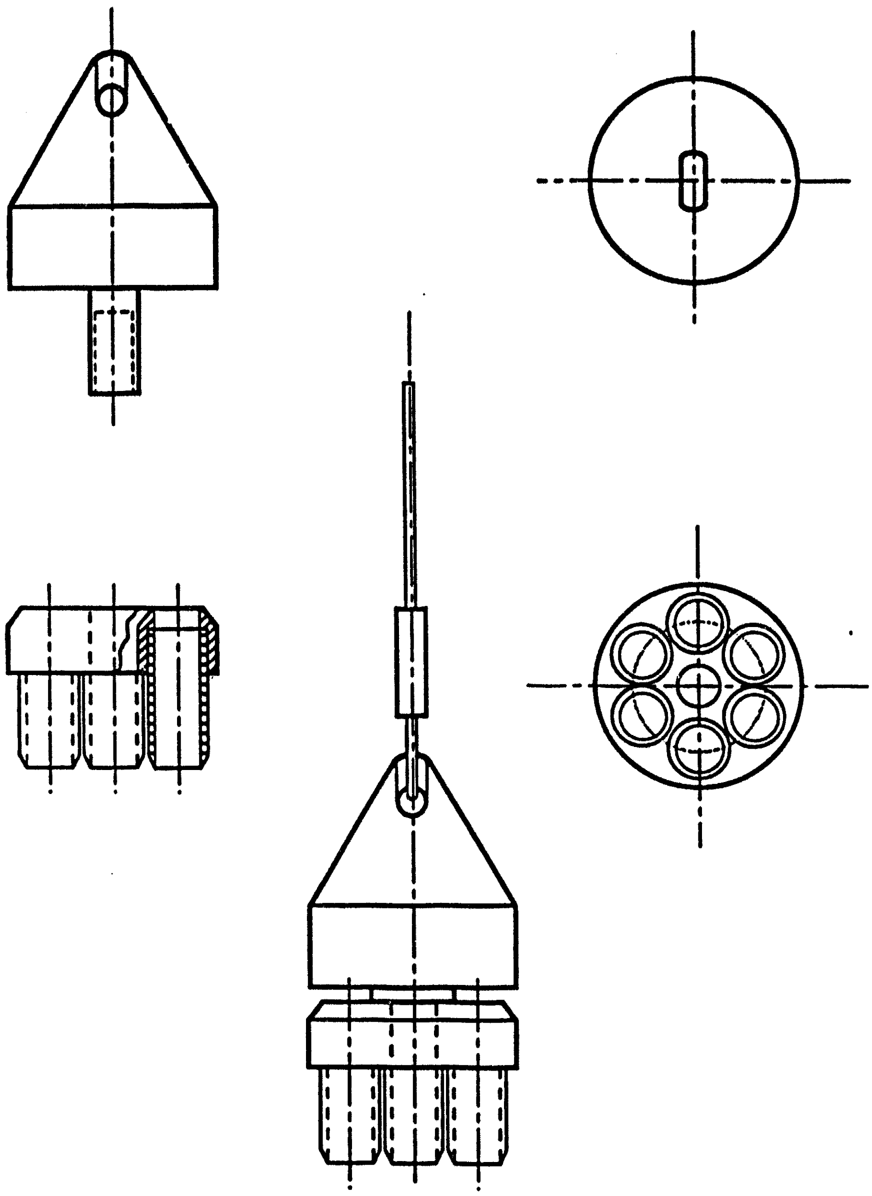


Figure C-3. Supernatant Sampling Assembly.

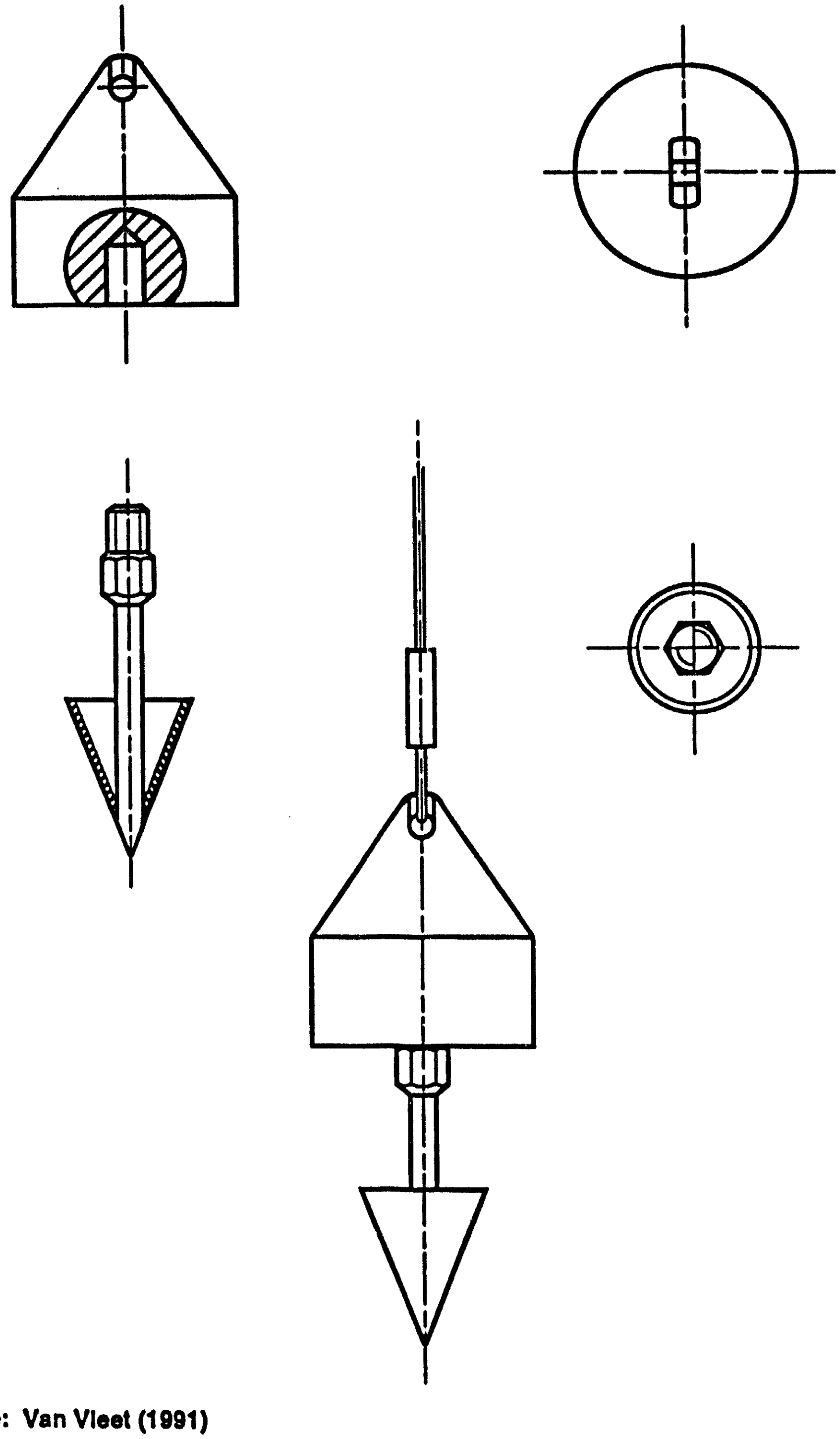
JFP\M111293-B7



Source: Van Vleet (1991)

H9109011.2

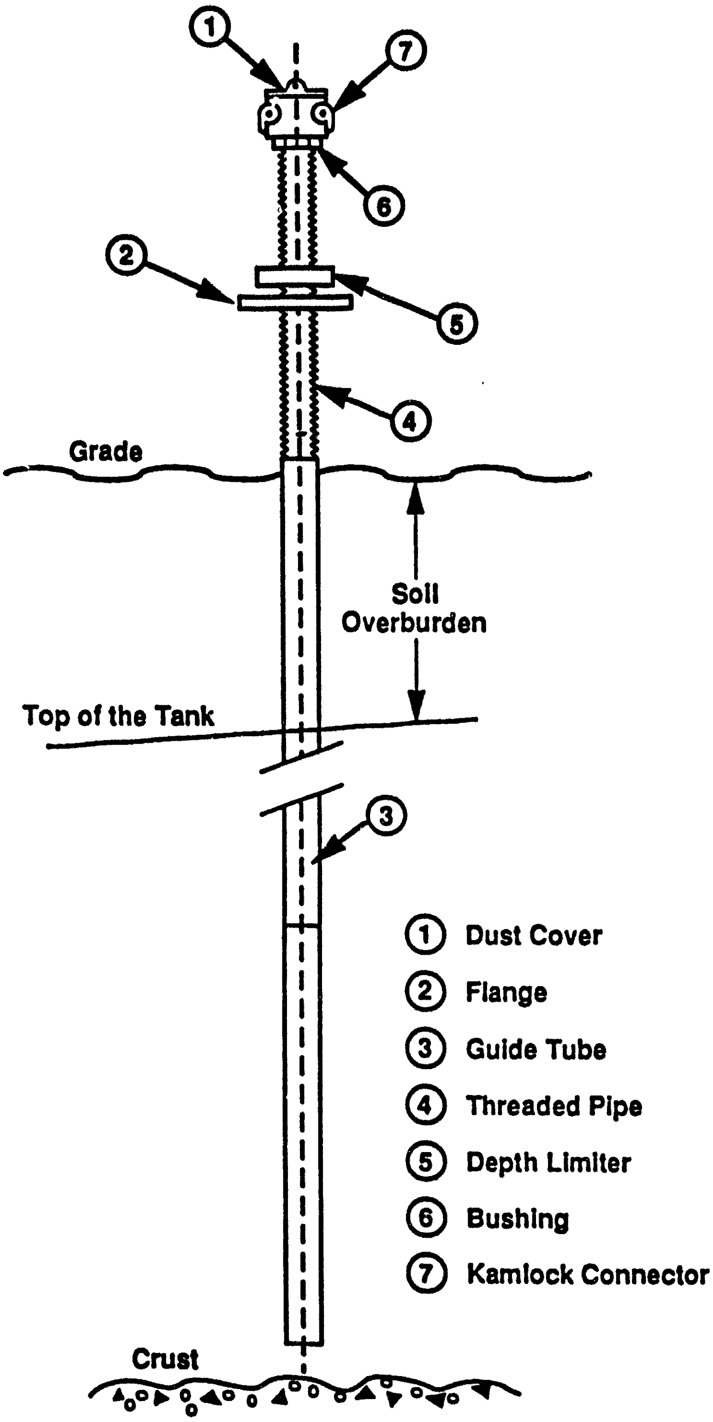
Figure C-4. Six-Tube Sludge Weight Sampler.



Source: Van Vleet (1991)

H9109011.1

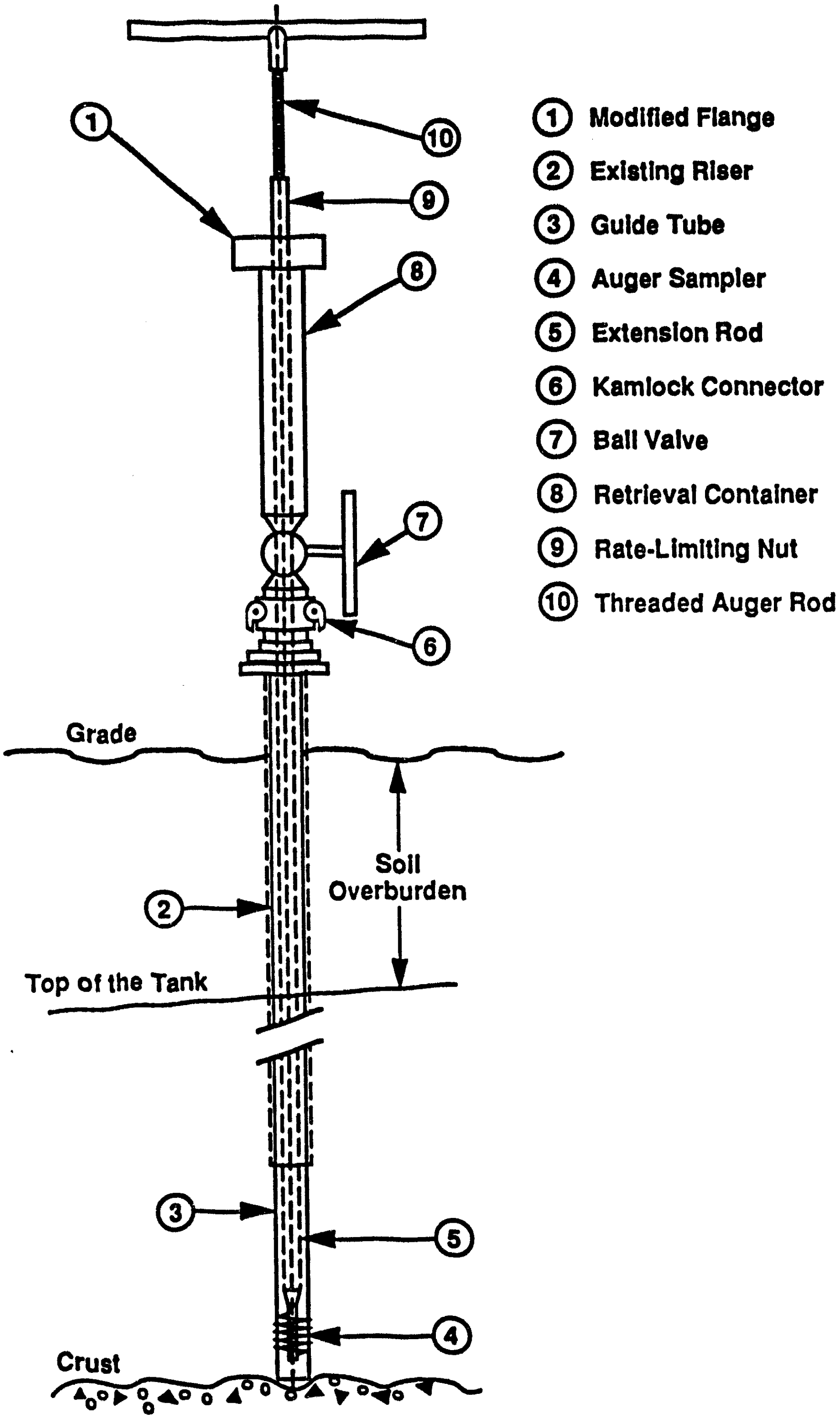
Figure C-5. Inverted-Cone Sludge Weight Sampler.



Source: Van Vleet (1991)

H9109011.4

Figure C-6. Guide Tube Assembly.



Source: Van Vleet (1991)

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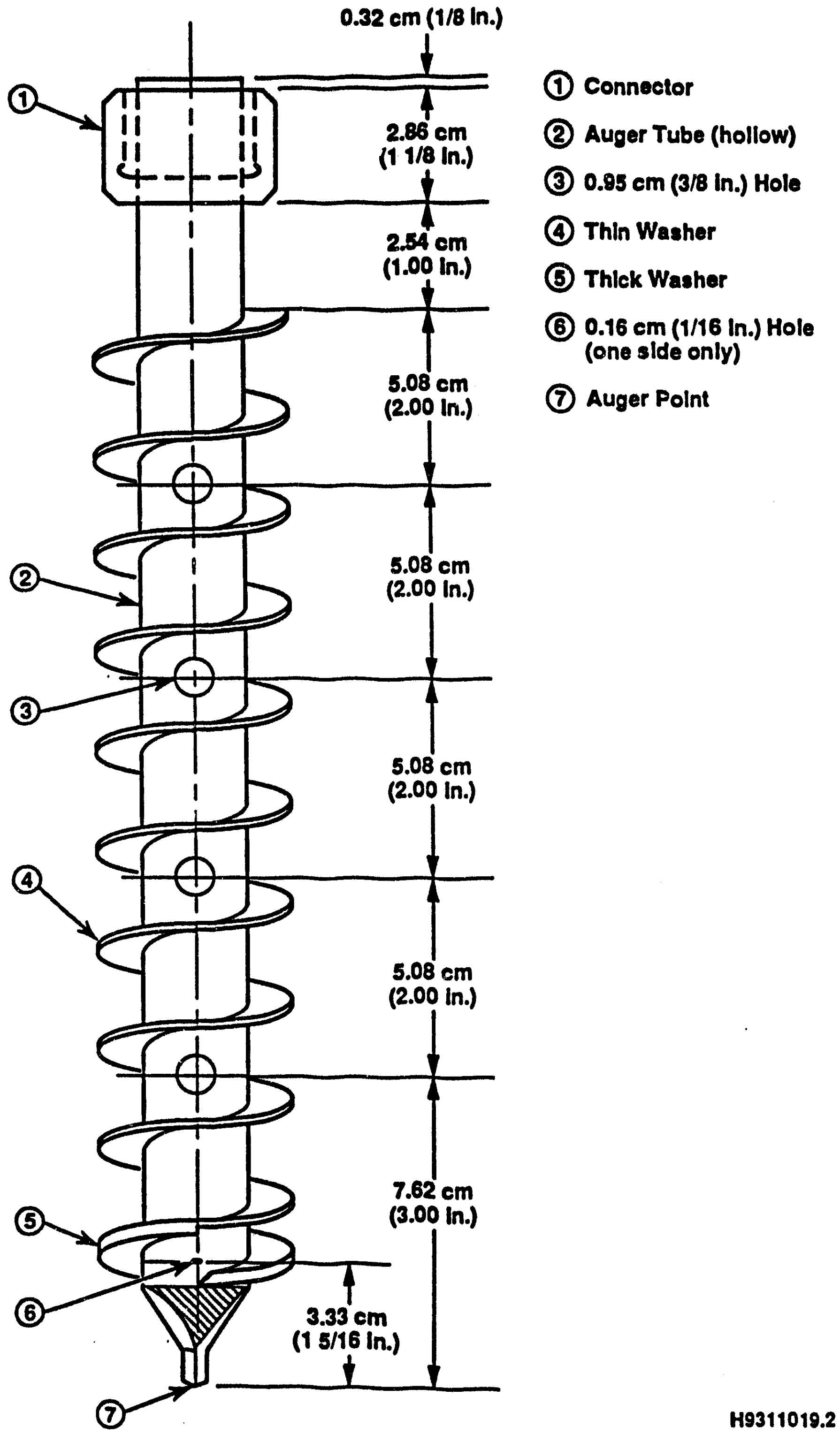
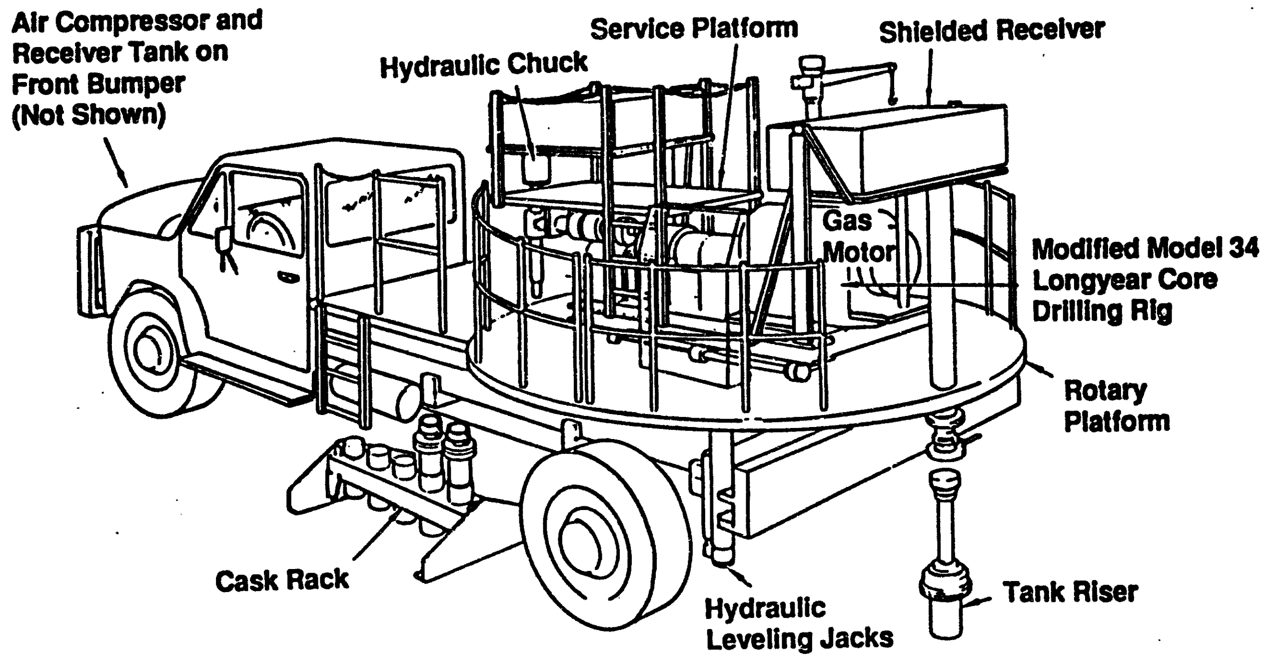
Figure C-7. Auger Sampler Assembly.



Source: Van Vleet (1991)

Figure C-8. Details of the Auger Bit.



Source: Van Vleet (1991)

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Figure C-9. Schematic of the Core Drill Truck.

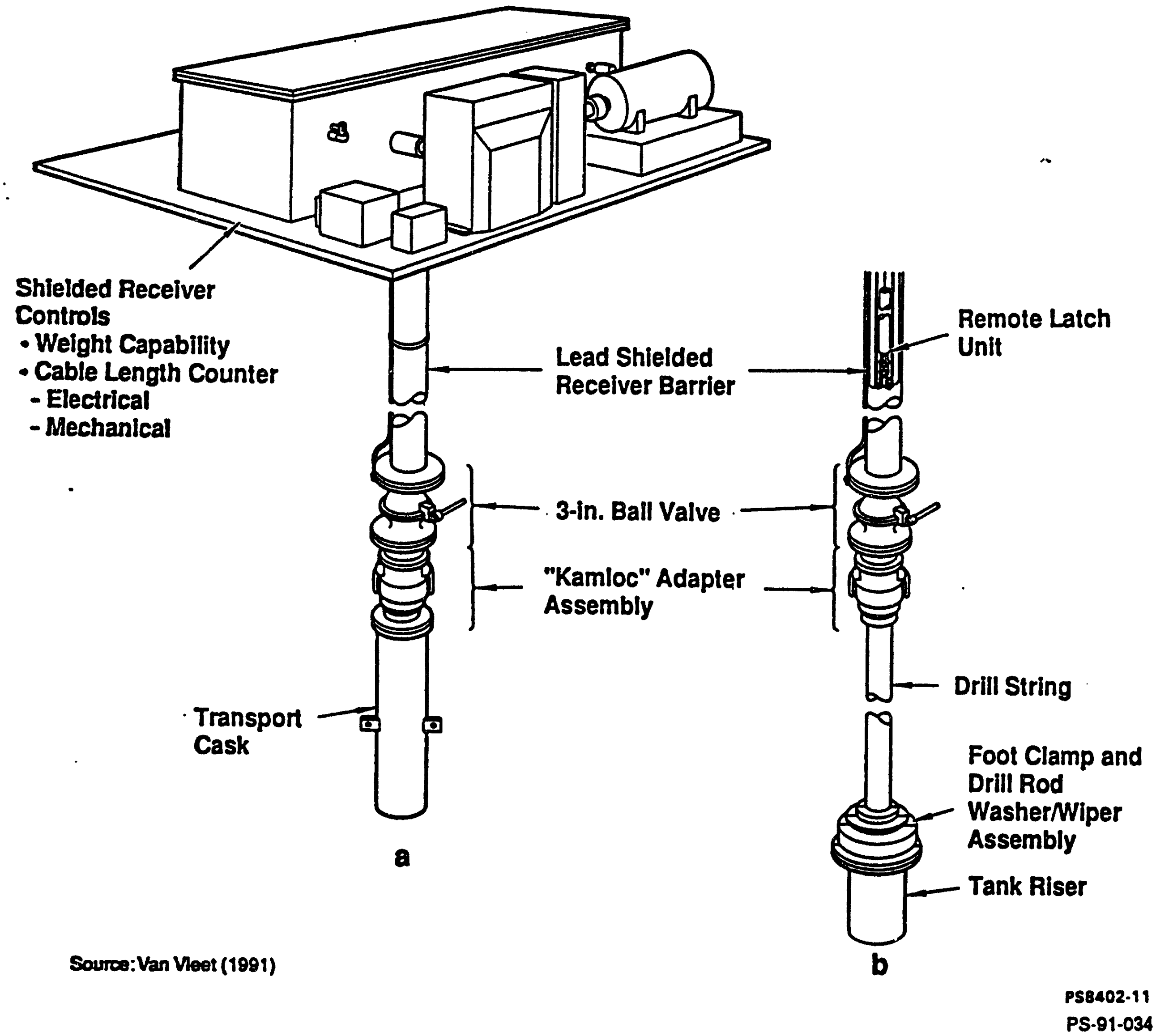
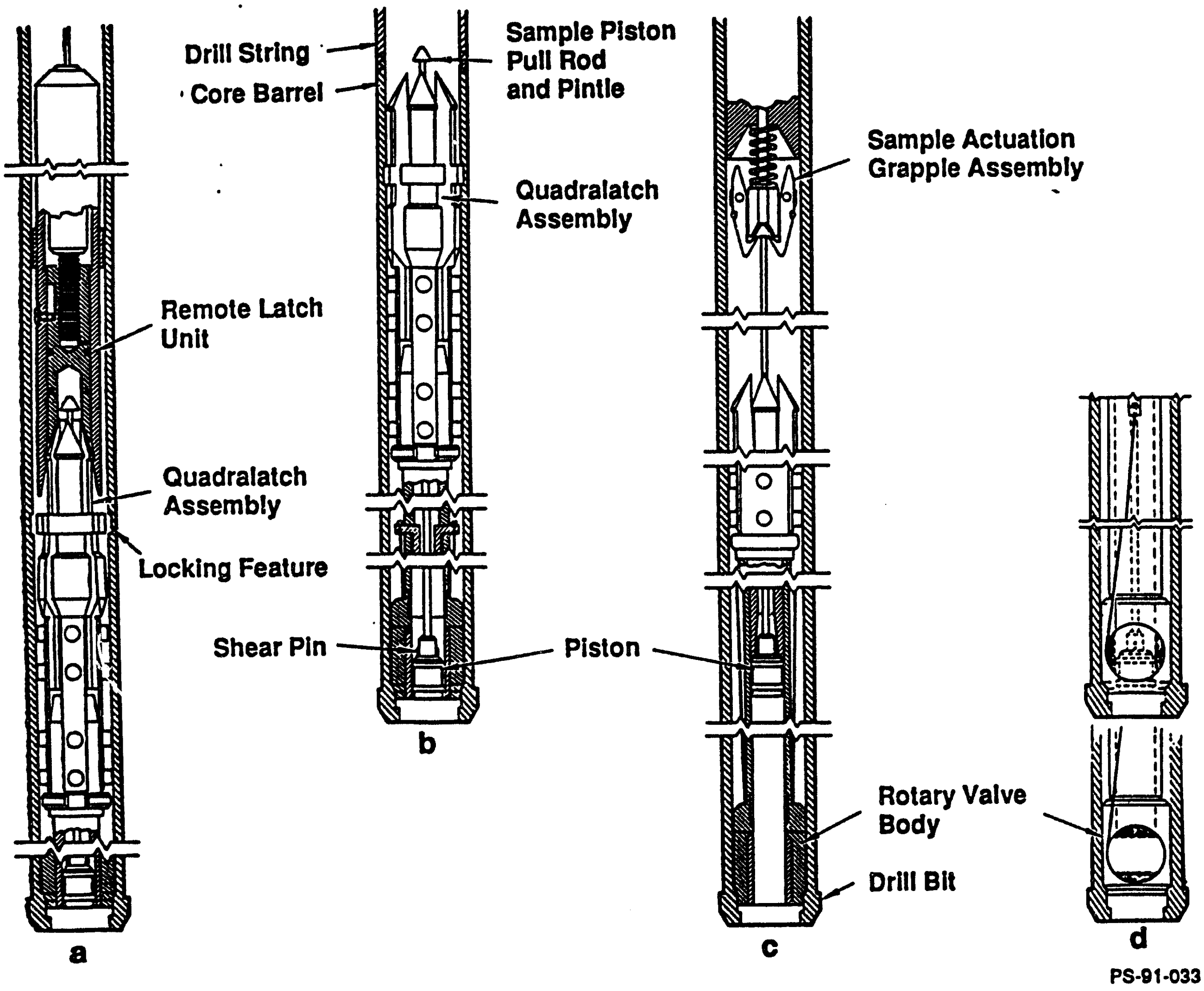


Figure C-10. Shielded Receiver and Associated Equipment.



Source: Van Vleet (1991)

Figure C-11. Core Sampler Assembly in the Drill String.

APPENDIX D

PERTINENT CORRESPONDENCE

CONTENTS

Golder Associates

TELECON / CONTACT MEMORANDUM

ROUTE TO:
☒ Files
☒ Project
☐ Business Development
☐ Mailing List

☐ Personal Visit
X Telephone
X Incoming
☐ Outgoing

Company Name: Westinghouse Hanford Co.
Address:

Person: Steve Marske
Telephone: 373-4416
Job / Subject: SAIC/MISC. TANKS/WA

Job No. 923-E043
Date: 10/26/93
Time: 1345

Remarks: Steve is D&D cog. eng. for the Semiworks tanks and provided the following current status info:

241-CX-70 - D&D removed all liquids and a gravel-like solids from this tank and then dried the tank using an exhaust system; they consider it to be empty. They installed a TraceTek(TM) leak detection system which is monitored monthly for evidence of any leakage into the tank. The access manway has been covered and sealed against the weather and the above grade risers have blind flanges installed.

241-CX-71 - This neutralization tank was filled with grout in 1986; no tank waste materials have been removed. The tank was core drilled through the grout to obtain samples which were analyzed. The above grade risers have been sealed with blind flanges.

241-CX-72 - This experimental tank was also filled with grout in 1986. Although lots of engineering plans were prepared to drill out the grout and sample the waste materials, NO DRILLING OR WASTE SAMPLING WAS EVER DONE. Matthew Galbraith wrote a report about the potential waste contents based on process knowledge (WHC-SD-DD-TI-070, Rev. 0, 9/4/92).

Also Dan Saueressig (WHC permitting) just finished authoring a Part A permit for these three tanks, which was submitted to Ecology on 10/12/93 and is awaiting regulatory approval.

Action / Next Contact:

Integrate info. into report. ES to review Galbraith report.

By: Ken Moser [signature]

cc: ES
D. Dunster (add to tank files)
M. Anderson

Internal Letter | **Rockwell International**

Date. November 14, 1986 | No. 65950-86-717

TO: (Name, Organization, Internal Address) R. M. Marusich

FROM: (Name, Organization, Internal Address, Phone) W. S. Lewis

3-1129

Subject: Hydrogen Generation in Isolated Catch Tanks

Ref: Letter, November 3, 1986, W. S. Lewis to R. M. Marusich, "Hydrogen Generation of Isolated Catch Tanks"

Due to a lack of knowledge about the strontium concentrations of the sludge in the isolated catch tanks, a new method has been developed to identify tanks with a potential hydrogen generation problem. A plot of strontium concentration versus the ratio of void volume to waste volume (Vv/Vs) was prepared (attachment). The individual tank Vv/Vs ratios were plotted to show the minimum radionuclide concentration required to reach the four percent hydrogen limit in infinite time. To reach that limit, 78 percent of the isolated catch tanks would require a radionuclide concentration greater than 0.03 Ci/l. The radionuclide concentration in most of the tanks is less than this.

Based upon the Vv/Vs ratios and accessability, tanks C-301-C, T-301-B, and TX-302-A are the most likely candidates for hydrogen sampling. Process Engineering recommends that funding be made available by January 1987, to identify a method for, and to collect gas samples.

W S Lewis

W. S. Lewis, Engineer
Tank Farm Support Unit

WSL:wsl

Att.

cc: D. R. Ellingson
D. R. Groth BRG
J. O. Henrie JOH
S. J. Joncus SJ
G. L. Jones
D. W. Lindsey
D. A. Smith
W. H. Trott
E. C. Vogt
S. A. Wiegman
J. C. Womack
D. D. Wodrich

Ref - ARH609, RHO-CD-13, & LA7674-MS

ATTACHMENT

HYDROGEN GENERATION IN ISOLATED CATCH TANKS

Based on TRAC data, assume only Sr-90 in the sludge and that the sludge concentration is ten times the supernate concentration. Also assume that the heat generated from the supernate is negligible.

<u>VARIABLES</u>
Hd = Decay Heat (BTU/hr)
Vs = Volume of sludge (gal)
C = Concentration of Sr-90 in sludge (Ci/l)
HG = Hydrogen generation rate (l/hr)
Vv = Void tank volume (gal)
YRS= Years to reach 4% hydrogen concentration
$T_{1/2}$ = Half-Life of strontium

Equations and assumptions are developed in RHO-WM-EV-9

Hd = (C) Ci/l x (2.29E-2) BTU/hr Ci x (Vs) gal x (3.785) l/gal
Hd = C x Vs x 0.087 BTU/hr

Assume F factor (fraction of energy absorbed) = 0.8 and G (H2) (gas generation per unit of energy absorbed) = 0.45 molecules/100EV

HG = (Hd) BTU/hr x (0.293) Watt-hr/BTU x 1 J/Watt-sec x .8 x 100EV/1.6E-17J x 0.45 molecules/100EV x 1 l/2.7E22 molecules x 3600 sec/hr x 8760 hr/yr
HG = C x Vs x 0.67 l/yr

Infinite hydrogen generation

$HG_{\infty} = [(T_{1/2}/\ln 2) \times (.67) \times C \times Vs]$ l

The half-life of strontium is 28.6 years

$HG_{\infty} = 7.3 \times C \times Vs$

4% hydrogen limit = 7.3 x C x Vs / (Vv + 7.3 x C x Vs)

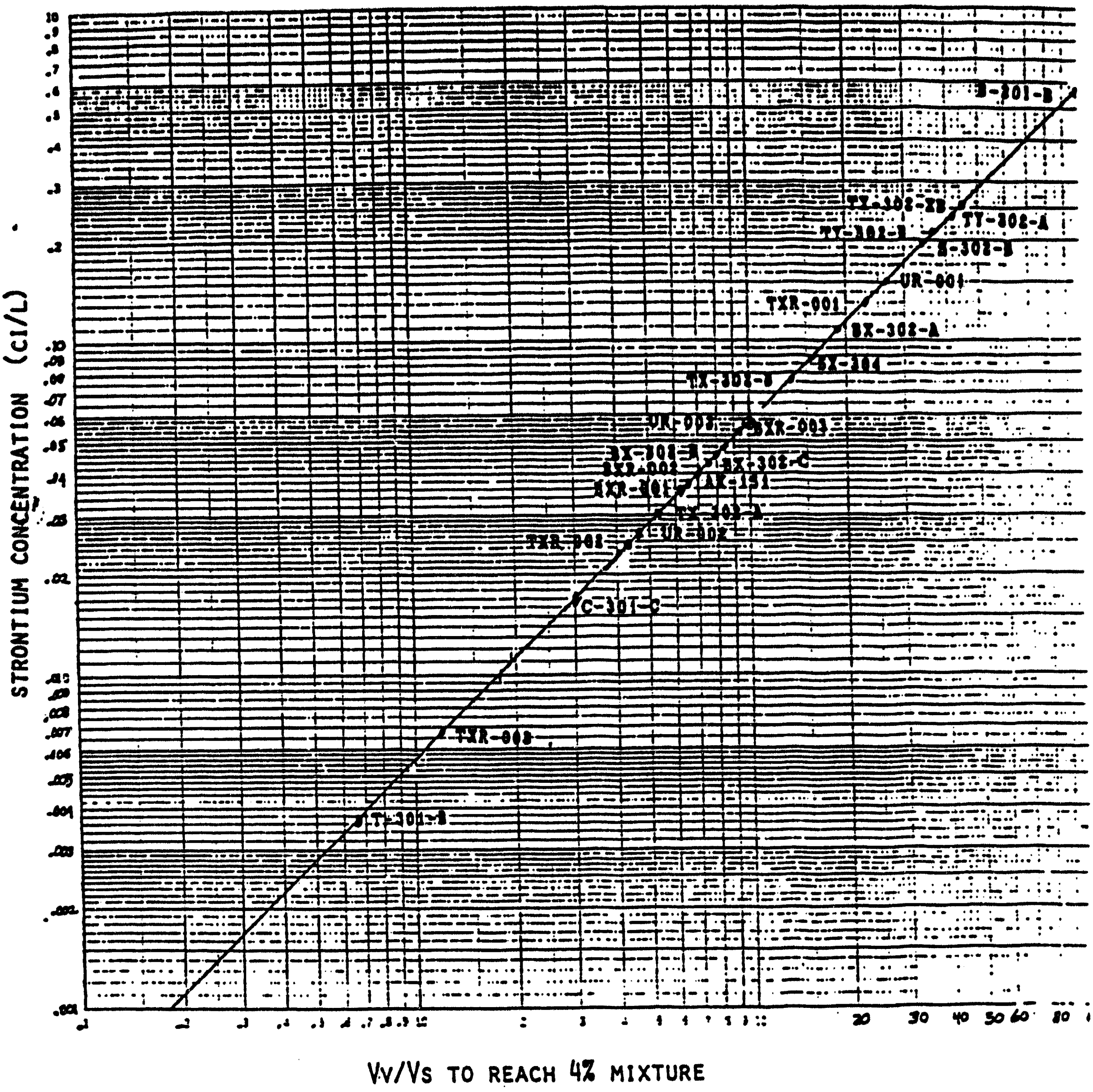
7.3 x C x Vs = .04 x (Vv +7.3 x C x Vs)

C = 0.0057 x (Vv/Vs)

The graph is a plot of strontium concentrations vs the ratio (Vv/Vs) which could cause the hydrogen concentration to reach the 4% lower flammability level in infinite time.

TANK	WASTE VOLUME Vs (GAL)	VOID VOLUME Vv (GAL)	Vv/Vs	MAX ALLOWABLE Sr-90 Ci/l
AX-151	400	6900	17.3	0.04
B-301-B	400	36000	90.0	0.5
BX-302-A	800	16900	21.1	0.12
BX-302-B	950	10450	11.0	0.06
BX-302-C	600	10800	18.0	0.1
BXR-001	7000	43000	6.1	0.035
BXR-002	1800	13200	7.3	0.04
BXR-003	1400	13600	9.7	0.055
C-301-C	9000	27400	3.0	0.017
S-302-B	400	13900	34.8	0.2
SX-304	1050	16650	15.9	0.09
T-301-B	21600	14800	0.7	0.004
TX-302-A	2400	15300	6.4	0.037
TX-302-B	1300	16400	12.6	0.07
TX-302-XB	350	13950	39.9	0.23
TXR-001	2300	47700	20.7	0.12
TXR-002	3000	12000	4.0	0.023
TXR-003	6500	8500	1.3	0.0075
TY-302-A	380	17320	45.6	0.26
TY-302-B	400	13900	34.8	0.2
UR-001	1800	48200	26.8	0.15
UR-002	2300	12700	5.5	0.031
UR-003	1500	13500	9.0	0.05

IN ISOLATED CATCH TANKS



Atlantic Richfield Hanford Company

167

4166

Date: March 10, 1977

To: D. T. Crawley

From: D. G. Bouse, 2-2419

Subject: 361-Z SLUDGE CHARACTERIZATION

Reference: Letter, October 19, 1976, A. L. Dressen to D. T. Crawley, same subject

The referenced letter is the last correspondence I can locate on the subject program.

A review of Ms. A. Louise Dressen's notes shows a few analyses that have not yet been reported. A check with 222-S personnel responsible for atomic absorption analyses revealed no samples had been submitted for Na, Cd, Fe, Al, or Si analyses. Oxygen analysis was requested from Hanford Engineering Development Laboratory. However, they report no method available for radioactive samples.

Completed core sample analyses are shown in Table I, attached.

Preparations will be made to handle future samples as expediently as possible. Please contact me if you have questions concerning this work.

DGB:ps

Att.

cc: W/att.
RE Felt
MR Fox
DG Harlow
AE Hinkson
DC Lini
Process Aids
File

TABLE I

361-Z CORE SAMPLE ANALYSES

Section Number	Volume % Solids	Pu Concentration, g/l In Solids	Pu Concentration, g/l In Sludge
3	*45.6	0.20	0.097
5	21.8	0.72	0.157

*A footnote indicated this sample was not completely dry after four days.

SAMPLES RUN BY HEDL

Section Number	C Wt. %	S Wt. %	Cl ppm	N ppm
2	2.08	0.081	310	7,500
4	0.57	0.045	180	1,500
6	1.17	0.056	280	3,000

EMISSION SPEC. ANALYSES OF SECTION 4 (ppm)

Al	60,000	Ga	80	Si	5,000
B	10	K	3,000	Sn	20
Be	10	Mg	19,000	Ta	400
Bi	50	Mn	400	Ti	150
Cd	50	Mo	300	V	200
Co	1,000	Na	50,000	W	400
Cr	800	Nb	160	Zn	5,000
Cu	2,500	Ni	2,000	Zr	160
Fe	40,000	Pb	200		

Internal Letter **Rockwell International**

Date: March 1, 1983 No: . 65950-83-850

TO: (Name, Organization, Internal Address)
. G. S. Kephart
.
.

FROM: (Name, Organization, Internal Address, Phone)
. J. G. Riddelle
. SIS Unit/TF&EPC
.
. 3-1134

Subject: . WR VAULT SUMP INTRUSION PATH ELIMINATION

Per your request of February 28, 1983, this letter will outline steps to be taken to insure that the liquid intrusion path into WR Vault sumps 001 and 002 has been eliminated.

Sump liquid levels in WR Vault will be measured periodically, at TF&EPC's request, to insure that no liquid level increase has occured. Periodic sump liquid level measurements will continue until the facility is isolated under project B-231. Any sump liquid level increase will be investigated by TF&EPC and the source will be eliminated.

Presently, the only intrusion source identified is the U Plant stack drain and provisions will be made to eliminate that path.

J. G. Riddelle
J. G. Riddelle
SIS Unit/TF&EPC

JGR:ra

cc: G. F. Boothe
J. E. Perham
F. E. Boyd
J. A. Bates
B. F. Weaver
R. A. Van Meter RAV
C. M. Walker

SEP 4 1973

Federal Building
Richland, Washington 99352
Telephone 509 942 7411

Route H6

H6

C-12

AUG 31 1973

U. S. Atomic Energy Commission
Richland Operations Office
Richland, Washington 99352

Attention: Mr. A. G. Fremling, Manager

Subject: WASTE STORAGE TANK LEAK DETECTION METHODS AND CRITERIA
Contract AT(45-1)-2130

References: (1) Letter, August 16, 1973, R. L. Ferguson to L. M. Richards, "Status Report on Atomic Energy Commission Recommendations"

(2) Letter, August 17, 1973, L. M. Richards to R. L. Ferguson, same subject

Gentlemen:

The Atlantic Richfield Hanford Company has been reviewing and revising operational controls for monitoring the integrity of the 200 areas waste storage tanks since the Tank 106-T leak incident. In addition to these actions, ARHCO has initiated studies to establish new technical criteria for leak detection, based on our best assessment of current capabilities, and to upgrade leak detection capability in a systematic manner whereby the maximum gain can be obtained in the minimum time.

Battelle-Northwest personnel were asked to consult with ARHCO, and leak detection studies were requested. The BNW preliminary reports were reviewed by ARHCO, and were incorporated with, and reinforced by, internal ARHCO analyses on liquid-level measurement, dry-well monitoring, and material-balance techniques. These studies are continuing, and changes of criteria for leak detection may be possible when the detailed investigations are completed.

00118

During the interim period, before new criteria are implemented, limits on tank farm primary leak

U. S. Atomic Energy Commission
Attention: Mr. A. G. Fremling
Page 2
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detection measurements have been established for all categories of tanks. When these limits are reached, the Manager, Manufacturing Department, and the Manager, Operations Support Engineering Department, are notified that the leak detection limit has been reached. These managers have the responsibility for determining the corrective action to be taken, and will carefully consider the available data prior to ordering partial or complete pumping of the suspect tank.

The notification limits for the four present waste storage tank categories are listed as follows:

- The <u>static storage tanks</u> are monitored by the Food Instrument Company (FIC) electrical continuity liquid-level instrument as the primary leak detection control. In-tank repeatability of these FIC gauges is about ±0.25 inches. These liquid levels are presently being manually read and recorded once per shift, but the automatic data acquisition system, which is being tested in the 200 East Area, should be operational in both the 200 East and 200 West areas by October 1, 1973.

  Unexplained discrepancies of greater than 0.5 inch (equivalent to 1,375 gallons) from baseline levels in these static tanks are required to be promptly reported, for corrective action, to the responsible department managers. The electrode tape manual gauges and dry-well readings are used as backup to the more accurate FIC gauges, and are monitored monthly or as requested to supplement FIC gauge data.

- The <u>static bottoms tanks</u> are monitored by manually-operated electrode tape gauges as the primary leak detection control mechanism. In-tank repeatability of these gauges is ±0.5 inch. The liquid levels are read once per shift, and an unexplained discrepancy of greater than one inch (equivalent to 2,750 gallons) is required to be reported to the responsible department managers for pumping decision. The dry-well

U. S. Atomic Energy Commission
Attention: Mr. A. G. Fremling
Page 3
AUG 21 1973

monitoring readings are used as a backup to the liquid-level monitoring and are taken on a weekly or monthly frequency.

- The operating bottoms tanks are monitored by calculating the overall material balances around the evaporator system on a daily basis. Material-balance discrepancies of more than 3.5 inches (equivalent to 9,600 gallons) must be reported to the responsible section managers, and accumulative discrepancies indicating potential loss of ten inches (equivalent to 27,500 gallons) are required to be reported to the responsible department managers, for evaporator shutdown, in order to allow for static tank liquid-level monitoring of the suspect tanks pending a decision for pumping. The dry wells surrounding these tanks are used as a backup to the material-balance calculation and are monitored on a minimum weekly frequency.

- The only boiling-waste tank now containing self-boiling waste (101-AY) is protected from leak release by double-wall construction. The primary leak detection mechanism for this tank is the continuous monitoring of the annular space for radioactive solutions, which would indicate failure of the inner liner.

  The remaining tanks in this use category contain strontium sludge and/or nonboiling supernatants. The primary leak detection method for the tanks in this use category in the SX and A farms are the horizontal laterals drilled under the tanks. The primary leak detection mechanism for the tanks in the AX farm is the grid system sump measurement and alarm equipment.

  The laterals in the SX and A farms are monitored on a daily-to-weekly basis, depending on radioactivity and location. The responsible section managers are notified immediately when radiation levels increase. The maximum undetectable leak for this system has been calculated at 5,500 gallons, which is equivalent to a two-inch loss

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Attention: Mr. A. G. Fremling
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AUG [illegible]

of liquid. The grid-drainage leak detection pits in the AX and AY farms are checked twice per shift. The responsible section managers are notified immediately when liquid levels or radiation readings increase. In the AY farm, the tank annulus liquid levels are recorded once per shift, and supervision is notified immediately in the event of system alarms or recorded liquid-level increases. The responsible department managers are notified for decision as soon as the recorded increases are verified by the responsible section managers.

The backup leak detection system for these tanks is the liquid-level measurement taken once per shift, and the dry-well monitoring reading taken on a weekly or monthly frequency.

The dry-well system is no longer considered to be the primary leak detection method for any tank category. The measurement capability of the dry-well system in place around bottoms tanks was evaluated by BNW, and the calculations were refined by ARHCO experts, taking into account the most recent geological and hydrological data. The average volume of a maximum undetectable leak for all tanks presently in, or available for, bottoms loop service is 51,000 gallons, and ranges from 14,000 to 145,000 gallons. While small leaks can be, and have been, detected by the dry-well monitoring system, when the leak is not near the dry well, the possibility of large undetected leaks still remains. To some extent, the large maximum undetected leaks are a result of insufficient wells around tanks, but, additionally, the present asymmetric placement of the wells allows large areas for leaks to remain undetected. With symmetrical spacing of wells around tanks, the maximum undetected leak calculation results are as follows:

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Attention: Mr. A. G. Fremling
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Number of Symmetrical Dry Wells	Maximum Undetected Leak (gallons) 200 East	200 West
2	168,000	110,000
3	64,000	43,000
4	30,000	20,000
5	17,500	11,500

The asymmetry of dry-well placement was caused by the incremental drilling over a period of years, with each drilling aimed at obtaining the maximum benefit for the least cost, and by drilling around existing equipment. It should be noted that once a given number of wells are drilled symmetrically around a tank, the maximum undetected leak can only be reduced by doubling the number of wells around the tank.

In the dry-well monitoring system, the number of wells would have to be approximately doubled to reduce the maximum undetectable leak to 10,000 gallons. However, seven additional dry wells located near four of the waste tanks would reduce the maximum undetectable leak from the 145,000 gallons, cited previously, to 75,000 gallons. We are continuing a program to improve the dry-well monitoring system as a backup leak detection mechanism. Our aim will be to lower the maximum undetectable leak, through careful placement of additional wells.

Both the BNW and ARHCO studies indicate the dry wells should be monitored as frequently as possible, in order to limit the leak volume. However, it is not feasible to monitor all the bottoms loop tank dry wells more frequently than once per week with existing or ordered equipment. If leaks are indicated in a particular tank, by the primary leak detection system, the dry wells associated with that tank are monitored on an accelerated schedule. Investigations to improve dry-well monitoring equipment and procedures are continuing and will possibly allow some increase in monitoring frequency.

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Attention: Mr. A. G. Fremling
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AUG [illegible]

Additional programs are under way to improve leak detection methods. Additional FIC gauges are being procured and installed in boiling waste and bottoms loop tanks for evaluation. Battelle-Northwest will provide assistance to ARHCO, through detailed investigations of commercially available liquid-level sensors for crusted liquids, material-balance techniques for evaporator systems, modifications to provide for liquid-level gauge failure notification, and dry-well monitoring capabilities. Waste tank inspection is being evaluated by Westinghouse Hanford Company's nondestructive testing group. Such inspection, if available, could determine possible leakers or identify probable leak levels before refilling tanks with waste solutions.

You will be kept advised of the progress of the above-mentioned studies and other ARHCO evaluations, and notified of any change in the decision criteria listed.

Very truly yours,

ORIGINAL SIGNED BY
L. M. RICHARDS

L. M. Richards
President

LMR:GEB:ap

cc: RL Ferguson, AEC-RL

bcc: MD Alford
GE Benedict
GL Borsheim
J Faulhaber
DJ Larkin (2)
WD Luening
CW Malody
LM Richards (2)
HP Shaw
AE Smith
PW Smith
JA Teal (2)
JH Warren
DD Wodrich
Central File

Internal Letter | **Rockwell International**

Date. May 9, 1983 | No. 65453-83-137

TO: (Name, Organization, Internal Address)
J. G. Riddelle
Process Engineering
2750E/A119/200 East

FROM: (Name, Organization, Internal Address, Phone)
M. T. Jansky
Separations Process Development Unit
222-S/MO-037/200 West
3-1571

Subject: WR Vault Samples

Two samples from the WR vault were received by the Separations Process Development Unit (SPDU) at the end of February, 1983. The samples were labeled 001-WR-Sump and 002-WR-Vault. Both samples had a thin layer of "gray fluff" on the bottom of the sample bottle, as well as some sand. The "gray fluff" was easily suspended when the sample was agitated. As per your request, the samples were analyzed for various components. The analytical results are shown in the attached table.

Please call if you have any questions or comments.

M. T. Jansky
Senior Chemist

MTJ/naj

Attachment

cc:

J. F. Albaugh
R. B. Bendixsen
J. S. Buckingham
D. L. Herting
S. J. Joncus
R. D. Wojtasek
File Code: WB621
Process Aids
Letterbook

Content of WR Vault Samples

Component	Concentration	
	001-WR-Sump	002-WR-Vault
Total Beta (µCi/L)	612	77.6
Total Alpha (µCi/L)	2.09×10^{-2}	$<3.26 \times 10^{-3}$
Cs^{137} (µCi/L)	1.50	5.27
Sr^{90} (µCi/L)	187	57.3
Pu (g/L)	1.18×10^{-6}	7.22×10^{-7}
U (g/L)	2.66×10^{-4}	3.14×10^{-3}
Th (g/L)	$<2.7 \times 10^{-4}$	$<2.7 \times 10^{-4}$
NO_2 (molar)	0.0198	8.96×10^{-5}
NO_3 (molar)	0.286	0.114
pH	7.73	8.75
SpG	0.991	0.983

Atlantic Richfield Hanford Company

Date: September 22, 1976

To: E. J. Kosiancic

From: R. L. Walser, 2-2447

Subject: WASTE TANK SURVEY STATUS

References:

(1) Letter, June 19, 1974, O. J. Elgert to G. T. Stocking, "Waste Tank Survey"

(2) Letter, January 22, 1975, J. F. Geiger to G. C. Oberg, "Pumping Out Two 231-W-151 Tanks"

(3) Letter, February 2, 1976, R. E. Felt to D. G. Harlow, "Disposition of Tank 241-Z-361 Plutonium"

(4) Letter, March 9, 1976, H. P. Shaw to O. J. Elgert, "Status: Disposal of Redox Organic Waste"

(5) Letter, June 21, 1976, D. A. Dodd/W. H. Price to D. C. Bartholomew, "241-Z-361 Tank Sludge"

(6) Letter, August 23, 1976, R. L. Walser to D. A. Armstrong, "Pump Selection and Procurement for Tanks 361-B, 361-T, 361-U and CX-70"

(7) Letter, September 16, 1976, R. L. Walser to File, "Criteria for Characterization of Waste Tank Survey Solids"

Per D. C. Bartholomew's request, a study of the tanks and sumps included in the reference 1 waste tank survey with the primary goal of compiling pertinent information has been completed. In summary, the recommended action plan for most of these tanks and sumps continues to call for sampling the liquid contents, removing and neutralizing (if necessary) the supernate, characterizing the solids, isolating the tanks and sumps, and storing the solids in-situ until final disposition plans are determined and funded. The overall status of each item in the plan is discussed below. This is followed by a detailed status listing for each tank grouping, which is then shown in summary form in

Atlantic Richfield Hanford Company

E. J. Kosiancic
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Table I. Analytical results are presented in Table II. Future questions regarding this program should be addressed to the responsible engineers, D. T. Crawley (2-2545) for Tanks 216-Z-8 and 241-Z-36; and J. E. Mirabella (2-2961) for all others.

STATUS SUMMARY

- The liquid contained in accessible tanks and sumps other than the 004-UR Tank has been sampled and analyzed.
- The supernate from Tank 216-Z-8 and all but 200 gallons of a starting 30,000 gallon supernate volume from 241-Z-361 have been removed to an underground waste storage tank. The initial removal of supernate from the BXR, TXR and UR Vaults has been completed. As discussed later, this effort must be repeated in many cases.
- The solids contained in Tanks 231-W-151 #2, 216-Z-8 and 241-Z-361 have been characterized. Initial solids samples from Tanks 241-CX-70 and 241-U-361 have been analyzed and taken, respectively. Reference 7 recommended core samples to be taken in the latter two and other tanks.
- Isolation plans and schedules for these tanks and sumps are to be included in the overall isolation-stabilization plan to be submitted on October 1, 1976. Action taken and timing will depend on budget, manpower, and priority considerations. Current indications are that isolation work on all but leaker tanks will be done on a project basis with action not expected until late calendar year 1977 or beyond.
- In-situ storage of solids has been accepted as safe for an indefinite interim period.
- Final disposition of the solids contained in these tanks and sumps has not been determined, nor is the question currently being considered by the Hanford Waste Engineering Section.

STATUS DETAILS

BXR, TXR and UR Vaults

- Tanks were used during the uranium recovery program.

Atlantic Richfield Hanford Company

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- No action has been taken with respect to the 004-UR Tank, which is not contaminated.
- Liquid samples from the other ten tanks and ten sumps have been analyzed.
- Characterization of contained solids is required. Per reference 7, core samples are needed from the four BXR Tanks, three BXR Sumps and the 001-UR Sump.
- Since pumping or jetting to a minimum heel, the liquid levels for the sumps or tanks listed below have increased sufficiently to require a second supernate removal operation.

Sumps		Tanks
001-BXR	001-TXR	001-BXR
002-BXR	002-TXR	002-BXR
003-BXR	002-UR	001-TXR
011-BXR		

- The 002 Sumps received drainage from the 151 diversion boxes in the respective areas. Rerouting of these drain lines has been estimated to cost $25,000 or more each. Abandonment of the boxes may be possible before the work can be completed by project action.
- Liquid level increases in other sumps are believed due to surface water in-leakage.
- About 2,000 gallons of water added to the 002-BXR Tank on December 31, 1974, was not removed.
- The liquid level increase in the 001-BXR tank occurred during May and June 1976.
- Increases in the 001-TXR Tank liquid level occurred on March 18, 1975 (plus 6.5 inches) and July 24, 1975 (plus 4.25 inches).
- The three vaults have a total of 18 incoming process lines to be blanked during the isolation program.

Organic Storage Tanks 141-S and 142-S

- Tanks contain hexone used during operation of the Redox Plant.

Atlantic Richfield Hanford Company

E. J. Kosiancic
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- Liquid has been sampled and analyzed.
- A Waste Solidification Engineering Design Study (reference 4) indicates the integrity of each tank is good.
- Leased railroad tank cars will be modified onsite for contingency interim storage vessels.
- Work order for modification of load-out facility and tank cars has been written by D. L. Merrick.
- Maximum tank car storage period currently allowed is eight weeks.
- Procedure for transfer to tank cars requires Tank Farm Operations approval for issue.
- Action on plan to bring tanks from 183-D for underground installation as long term storage vessels is being delayed by TFO pending evaluation.
- Method for organic disposal is required.

<u>361-B, T, U Low Level Waste Settling Tanks</u>

- Low level wastes from the respective facility passed through tanks on way to crib.
- Liquids have been sampled and analyzed.
- Supernate in 361-U requires neutralization.
- Selection and procurement of pump for supernate removal from tanks requested in reference 6.
- The procedure for supernate transfer to an underground waste storage tank via tank truck requires TFO approval.
- Core samples of solids from all three tanks are required per reference 7. The initial solids sample has been taken from 361-U.
- Inlets to 361-B and 361-T are capped. Inlet to 361-U to be capped.
- Solids to remain in place.
- Surveillance may be discontinued after transferring supernates and capping inlet lines.

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241-CX-70, 71, 72 Tanks

- Tanks were used in conjunction with operation of the Hot Semiworks Facility.
- Liquid samples have been analyzed.
- CX-71 contains limestone with a minimum supernate heel. CX-72 also has a minimum supernate heel.
- Inlets to all three tanks are blanked.
- Surveillance of CX-71 and CX-72 is not required.
- The initial solids sample from CX-70 has been analyzed. A core sample from the tank is required per reference 7.
- No solids sample from CX-71 is required.
- A grab-type solids sample is required from CX-72.
- The supernate transfer pump used in the 361 B, T, and U Tanks will also be used in CX-70.
- A computer program based on the reported fission product content of CX-70 supernate indicates unacceptably high radiation readings would be expected from a full tank truck. Another sample will be requested for analysis.
- An alternate pumping route requiring extensive preparation work is being planned if the tank truck cannot be used for CX-70 supernate transfer.

301-B, C, T and U Catch Tanks

- These four active tanks receive drainage, primarily flushes and surface water run-off from the 152 and 153 diversion boxes in the respective tank farms.
- Liquid samples from all four tanks have been analyzed.
- Tanks are pumped as required to maintain acceptable liquid levels.

270-E-1 and W Neutralizer Tanks

- Tanks contain limestone with minimum supernate heel.

Atlantic Richfield Hanford Company

E. J. Kosiancic
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September 22, 1976

- Samples are not required.
- Surveillance of the tanks is not required.
- Bypassing of the 270-W Tank required prior to operation of the UO_3 Plant.
- Blanking of the inlet to 270-E-1 is required.

Z Plant Silica Gel Tank (216-Z-8)

- Tank was used as a settling tank for the Recuplex feed filter back flushes.
- Supernate has been sampled, analyzed and removed.
- Solids have been characterized and will remain in place for interim period.
- Tank has been isolated.

216-Z-361 Settling Tank

- Tank was used as a settling tank for 234-5 Building salt wastes.
- Supernate has been sampled, analyzed and removed except for about 200 gallons.
- Selection of a method for removing the remaining supernate (either pump or evaporation) expected this month.
- The pump previously recommended for removal of the remaining supernate is onsite.
- Solids characterization with primary emphasis on plutonium concentration is near completion.
- The reference 5 study indicates that, in the worst case, a tank leak would result in the release of up to 30 volume percent of the sludge in a six meter radius.
- The solids will remain in place for an indefinite period.
- Methods for the recovery of plutonium were studied per reference 3.

Atlantic Richfield Hanford Company

E. J. Kosiancic
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September 22, 1976

BNW 231-W-151 #1 and #2 Waste Disposal Vault Tanks

- The tanks were used for neutralizing 231-Z Building wastes prior to disposal to a crib.
- Supernate samples have been taken and analyzed.
- Solids contained in the #2 tank have been sampled and analyzed.
- Tanks are under Battelle-Pacific Northwest Laboratories surveillance.
- Inlets to both tanks are disconnected.
- Atlantic Richfield Hanford Company prepared a cost estimate (reference 2) of $22,400 for pumping out the tanks.
- Battelle indicates the tanks will be emptied within the next year.

BNW Critical Mass Laboratory Waste Holdup Tank

- Active.
- Under BNW surveillance.

205-SG-1 Column, SG-2 Tank and Sump

- Column used for silica gel treatment of Redox uranium product.
- Tank used for neutralization of silica gel regeneration wastes.
- Column was regenerated and flushed during Redox deactivation.
- Sampling and surveillance of column are not considered necessary.
- Sump contents have been jetted to and sampled in 205-SG-2 Tank.
- Tank Liquid sampled and analyzed.

Atlantic Richfield Hanford Company

E. J. Kosiancic
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- Procedure for jetting tank liquid to an underground waste storage tank is routing for signatures.

RLW:ph

Att.

cc: w/att.
JD Anderson
DA Armstrong
DC Bartholomew
CD Compton, ERDA-RL
DT Crawley
JF Geiger
DG Harlow
MC Jacobs
HF Jensen
DL Merrick
JE Mirabella
JA Teal
CM Walker
RL Walser
JC Womack

DATE
FILMED
9/13/94

END