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Hanford TY-Farm Leak Assessments Report

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Abstract: This report documents reassessment of past leaks in the 241-TY Tank Farm using a process developed by Washington State Department of Ecology along with the tank farm contractor for the U.S. Department of Energy. Waste loss events were reassessed for the single-shell tanks and other unplanned releases to estimate the volume and inventory of waste released to the soil in the 241-TY Tank Farm.

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HANFORD TY-FARM LEAK ASSESSMENTS REPORT

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EXECUTIVE SUMMARY

Washington State Department of Ecology along with the tank farm contractor for the U.S. Department of Energy developed a process to reassess selected tank leak estimates (volumes and inventories), and to update single-shell tank leak and unplanned release volumes and inventory estimates as emergent field data is obtained (RPP-32681, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*). This process does not represent a formal tank leak assessment in accordance with procedure TFC-ENG-CHEM-D-42, "Tank Leak Assessment Process." This report documents reassessment of past leaks in the 241-TY Tank Farm.

Tank waste loss events were evaluated for single-shell tanks 241-TY-101, 241-TY-103, 241-TY-104, 241-TY-105 and 241-TY-106. These tanks were designated as suspected to have leaked waste to the ground. Table ES-1 summarizes the results of the tank waste loss events evaluation for these single-shell tanks and provides a comparison to the waste loss estimates contained in HNF-EP-0182, *Waste Tank Summary Report for Month Ending December 31, 2009*, Rev. 261. In addition, tanks currently designated as "sound" were evaluated for the potential having past tank leaks. When known the estimated volume and type of waste lost from the tank was used to derive the estimated inventory of constituents necessary to update RPP-26744, *Hanford Soil Inventory Model, Rev. 1*.

Table ES-1. Summary of Tank Waste Loss Events (2 sheets)

Tank	Description	HNF-EP-0182 (Rev. 261) Estimate	Revised Estimate[1]
241-TY-101	Tank TY-101 was classified a potentially leaking tank based on a liquid level decrease of 0.35 inches in 1973. The surface level measurements appear to have been drifting in and out of calibration and the 0.35 inch liquid level decrease is suspect and considered to be within the margin of uncertainty. Low levels of activity observed in drywells near TY-101 were attributed to other sources. It was determined that there is no basis for a leak inventory estimate for tank TY-101.	1,000 gal	0 (source of soil contamination likely from a line/riser release at TY-102, no basis for estimate)
241-TY-102	As in previous assessments, participants concluded that there is little evidence of a leak from tank TY-102 and several probable explanations for activity in drywell 52-02-11 near the base of the tank. Previous assessments did not mention a leak injection test in drywell 52-02-11 or that the drywell was perforated along the bottom 3 ft at the time of the test.	0	No change
241-TY-103	Tank TY-103 was classified as a leaking tank based on liquid level decreases and increased activity in drywells in 1973. The tank may have leaked up to 3,600 gal of 242-T evaporator feed with a ^{137}Cs inventory of 422 Ci. Current SIM inventory estimates should be divided by a factor of 7.2 to account for the lower supernatant contaminate concentrations of the 1973 tank waste compared to the concentrated T2-Sltck that was used in SIM.	3,000 gal	3,600 gal ^{137}Cs: 422 Ci SIM ratio: 0.14

Table ES-1. Summary of Tank Waste Loss Events (2 sheets)

Tank	Description	HNF-EP-0182 (Rev. 261) Estimate	Revised Estimate[1]
241-TY-104	Tank TY-104 was classified as a leaking tank based on a 0.5 in liquid level decrease in 1981. The pattern of the liquid level decrease is a strong indication of a leak. Analytical results for TY-104 samples representative of supernatant in the tank at the time of the leak shows a ^{137}Cs concentration of 0.21Ci/gal compared to 0.044 Ci/gal in SIM. Inventories in SIM should be increased by a factor of 4.8 (0.21/0.044= 4.8).	1,400 gal	1,400 gal ^{137}Cs: 2.09E5 SIM Ratio: 4.8
241-TY-105	Tank TY-105 was classified as a leaking tank based on liquid level decreases between 1959 and 1961. The range in leak volumes is due to discrepancies in the liquid level information. The supernatant leaked was TBP-UR waste with a ^{137}Cs conc. of 0.04 Ci/gal. No representative liquid sample was identified for TY-105 at the time of the leak. However, the HDW/SIM estimate appears reasonable for TPB-UR waste. SIM inventory estimates should be adjusted for a range of 30,000 to 43,000 gallons.	35,000 gal	30,000-43,000 ^{137}Cs: 1200-1700 Ci
241-TY-06	Tank TY-106 was classified as a leaking tank based on liquid level decreases between August and October 1959. An estimated 18,000 gal of TBP supernatant waste leaked. No liquid sample data was identified for tank TY-106. The SIM estimate for ^{137}Cs of 0.04 Ci/gal was used. SIM inventories should be multiplied by 0.9 to account for the correction in the leak volume estimate (18,000/20,000).	20,000 gal	18,000 gal ^{137}Cs: 720 SIM ratio: 0.9

[1] Except as noted, ^{137}Ci inventories are decayed to January 1, 2001 consistent with values in SIM. The SIM ratio is a multiplier to modify current SIM inventory values for a tank leak or UPR based on leak volume estimates and measured ^{137}Cs values presented in this report.

HDW = Hanford Defined Waste
SIM = Hanford Soil Inventory Model
TBP = tributyl phosphate
UPR = unplanned release
UR = uranium recovery

DOE/RL-88-30, *Hanford Site Waste Management Units Report*, contains the official listing of unplanned releases identified at the Hanford Site. The operational history for the 241-TY Tank Farm was reviewed to determine if additional information exists for the unplanned releases within the 241-TY Tank Farm boundary not associated with tank waste loss events. No significant new information was located for these unplanned releases. However, potential new unplanned releases as a result of pipeline failures were identified through review of the operational histories for the 241-TY Tank Farm, as summarized in Section 5.6. Insufficient information was available to estimate a volume or inventory of tank waste potentially discharged to the soil for a majority of the identified pipeline failures.

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LIST OF TERMS

Abbreviations and Acronyms

AEC-RL	Atomic Energy Commission-Richland Operations
ARHCO	Atlantic Richfield Hanford Company
bgs	below ground surface
CF	concentration factor
CI	confidence interval
CW	cladding (coating) removal waste
DCRT	double contained receiver tank
DE	diatomaceous earth
DOE	U.S. Department of Energy
DOE-ORP	DOE Office of River Protection
DST	double-shell tank
Ecology	Washington State Department of Ecology
FIC	Food Instrument Corporation (conductivity gauge)
GPR	ground penetrating radar
HDW	Hanford Defined Waste
HLW	high-level waste
HRLS	high rate logging system
IX	ion exchange
KUT	potassium, uranium, thorium
LOW	liquid observation well
PUREX	Plutonium Uranium Extraction (Plant)
R2	Reduction Oxidation high-level waste (1959-1966)
RAS	radionuclide assessment system
REDOX	Reduction Oxidation
RHO	Rockwell Hanford Operations
RIX	REDOX IX waste type
SACS	Surveillance Analysis Computer System
SGE	Surface Geophysical Exploration
SGLS	spectral gamma logging system
SIM	Hanford Soil Inventory Model
SST	single-shell tank
TBP-UR	tributyl phosphate-uranium recovery
UPR	unplanned release
WIDS	Waste Information Data System
WMA	Waste Management Area
WRPS	Washington River Protection Solutions, LLC

Units

c/s, cps	counts per second
Ci	Curie
kgal	kilogallon (10^3 gallons)
pCi	picocurie (10^{-12} curies)
rad	radiation adsorbed dose

Waste Type Abbreviations

1C	first cycle waste
1C-FeCN	treated 1C (ferrocyanide) waste
B	B Plant high level waste
$BiPO_4$	bismuth-phosphate
BL	B Plant low level waste
CW	cladding (coating) waste
DW	decontamination waste
EB	Evaporator Bottoms
IX	ion exchange waste
OWW	organic wash waste
P	PUREX waste
R	REDOX waste
RIX	ion exchange waste from supernatant
T2-SltCk(P2')	242-T Evaporator saltcake waste type (1965-1976)
TBP	tributyl phosphate waste
U	Unavailable

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1.0 INTRODUCTION

Vadose zone inventories are estimated by multiplying the estimated leak volume by the contaminant concentration in the leak. This concentration is based on process knowledge of the composition of waste in the tank at the time the release occurred which can be different from the time when the evidence for a release was discovered—especially in drywells. For some major tank leaks and unplanned releases (UPRs), historical records confirm the waste loss event and provide a strong technical basis for leak volume and inventory estimates. However, for many tank leaks and UPRs little data is available.

Numerous studies and investigations have estimated the inventory of contaminants in the tank farms vadose zone. HNF-EP-0182, *Waste Tank Summary Report for Month Ending December 31, 2009* provides the commonly accepted basis for tank leak volume estimates, but it does not provide associated inventory estimates or UPR volumes. HNF-EP-0182 was prepared to guide tank farm operations and was never intended to be a catalog of released volumes or inventories. Tank leak volume estimates reported in HNF-EP-0182 have not been updated for many years. RPP-23405, *Tank Farm Vadose Zone Contamination Estimates* summarizes vadose zone tank leak characterization and investigations. It is consistent with many of the tank leak volume estimates listed in HNF-EP-0182 and provides UPR volume estimates. However, RPP-23405 shows large differences in estimated leak volumes, both higher and lower, compared to some tank leak volume estimates in HNF-EP-0182. The RPP-23405 volume estimates were used in RPP-26744, *Hanford Soil Inventory Model, Rev. 1* (SIM) to estimate leak inventories for DOE/ORP-2005-01, *Initial Single-Shell Tank System Performance Assessment for the Hanford Site*. Volume uncertainties are not addressed in RPP-23405 and some of the leak volume estimates, data interpretations, and conclusions presented in RPP-23405 are questioned.

Washington State Department of Ecology (Ecology) along with the tank farm operations contractor for the U.S. Department of Energy (DOE) developed a process to reassess selected tank leak estimates (volumes and inventories), and to update tank leak and UPR volumes and inventory estimates as emergent field data is obtained (RPP-32681, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*). This report documents the results of applying the process described in RPP-32681 to reassess UPRs and tank leak estimates in the 241-TY Tank Farm.

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2.0 BACKGROUND

Approximately 57 million gal of radioactive waste from chemical processing and plutonium processing operations are stored in 177 underground storage tanks on the Hanford Site. Of these tanks, 149 are single-shell tanks (SST), which consist of a single steel liner inside a concrete shell. Nominal capacities range from 55,000 to 1,000,000 gal. For the immediate future, plans call for retrieval of waste from the SSTs and transfer to the 28 double-shell tanks (DST), with eventual transfer for treatment in the Waste Treatment and Immobilization Plant.

2.1 IN-TANK MEASUREMENTS

Historically, SST integrity was assessed by two independent methods. From the beginning of Hanford Site tank farm operations, the primary leak detection system was routine monitoring of liquid-surface levels within each tank. Originally liquid levels were measured using pneumatic dip tubes (HW-10475-C, *Hanford Technical Manual Section C*, p. 908). This practice was later replaced and a manual tape with a conductivity electrode was used to detect the liquid surface (H-2-2257, *Conductor Reel for Liquid Level Measurement*). The biggest limitations of the manual tape measurements were failures of the electrodes, solids forming on the electrode and measurement precision. The statistical accuracy of the manual tape and electrode measurement technique was 0.75 in. (~2,060 gal), as determined in July 1955 (HW-51026, *Leak Detection -- Underground Storage Tanks*, p. 4). Later, liquid-level determinations were automated in many of the SSTs to provide more accurate and reliable measurements. However, surface-level measurements remain highly uncertain in the waste tanks that contained boiling wastes (e.g., 241-A, 241-AX and 241-SX Tank Farms), when supernate has been removed from tanks leaving solids or precipitated salts, or where solid crusts have formed on the waste surfaces. Liquid levels are generally unavailable for periods of waste transfer during which large volumes of liquids were on the move among tanks and other facilities.

In addition to uncertainty in measurements, liquid level decreases may be caused by a leak, evaporation or physical changes in waste surfaces (i.e., floating solids, surface collapse, gas release events or forming salt crystals). Liquid level increases may be caused by intrusions into a tank or by gas pressure build-up in the waste.

Liquid observation wells (LOWs) were installed in many of the tanks to measure interstitial liquid levels using gamma and neutron probe measurements. Following is a description of in-tank monitoring instrumentation summarized from RPP-9645, S*ingle-Shell Tank System Surveillance and Monitoring Program*.

ENRAF™. The ENRAF[1] gauge is the most accurate level gauge currently used in the tank farms. This gauge tracks level changes in tank waste by using a load cell to monitor the weight of a displacer. For the purposes of leak detection, the ENRAF gauge needs a free liquid surface below the displacer. The vendor quotes an ENRAF precision of ± 0.004 in. and an accuracy of

[1] ENRAF - Nonius Series 854 is a trademark of ENRAF-Nonius, N.V. Verenigde Instrumentenfabrieken, ENRAF Nonius Corporation Netherlands, Rontegenweg 1, Delft, Netherlands.

± 0.04 inches. However, in-tank ENRAF instruments are calibrated to an accuracy of ± 0.1 in. and the 2-decimal readout on the gauge provides a precision of ± 0.01 inch.

The condition providing the highest sensitivity to a potential leak is a smooth, pure liquid waste surface combined with the most accurate gauge (ENRAF). These measurements are impacted very little by day-to-day variation from either the waste surface or gauge error. If the waste surface becomes more irregular or a gauge with lower resolution is used, the measurement data becomes more scattered (increases) during the normal day-to-day readings. For a heavy slurry waste with a highly irregular surface and a low-resolution instrument, the day-to-day readings exhibit a higher degree of nominal data scatter. Surface level gauges are not used for leak detection if the waste has a solid surface, since the level would not decrease in response to a leak. Liquid levels cannot be measured accurately during waste transfer operations or in self-boiling tanks with a dynamic surface.

Manual Tape. The manual tape is still used in a few tanks. It relies on a metal tape with a plummet contacting an electrically conductive waste surface. A manual tape in good working order on a highly conductive surface should be accurate and repeatable to about ¼ inch. As the waste dries out, the device becomes less accurate, until ultimately no signal is received. Uncertainty for different tanks varied from ¼ in. to 2 inches. The drying out of the waste surface is typically observed as increasing levels of data scatter during routine data reviews. Most DSTs use the manual tape as a backup to the ENRAF.

The Food Instrument Corporation conductivity gauge (FIC[2]) is no longer used. The FIC was functionally equivalent to the manual tape, except that the tape and plummet are raised and lowered by a motor rather than manually. All FICs have now been replaced by ENRAF gauges.

Interstitial Liquid Level Measurements. Levels of waste phases can be measured by using geophysical techniques deployed inside a LOW placed in a tank. The LOWs were installed in tanks containing permeable waste (i.e., tanks containing salt cake vs. sludge) and/or tanks with a solid waste surface. Originally the uncertainty of waste surface level measurements varied from 1 to 3 in. depending on the waste and barometric pressure changes. Interpreting LOW measurements is complicated, especially when the liquid level was moved between two waste layers with different permeability (e.g., saltcake and sludge). Updated methodologies have improved the accuracy of current LOW measurements, including such actions as calibrating the waste depth measuring system daily before going to the field to ensure measurements are within ± 0.25 in. of its known value; verifying the neutron and gamma probes before each use; and comparing all of the measurement scans to a "reference scan" to identify any spikes, drifting, dead zones, or other anomalous problems.

[2] FIC is a product of Food Instrument Corporation, Federalsburg, Maryland.

2.2 EX-TANK MEASUREMENTS

Routine monitoring of gross gamma activity in drywells near the SSTs provides the second leak detection method. Most drywells were constructed in the early 1970s after many SSTs had been in operation for a decade or more. For 241-A SSTs and some 241-SX SSTs, laterals (horizontal boreholes) were installed approximately 10 ft beneath the tank bottom for gross gamma monitoring beneath these tanks. However, there are no laterals in TY-Farm. As with the tank waste surface-level measurements, there are uncertainties associated with these secondary leak detection methods. Three sources of uncertainty are as follows.

1. Number and location of wells: There were rarely more than six drywells surrounding the 100-series SSTs (circumference ~235 ft) and often fewer. These drywells are generally 6 in. diameter steel casings that extend vertically 75 to 125 ft below ground surface (bgs) (groundwater is between 245 and 300 ft bgs) and that allow access to geophysical probes. Because the holes had to be cased to prevent collapse and loss of the borehole, only gamma-emitting radionuclides within about a 12 in. radius of a drywell are detected so large areas between drywells are not covered. Alpha- and beta-emitting radionuclides, including daughter products, are not detected, and most of the long-lived, mobile radionuclides do not emit gamma radiation during decay. Consequently, the absence of gamma activity in a well, lateral, or leak detection pit does not necessarily indicate that a tank did not leak. Over the course of historical drywell logging, probe types changed several times, thus changing detection limits. The rate of withdrawal of any probe from a borehole and count times also affect the detection capability of any instrument and these too changed with time.

2. Waste type: The overall effectiveness of gross gamma logging in drywells as a leak detection system depends on the waste type in the tank. The gross gamma logging system is most effective with waste types containing high concentrations (activities) of gamma emitting radionuclides (e.g., ^{137}Cs or ^{60}Co) and large releases, and less effective with low-activity waste types such as aluminum cladding waste. In addition to limitations on the effectiveness of gamma measurements for different waste types, lags of months to years between release and detection were possible wherein multiple waste transfers may have occurred. Consequently, the type of waste in a tank when a leak was detected may not be the same as the waste that leaked. This contributes to uncertainty in inventory and leak volume estimates.

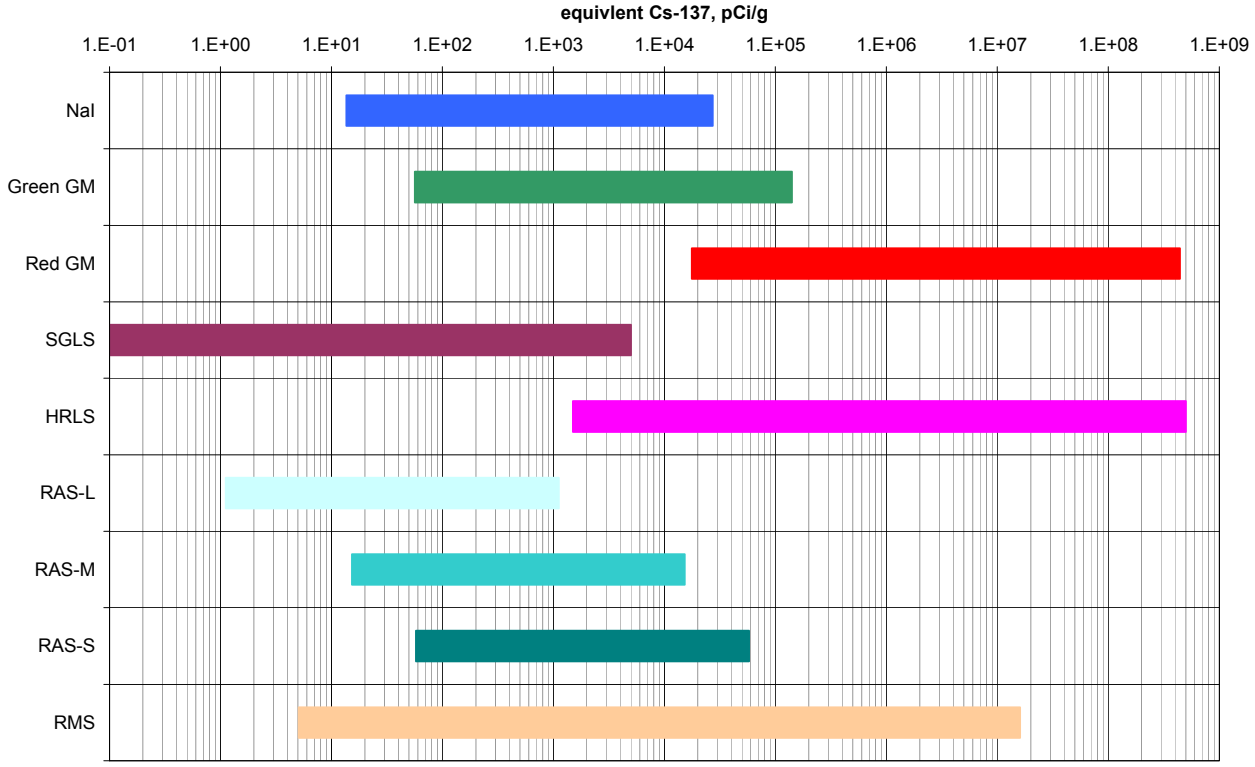
3. Other contamination sources: Gamma activity observed in drywells may also have originated from near-surface waste loss events, transfer line leaks or tank overfills, in which case there is no loss of integrity of the steel liner in the tank.

Geophysical techniques can also be used outside of a tank to measure increased moisture and gamma-emitting contaminants. Dry borehole neutron moisture and/or radionuclide assessment system (RAS) total gamma leak detection monitoring is performed during retrieval in accordance with tank waste retrieval work plans. The accuracy of dry borehole logging count rate is roughly the square of the total number of counts (*Radiation Detection and Measurement*, 3rd Ed., [Knoll 2000] pp. 94-96). The correlation between counts per second (c/s) and radioactivity or moisture measurements varies by detector.

Leak detection monitoring for retrieval is conducted by observing changes in neutron readings (c/s) compared to an established baseline for the detector being used. Therefore, for a given detector, accuracy of calibration is not a factor. The level of moisture change that triggers additional RAS monitoring is specified in process control plans.

The RAS truck was designed for routine gamma monitoring against the baseline established from the spectral gamma logging system (SGLS) data. The RAS uses a series of three interchangeable NaI(Tl)-based scintillation detectors (RAS-L, RAS-M, and RAS-S) for measurement over the range from background levels to about 10^5 pCi/g ^{137}Cs. The size of a leak that can be detected by RAS depends on the radioactivity level of the waste leaked, the leak rate, proximity of a dry borehole to the leak, and subsurface soil properties controlling flow rate and direction. Consequently, there is no single value that can be stated as the maximum leak that could go undetected by drywell monitoring for an SST. Leak detection approximations presented in Appendix B of RPP-10413, *Tank S-112 Saltcake Waste Retrieval Demonstration Project Leak Detection, Monitoring, and Mitigation Strategy* range from a mean of 100 gal for a leak located 10 ft from a drywell to a mean of 6,200 gal for a leak 45 ft from a drywell. Approximate measurement ranges of different types of gamma radiation detectors are shown in Figure 2-1.

Figure 2-1. Measurement Ranges of Tank Farm Gamma Detectors



In addition to the RAS truck and instrumentation which perform only total gamma measurements, the SGLS provides isotope specific gamma measurements. For areas of higher activity (> 2,000 pCi/g) a high rate logging system (HRLS) is used to quantify activity levels as

high as 10E8 pCi/g. The SGLS uses a high-purity germanium detector. Baseline spectral gamma logging of tank farm drywells was performed between 1995 and 2000. Figure 2-1 shows measurement ranges for SGLS and HRLS.

Ex-Tank High Resolution Resistivity. High resolution resistivity is used during retrieval operations and measures changes in resistivity against baseline conditions as specified in tank waste retrieval work plans. Because tank waste is high in sodium and nitrate, changes in resistivity/conductivity are a potential indicator of a tank leak. In leak injection tests in S-Farm, where 13,000 gal of saline solution were injected to the soil near tank 241-S-102, it was determined that high resolution resistivity could detect a leak of 2,100 gal or more with 95% accuracy. Initial tests showed responses after only a few hundred gallons of saline solution were injected (RPP-30121, *Tank 241-S-102 High-Resolution Resistivity Leak Detection and Monitoring Test Report*). In comparison, drywell neutron moisture measurements showed negligible changes during leak injection tests. The high resolution resistivity system does not quantify leak volume or rate, but provides a continuous measure of resistivity during retrieval as compared to weekly moisture measurements and provides more special measurements compared to measurements indicating conditions within about a radius of 1 ft from a drywell.

2.3 TANK LEAKS

Sixty-seven of 149 SSTs have been designated as "confirmed or suspected leakers" over the SST operational timeline (1945 to 1980) (HNF-EP-0182). During the active operation of the SST farms, either an anomalous liquid-level measurement or a significant increase in gamma activity in a drywell, lateral or leak detection pit was generally a sufficient reason for the tank to be listed as "questionable integrity" or an "assumed leaker" as discussed in SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*. When a tank was designated as "questionable integrity" it was pumped to a "minimum heel" and taken out of service. In a limited number of cases the "questionable integrity" designation was followed up with additional investigations. However, in many cases no additional investigations were performed. In the late 1980s, all SSTs that had been flagged as potential or known leakers were combined into the list contained in the monthly waste tank summary report (HNF-EP-0182) and flagged as "confirmed or assumed leakers." Because of the uncertainty associated with the measurements, unexplained waste level decreases were generally considered as an inadequate basis for designating a tank as a "confirmed leaker." The "confirmed leaker" designation required an observed waste level decrease combined with increasing gamma activity in a nearby drywell. The "assumed leaker" designation could be assigned based on either measurement (an observed waste level decrease or increasing gamma activity in a nearby drywell), without confirmation from the other measurement.

These uncertainties, associated with both the primary and secondary leak detection systems for the SSTs, led to a number of decisions. By the early 1960s, decisions were made to move from an SST design to a DST design for construction of new tanks. The double-shell design provided both secondary containment and reliable leak detection systems. A decision was also made to pump liquids stored in the SSTs into the DSTs to remove pumpable liquid and term the SSTs as interim stabilized.

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3.0 SCOPE AND CRITERIA

An assessment team comprised of representatives from DOE Office of River Protection (DOE-ORP), Ecology, and the current Tank Operations Contractor was assembled to review available information relating to waste loss events in the 241-TY Tank Farm. The assessment team membership is listed in Table 3-1. Minutes from team meetings are included in Appendix A.

Table 3-1. Waste Loss Event Assessment Team

Name	Organization	Role
Joe Caggiano	Washington State Department of Ecology	Regulatory oversight (primary focus: vadose zone and groundwater data)
Jim Field	Washington River Protection Solutions	Process lead Knowledge and experience in reviewing, analyzing, and interpreting in-tank (i.e., surface liquid level and liquid observation well) data and vadose zone data and of tank process history
Les Fort	Washington State Department of Ecology	Lead regulatory oversight (primary focus: tank waste processing operations)
Paul Henwood	S. M. Stoller, Inc.	Knowledge and experience in obtaining and analyzing drywell data
Bob W. Lober (did not attend meetings)	U.S. Department of Energy Office of River Protection	Tank Farms Programs and Project Division representative
Beth Rochette	Washington State Department of Ecology	Regulatory oversight (primary focus: UPRs and direct exposure pathway)
Marcus I. Wood	CH2M HILL Plateau Remediation Contract	Knowledge and experience in reviewing, analyzing, and interpreting drywell and groundwater monitoring data

In accordance with RPP-32681, the following steps were conducted in reassessing waste losses within the 241-TY Tank Farm.

- Data and information regarding any waste leaks from ancillary equipment in the area of the facility being evaluated were collected, as well as any reported UPRs.

- Data and information regarding any past or present waste leaks from tanks, as well as any reported UPRs, were collected, and collated with any reported ancillary equipment waste leaks.

- All of the information from previously reported waste tank leaks and UPRs was compiled to determine a justifiable basis of the volumes of tank waste that leaked to the vadose zone and the time at which these leaks occurred.

- Data and information regarding the waste composition at the time of the leak from the waste tank, ancillary equipment or UPR were compiled from the available sources, such as Tank Waste Information System Best Basis Inventory, Hanford Defined Waste model etc., and were applied to the facility being investigated.

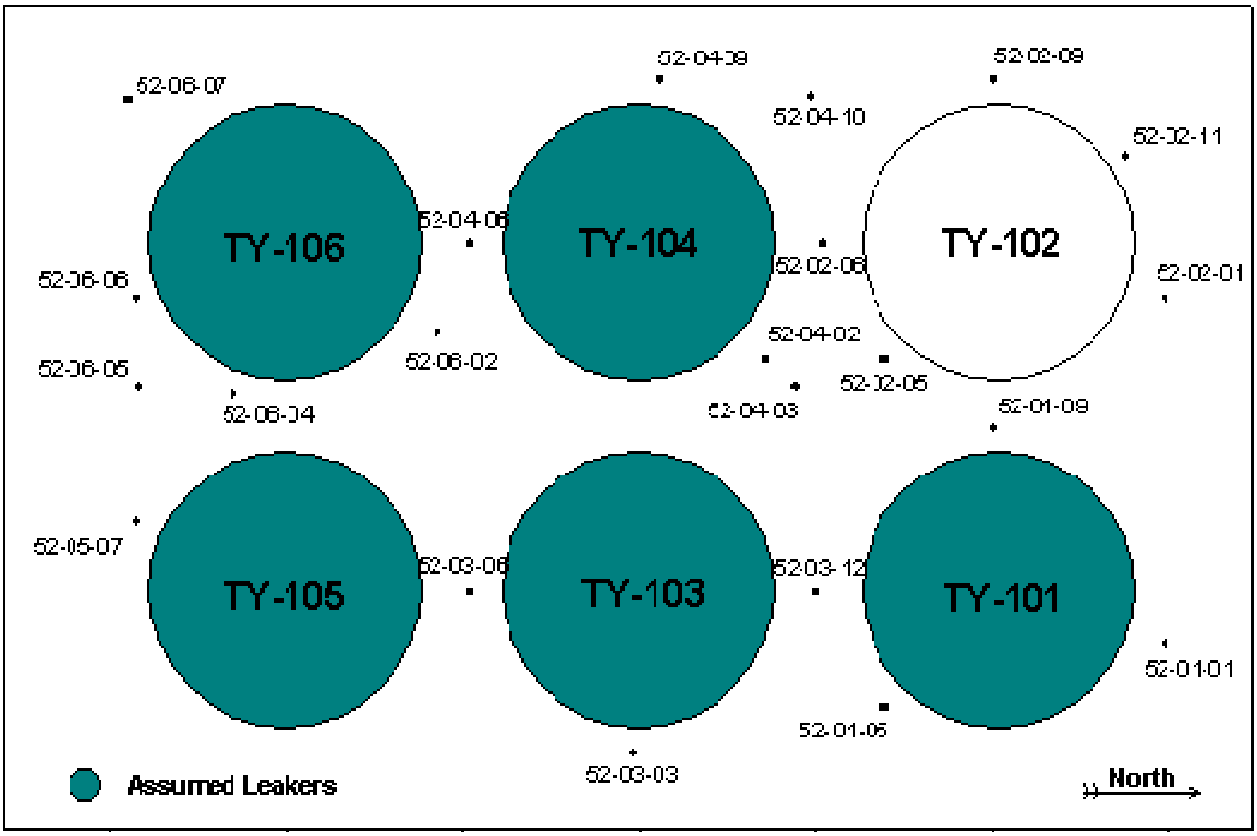
- The waste leak volume estimates were combined with the waste compositions at the time of leak to estimate the radionuclide and chemical inventory which entered the soil.

4.0 REASSESSMENT OF WASTE LOSS EVENTS IN 241-TY FARM

There are six SSTs in the 241-TY Tank Farm.

The TY-Farm was constructed at the Hanford Site to store high-level radioactive waste generated by chemical processing of irradiated uranium fuel at the chemical separation plants. Located in the northwest portion of the 200 West Area just north of the TX-Farm and southwest of T Plant, the TY-Farm was constructed during 1951 and 1952. The TY-Farm consists of six second-generation single-shell underground waste storage tanks (WHC-SD-WM-ER-351, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area*). Figure 4-1 shows the relative positions of the TY-Farm tanks and 21 vadose zone monitoring boreholes installed around them between 1952 and 1977 for primary or secondary leak detection. Internal leak-detection devices include liquid observation wells and ENRAF level detectors.

Figure 4-1. 241-TY-Farm Tanks and Drywells



These domed, steel-lined tanks are 75 ft in diameter, with a maximum operational height (cascade overflow level) of 283 in. (about 23.6 ft) above the center of the dished tank base; the center of the dished base is 1 ft lower than the base perimeter. Each tank is covered by a 15-in.-thick reinforced concrete shell that extends about 13 ft above the maximum operating level of the tank.

The tanks are entirely below the ground surface and are covered with about 8 to 12 ft of backfill material. The base of the TY-Farm excavation is about 50 ft bgs, allowing space for footings and other construction requirements (WHC-SD-WM-ER-351). The inside bottom of the first tank in the cascading series is approximately 45 ft bgs, with the other tank bottoms in each cascade are successively lower by 1 ft (WHC-SD-WM-ER-351).

The storage portion of the tank is lined with a carbon-steel liner of varying thickness. The upper portion of the steel liner is 1/4 in. thick and the lower portion is 5/16 in. thick. The dished bottoms of the tanks have 3/4-in.-thick steel plate liners. The bottom and side liners are joined by rounded knuckles of 3/8-in.-thick steel plate. The steel liners on the tank sides extend about 1.5 ft above cascade-line connections that interconnect the tanks from east to west. The concrete dome tops of the tanks are unlined and exposed to vapors within the tanks (WHC-SD-WM-ER-351).

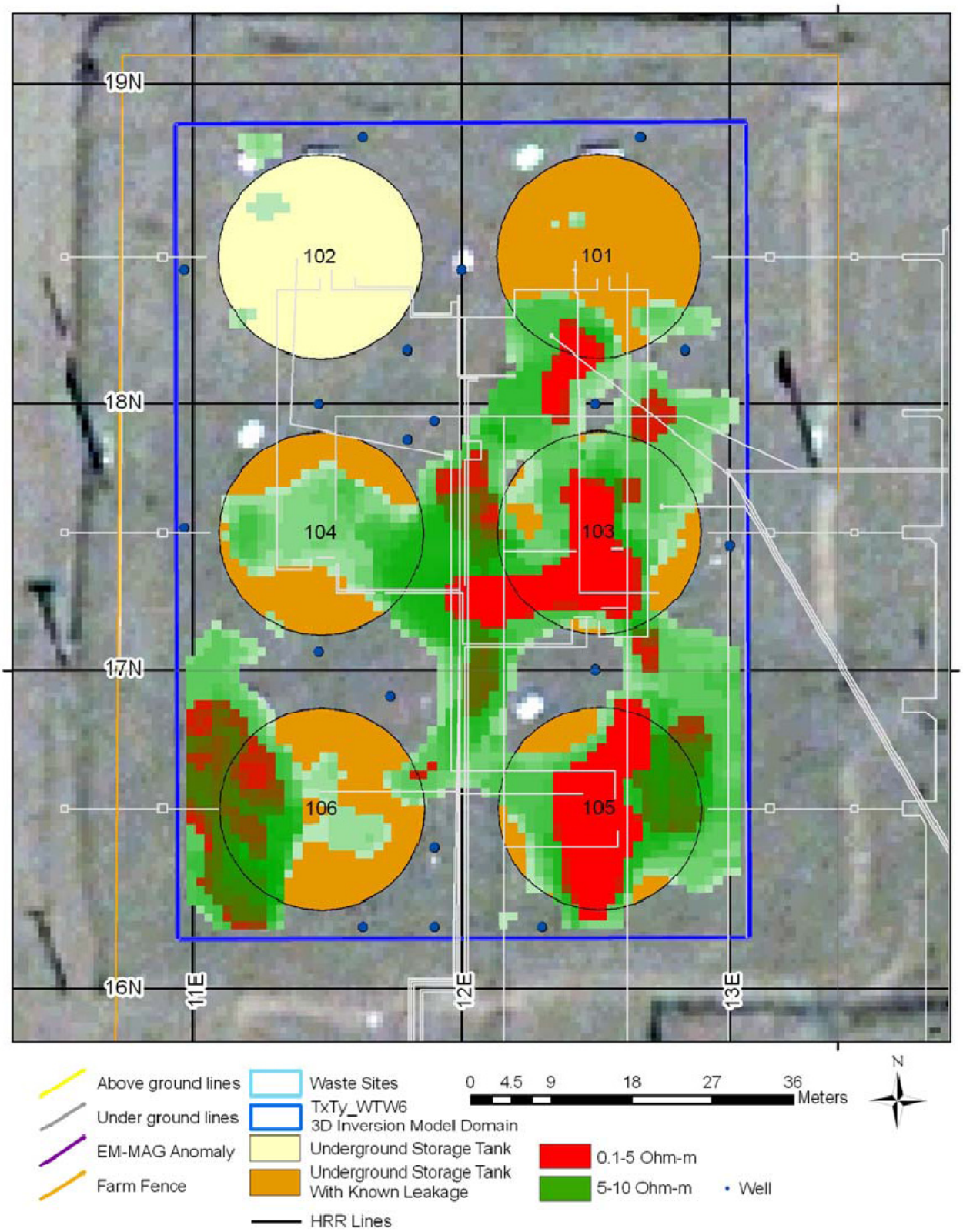
The TY-Farm tanks are connected in three two-tank cascade series. These cascade series consist of tanks 241-TY-101 (TY-101) and 241-TY-102 (TY-102), 241-TY-103 (TY-103) and 241-TY-104 (TY-104), and 241-TY-105 (TY-105) and 241-TY-106 (TY-106). The cascade tanks are arranged with each successive tank sited at a lower elevation (with the receiving tank 1 ft lower than the feed tank), creating a gradient allowing fluids to flow from one tank to another as they were filled. The cascade-line connections between the tanks are 24 to 26 ft bgs. The remaining supernatant liquid was cascaded to cribs when the last tank in the cascade series was filled.

4.1 SURFACE GEOPHYSICAL EXPLORATION

A Surface Geophysical Exploration (SGE) survey was conducted in September 2007 to collect and analyze soil electrical resistivity data as a means to identify and locate low resistivity regions in and around the TY-Farm area. This was done to identify potential areas of high nitrate or sodium contamination (RPP-ENV-38767, *Summary and Assessment of Surface Geophysical Exploration in the TX and TY Tank Farms*). The initial part of the survey effort integrated ground penetrating radar and electrical resistivity. High-resolution electrical resistivity data were collected in a well-to-well survey using existing groundwater and vadose zone wells in the TY-Farm area.

Figure 4-2 displays survey results. Resistivity anomalies less than 5 ohm-m are shown in red. Resistivity values between 5 and 10 ohm-m are shown in green. Low-resistivity is an indicator of increased moisture or increased concentration of electrolytes compared to background conditions. The results of the data interpolation modeling show lowest resistivity near tanks TY-103, TY-105 and TY-106. The extent of the resistivity anomalies beyond the blue line was not analyzed.

Figure 4-2. 241-TY-Farm Surface Geophysics Exploration Results



Note: "5-10 Ohm-m" applies to all shades of green. Dark green is 5, light green is 10.

4.2 GROUNDWATER CONTAMINATION FROM TANK WASTE LEAKS AT 241-TY FARM

Groundwater contaminants underlying TY-Farm that could have originated from tank waste leaks include ^{99}Tc, ^{129}I, chromium and nitrate. The sources that have caused the observed contamination are not clearly indicated because of several factors. These include the number of possible sources, the complex history of primary groundwater flow directions, the impacts of pump and treat operations to the west and south of the area and a limited groundwater monitoring history (since the early to mid-1990s). In the immediate vicinity of TY-Farm (Figure 4-3) are the tank leaks (notably at TY-105, TY-106 and TY-103) and crib discharges (T-26, T-27 and T-28) just east of the tank farm boundary. In addition, other possible sources affecting the aquifer underneath TY-Farm are tank waste releases and crib discharges (e.g., T-19) at TX-Farm and crib discharges at T-Farm. Thus, a mixture of tank wastes and less concentrated crib discharges are plausible sources of groundwater contamination. Pump and treat operations for the removal of carbon tetrachloride have been ongoing primarily to the south of TX-Farm since the mid-1990s and groundwater extraction has apparently been sufficient to alter the groundwater flow direction and thus the natural movement of contaminants in affected portions of the aquifer. At TY-Farm, one extraction well on the west boundary (299-W15-765) has been an extraction well since 2005 and has clearly influenced contaminant movement. These factors are considered in the following discussion of major groundwater contaminants.

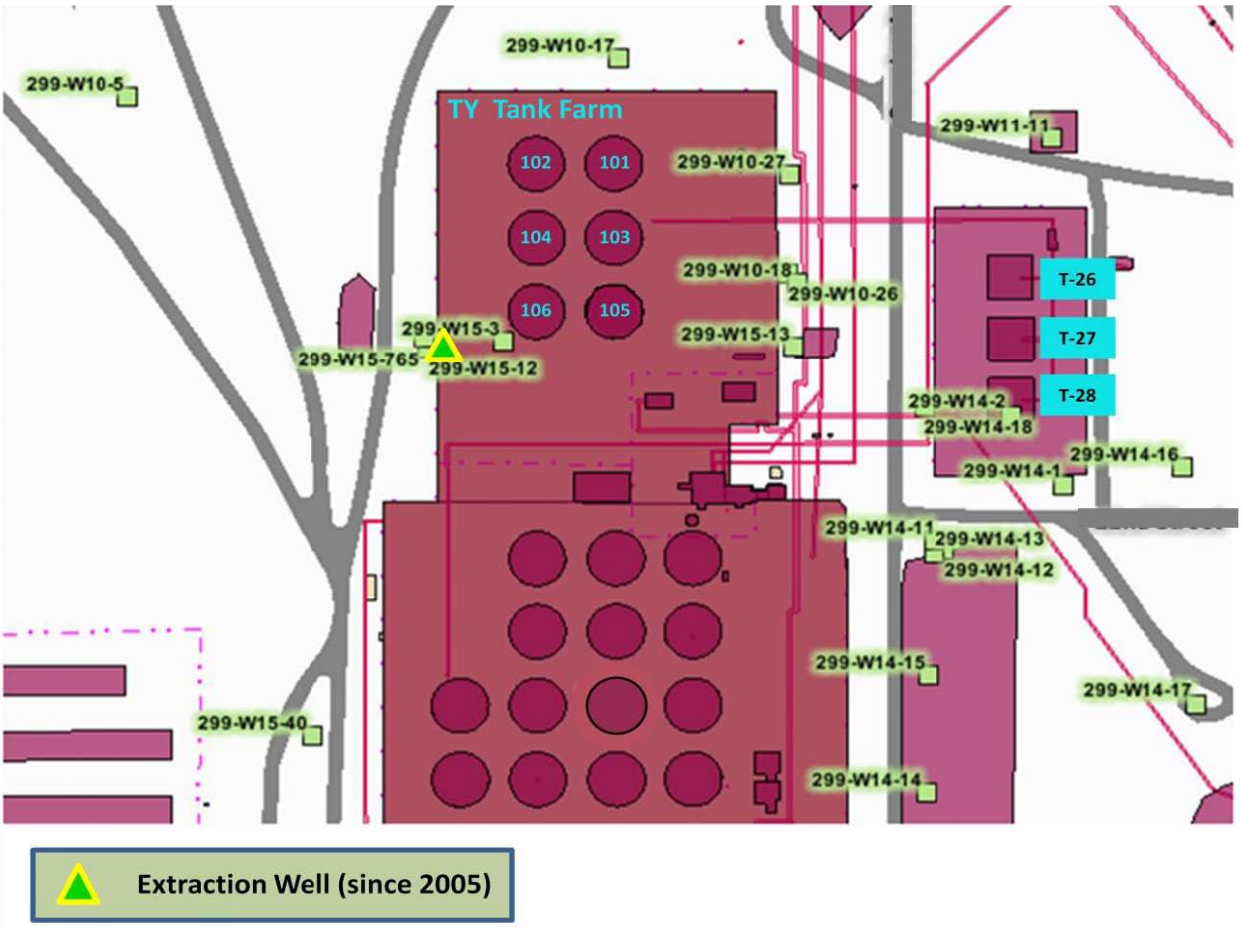
Since the beginning of extensive groundwater monitoring around the TY-Farm in the early 1990s, consistently high contamination levels for ^{99}Tc, chromium, nitrate and ^{129}I (Figure 4-4) have occurred in the vicinity of wells 299-14-12 and 299-W14-13 at the northeast corner of TX-Farm. All contaminants decreased after 1992 to low values around 1996 and remained at low concentrations until about 1998. At this time increases occurred sharply until 2000 and have fluctuated around an average value since then. These trends coincide with known changes in the general direction of groundwater flow under the TX-TY Waste Management Area (WMA) and are described below by comparing changes in head distributions and spatial/temporal changes in ^{99}Tc contamination levels at wells encompassing TY-Farm.

To illustrate the transient nature of groundwater flow that has occurred under the TX-TY WMA, head data between 1991 and the present are shown in Figure 4-5 for monitoring wells to the northwest, east and southwest of the TX-TY WMA, thereby encompassing the WMA. The Figure 4-5 well locations are shown in Figure 4-3 for all but the southwest wells. Wells 299-15-22 and 299-W14-763 are at the southern boundary of TX-Farm about 100 and 240 m south and east of well 299-W15-40 (shown in Figure 4-3), respectively.

In Figure 4-5a, three different head distributions are evident. Up until about 1996, general flow had a strong northerly component with the highest head value at the southwest well 299-W25-22. During this time contamination levels steadily decreased at wells 299-W14-12 and 299-W14-13 (Figure 4-4), suggesting northerly movement of a contaminant plume containing all four contaminants located mostly underneath the tank farms. The data indicate that the center of the plume had passed to the north of 299-W14-12 and 299-W14-13 in 1996. The fact that high ^{99}Tc concentrations were not observed at wells to the north suggests that the highly concentrated portion of the plume had a footprint smaller than the TY-Farm area. For example, ^{99}Tc levels

rose between 1992 and 1996 at well 299-W10-18 about 100 m northwest of well 299-W14-13 (Figure 4-3), but maximum values did not exceed 300 pCi/L.

Figure 4-3. Location of Tank Leak Sites, Crib Discharges and Primary Monitoring/Extraction Wells Around 241-TY Farm

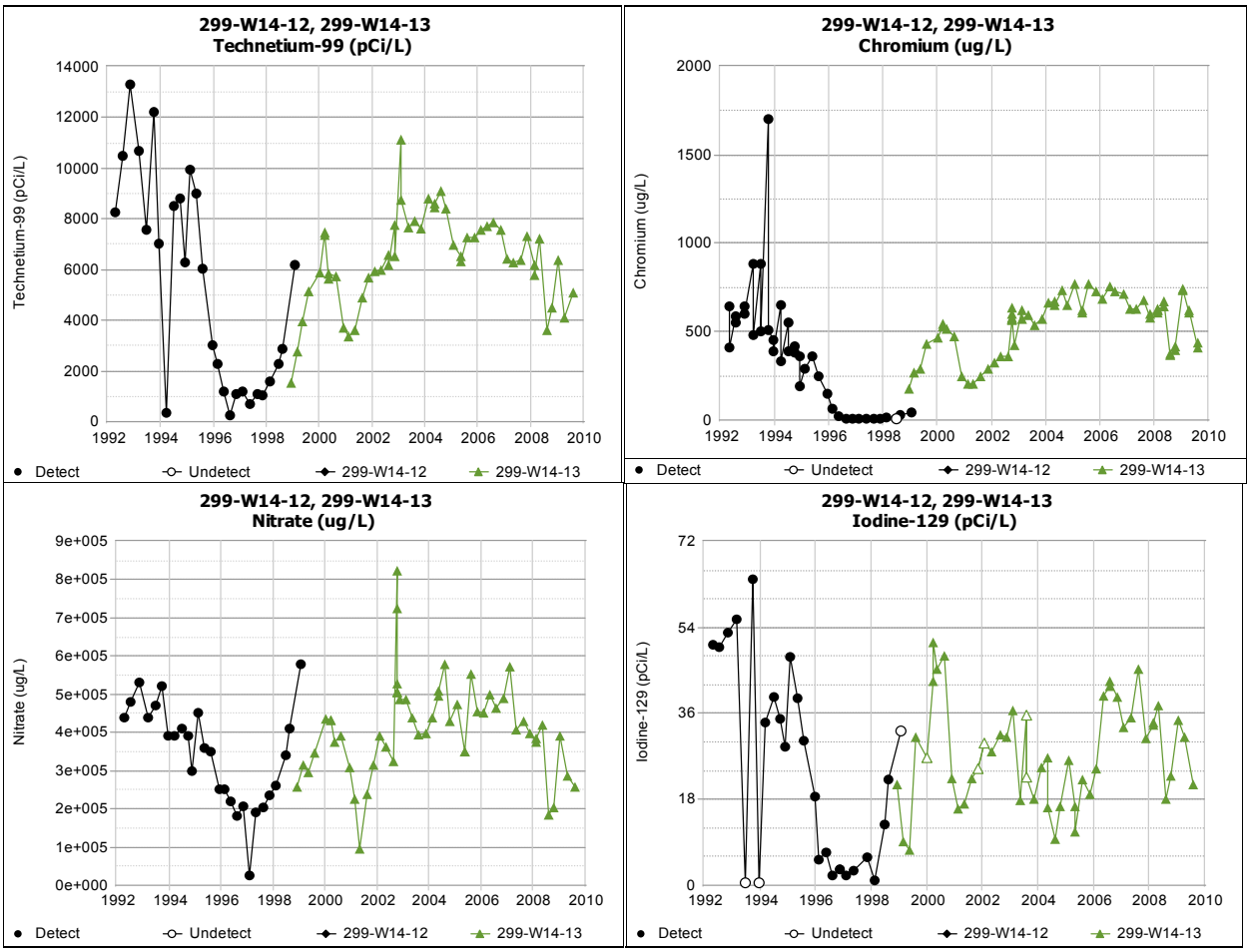


Beginning in 1996, water table elevations dropped at a more rapid rate in all three locations and the gradient under the WMA flattened noticeably until 1998. The more rapid rate of head decline was indicative of a Site-wide process caused by the cessation of major liquid discharge to the soil across the Site which had artificially elevated the water table above pre-Hanford levels since the early 1950s. The convergence of heads across the TX-TY WMA may have been partially influenced by the pump and treat operations near the southwest corner of TX-Farm that began in 1996 and drew down water table elevations in nearby wells such as 299-W15-22. With the onset of a low gradient, plume movement slowed and contamination levels at all monitoring well locations changed very little.

By the end of 1998 the current aquifer head distribution began to form a general flow direction easterly and slightly southerly across the TY-Farm. As a result the maximum head in the region occurs at the northwest well and the southern and eastern well and the well head levels are about the same. Figure 4-5b shows the continuation of this trend. The plume would have also shifted

directions and moved towards the east, once again passing across the eastern part of the TX-TY WMA causing the concentration levels to rise at the eastern monitoring wells. Since 2000 the eastern monitoring wells showing ^{99}Tc concentrations exceeding 2,000 pCi/L include 299-W10-26, 299-W14-13 and 299-W14-15 with the center of the plume passing underneath 299-W14-13. These measurements suggest essentially due east migration of this plume and some reduction in peak contaminant concentrations due to dispersion of the plume center since the early 1990s. The degree of dispersion can be seen qualitatively by comparing ^{99}Tc concentrations at well 299-W14-13 before 1996 and after 2000 (Figure 4-4).

Figure 4-4. Groundwater Concentrations Versus Time for Technetium-99, Chromium, Nitrate and Iodine-129 at Monitoring Wells 299-W14-12 and 299-W14-13



Maximum contaminant levels: Technetium-99=900 pCi/L, Iodine-129=1 pCi/L, Chromium= 0.1 mg/L, Nitrate = 45 mg/L

Despite the similarity in trends for all four contaminants in Figure 4-4, it is unlikely that only one source is contributing to the observed contamination because these constituents are not present in all wells at similar levels and do not necessarily show simultaneous trends. The best agreement in contaminate distribution over time appears to be between ^{99}Tc and chromium, indicating a common source. A comparison of ^{99}Tc and chromium behavior at wells 299-W14-13 and 299-W15-763 (about 225 m to the northwest of 299-W14-13) is insightful (Figure 4-6).

Figure 4-5. Comparison of Head Data at Wells to the Northwest, Southwest and East of 241-TY-Farm

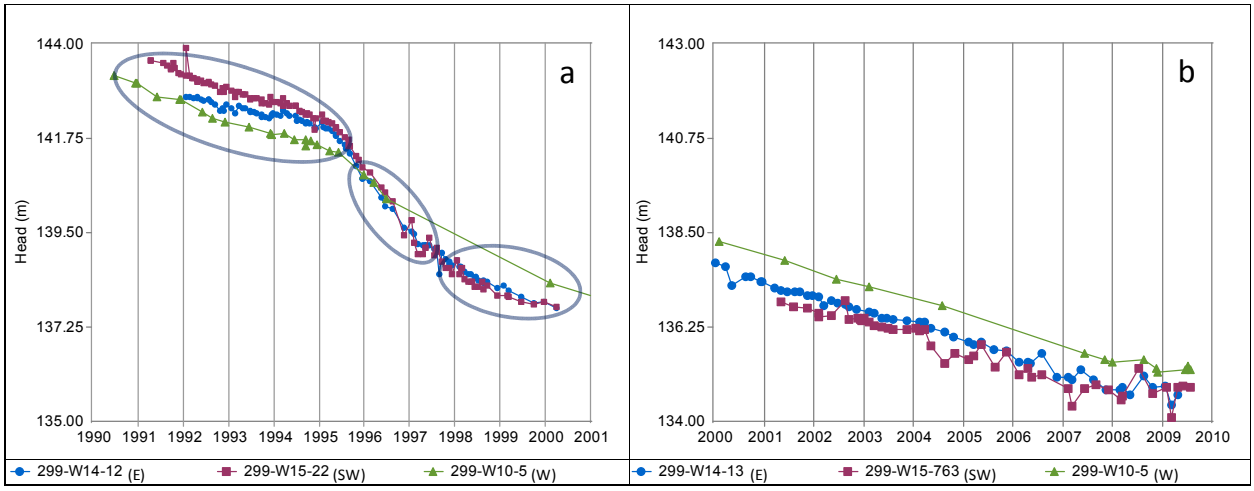
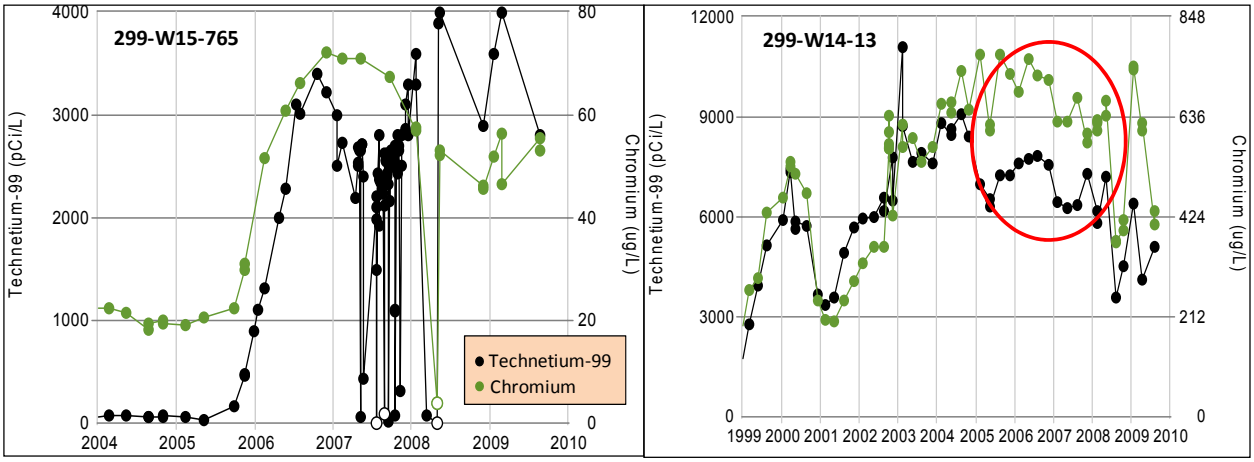


Figure 4-6. Technetium-99 and Chromium Contamination at Well 299-W15-765 and 299-W14-13 Between 1999 and 2010



Prior to late 2005, well 299-W15-765 was a monitoring well. During this time low levels of ^{99}Tc and chromium were measured. Shortly after conversion of well 299-W15-765 to an extraction well, both ^{99}Tc and chromium concentrations began to rise rapidly. At the same time, ^{99}Tc concentrations dropped at well 299-W14-13. Technetium-99 and chromium concentrations are higher at well 299-W14-13, ~3 and 10 times, respectively. These data suggest that aquifer drawdown from groundwater extraction captured mobile contaminants from the plume underlying the TY-Farm that have been inferred from previous measurements at wells 299-W14-12 and 299-W14-13. Given the lower concentration levels and a relatively larger reduction of chromium at well 299-W15-765, the center of the plume appears to be closer to the east side of the TY-Farm and chromium appears to be less widespread than ^{99}Tc. Chromium migration may also be slightly retarded compared to ^{99}Tc.

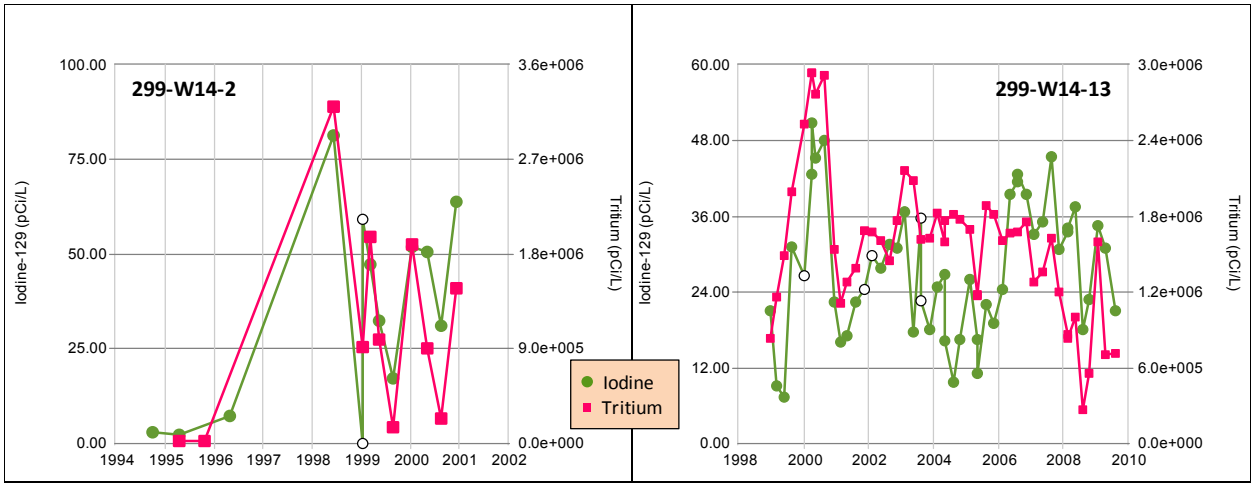
Chromium and ^{99}Tc migration patterns are similar at other wells. Since 2000, an easterly chromium migration pattern is apparent in which the highest contamination levels (~600 µg/L) are moving through well 299-W14-13. However, unlike ^{99}Tc where moderate concentrations were observed at wells to the north and south of 299-W14-13, the only other well showing moderate chromium concentrations above 100 µg/L is well 299-W14-15 to the south. Also, small increases in chromium concentration (up to 30 µg/L) are occurring at well 299-W14-14 south of well 299-W14-15 (Figure 4-3). In contrast a decrease in ^{99}Tc has been observed at this southernmost well. Therefore, the chromium plume is apparently narrower than the ^{99}Tc plume and slightly more concentrated towards the southern end of the plume. Another small area of modest chromium contamination (up to ~50 µg/L) occurs at the northeast corner of TY-Farm at wells 299-W10-17 and 299-W10-27 where chromium contamination levels have generally risen since 1998 and 2002, respectively. A concurrent elevation in ^{99}Tc has not been observed at these wells. These observations suggest a different source of contamination is likely associated with a larger chromium plume emanating from the T-Farm area to the north.

Of the two remaining contaminants, some portion of the nitrate aquifer contamination must have originated from the same source as the ^{99}Tc and the major portion of chromium because all major discharge streams around TY-Farm contained nitrate. There is a slight increase in nitrate concentrations in the TY-Farm monitoring wells versus surrounding wells (e.g., ~10^5 versus 10^4 µg/L) and the general migration patterns described for ^{99}Tc and chromium are generally followed by nitrate. However, the relative concentrations among the wells that are seen with ^{99}Tc and chromium are not particularly distinct for nitrate and there are significant divergences in nitrate versus ^{99}Tc trends in various wells at various times. These observations reflect the fact that multiple sources contribute nitrate to the aquifer making quantification of any particular waste source contribution ambiguous. However, given the generally consistent nitrate responses to groundwater flow patterns, it seems likely that a significant portion of the nitrate source can be attributed to the same source as ^{99}Tc and chromium.

The ^{129}I distributions in the TY-Farm have been and continue to be strongly oriented along an axis defined by wells 299-W14-2, 299-W14-12/299-W114-13 and 299-W14-15 on the east side of TY-Farm. The largest ^{129}I concentrations (50 to 64 pCi/L) have occurred in the early 1990s at well 299-W14-12 (Figure 4-4) and at 299-W14-2 in 1999 and 2000. Currently maximum concentrations are at well 299-W14-13 (20 to 30 pCi/L) and drop off sharply to the south (e.g., concentrations are generally less than 5 pCi/L at well 299-W14-15). Contaminate concentrations to the north are not known because measurements can no longer be taken at well 299-W14-2. Outside of these wells, ^{129}I has been measured sporadically and at low concentrations (< 1pCi/L) at only a few other nearby wells indicating a very limited distribution in the aquifer underneath the TX-TY WMA. Considered collectively, these data indicate that the ^{129}I center of mass is present in the vicinity of wells 299-W14-2 and 299-W14-13 and has been moving eastward since 1998 in response to the changing groundwater flow patterns. On the regional scale, ^{129}I has been measured at several wells to the northeast of the WMA.

This spatial distribution and the temporal trends are clearly dissimilar to the ^{99}Tc/chromium distributions and trends described above. On the other hand, the ^{129}I trends at these wells track fairly closely with tritium (Figure 4-7). Tritium is more widely distributed than ^{129}I, but like ^{129}I, has been most strongly concentrated around wells 299-W14-2 and 299-W14-13.

Figure 4-7. Iodine-129 and Tritium Contamination at Well 299-W14-2 and 299-W14-13 Between 1994 and 2010



The groundwater data summarized above suggests that two primary contamination plumes are affecting the unconfined aquifer underlying TY-Farm. The first plume includes ^{99}Tc, chromium and nitrate as major contaminants. The high ^{99}Tc content strongly indicates a tank waste source. However, the specific tank waste release or releases responsible for this contamination is not known. Because the historical groundwater flow paths have been northerly since the mid-1950s, the plume appears to have originated to the south of TY-Farm in TX-Farm where several releases from the tank farm infrastructure (transfer pipelines) are known to have occurred. The second plume includes ^{129}I and tritium, two contaminants that are not commonly associated with tank waste releases, but are present in several crib discharges. Tritium in particular was a common crib contaminant. In this case, trench T-28 is a plausible source. The centers of mass of both ^{129}I and tritium are both near trench T-28 (e.g., well 299-W14-2 was drilled through crib T-28) and discharge volumes through trench T-28 in the mid-1960s were sufficient to break through to the unconfined aquifer. For example, peak discharges of more than 15 million L occurred in 1965 and a tritium spike in well 299-W14-2 was also measured that year. The discharged waste stream that may have contained ^{129}I is ambiguous but could have been a contaminant in laboratory waste whose contents were not quantified in historical documents.

Recent groundwater monitoring results and trends in the TX-TY WMA are presented in SGW-39325, *RCRA Quarterly Report April – June 2008*.

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5.0 LEAK ASSESSMENT RESULTS

The information gathered and the reassessment results for each of the SSTs and UPRs in the 241-TY Tank Farm are discussed in the following sections.

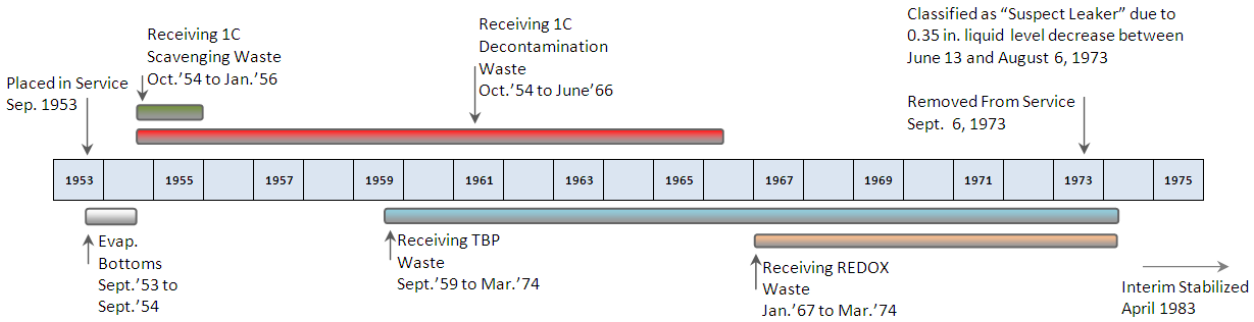
Several processes were conducted at the Hanford Site that generated wastes transferred to the 241-TY Tank Farm. These processes and the waste types generated are discussed in HNF-SD-WM-TI-740, *Standard Inventories of Chemicals and Radionuclides in Hanford Tank Wastes*. High-level radioactive waste generated at Hanford from 1945 to 1989 was derived predominantly from the chemical dissolution and extraction of plutonium and uranium from irradiated reactor fuel elements. The extraction processes over these years evolved through three basic processes: the bismuth-phosphate ($BiPO_4$) process, the reduction-oxidation (REDOX) process, and the plutonium-uranium extraction (PUREX) process. These processes were used for the extraction of plutonium. A fourth process, the tributyl phosphate (TBP) process, was designed for the recovery of uranium. The wastes from these processes were neutralized and discharged to the underground storage tanks.

Specific wastes discharged to the TY Tank Farm tanks include TBP waste, REDOX waste, PUREX waste, B Plant waste, evaporator feed and bottoms waste, ferrocyanide (FeCN) scavenging waste, first-cycle (1C) decontamination waste (DW), and coating waste. Tank TY-106 received 30 tons of diatomaceous earth that were added to stabilize the tank's contents. These wastes are defined and discussed in detail in WHC-MR-0132, *A History of the 200 Area Tank Farms*.

5.1 TANK 241-TY-101 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-101. The waste operations summary for tank TY-101 is summarized in Figure 5.1-1. Figure 5.1-2 shows a plan view of tank TY-101.

Figure 5.1-1. Tank 241-TY-101 Waste Operations Summary



5.1.1 Tank 241-TY-101 Waste History

Tank TY-101 contained evaporator bottoms (EB) between 1953 and 1954 (SD-WM-TI-356). From 1954 to 1956, tank TY-101 received 1C-FeCN scavenging waste. From 1954 to 1966, the

tank received 1C DW. From 1959 to the first quarter of 1974, the tank received TBP waste. From 1967 to the first quarter of 1974, the tank received REDOX waste. A leak was suspected due to a 0.35-in. liquid level decrease between June 13 and August 6, 1973 (RHO-CD-896, *Review of Classification of Nine Hanford Single-Shell "Questionable Integrity" Tanks*). The tank was then pumped to a minimum heel of 110 in. and removed from service on September 6, 1973 (ARH-2794 C, *Chemical Processing Division Waste Status Summary , July 1, 1973 through September 30, 1973*, p. 7; RHO-CD-896). Table 5.1-1 shows waste transfers for tank TY-101 from 1953 to 1975 and Figure 5.1-3 shows the waste surface profile.

Figure 5.1-2. Tank 241-TY-101 Plan View

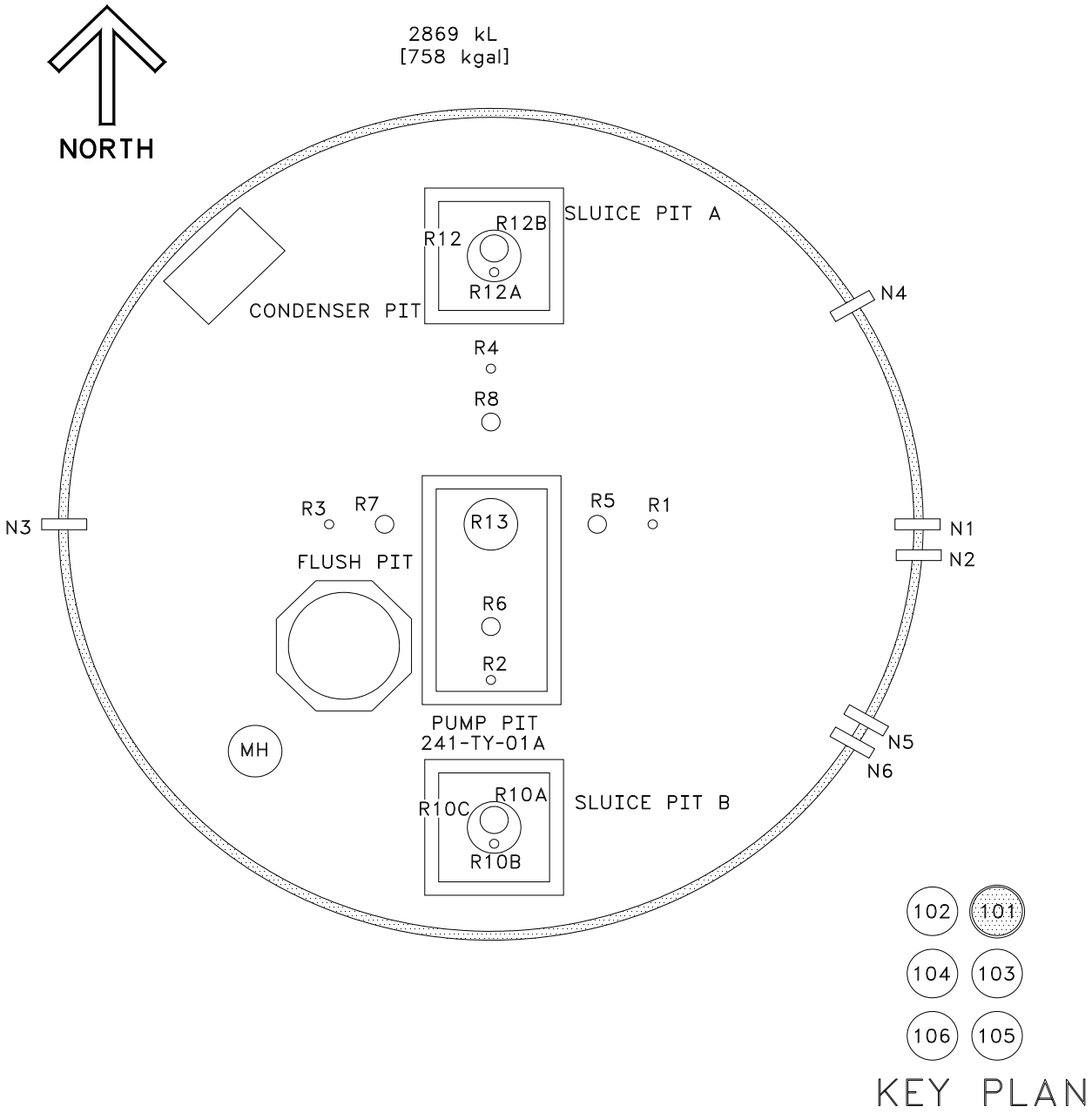


Table 5.1-1. Tank 241-TY-101 Transfers 1953 to 1975 (2 sheets)

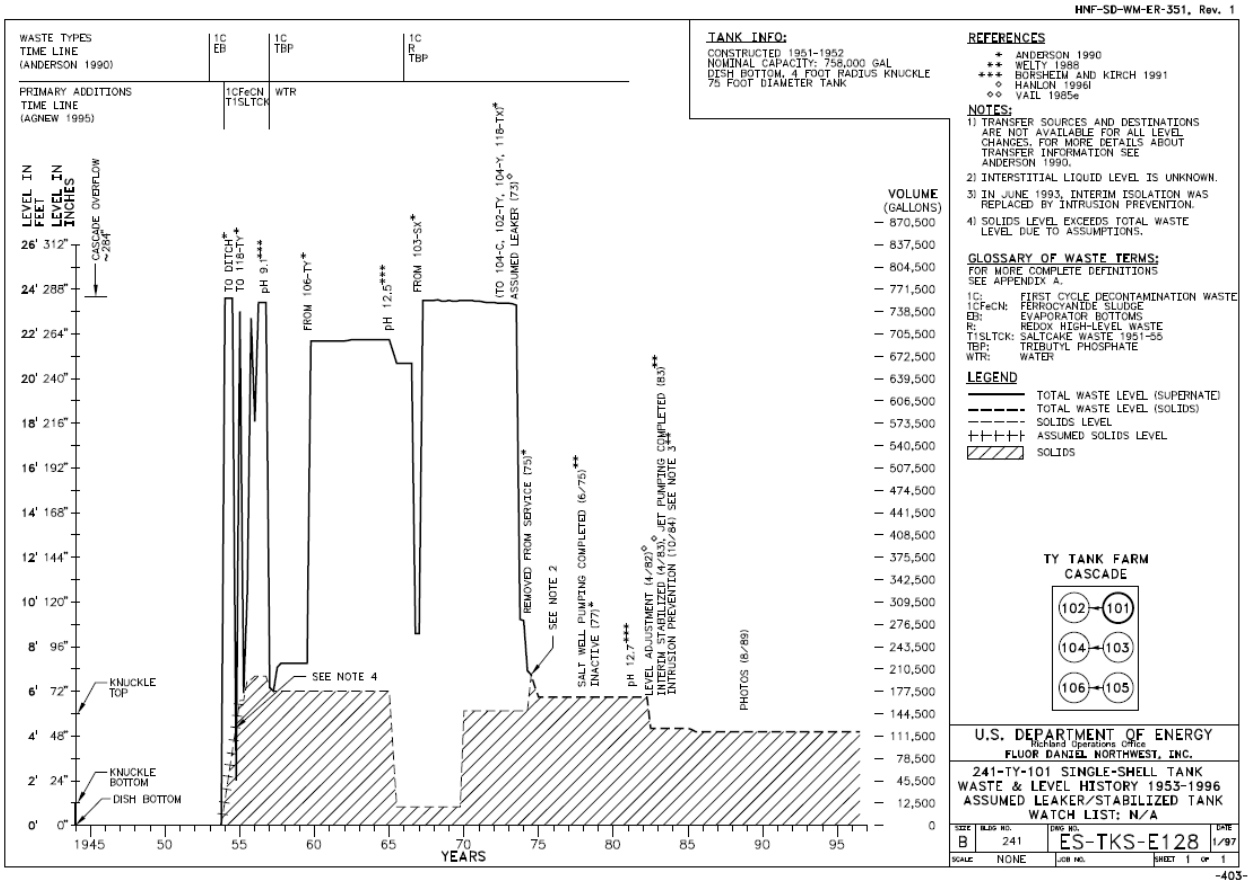
Date/Date Range	*Transfer Type*[1]	*Transfer Volume (gal*1,000)*	*Total Vol. In Tank (gal*1,000)*[2]	*Discrepancy with previous reading (gal*1,000)*[3]	*Waste type*[4]	*Transfer tank from/to*	*Document Number*[5]
Sept.-1953	IN	556	556		EB	117-TX	HW-29624
Oct.-1953 to Aug.-1954	IN	202	758		EB		HW-29905
Sept.-1954	OUT	-712	46		EB	Evap. bottoms	HW-33396
Oct.-1954	IN	104	150		1C		HW-33544
Nov.-1954	IN	294	444		1C		HW-33904
Dec.-1954 to Feb.-1955	IN	295	739		1C		HW-34412
Mar.-1955 to May-1955	OUT	-564	175		1C	Supernate to118-TX	HW-36001
June-1955	IN	151	326		1C		HW-38000
July-1955	IN	253	579		1C		HW-38401
Aug.-1955 to Sept.-1955	IN	150	729		1C		HW-38926
Oct.-1955	OUT	-441	288		Possible decanting		HW-39850
Nov.-1955	IN	176	464		1C		HW-40208
Dec.-1955	IN	112	576		1C		HW-40816
Jan.-1956	IN	101	677		1C	T Plant Waste In	HW-41038
Feb.-1956 to Oct.-1956	IN	75	752		1C	Settling for decanting	HW-41812
Nov.-1956 to Dec.-1956	OUT	-569	183		1C	TY-1 Cavern	HW-47052
Jan.-1957 to Mar.-1957	STAT		178	-5	1C		HW-48144
Apr.-1957	STAT		183	5	1C		HW-50127
May-1957 to June.-1957	IN	30	213		1C, EB		HW-50617
July-1957 to July.-1959	STAT	6	219	6	1C		HW-51858
Aug.-1959	IN	74	293		1C, EB	106-TY	HW-61952
Sept.-1959 to Dec.-1961	IN	402	695		1C, TBD	106-TY	HW-62421
Jan.-1962 to Dec.-1964	STAT		697	1	1C, TBD		HW-74647
Jan.-1965 to June-1966	OUT	-35	662		1C, TBD		RL-SEP-659
July-1966 to Dec.-1966	OUT	-399	263		1C	118-TX	ISO-538 p. 7
Jan.-1967 to Dec.-1970	IN	492	~755		TBP, R	103-SX	ISO-806 p. 7

Table 5.1-1. Tank 241-TY-101 Transfers 1953 to 1975 (2 sheets)

Date/Date Range	*Transfer Type*[1]	*Transfer Volume (gal*1,000)*	*Total Vol. In Tank (gal*1,000)*[2]	*Discrepancy with previous reading (gal*1,000)*[3]	*Waste type*[4]	*Transfer tank from/to*	*Document Number*[5]
Jan.-1971 to Mar.-1971	STAT		753	-2	TBP, R		ARH-2074 A
Apr.-1971 to June-1971	STAT		752	-1	TBP, R		ARH-2074 B
July-1971 to Sept.-1971	STAT		755	3	TBP, R		ARH-2074 C
Oct.-1971 to Dec.-1971	STAT		752	-3	TBP, R		ARH-2074 D
Jan.-1972 to Dec.-1972	STAT		751	-1	TBP, R		ARH-2456 A
Jan.-1973 to Mar.-1973	STAT		750	-1	TBP, R		ARH-2794 A
Apr-.1973 to June-1973	STAT		748	-2	TBP, R		ARH-2794 B
July-1973 to Sept.-1973	IN	1			Water		ARH-2794 C
July-1973 to Sept.-1973	OUT	-465	284 (Reported Value)	+1	TBP, R	118-TX/104-TX/ 104-C	ARH-2794 C
Sept. 6, 1973			*REMOVED FROM SERVICE*				RHO-CD-896
Oct.-1973 to Dec.-1973	STAT		282 *SUSPECT LEAKER*	-2	TBP, R	NA	ARH-2794 D
Jan.-1974 to Mar.-1974	OUT	-78	208 (Reported Value)	+4	TBP, R	118-TX	ARH-CD-133A
Apr.-1974 to June-1974	OUT	-27	202	+21	Water Addition?	102-TY	ARH-CD-133B
July.-1974 to Sept.-1974	OUT	-6	184	-12		102-TY	ARH-CD-133C
Oct.-1974 to Dec.-1974	OUT	-9	169	-6		102-TY	ARH-CD-133D
Jan.-1975 to Mar.-1975	OUT	-5	164			102-TY	ARH-CD-336 A
Mar.-1975 to Apr.-1975	STAT		169	+5			ARH-CD-336 A

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.
[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Transfer volumes are from references shown and LA-UR-97-311.
[3] Small discrepancies may be attributed to effects such as evaporation or water additions.
[4] Waste types: EB = Evaporator Bottoms, 1C = First cycle waste, TBP = tributyl phosphate, R = Reduction-Oxidation.
[5] For reference titles, see Section 6.0 REFERENCES.

Figure 5.1-3. Tank 241-TY-101 Waste Fill History



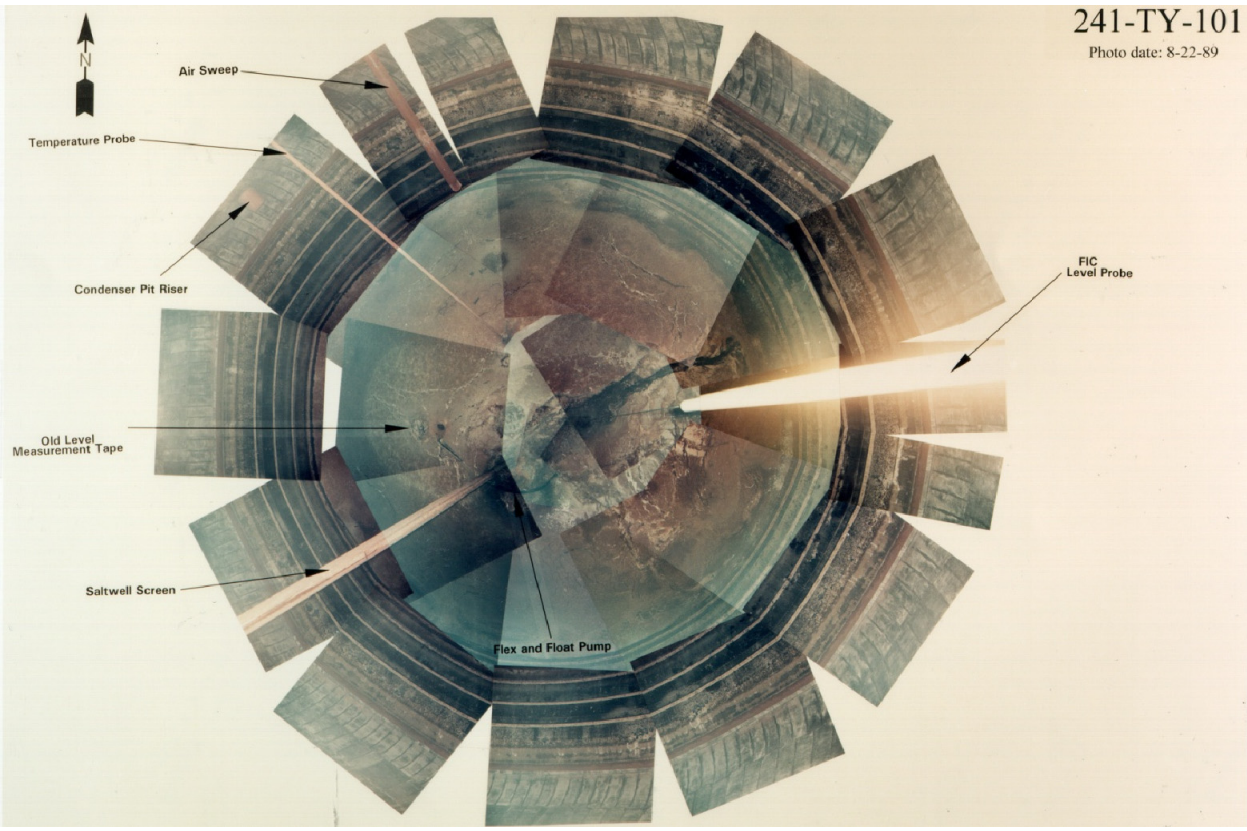
5.1.1.1 Integrity of Tank 241-TY-101. Tank TY-101 was categorized as "questionable integrity" due to a liquid level decrease of 0.35 in. between June 13, 1973 and August 6, 1973. During 1973 increased activity was observed in two of the drywells external to the tank (SD-WM-TI-356). Based on the liquid level decrease the current leak estimate for tank TY-101 is less than 1,000 gal (HNF-EP-0182). The SIM (RPP-26744) assumes the liquid waste present in tank TY-101 in 1973 was a mix of 242-T Evaporator (1965 to 1976) saltcake [T2-Sltck(P2') waste], TBP-uranium recovery (TBP-UR) and REDOX (1959 to 1966) high-level waste (HLW) (R2 waste).

No sample data representative of tank TY-101 waste at the time of the leak was available. The tank was sluiced in 1973 and core samples were obtained in 1985. Therefore the SIM value using RPP-19822, *Hanford Defined Waste Model – Revision 5.0* waste type estimates is assumed to provide the best available inventory estimate.

5.1.1.2 Interim Stabilization. In May 1974 a P-10 saltwell system was installed in tank TY-101. Between May 1974 and June 1975 6,000 gal of interstitial liquid were removed by jet pumping. The tank was jet pumped starting November 1982 and stabilized after reaching less than a 0.025 gal/min flow rate in February 1983 (HNF-SD-RE-TI-178, *Single–Shell Tank Interim Stabilization Record*). A photo mosaic (Figure 5.1-4) of the waste surface in

tank TY-101 as of August 1989 shows a dry, caked uneven surface with no visible liquid. As of September 2008 the tank is estimated to contain 72,000 gal of sludge and 46,000 gal of saltcake including 4,000 gal drainable interstitial liquid in the saltcake and no supernate (HNF-EP-0182 Rev. 261).

Figure 5.1-4. Tank 241-TY-101 Waste Surface Photo Mosaic



5.1.1.3 Tank 241-TY-101 Temperature History. Figure 5.1-5 shows a thermal history for thermocouple 1 in Riser 4 of tank TY-101 from 1972 through 1995. The tank temperature for all thermocouples in Risers 3 and 4 varied between 60 and 80 °F during this time. These measurements are shown in Surveillance Analysis Computer System (SACS). No temperature information was found before 1972.

5.1.2 Data Review and Observations

5.1.2.1 Surface Level Data. Letter Luening 1973, "Status of Tank 241-TY-103 Contract AT(45-1)-2130" estimated that 1,400 gal of liquid waste containing about 520 Ci of ^{137}Cs leaked from the tank based on a 0.5-in. liquid level decrease. HNF-EP-0182 reports a < 1,000-gal leak based on a 0.35-in liquid level decrease.

Figure 5.1-5. Tank 241-TY-101 Temperature Measurements

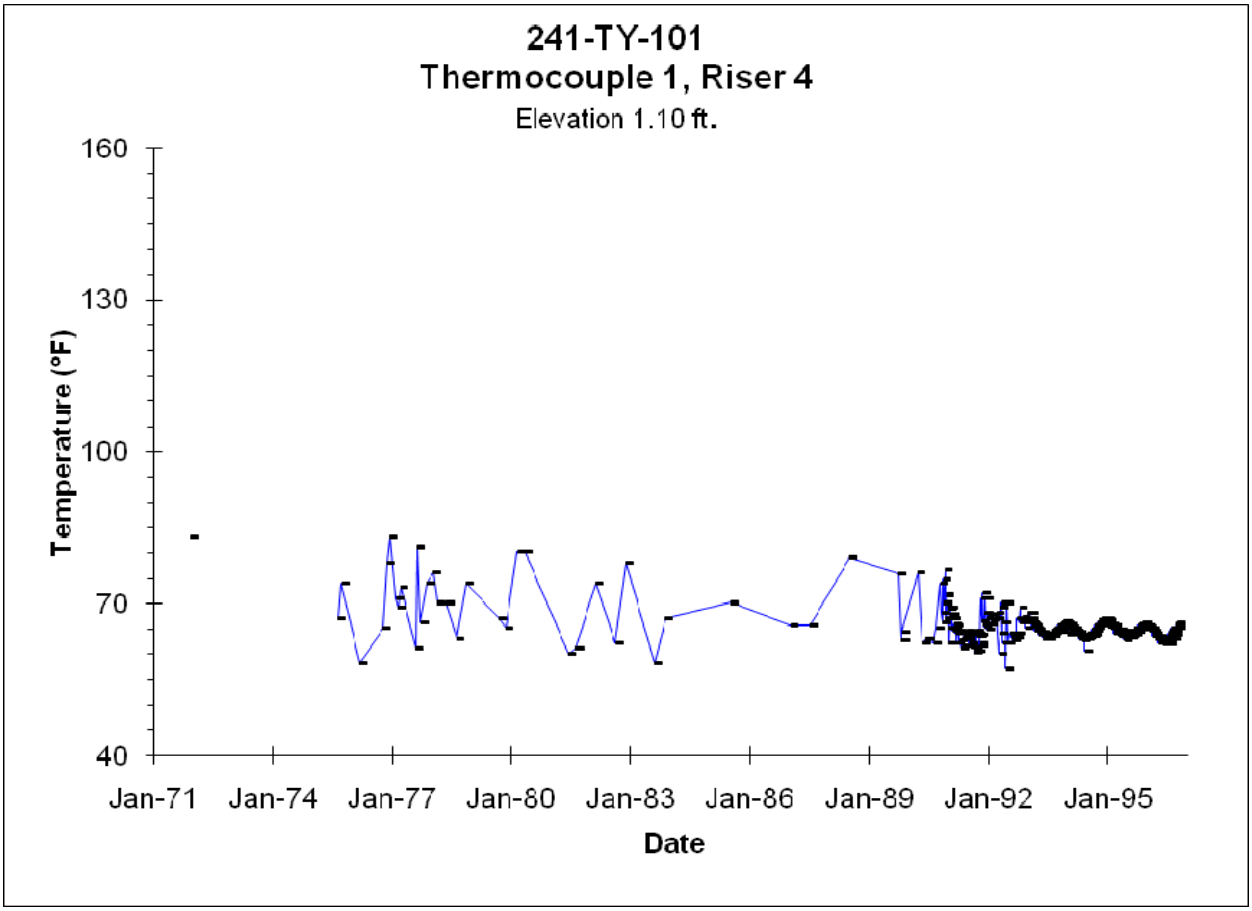


Table 5.1-2. 1973-1974 Tank 241-TY-101 Liquid Level Measurements (SD-WM-TI-356)

Date	Liquid Level (in.)	Change from previous reading	Cumulative Change	Comments
06/13/73	279.30			Food Instrument Corporation Gage
07/26/73	279.20	-0.10	-0.10	Slow decrease
07/27/73	281.55		-0.10	Calibration
08/06/73	269.50		-0.10	Transfer
08/27/73	269.15	-0.35	-0.45	Slow decrease
09/07/73	111.0		-0.45	Transfer
03/06/74	109.40	-1.60	-2.05	Slow decrease
03/07/74	108.75	-0.65	-2.05	Flush and calibrate
03/14/74	108.65	-0.10	-2.15	Slow decrease
03/27/74	71.25		-2.15	P-10 saltwell pumping
03/29/74	85.75		-2.15	Food Instrument Corporation out of service

Reference: SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*.

SD-WM-TI-356 records several unexplained liquid level decreases between 1973 and 1974 (Table 5.1-2). In 1973, saltwell pumping began in the tank. By 1974, the liquid level measuring device was contacting the solid surface of the saltcake. Erratic surface level measurements were recorded between 1974 and 1986.

In-tank photos indicate that the liquid level in tank TY-101 reached the level of the cascade line (284 in.) in the tank.

5.1.2.2 Drywell Logging Data. Four vadose zone monitoring drywells surround tank TY-101. All the drywells were drilled at the end of 1971. These boreholes are within 9 ft of the tank and were drilled to a depth of 100 ft using 6-in.-inside-diameter casing.

Total gamma and spectral gamma-ray data were acquired in drywells 52-01-01, 52-01-05, 52-03-12, and 52-01-09. Figure 5.1-6 shows spectral gamma results for these drywells. The drywells are arranged in clockwise order around tank TY-101 (Figure 5.1-7).

Figure 5.1-6. Tank 241-TY-101 Drywell Spectral Gamma Data

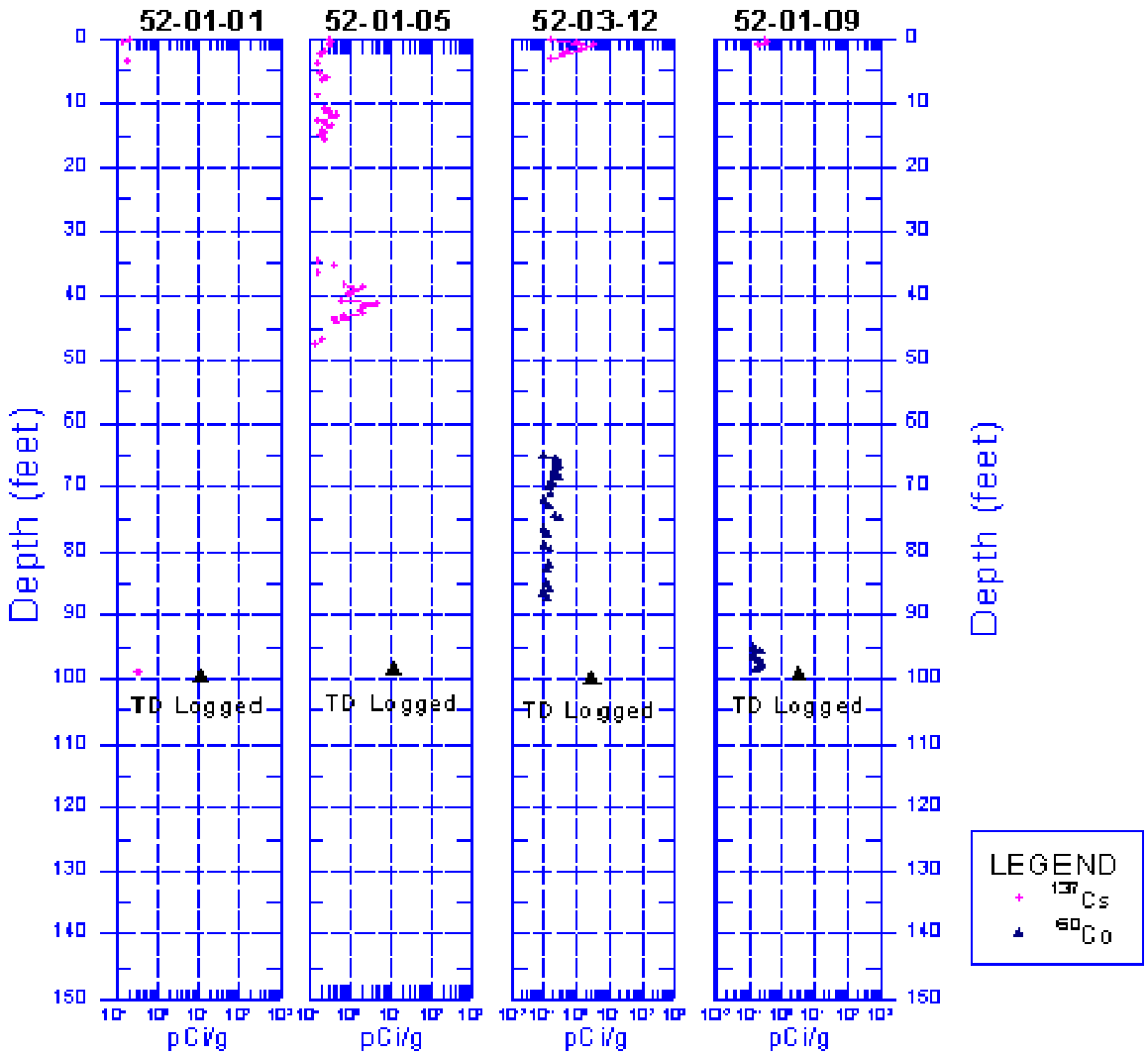


Figure 5.1-7. Three-Dimensional Plot Illustrating Spectral Gamma Results

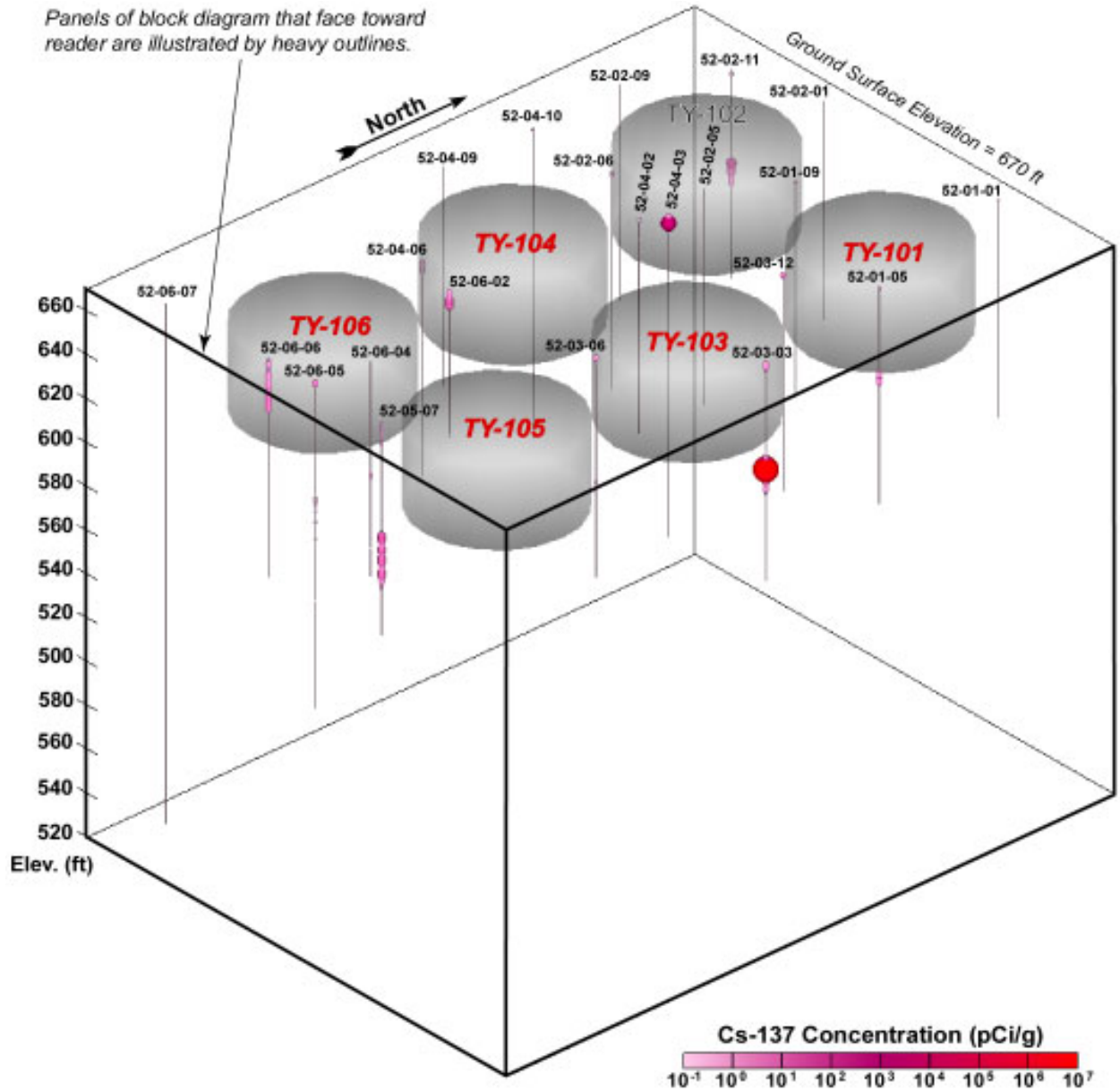


Table 5.1-3 shows peak total gamma results measured between 44 and 57 ft bgs from July 1973 to June 1986. Figures 5.1-8 and 5.1-9 illustrate drywell 52-01-05 and 52-01-09 total gamma results over time and decay curves.

The SGLS measured ^{137}Cs between 34.5 and 47.5 ft in borehole 52-01-05 between 1 and 10 pCi/g, which correlates with anomalous zones of elevated activity identified in historical gross gamma log data as early as 1973. Historical gross gamma data identified anomalous zones of activity between 45 and 55 ft in boreholes 52-03-12 and 52-01-09. The SGLS did not detect any gamma-emitting radionuclides in this region. The 1998 SGLS measurements detected ^{60}Co contamination in boreholes 52-03-12 from 65 to 94 ft and in borehole 52-01-09 from 95 to

98.54 ft (GJ-HAN-64, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank TY-101*). Historical gross gamma log data do not identify anomalous zones of activity in these intervals but data from 1975 to 1980 at 50 to 60 ft bgs follow a ^{106}Ru decay curve (HNF-3831, *Analysis of Historical Gross Gamma Logging Data from TY Tank Farm*).

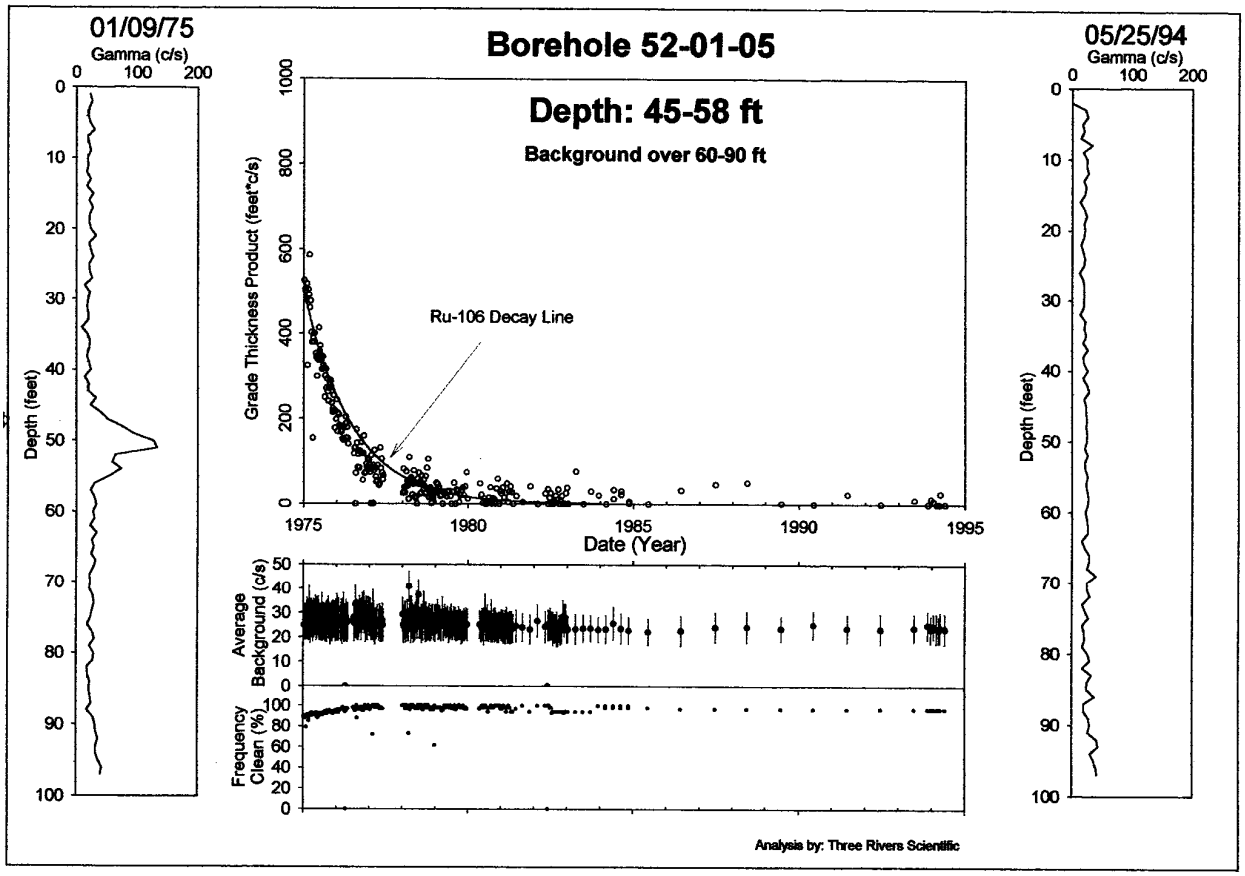
Table 5.1-3. Tank 241-TY-101 Total Gamma Drywell Measurements

Date	52-01-01	52-01-05	52-01-09	52-03-12
	Peak Reading (counts per second)			
7/73	<200	680	360	NA
10,11/73	<200	900	410	240
4/74	<200	850	600	310
5-6/74	<200	760		
8/74	<100	150	150	<100 new equip
2/75	<50	130	122	60
7/75	<50	84	89	70
12/75,1/76	<50	69	73	70
5/76	<50	62	57	70-77
9/76	<50	58	61	77-65
5/77	<50	45	59	61
10/77	<50	44	58	72
10/78	<50	<50	45	72
10/79	<50	<50	43	53
11/80	<50	<50	37	46
11/81	<50	<50	<50	48
11/82	<50	<50	<50	46
9/83	<50	<50	<50	42
8/84	<50	<50	<50	48
6/85	<50	<50	<50	43
6/86	<50	<50	<50	46

5.1.2.3 Tank 241-TY-101 Assessment. Tank TY-101 was one of nine "questionable integrity" tanks reviewed in RHO-CD-896. In the review, all three expert panels and the Chief scientist concluded that tank TY-101 should remain classified "questionable integrity" at a 95% confidence level, meaning there was insufficient evidence to conclude that the tank leaked, but also insufficient evidence to verify it did not leak. The assessment findings included the following:

- The 0.35-in. decrease is within error limits of the measurement system or could indicate a leak.

Figure 5.1-8. Drywell 52-01-05 Total Gamma Results



- Increasing activity and leveling off in drywell 52-01-09 appears to be associated with the liquid level decrease and subsequent pumping to a minimum heel.

- The tank TY-102 liquid surface level was static at 275 in. both before and after changes in drywell activity were observed.

- Drywell 52-01-05 activity appears to be from ^{106}Ru which has traveled some distance (possible tank TY-103).

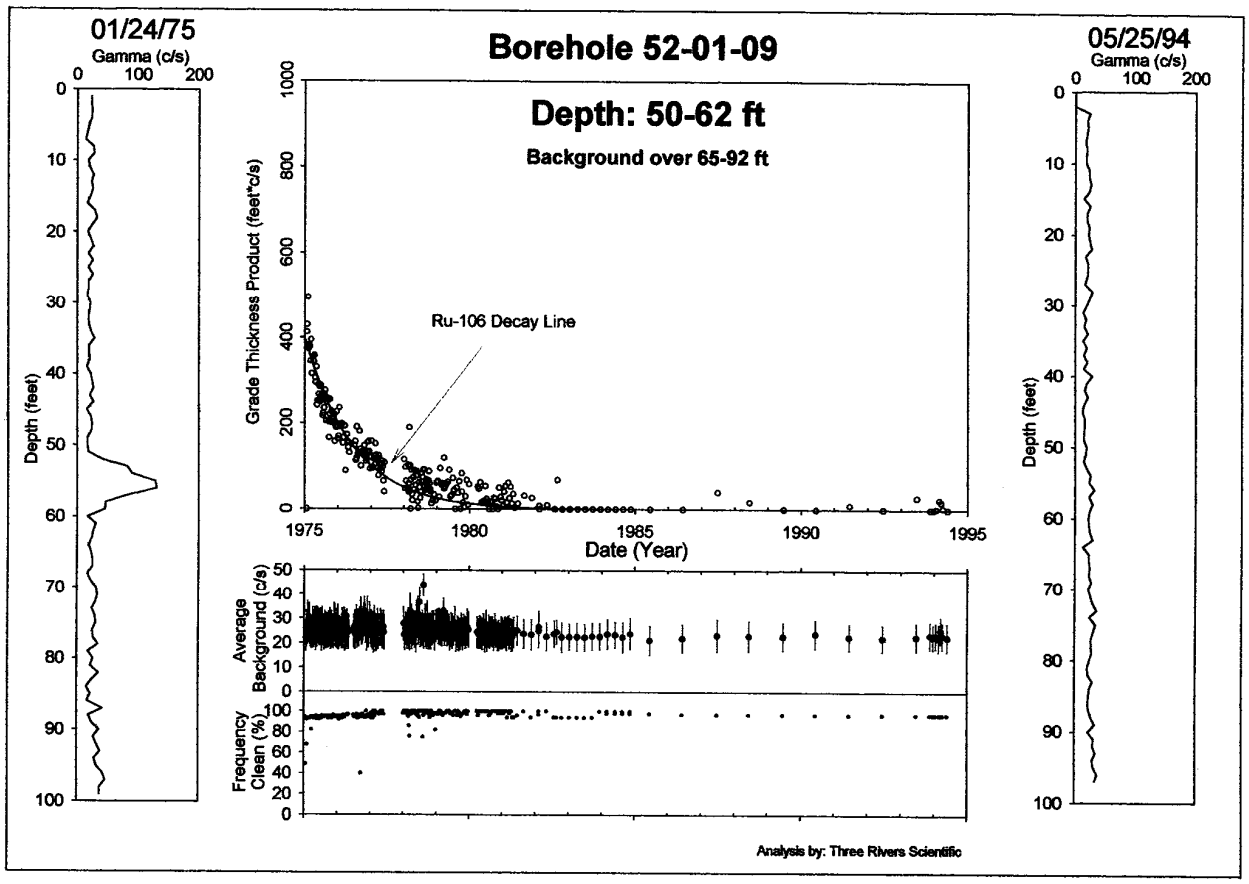
- Activity in 52-01-09 and 52-03-12 has remained stable and appear to be due to longer lived radionuclides (e.g., ^{137}Cs).

- Drywell 52-01-09 is located within 5 ft of the cascade line between tanks TY-101 and TY-102. Cascade must be considered as a possible source of contamination; TY-103 is also a possible source.

- Activity in 52-01-09 increases and decreases like 52-01-05, indicating TY-103 influence.

- The level of drywell activity was considered insufficient to conclude TY-101 leaked.

Figure 5.1-9. Drywell 52-01-09 Total Gamma Results



5.1.3 Conclusion

The surface level measurements appear to have been drifting in and out of calibration and the 0.35-in. liquid level decrease is suspect and considered to be within the margin of uncertainty. A cascade line overflow was identified as a possible source for the steady decrease in liquid level from March 20, 1973 to May 15, 1973 that coincided with increases in drywell 52-01-09 from April to the end of the year. However, no contamination was detected in the drywell at the depth of the cascade line.

The SGLS and total gamma logs indicate that activity observed in drywells 52-01-05, 52-01-09 and 52-03-12 was primarily ^{106}Ru and ^{60}Co. Less than 10 pCi/g ^{137}Cs was observed by SGLS in 52-01-05 at 40 ft bgs. This level of drywell activity was considered insufficient to conclude tank TY-101 leaked and suggests the TY-103 leak as a possible source. However, the general immobility of ^{137}Cs would suggest the source is closer to the drywell or a preferential pathway. Activity in 52-01-09, 52-03-12, and 52-01-05 appeared about the same time and increased and decreased in similar patterns. It was noted that the available drywell data begins in July 1973, several months after the liquid level decrease. It is suggested that tank TY-103 is the possible source for the activity in all three wells or that an overflow from tank TY-102 as the source for activity in drywell 52-01-09. Due to the uncertainty of the information, based on drywell activity, a possible leak from tank TY-101 may also be the cause.

By consensus it was determined that there is insufficient data to establish a leak inventory estimate for tank TY-101 and that the tank be reassessed per TFC-ENG-CHEM-D-42, *Tank Leak Assessment Process*.

5.2 TANK 241-TY-102 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-102. Figure 4-1 shows monitoring wells near tank TY-102. Six vadose zone monitoring drywells surround tank TY-102.

The tank was equipped with a barometric condenser when built. These condensers were removed from the tank farms in the late 1970s after they were identified as a source of environmental contamination. The barometric condenser on tank TY-102 was located on a tank riser immediately adjacent to the drywell that detected radionuclides during gamma logging (H-2-2223, *Waste Disposal Facilities 200 West Area General Layout*, Sheet 1).

Drawings show the barometric condensers were comprised of 50 finned 1-in. outside diameter, 20 ft long tubes. The tubes were vertical inside rectangular housing, 10 tubes by 5 tubes. The bottom tube sheet rested directly on a rectangular concrete riser. A 24-in. diameter vitrified clay concrete encased pipe exited the tank dome upwardly and then horizontally to the condenser riser (consisting of a rectangular concrete box located just above the outside wall of the tank).

Water in the air flowing by natural convection into the condenser assembly would condense on the tubes and flow back into the tank removing heat from the tank waste. This condensate drained back into the tank through the jointed vitrified clay pipe connection.

5.2.1 Tank 241-TY-102 Waste History

The following subsections provide a brief discussion of the waste operations for tank TY-102 summarized in Figure 5.2-1. Figure 5.2-2 is a plan view of the tank.

Figure 5.2-1. Tank 241-TY-102 Waste Operations Summary

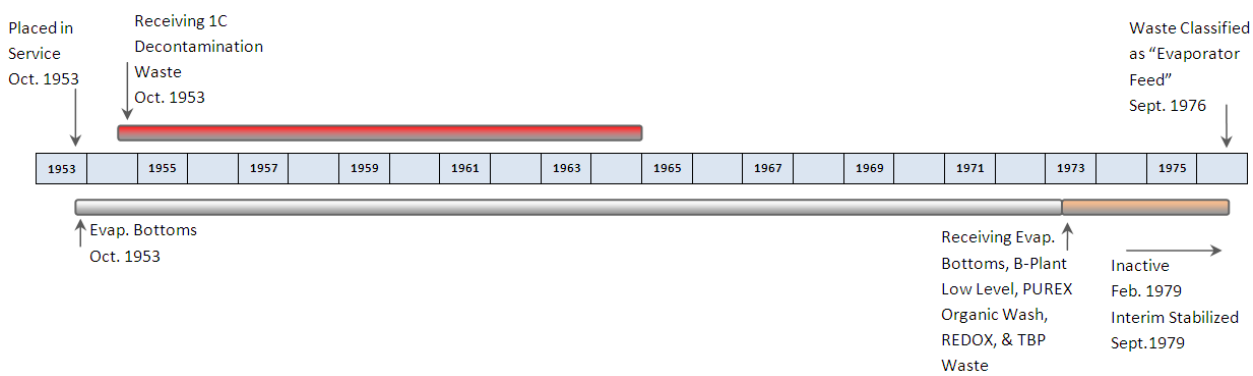
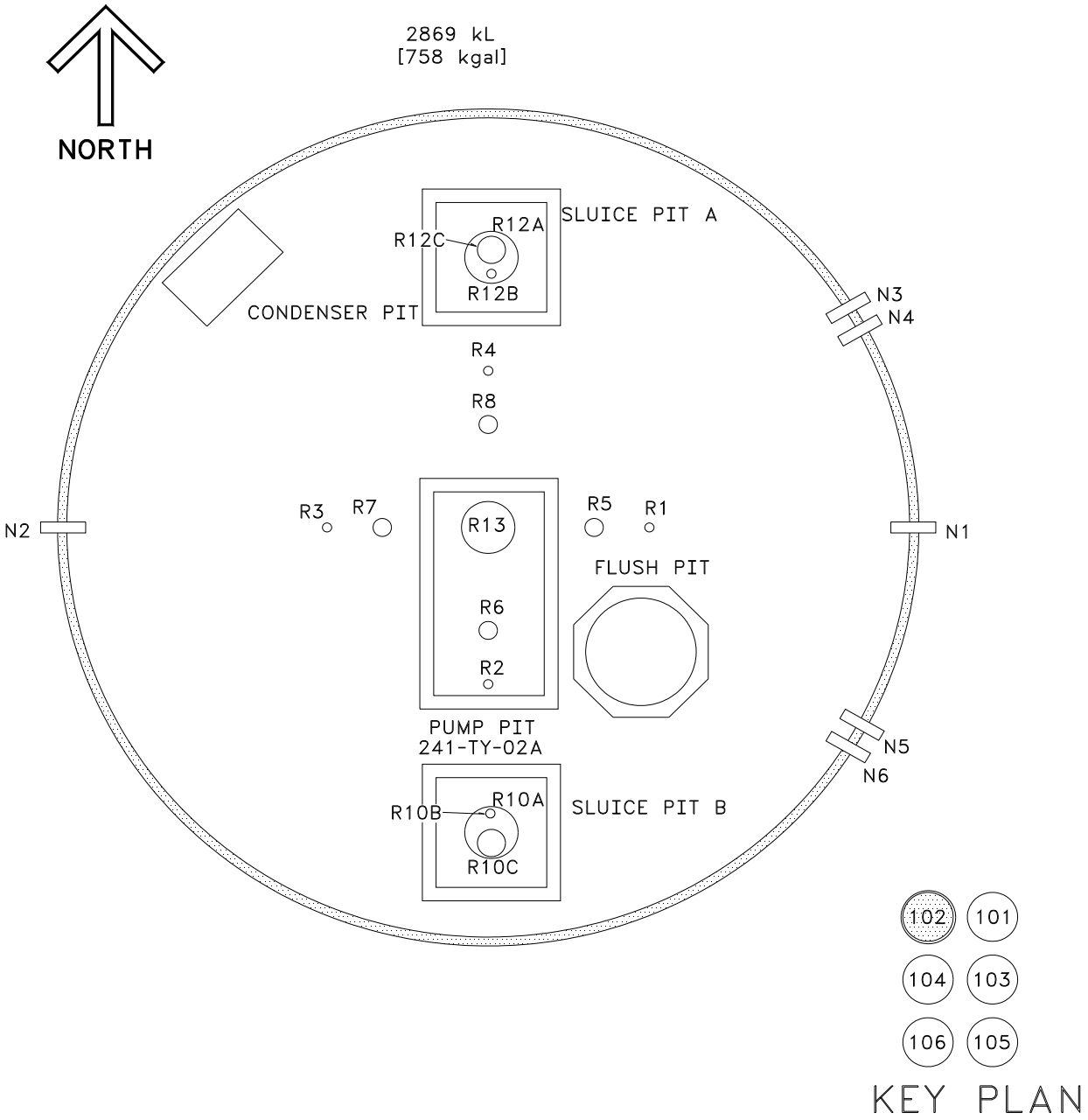


Figure 5.2-2. Tank 241-TY-102 Plan View



Tank TY-102 began receiving EB in 1953, and by late 1954 the tank began to receive 1C DW (SD-WM-TI-356). From 1973 to 1976, the tank received EB waste, B Plant low-level waste (BL), PUREX Plant organic wash waste, REDOX ion exchange (RIX) waste, TBP waste, and REDOX waste. In mid-1976, the tank waste was classified as evaporator feed. By 1978, the waste was classified as non-complexed waste. Table 5.2-1 shows waste transfers and process history from 1953 to 1994. Figure 5.2-3 shows tank TY-102 waste surface levels.

Table 5.2-1. Tank 241-TY-102 Waste Transfer History (2 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1,000)	Total Vol. In Tank (gal*1,000)[2]	Discrepancy with previous reading (gal*1,000)[3]	Waste type[4]	Transfer tank from/to	Document Number[5]
Oct.-1953 to Dec. 1953	IN	140	140		EB	116-TX	HW-29905
Jan.-1954 to Aug.-1954	STAT		138	-2	EB		HW-30851
Sept.-1954	OUT	-128	10		EB	1C Evap. Bottoms pumped to ditch	HW-33396
Oct.-1954	IN	618	628		1C, EB	117-TX	HW-33544
Nov.-1954 to May-1955	IN	68	696		1C, EB	117-TX	HW-33904
Jun.-1955 to Dec.-1956	IN	62	758	Tank overfilled through Dec. 1964	1C, EB	TX-118	HW-38000
Jan.-1957 to Apr.-1957	STAT		705 (LANL comments "bad stat" reading)	-53	1C, EB		HW-48144
May-1957 to June-1957	IN	66	771				HW-50617
July-1957 to Sept.-1959	STAT		772	1	1C, EB		HW-51858
Sept.-1959	STAT		771	-1	1C, EB		HW-62421
Oct.-1959 to Dec.-1964	STAT		769	-2	1C, EB		HW-62723
Jan.-1965 to Dec.-1967	STAT		755	-14[6]	EB		RL-SEP-659
Jan.-1968 to June-1970	STAT		756	1	EB		ARH-534
July-1970 to Sept.-1970	OUT	-194	562		EB	118-TX	ARH-1666 C
Oct.-1970 to Sept.-1971	OUT	-33	530		EB	118-TX	ARH-1666 D
Oct.-1971 to Mar.-1973	STAT		531	1	EB		ARH-2074 D
Apr.-1973 to Jun.-1973	IN	202	733		EB, BL, OWW, RIX	103-TY	ARH-2794 B
July-1973 to Sept.-1973	STAT	738	738	5	EB, BL, OWW, RIX		ARH-2794 C
Oct.-1973 to Mar.-1974	STAT		739	1	EB, BL, OWW, RIX		ARH-2794 D
Apr.-1974 to June-1974	IN	27			EB, BL, OWW, RIX, TBP, R	101-TY	ARH-CD-133B
Apr.-1974 to June-1974	OUT	-62	706	2	EB, BL, OWW, RIX, TBP, R	118-TX	ARH-CD-133B
July-1974 to Sept.-1974	IN	6			EB, BL, OWW, RIX, TBP, R	101-TY	ARH-CD-133C
July-1974 to Sept.-1974	IN	5			EB, BL, OWW, RIX, TBP, R	103-TY	ARH-CD-133C
July-1974 to Sept.-1974	IN	2			EB, BL, OWW, RIX, TBP, R	104-TY	ARH-CD-133C
July-1974 to Sept.-1974	IN	3			EB, BL, OWW, RIX, TBP, R	105-TY	ARH-CD-133C

Table 5.2-1. Tank 241-TY-102 Waste Transfer History (2 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1,000)	Total Vol. In Tank (gal*1,000)[2]	Discrepancy with previous reading (gal*1,000)[3]	Waste type[4]	Transfer tank from/to	Document Number[5]
July-1974 to Sept.-1974	OUT	-121	601	-1	EB, BL, OWW, RIX, TBP, R	118-TX	ARH-CD-133C
Oct.-1974 to Dec.-1974	IN	9			EB, BL, OWW, RIX, TBP, R	101-TY	ARH-CD-133D
Oct.-1974 to Dec.-1974	IN	6			EB, BL, OWW, RIX, TBP, R	103-TY	ARH-CD-133D
Oct.-1974 to Dec.-1974	IN	1			EB, BL, OWW, RIX, TBP, R	104-TY	ARH-CD-133D
Oct.-1974 to Dec.-1974	OUT	-123	494		EB, BL, OWW, RIX, TBP, R	118-TX	ARH-CD-133D
Jan.-1975 to Mar.-1975	IN	5	499		EB, BL, OWW, RIX, TBP, R	101-TY	ARH-CD-336 A
Apr.-1975 to July-1975	IN	1	500		EB, BL, OWW, RIX, TBP, R	101-TY	ARH-CD-336 B
Apr.-1975 to Dec.-1975	OUT	-31	469		EB, BL, OWW, RIX, TBP, R	118-TX	ARH-CD-336 B
Jan.-1976 to Mar.-1976	OUT	-162	307		EB, BL, OWW, RIX, TBP, R	101-TX	ARH-CD-702 A
Jan.-1976 to Aug.-1976	IN	3	312 (Reported Value)		EB, BL, OWW, RIX, TBP, R	103-TY	ARH-CD-702 A
Sept.-1976 to Dec.-1977	STAT		315	3			ARH-CD-702 I
Jan.-1977	OUT	-236	79				ARH-CD-822 JAN
Feb.-1977 to July.-1977	STAT		81	2			ARH-CD-822 FEB
Aug.-1977	OUT	-16	65				RHO-CD-14 AUG
Sept.-1977 to July-1978	STAT	0	68	3		102-SY	RHO-CD-14 SEP
Feb.-1979			CLASSIFIED AS INACTIVE				RHO-CD-14 FEB
Sept.-1979			INTERIM STABILIZED				HNF-EP-0182
Sept.-1979 to Dec.-1980	STAT		73				RHO-CD-14 SEP
1983 to ___	OUT	-9	64				RHO-RE-SR-14 (estimated)
March 3, 1984	OUT	-6.5	57.5			244-TX	SD-WM-TI-356

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.

[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Transfer volumes are from references shown and LA-UR-97-311.

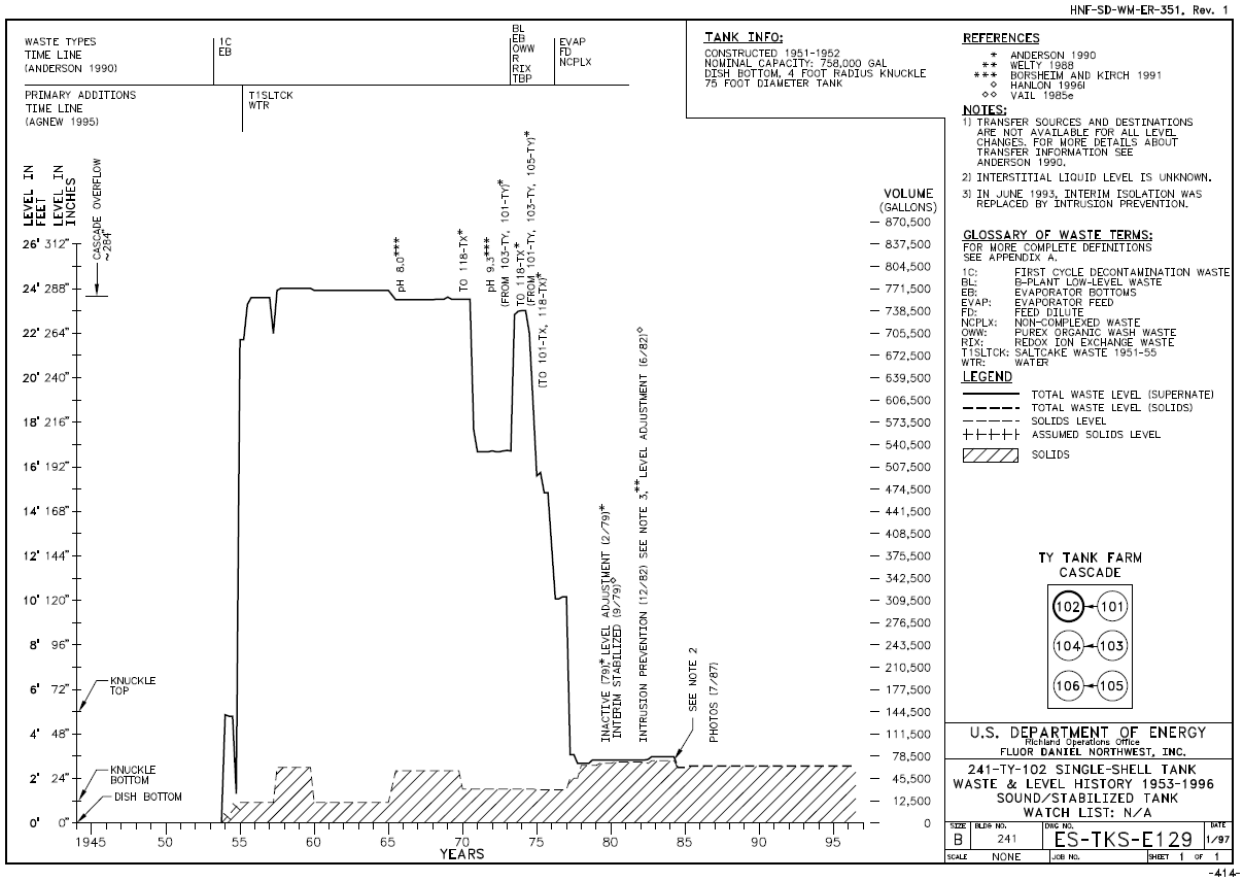
[3] Small discrepancies appear normal and may be attributed to effects such as evaporation.

[4] Waste types: EB = Evaporator Bottoms, 1C = First cycle waste, BL = B Plant low level waste, OWW = Organic wash waste, RIX = Ion exchange waste from supernate, TBP = tributyl phosphate, R = Reduction-Oxidation.

[5] For reference titles, see Section 6.0 REFERENCES.

[6] *Tank supernate overflowed to crib, some may have been lost through spare inlets. Decrease may also be attributed to gas release.*

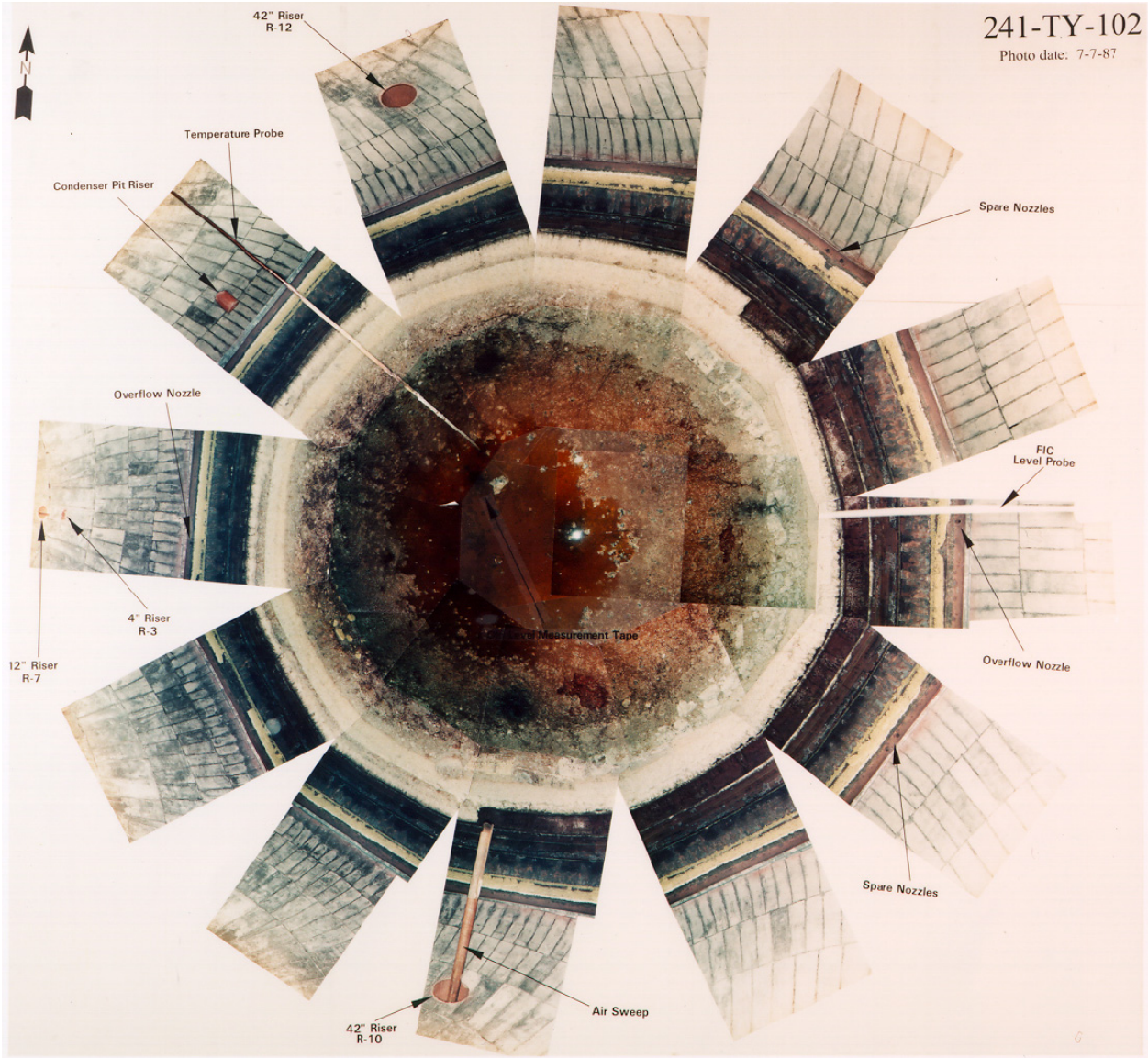
Figure 5.2-3. Tank 241-TY-102 Historical Tank Content Estimate Waste Fill History (WHC-SD-WM-ER-351)



5.2.1.1 Integrity of Tank 241-TY-102. Tank 241-TY-102 is classified as "sound." A record search revealed one 1977 occurrence report written for a liquid level decrease in tank TY-102. The report attributed the liquid level decrease to movement of sludge following a pump removal (OR-77-116, *Occurrence Report 77-116 Tank 102-TY Liquid Level Decrease Exceeding Criteria*). Gamma activity was also observed near the base of the tank in drywell 52-02-11. However, two previous leak assessments described in Section 5.2.3 concluded that a breech in tank TY-102 was probably not the source of the contamination.

5.2.1.2 Interim Stabilization. Tank 241-TY-102 declared stabilized in September 1979, but an additional 6,500 gal of supernate was removed on March 23, 1984. On March 26, 1984 photos showed a solid surface with a liquid pool in the center of the tank estimated to be 16 ft in diameter and 1 in. deep (110 gal). The depth estimate is based on the observation that the FIC was touching solids (HNF-SD-RE-TI-178). Figure 5.2-4 depicts a mosaic of the waste surface in tank TY-102 as of August 1987. The tank is currently estimated to contain 69,000 gal of saltcake consisting of 53,000 gal of T-saltcake solids and 16 kgal of drainable liquid (HNF-EP-0182 Rev. 261). No supernate was estimated to remain in the tank.

Figure 5.2-4. Tank 241-TY-102 Photo Mosaic (August 1987)



5.2.1.3 Tank TY-102 Temperature History. Thermal data for tank TY-102 from SACS (Figure 5.2-5) shows temperatures ranged from 55 °F to 80 °F between 1975 and 1994 indicating a relatively low temperature waste.

5.2.2 Data Review and Observations

5.2.2.1 Surface Data. Table 5.2-2 shows FIC surface level measurements between June 1973 and July 1986. Several unexplained liquid level decreases and increases were observed during this time (Table 5.2-2). The cumulative surface level increase was close to 6 in. between 1973 and 1984. In 1973, saltwell pumping began in the tank. By 1974, the liquid level measuring device was contacting the solid surface of the saltcake. No liquid level measurements other than

process volume records were available before June 1973. Liquid level decreases of 0.3 in. and 0.5 in. on July 8 and 9 resulted in occurrence report OR-77-116. The report noted that "the sudden drop in liquid level was typical of a saltcake breaking down or deposited material on the plummet sloughing off" and attributed the decrease to liquid level changes following removal of a pump and flushing from June 26, 1977 to June 28, 1977. No change in drywell radioactivity measurements was observed during this time and it was concluded that the tank is sound.

Figure 5.2-5. Tank 241-TY-102 Temperature History (1975 to 1994, Surveillance Analysis Computer System)

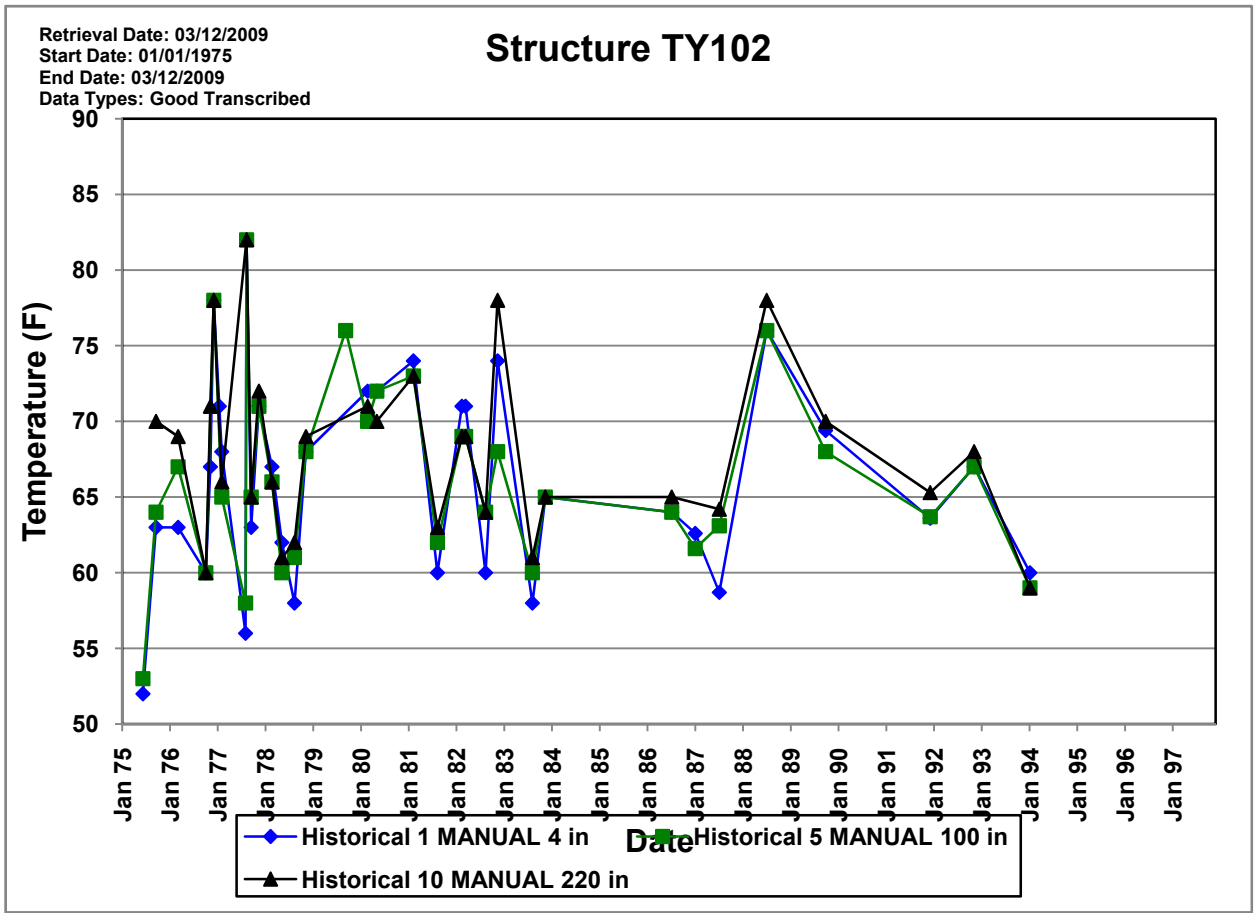
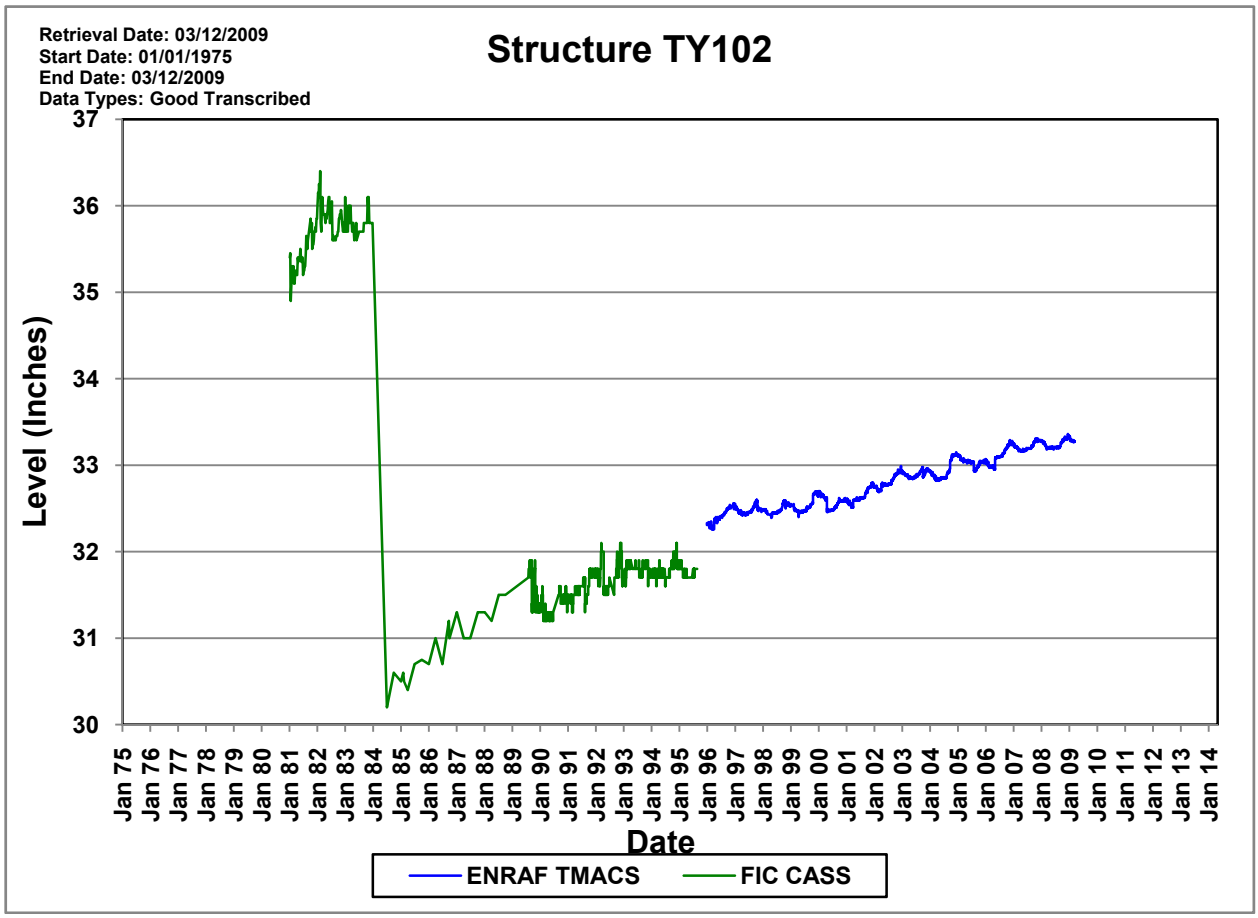


Figure 5.2-6 shows a gradual increase in the surface level measurements for tank TY-102. This is typical of many of the SSTs and is attributed to gas build-up in the waste. Photographs taken November 8, 2004 confirmed an intrusion of water into the tank. Although such an intrusion was observed previously, there is no correlation between surface level increases and weather events, as is typically observed with intrusions into a tank, and no correlation with barometric pressure, further indicating that surface level increases are due to gas build-up in the waste.

Table 5.2-2. 1973 to 1986 Tank 241-TY-102 Liquid Level Measurements (SD-WM-TI-356)

Date	Liquid level (in.)	Baseline ref.	Change from previous reading (in.)	Cumulative change (in.)	Comments
06/13/73	274.10				FIC gage
07/26/73	274.10				Stable
07/27/73	275.50				Calibration
01/14/74	276.20		+0.70	+0.70	Slow increase
03/19/74	276.20			+0.70	Stable
05/25/74	276.45		+0.25	+0.95	Slow increase
05/26/74		253.60		+0.95	Transfer
08/24/74	222.50			+0.95	Transfers
09/25/74	223.15			+0.95	Salt well transfer
02/10/75		187.80		+0.95	Transfers
03/18/75	187.80			+0.95	Stable
03/19/75	188.55			+0.95	Transfer
04/22/75	188.65		+0.10	+1.05	Slow increase
04/23/75		177.55		+1.05	Transfer to 118-TX
06/18/75	177.70		+0.15	+1.20	Slow increase
06/19/75		177.80		+1.20	Salt well transfer
12/11/75	177.95		+0.15	+1.35	Slow increase
12/12/75	178.10	178.10		+1.35	Transfer
01/08/76	178.10			+1.35	Stable
02/23/76	120.90			+1.35	Transfers and flushes
03/14/76		121.50		+1.35	Transfer
04/04/76	121.70		+0.20	+1.55	Slow increase
05/03/76		121.20	-0.50	+1.05	Quality assurance FIC calibration
01/19/77	122.05		+0.85	+1.90	Slow increase
01/27/77		35.70		+1.90	Transfer
06/25/77	36.70		+1.00	+2.90	Slow increase
06/28/77		37.50		+2.90	Water addition during pump removal
07/08/77	37.20		-0.30	+2.60	Slow decrease
07/09/77	36.70		-0.50	+2.10	Unexplained drop; OR 77-116 written. Final 9/16/77
08/08/77	37.10			+2.10	Salt well installed
08/19/77		30.70		+2.10	Transfers
09/09/77	31.80		+1.10	+3.20	Slow increase
09/10/77	32.50	31.40		+3.20	Pump removal
11/02/77	32.30	32.30	-0.20	+3.00	Erratic decrease; no explanation
01/18/78	33.20		+0.90	+3.90	Slow increase
01/19/78	33.85	32.90		+3.90	Water transfer flush
01/20/78	33.60		-0.25	+3.65	Slow decrease
01/21/78	33.40		-0.20	+3.45	Slow decrease
03/12/80	34.40		+1.00	+4.45	Slow increase
03/13/80		34.50		+4.45	Flushed and recalibrated
11/13/80	35.05		+0.55	+5.00	Slow increase
11/16/81	35.60		+0.55	+5.55	Slow increase
10/27/82	35.90		+0.30	+5.85	Slow increase
11/15/83	35.80		-0.10	+5.75	Stable
03/23/84	29.80			+5.75	Pumped to 244-TX (6,500 gal)
03/26/84		29.80		+5.75	Stable
10/01/84	30.60			+5.75	Slow increase trend
10/03/85	30.80			+5.75	Slow increase trend
01/06/86		30.70		+5.75	Attributed to intrusions
07/01/86	30.70			+5.75	Stable

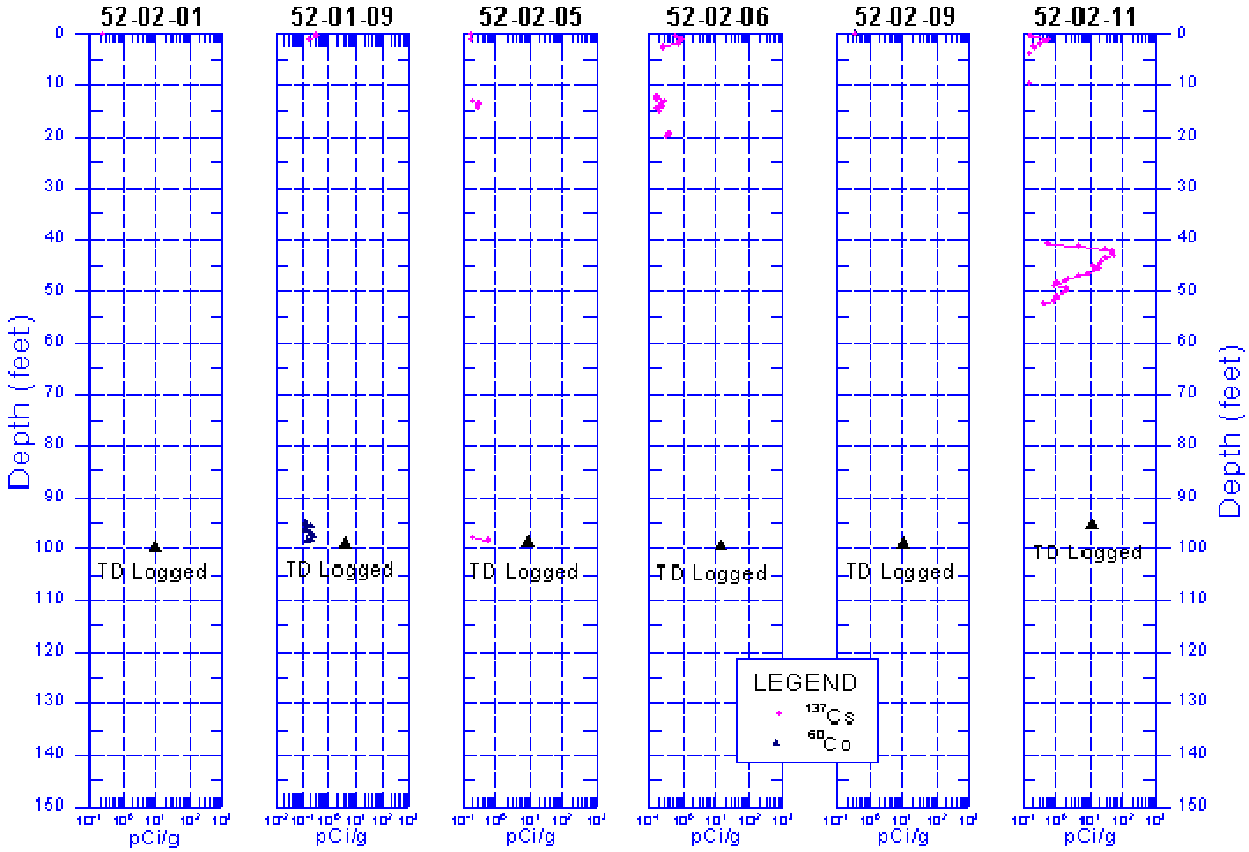
Figure 5.2-6. 1980 to 2009 241-TY-102 Liquid Level Measurements (Surveillance Analysis Computer System)



5.2.2.2 Drywell Logging Data. Figure 5.2-7 shows SGLS profiles for the drywells surrounding tank TY-102. The SGLS detected ^{137}Cs contamination in the upper sections of the entire drywells surrounding tank TY-102. The near-surface contamination in drywell 52-02-11 is attributed to surface spills that have migrated down into the backfill surrounding the drywell or contamination that was carried down during the drilling of this drywell. Drywells 52-02-11 and 52-01-09 showed contamination at depth. The following description and discussion of drywell construction and data for these drywells is provided in GJ-HAN-65, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank TY-102*.

Drywell 52-02-11 is located approximately 2 ft from the northwest side of tank TY-102. The drywell was originally drilled in 1975 to a depth of 45 ft and was perforated along the bottom 3 ft of the casing. The casing size is assumed to be schedule-40, 6-in. steel pipe that was typically used during the mid-1970s. The driller's log indicates that this drywell was originally installed for a leak study. The original drywell was installed to allow injection of a salt solution ($NaNO_3$) to study resistivity measurements for leak-detection development (SD-WM-TI-356).

Figure 5.2-7. Spectral Gamma Logging System Measurements around Tank 241-TY-102

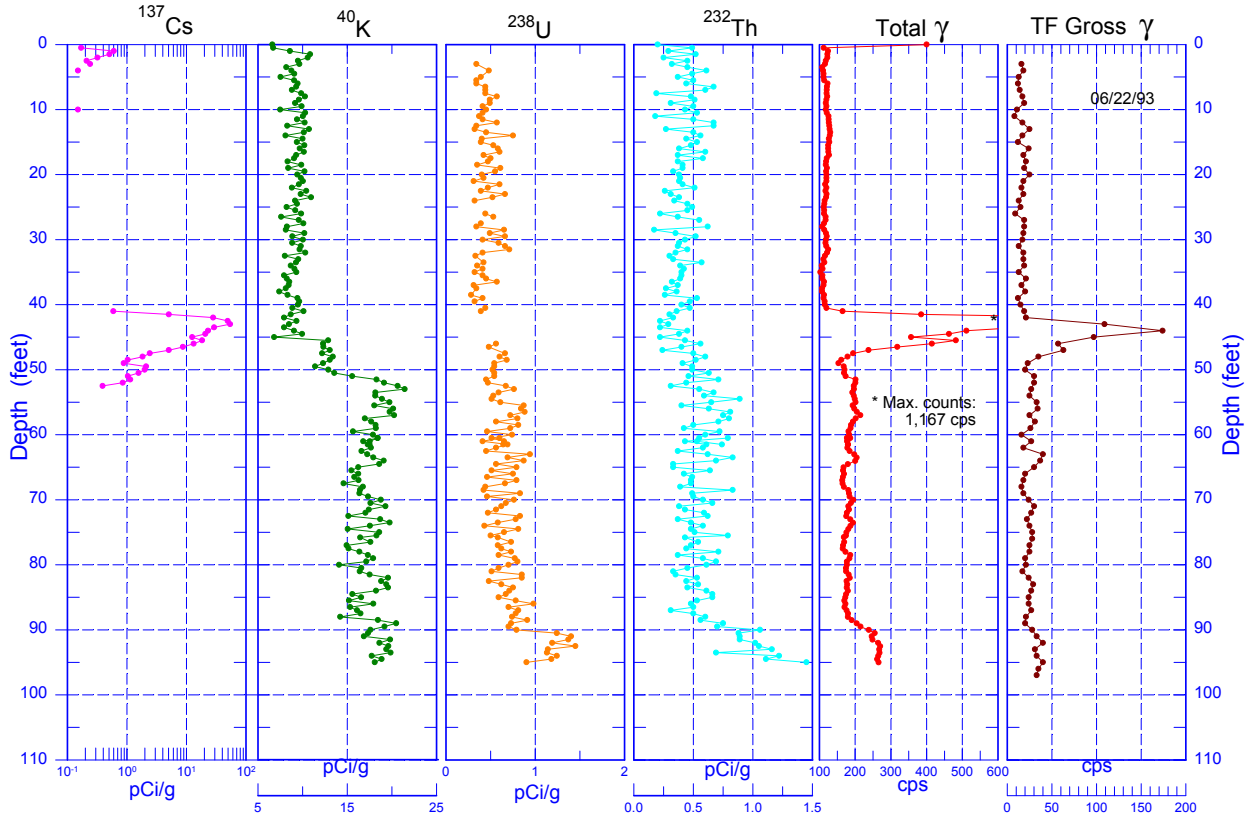


In 1977, the drywell was extended to a depth of 105 ft and completed to 100 ft with 4-in. casing. According to the driller's record, the 4-in. casing was not perforated but was grouted. Approximately 6 gal of grout was added to the bottom of the drywell. It is unknown whether the 6-in. casing was removed; however, the ^{40}K log plot indicates that it was not removed.

As shown in Figures 5.2-7 and 5.2-8, the only man-made radionuclide detected in this drywell in 1996 by SGLS measurements was ^{137}Cs. Measurable ^{137}Cs was detected almost continuously from the ground surface to about 4.5 ft, at 10 ft, and continuously between 41 and 52.5 ft. The maximum ^{137}Cs concentration was about 54 pCi/g at 43 ft.

The naturally occurring ^{40}K, ^{238}U and ^{232}Th concentrations (Figure 5.2-8) appear to be characteristic for sediments of the Hanford Site in the 200 West Area. A concentration increase is shown on the ^{40}K concentration plot (Figure 5.2-8) starting at about 45 ft that probably represents the change from the 6-in. and 4-in. casing combination to only the 4-in. casing. Another concentration increase is shown on the ^{40}K plot beginning at about 50 ft that probably represents a change in lithology from backfill material to the undisturbed sediments of the Hanford formation below this depth. The driller's log confirms a change from backfill material to sand at this depth. The ^{238}U and ^{232}Th concentration values begin to increase at about 90 ft. The driller's log records silt at about 90 ft and caliche at about 100 ft.

Figure 5.2-8. Drywell 52-02-11 Combination Plot



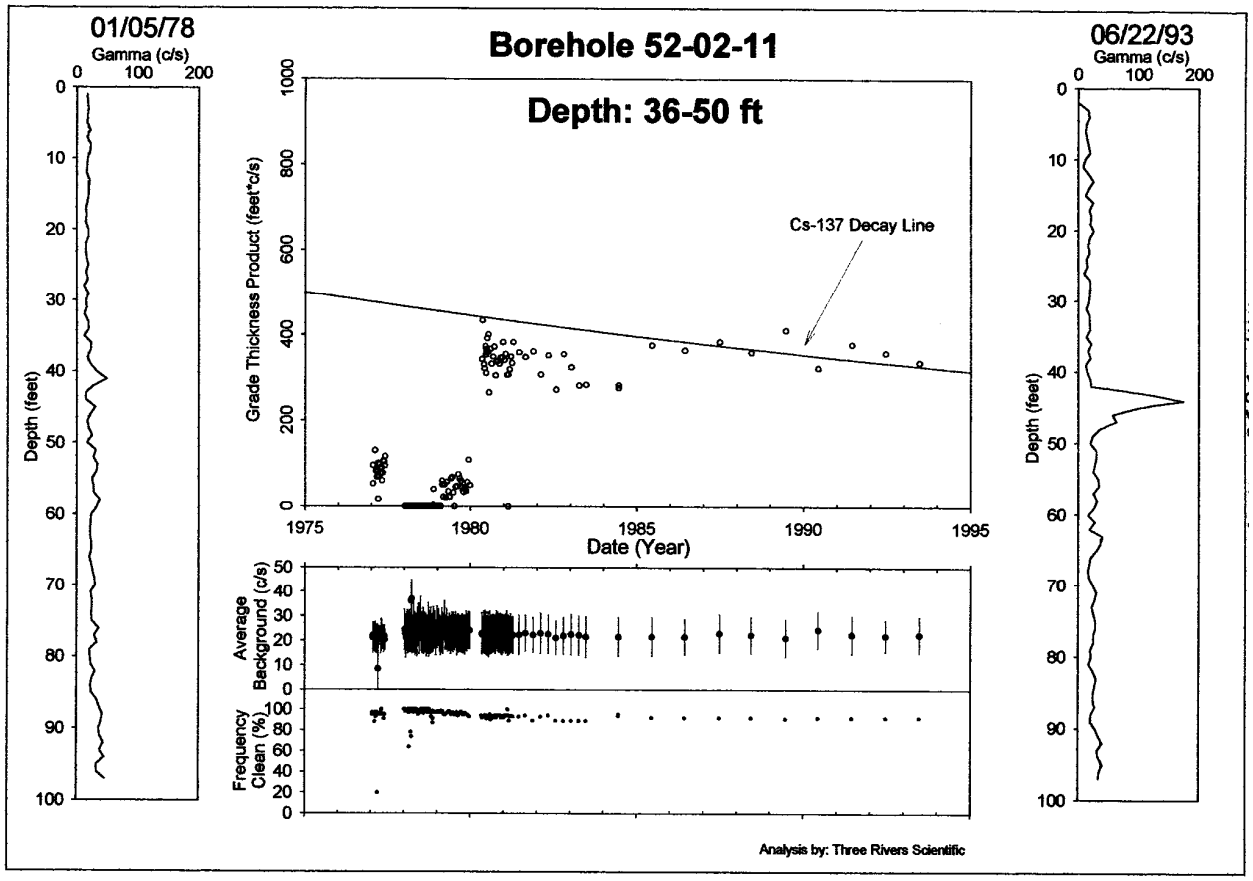
Historical gross gamma log data from 1977 to 1993 and data summarized in SD-WM-TI-356 were reviewed. A time-sequence plot of total gamma measurements (Figure 5.2-9) shows a peak at about 40 ft that remained stable through the end of 1979. The activity level recorded between May 1977 and January 1980 is very low, and given the unknown quality of the historical gross gamma log data, the log data acquired during this time interval may simply be background activity and not contamination.

In January 1980, the activity increased by a factor of three. The earliest available log that includes the increase was recorded in May 1980. The time-sequence plot shows the anomaly remained stable through 1990. The latest gross gamma log data presented on the combination plot show the contamination also remained stable through June 1993.

The ^{137}Cs contamination detected by the SGLS in 1996 between 41 and 52.5 ft bgs occurs at the maximum depth of a leak detection study in which a salt solution ($NaNO_3$) was injected to about 50 ft to study resistivity measurements for leak-detection development (ARH-LD-120, *Nuclear Waste Tank and Pipeline External Leak Detection Systems*).

Drywell 52-01-09 is located approximately 11 ft from the east side of tank TY-102. The drilling was completed in December 1971 to a depth of 100 ft using 6-in. casing. The driller's report does not mention if the casing was perforated or grouted.

Figure 5.2-9. Drywell 52-02-11 Total Gamma Historical Measurements



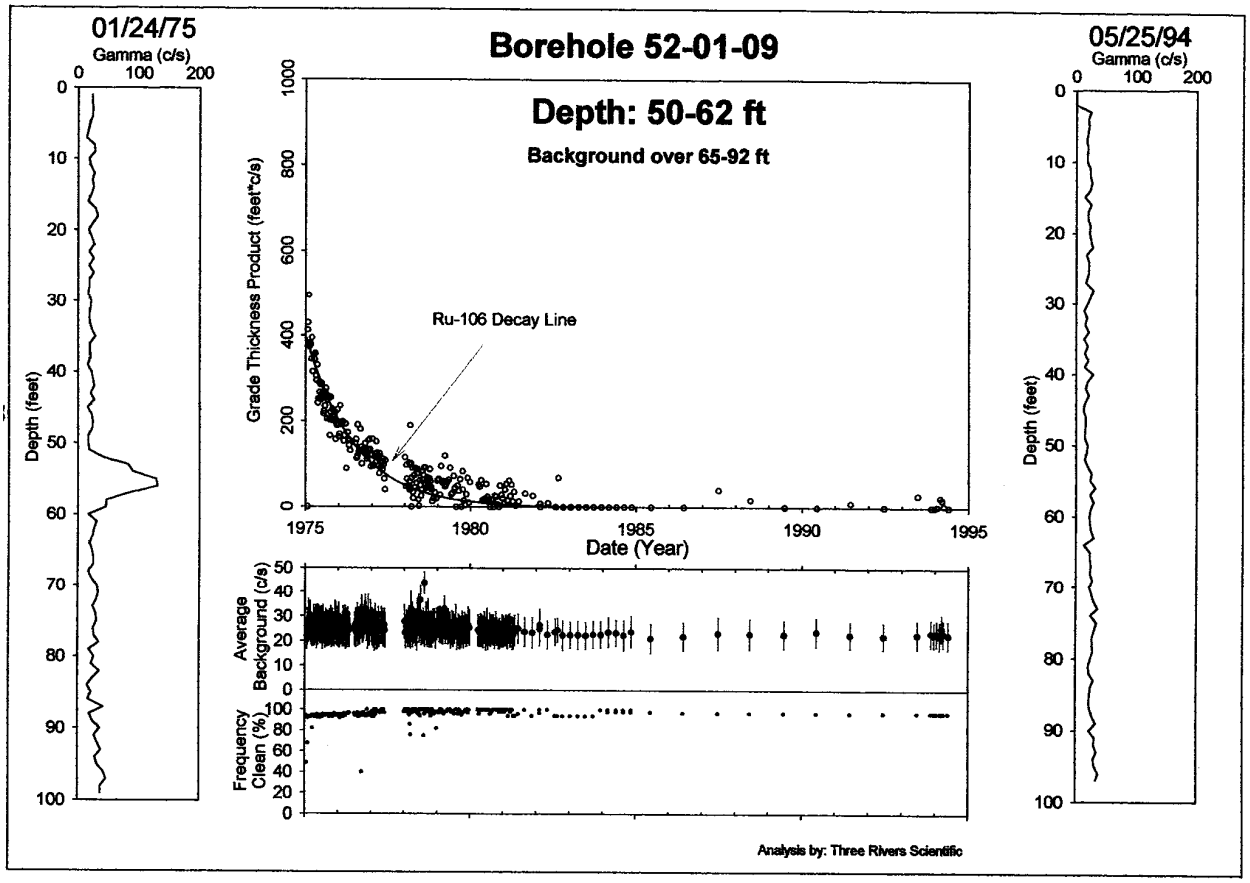
The man-made radionuclides ^{137}Cs and ^{60}Co were detected in this drywell. Measurable ^{137}Cs concentrations were detected from the ground surface to about 1.5 ft with a maximum concentration of 0.36 pCi/g at 0.5 ft.

Historical gross gamma data show an anomalous zone of activity between 45 and 55 ft appearing in drywell 52-01-09 in 1973 with peak activity of 600 c/s at 52 ft in 1974 (SD-WM-TI-356). This data appears to follow a ^{106}Ru decay curve (Figure 5.2-10). By 1981, the radionuclides decayed to a level where the gross gamma logging tool could no longer detect them and the SGLS did not detect any gamma-emitting radionuclides between 50 and 57 ft.

The SGLS detected ^{60}Co contamination at the bottom of this drywell (95 to 100 ft). This contamination may have migrated from tank TY-103 or may be drawdown from a spare inlet overflow.

Other Drywells. The SGLS did not detect contamination between 40 and 55 ft in drywells 52-02-01, 52-02-06, and 52-02-09. In drywells 52-02-01 and 52-02-09, contamination was detected at only the ground surface. Drywells 52-02-05 and 52-02-06 have contamination throughout a small interval in the upper sections of the drywells.

Figure 5.2-10. Drywell 52-01-09 Total Gamma Historical Measurements



5.2.2.3 Tank TY-102 Leak Simulation Test. In 1975 a leak simulation test was conducted near tank TY-102 (ARH-LD-120). A total of 3,520 L of 3M $NaNO_3$ were injected into drywell 50-02-11 which was drilled for this purpose. This presents yet another driving force for contaminants observed at this drywell.

5.2.3 Tank 241-TY-102 Leak Assessments

5.2.3.1 1998 Assessment. Two leak assessments were conducted for tank TY-102. The first, in 1998, concluded the following.

Based on the reports and readily available data, the evidence for leakage from tank TY-102 is inconclusive. This conclusion is based primarily on the fact that the changes in the ^{137}Cs contamination zone in drywell 52-02-11 have been episodic. With the exception of two occasions, the zone has remained stable since discovery. These occasions were in 1980 after the 241-TY Tank Farm surface was flooded by rapid snow melt, and again in 1985 after an additional 6,500 gal were pumped from the tank. The contamination zone exhibited instantaneous, one-time increases after these events, but no other changes. These observations suggest a contamination source other than a tank leak could be supplying the zone. Several plausible sources and a transport mechanism were discovered during the evaluation.

As a result, it was recommended that the tank continue to be classified as "assumed sound" (Letter FDH-9852214A R1, "Contract Number DE-AC06-96RL13200; Request for Expedited Review of Tank Waste Remediation System Single-Shell Tank 241-TY-102 Integrity Status").

5.2.3.2 2001 Assessment. The second assessment was conducted June through July 2001. The 1998 assessment was revisited to apply a new assessment process in response to stakeholder concerns about the previous assessment (Interoffice Memo 7G300-01-01, "Tank 241-TY-102 Leak Assessment Team").

The assessment team agreed that "the evidence is that tank TY-102 does not appear to be leaking at the present time and that with the available in-tank and ex-tank evidence: it is not likely that the tank has leaked in the past. The evidence is that the low level of radiation observed has another source, with tank overfill or surface spills being conducted to the base of the tank by precipitation."

The following are key elements of the observed facts considered in the reasoning that lead to this conclusion.

- The man-made radionuclide, ^{137}Cs, is the only one identified by current spectral gamma monitoring of the drywell where gamma radiation is observed.

- The observed behavior of the gamma radiation detected is consistent with an event in 1980 followed by one in the period 1984 to 1987.

- Internal level data do not indicate any sudden or extended changes in the level of waste in the tank.

Inspection of the fill history of the tank (Table 5.2-1) shows that the tank was filled as high as 772 kgal, which is above the level of the tank inlet port and spare. This could explain activity observed at drywell 52-01-09. However, the spare inlet is not located near drywell 52-02-11.

Another potential source of the contamination considered was the barometric condenser. The tank was equipped with a barometric condenser when built. These condensers were removed from the tank farms in the late 1970s after they were identified as a source of environmental contamination. The barometric condenser on tank TY-102 was located at a position near the drywell where radionuclides were detected by gamma ray logging. The barometric condensers were known to have leaked; it is not known if ^{137}Cs was associated with the leaks. Precipitation or snow melt, sufficient to saturate the soil above the tank, could transport contamination on or near the tank down the side of the tank. The contamination would then collect at the concrete footing and spread horizontally until it intersected the nearest drywell. This mechanism is commonly referred to as the "umbrella effect," with the tank dome acting like an opened umbrella to conduct water to the sides of the tank, then down. Mobilization of either surface contamination or contamination associated with the barometric condenser remains a possible explanation, but one would expect to see some evidence of contamination between the surface and 40 ft, particularly since 52-02-11 is only 2 ft from the tank wall.

Another potential explanation for the contamination is that between 1955 and 1972 when the waste level in the tank was at or above maximum capacity, the tank may have contained more than 771,000 gal. Between 1957 and 1960, the waste level is reported to have been at 288 in., which is at or near the top of the steel liner. By 1977, the waste level was reduced to a minimum value. This suggests that the observed increase in 1980 is not directly related to the tank waste level. If a major leak had occurred, the anomaly should have been apparent much earlier. However, if the waste level reached the top of the steel liner, it is possible that a small amount of waste liquid may have been trapped between the outside of the steel liner and the inside concrete tank wall. Removal of waste from the tank would not affect any waste trapped outside the liner. The most likely spot for this liquid to escape would be the construction joint between the tank wall and the base slab. The result would be a limited contamination plume beginning at the top of the base slab. This could easily occur years after the waste was withdrawn, since there is a very limited volume, little driving force, and no major opening in the concrete. This hypothesis is consistent with the observed internal and external data, and does not depend on mobilization of external contamination by surface water. Although technically a leak, in the sense that waste from inside the tank has found its way to the outside, this hypothesis does not imply any loss of integrity of the steel liner. Moreover, it will consist of a very limited volume and is not likely to recur as long as the waste level remains well below the top of the liner.

5.2.3.3 Discussion of Assessments and Data Reviewed. In addition to reviewing the data, concerns about previous TY-102 assessments identified by Heart of America Northwest (*Recent Leaks From Hanford's High-Level Nuclear Waste Tanks: USDOE's Failure to Monitor, Report or Characterize Tank Leaks* [Brodeur 2006]) were discussed. Three key questions about previous TY-102 assessment conclusions were raised.

1. The maximum contamination levels near surface are less than 1 pCi/g of ^{137}Cs while the subsurface contamination at the base of the tank exceeds 100 pCi/g of ^{137}Cs. How is this possible without leaving a contamination trail? Answer: This question was also raised in the 2001 assessment. At a distance of 2 ft or more from the drywell, it is plausible that the gamma probe and SGLS may not have detected the low activity ^{137}Cs until it concentrated in a pool at the base of the tank. The tank wall could have provided a preferential pathway for this to occur. Alternatively, drywell installation and the 1975 leak injection test provided a mechanism to drive contaminants from the surface deeper in the drywell.

2. Cesium-137 would not show up in condensed moisture if the source was release from an atmospheric condenser. Answer: The condensers were known to leak and be an environmental hazard. If supernate flowed through the condenser and leaked out, cesium may have remained in the supernate.

3. If contamination had migrated down, it would be seen in the upper portion of the borehole and be seen as a spike at the shoulder of the tank. Answer: similar to question 1.

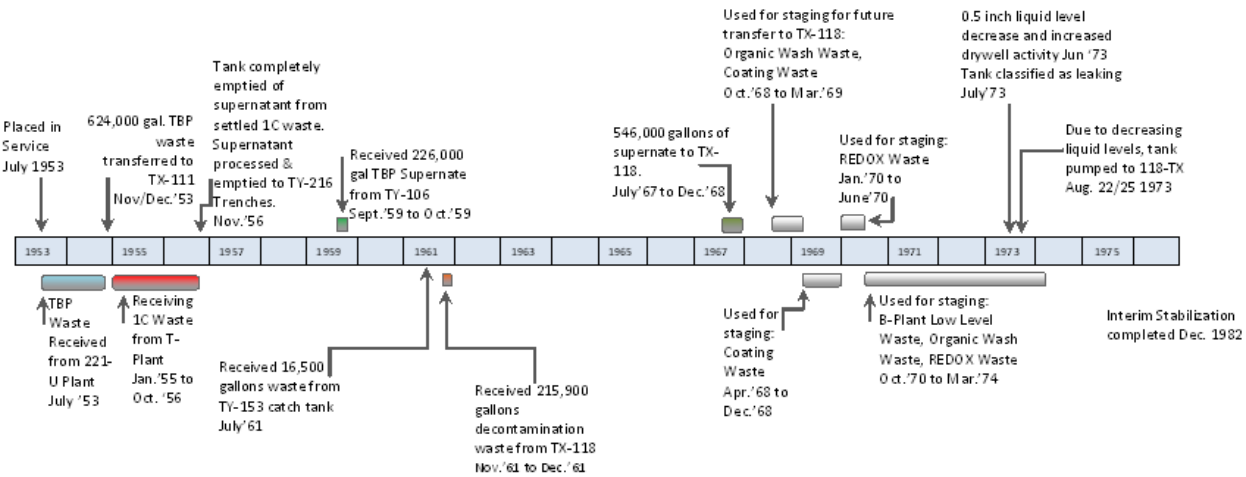
5.2.4 Conclusion

As in previous assessments, participants concluded that there is little evidence of a loss of liner integrity associated with tank TY-102 and several probable explanations for activity in drywell 52-02-11 near the base of the tank. Previous assessments did not mention a leak injection test at tank TY-102 or the fact that the drywell was perforated along the bottom 3 ft at the time of the test. This is another driver and potential explanation for contaminants near the base of the tank.

5.3 TANK 241-TY-103 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-103. The following subsections summarize the waste operating history for tank TY-103 shown in Figure 5.3-1 and Table 5.3-1.

Figure 5.3-1. Tank 241-TY-103 Waste Operations Summary



5.3.1 Tank 241-TY-103 Waste History

Tributyl Phosphate Waste (1953 to 1954). Single-shell tank TY-103 was placed in service in July 1953 and used to store waste from the 221-U TBP Plant (HW-29054, *Separations Section Waste – Status Summary July 31, 1953*, p. 7). Tank TY-103 was filled to ~758,000 gal with TBP waste in August 1953 (HW-29242, *Separations Section Waste – Status Summary August 31, 1953*, p. 7). Approximately 624,000 gal of TBP waste was transferred from tank TY-103 to tank 241-TX-111 (TX-111) in November (HW-33904, *Separations Section Waste – Status Summary for November 1954*, p. 7) and December 1954 (HW-34412, *Separations Section Waste – Status Summary for December 1954*, p. 7), leaving ~131,000 gal of TBP waste in tank TY-103.

Table 5.3-1. Tank 241-TY-103 Waste Transfer History (3 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1,000)	Total Vol. In Tank (gal*1,000)[2]	Discrepancy with previous reading[3] (gal*1,000)	Waste type[4]	Transfer tank from/to	Document Number[5]
July-1953	IN	470	470		TBP		HW-29054
Aug.-1953 to Dec.-1953	IN	288	758		TBP	I	HW-29242
Jan.-1954 to Mar.-1954	OUT	-6	752		TBP		HW-30851
Apr.-1954 to Nov.-1954	STAT		755	3	TBP		HW-31811
Dec.-1954	OUT	-624	131		TBP	TX-111	HW-34412
Jan.-1955	IN	306	437		TBP, 1C		HW-35022
Feb.-1955	IN	281	718		1C		HW-35628
Mar.-1955	OUT	-510	208		1C	TY-104	HW-36001
Apr.-1955	IN	135	343		1C		HW-36553
May-1955	IN	269	612		1C		HW-37143
June-1955 to July-1955	IN	138	750		1C		HW-38000
Aug.-1955	OUT	-460	290		1C		HW-38926
Sept.-1955	IN	300	590		1C		HW-39216
Oct.-1955 to Dec.-1955	IN	168	758		1C	Settling for decanting	HW-39850
Jan.-1956	OUT		226		1C	TY-1 / 216-TY Cribs	HW-41038 / HW-44784 p. 42
Feb.-1956 to Mar.-1956	IN	202	428		1C		HW-42394
Apr.-1956	IN	60	488		1C		HW-42993
May-1956	IN	24	512		1C		HW-43490
June-1956 to July-1956	IN	12	524		1C	T Plant	HW-43895
Aug.-1956	IN	11	535		1C	T Plant	HW-45140
Sept.-1956 to Oct.-1956	IN	11	546		1C	T Plant	HW-45738
Nov.-1956 to Dec.-1956	OUT	-358	188		1C	TY-1 / 216-TY Cribs	HW-47052 / HW-48518 p. 38
Jan.-1957	IN	32	220		Possible Water Transfer		HW-48144
Feb.-1957 to Mar.-1957	STAT	13	233	13	Possible Water Transfer		HW-48846
Apr. 1957 to May-1957	STAT		216	-17			HW-50127
June-1957	IN	74	290		Possible Water Transfer		HW-51348
July-1957 to Apr.-1959	STAT	3	293	3	Possible Water Transfer		HW-51858
May-1959 to Aug.-1959	STAT		290	-3	1C		HW-60738
Sept.-1959	IN	19	309		1C, TBD	TY-106	HW-62421
Oct.-1959 to Dec.-1960	IN	207	516		1C, TBD	TY-106	HW-62723
Jan.-1961 to June-1961	STAT		510	-6	1C, TBP, DW		HW-71610

Table 5.3-1. Tank 241-TY-103 Waste Transfer History (3 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1,000)	Total Vol. In Tank (gal*1,000)[2]	Discrepancy with previous reading[3] (gal*1,000)	Waste type[4]	Transfer tank from/to	Document Number[5]
July-1961 to Dec.-1961	IN	231	741		1C, TBP, DW	TX-118, TY-153 Catch Tank	HW-72625
Jan.-1962 to Dec.-1964	STAT		739	-2	1C, TBP, DW		HW-74647
Jan.-1965 to June-1967	STAT		730	-9	1C, TBP, DW		RL-SEP-659
July-1967 to Sept.-1967	OUT	-184	546		1C, TBP, DW	TX-118	ARH-95 p. 8
Oct.-1967 to Dec.-1967	OUT	-362	184		1C, TBP, DW	TX-118	ARH-326
Jan.-1968 to Mar.-1968	IN	546	730		1C, TBP. OWW	AX-102	ARH-534
Apr.-1968 to June-1968	OUT	-540	190		OWW	118-TX	ARH-721
July-1968 to Sept.-1968	IN	1075			CW, OWW	102-BX, 103-BX	ARH-871
July-1968 to Sept.-1968	OUT	-765	500		CW, OWW	118-TX	ARH-871
Oct.-1968 to Dec.-1968	IN	481			CW, OWW	103-BX	ARH-1061
Oct.-1968 to Dec.-1968	OUT	-371	609 (Reported Value)		CW, OWW	118-TX	ARH-1061
Jan.-1969 to Mar.-1969	IN	413			CW, OWW	BX-103	ARH 1200 A
Jan.-1969 to Mar.-1969	OUT	-843	180 (Reported Value)		CW, OWW	118-TX	ARH 1200 A
Apr.-1969 to June-1969	IN	924			CW	112-T/103-T/115-TX	ARH 1200 B
Apr.-1969 to June-1969	OUT	-741	362 (Reported Value)		CW	118-TX	ARH 1200 B
July-1969 to Sept.-1969	IN	1457			CW	T Farm	ARH 1200 C
July-1969 to Sept.-1969	OUT	-1314	505		CW	118-TX	ARH 1200 C
Oct.-1969 to Dec.-1969	IN	690			CW	109-TX/107-T	ARH 1200 D
Oct.-1969 to Dec.-1969	OUT	-653	542		CW	116-TX	ARH 1200 D
Jan.-1970 to Mar.-1970	IN	418			R	112-U	ARH-1666 A
Jan.-1970 to Mar.-1970	OUT	-540	420		R	118-TX/104-TY	ARH-1666 A
Apr.-1970 to Jun.-1970	IN	474			R	104-S	ARH-1666 B
Apr.-1970 to Jun.-1970	OUT	-397	497		R	118-TX	ARH-1666 B
July-1970 to Sept.-1970	OUT	-349			EB	118-TX	ARH-1666 C
July-1970 to Sept.-1970	IN	246	394		EB	107-S	ARH-1666 C
Oct.-1970 to Dec.-1970	IN	1430			BL, OWW, RIX	111-U/106-BX	ARH-1666 D

Table 5.3-1. Tank 241-TY-103 Waste Transfer History (3 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1,000)	Total Vol. In Tank (gal*1,000)[2]	Discrepancy with previous reading[3] (gal*1,000)	Waste type[4]	Transfer tank from/to	Document Number[5]
Oct.-1970 to Dec.-1970	OUT	-1365	459		BL, OWW, RIX	118-TX/104-TY	ARH-1666 D
Jan.1971 to Mar.-1971.	IN	356			BL, OWW, RIX	106-BX	ARH-2074 A
Jan.1971 to Mar.-1971.	OUT	-94	722 (Reported Value)		BL, OWW, RIX	118-TX	ARH-2074 A
Apr.-1971 to Sept.-1971	STAT		723	1	BL, OWW, RIX		ARH-2074 B
Oct.-1971 to Dec.1971	STAT		722	-1	BL, OWW, RIX		ARH-2074 D
Jan.1972 to Mar.-1972	STAT		721	-1	BL, OWW, RIX		ARH-2456 A
Apr.-1972 to June-1972	STAT		720	-1	BL, OWW, RIX		ARH-2456 B
July-1972 to Sept.-1972	STAT		715	-5	BL, OWW, RIX		ARH-2456 C
Oct.-1972 to Dec.-1972	STAT		712	-3	BL, OWW, RIX		ARH-2456 D
Jan.-1973 to Mar.-1973	STAT		723	9	BL, OWW, RIX		ARH-2794 A
Apr.-1973 to June-1973	OUT	-202	520 (Reported Value)		BL, OWW, RIX	102-TY	ARH-2794 B
July-1973 to Sept.-1973	OUT	-80	*Pumped due to decreasing liquid levels*		BL, OWW, RIX	118-TX	ARH-2794 C / ARH-2416 RD DEL WHC-MR-0132 p. 817
July-1973 to Sept.-1973	OUT	-227	213 *(Tank classified as leaking)*		BL, OWW, RIX	104-TX	ARH-2794 C / ARH-2416 RD DEL
Oct.-1973 to Dec.-1973	OUT	-9	204		BL, OWW, RIX	118-TX	ARH-2794 D
Jan.-1974 to Mar.-1974	STAT		202	-2	OWW, RIX		ARH-CD-133A
Apr.-1974 to June-1974	OUT	-10	197 (Reported Value)			188-TX	ARH-CD-133B
July-1974 to Sept.-1974	OUT	-5	215 (Reported Value)			102-TY	ARH-CD-133C
Oct.-1974 to Dec.-1974	OUT	-6	219 (Reported Value)			102-TY	ARH-CD-133D
Jan.-1975 to Dec.-1975	STAT		219				ARH-CD-336 A
Jan.-1976 to Oct.-1978	OUT	-3	219 (Reported Value, Tank Inactive)			102-TX	ARH-CD-702 A

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.
[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Cascade level for TY-103 is 248" (760 kgal). Transfer volumes are from references shown and LA-UR-97-311.
[3] Small discrepancies may be attributed to water additions or effects such as evaporation.
[4] Waste types: TBP = tributyl phosphate, 1C = First cycle waste, DW = decontamination waste, OWW = Organic wash waste, CW = cladding (coating) removal waste, R = Reduction-Oxidation, EB = Evaporator Bottoms, RIX = Ion exchange waste from supernate.
[5] For reference titles, see Section 6.0 REFERENCES.

First Cycle Ferrocyanide Waste (1955 to 1956). Beginning in January 1955, tank TY-103 was used to receive 1C plutonium DW from the bismuth phosphate process conducted in the 221-T Plant (HW-35022, *Separations Section Waste – Status Summary for January 1955*, p. 7). The 1C waste was treated in 221-T Plant with potassium ferrocyanide, nickel sulfate, and sodium hydroxide to precipitate nickel ferrocyanide, which scavenged ^{137}Cs and ^{90}Sr from the supernate (HW-33184, *$BiPO_4$ Plant Nickel Ferrocyanide Scavenging Flowsheet for First-Cycle Waste Containing No Coating-Removal Waste* and HW-33499, *Justification for T Plant First Cycle Waste Scavenging*). The treated 1C waste (i.e., 1C-FeCN) was discharged to tanks 241-TY-101 and 241-TY-103 from October 20, 1954 (HW-33544, *Separations Section Waste – Status Summary for October 1954*, p. 7) through March 20, 1956, when the final processing of irradiated fuels for plutonium recovery was concluded in the 221-T Plant (HW-42219-DEL, *Monthly Report Hanford Atomic Products Operation for March 1956*, p. Ed-5). The nickel ferrocyanide precipitate and the scavenged fission products settled in these tanks, with 510,000 gal of supernate transferred in March 1955 to tank 241-TX-118 (TX-118) for processing in the 242-T Evaporator (HW-36001, *Separations Section Waste – Status Summary for March 1955*, p. 7) and disposal in 216-TY trenches from October 1955 (HW-44784, *Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities through June 1956*, p. 42) through November 1956 (HW-48518, *Radioactive Contamination in Liquid Wastes Discharged to Ground at Separations Facilities Through December 1956*, p. 34). Tank TY-103 was filled and emptied of 1C-FeCN waste several times in 1955 and 1956. After emptying all of the 1C-FeCN supernate from tank TY-103 in November 1956, tank TY-103 was reported to contain 188,000 gal of 1C-FeCN sludge (HW-47052, *Chemical Processing Department Waste – Status Summary November 1, 1956, – November 30, 1956*, p. 7).

No waste additions or removals from tank TY-103 were conducted from December 1956 through August 1959. The estimated supernate and sludge volumes in tank TY-103 was revised to 13,000 gal and 220,000 gal, respectively, in February 1957 (HW-48846, *Chemical Processing Department Waste – Status Summary February 1, 1958 – February 28, 1958*, p. 7), to 70,000 gal and 220,000 gal in June 1957 (HW-51348, *Chemical Processing Department Waste Status Summary June 1, 1957 – June 30, 1957*, p. 7), and again to 73,000 gal and 220,000 gal in July 1957 (HW-51858, *Chemical Processing Department Waste Status Summary July 1, 1957 – July 31, 1957 Planning and Scheduling – Production Operation*, p. 7), all based on electrode readings.

Tributyl Phosphate Waste (1959). In September and October 1959, tank TY-103 received 226,000 gal of TBP supernatant waste from tank TY-106, which was suspected to be leaking (HW-62421, *Chemical Processing Department Waste Status Summary September 1, 1959 – September 30, 1959*, p. 7 and HW-62723, *Chemical Processing Department Waste Status Summary October 1 – 31, 1959*, p. 7). No waste additions or removals from tank TY-103 were conducted from November 1959 through June 1961.

221-T Plant Decontamination Waste (1961). In July 1961, tank TY-103 received 16,500 gal of waste from the 241-TY-153 catch tank (HW-83906 E RD, *Chemical Processing Department 200 West Area Tank Farm Inventory and Waste Reports July 1, 1961 Through 1965*, p. 4). In November and December 1961, ~215,900 gal of DW were transferred from tank TX-118 into

tank TY-103 (HW-83906 E RD p. 5). Tank TX-118 was being used at this time to accumulate waste from decontaminating equipment in the 221-T Plant that contained radionuclide concentrations too high for disposal in a crib.

No waste additions or removals from tank TY-103 occurred again until 1967. However on June 30, 1965, the sludge volume in tank TY-103 was reported to be 101,000 gal, a 109,000 gal reduction from the previously reported 220,000 gal (RL-SEP-659, *Chemical Processing Department – Waste Status Summary, January 1, 1965 Through June 30, 1965*, p. 7). The decrease in the sludge volume could have been due to settling and/or dissolution of components from the 1C-FeCN present in tank TY-103.

In the third and fourth quarters of calendar year 1967, 546,000 gal of supernate were transferred from tank TY-103 to tank TX-118 for processing in the 242-T Evaporator (ARH-95, *Chemical Processing Division Waste Status Summary, July 1, 1967 Through September 30, 1967*, p. 8 and ARH-326, *Chemical Processing Division Waste Status Summary October 1, 1967 Through December 31, 1967*, p. 8).

242-T Evaporator Feed Staging Tank (1968). Tank TY-103 was next used as a staging tank for accumulating wastes for transfer to tank TX-118 and processing in the 242-T Evaporator. Tank TY-103 received the following waste types from various SSTs, as summarized in Table 5.3-1:

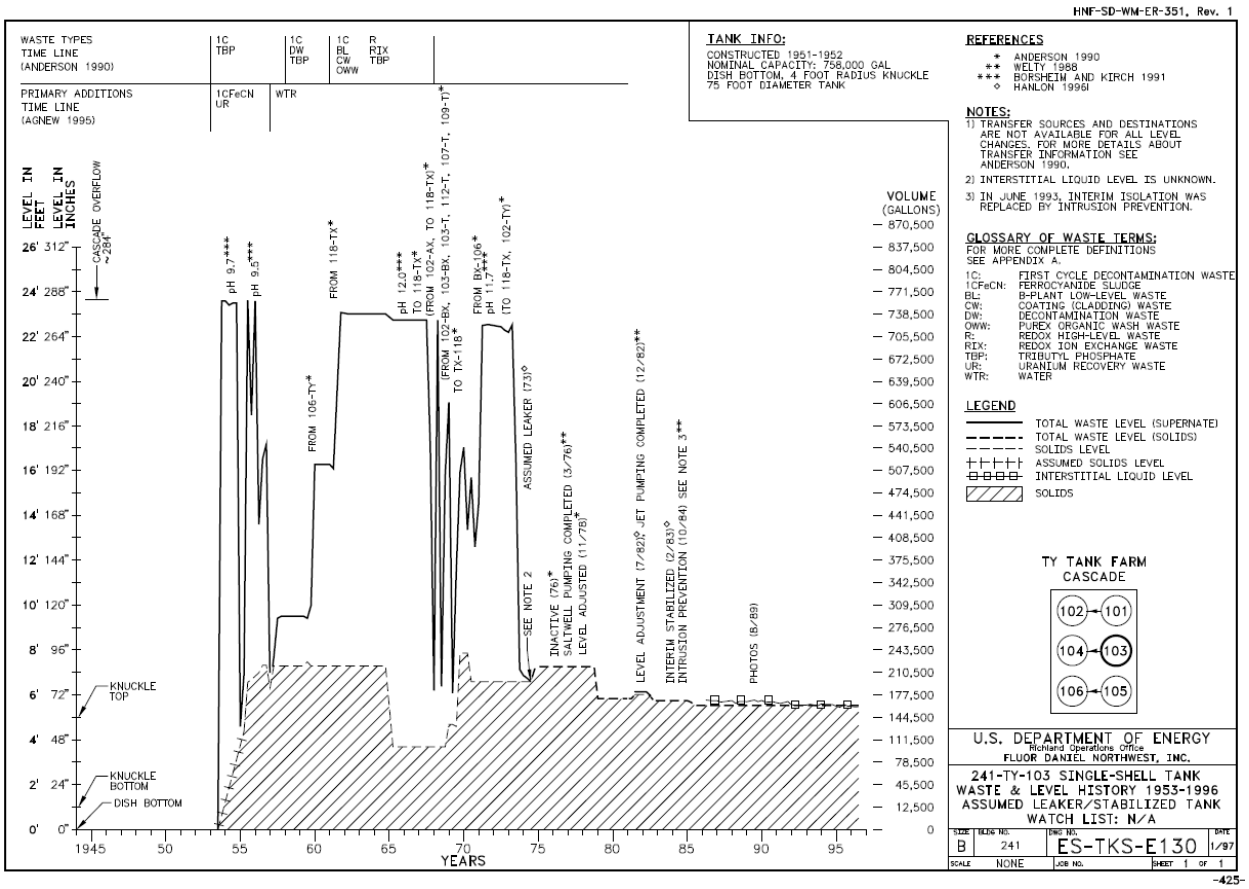
- PUREX organic wash waste (OWW)
- PUREX cladding (coating) removal waste (CW)
- 221-T Plant equipment DW
- 221-T Plant 1C/CW supernate
- 242-T EB
- 202-S REDOX Plant supernate waste (R)
- REDOX EB (R-EB)
- Ion exchange (IX) waste from processing REDOX HLW supernates in 221-B Plant (RIX)
- BL
- B Plant Cell 23 EB (B-EB)

Following these transfers, tank TY-103 was reported to contain a mixture of BL, PUREX OWW/CW, and RIX waste (ARH-2074 A, *Chemical Processing Division Waste Status Summary January 1, 1971 Through March 31, 1971*, p. 8). The sludge in tank TY-103 was a mixture of 1C-FeCN, PUREX CW, and solids from the other waste types stored in this tank. No additional waste transfers were made involving tank TY-103 until the second and third quarters of calendar year 1973, when this tank was determined to be leaking. Figure 5.3-2 shows tank TY-103 waste surface level history. Although the tank was nearly filled multiple times, transfer records indicate that the waste level did not overflow the cascade level (285 in. or 761 kgal).

5.3.1.1 Integrity of Tank 241-TY-103. On Monday, July 9, 1973, the Atomic Energy Commission-Richland Operations (AEC-RL) was verbally informed by the Atlantic Richfield Hanford Company (ARHCO) that the suspect leaker, tank TY-103, was classified as a confirmed

leaker. It was estimated that 1,400 gal and about 350 Ci of ^{137}Cs had escaped to the ground as of this date. The July 1973 monthly report from ARHCO (ARH-2416 RD DEL, *Chemical Processing Division Monthly Report Summaries Jan. 1972 – December 1973*) stated "The tank contained a blend of non-boiling wastes, including B Plant low-level waste, Purex organic wash waste, and ion exchange loading waste."

Figure 5.3-2. Tank 241-TY-103 Waste Surface Level Diagram (WHC-SD-WM-ER-351)

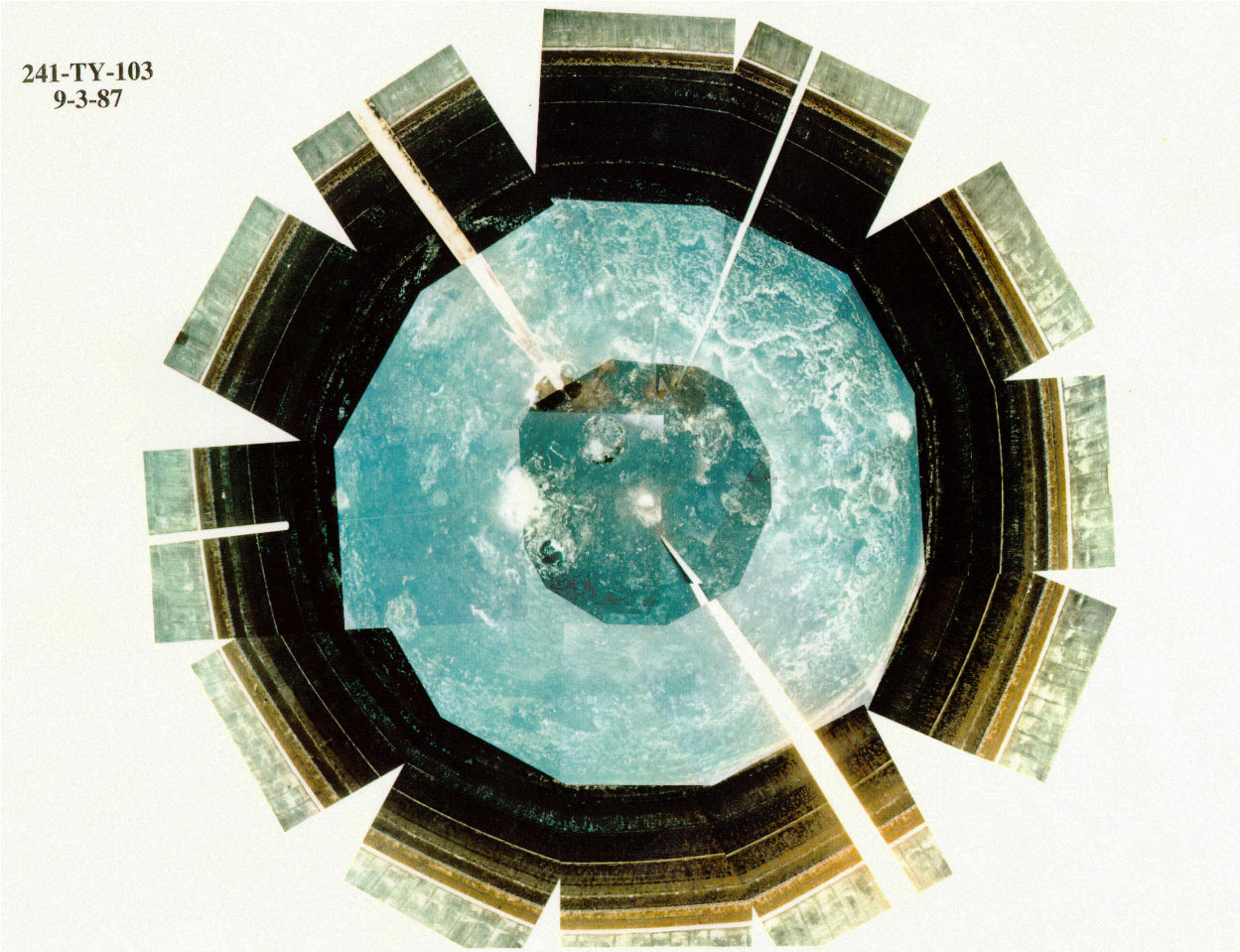


In September 1973 it was determined that an estimated 3,000 gal of liquid waste containing approximately 660 Ci of ^{137}Cs and 6 Ci of ^{90}Sr leaked to the ground from tank TY-103 (Luening 1973 – Letter). This is the current leak estimate in HNF-EP-0182.

5.3.1.2 Interim Stabilization. Tank 241-TY-103 was declared stabilized on December 18, 1982 after a jet pump failed. An estimated 5,000 gal of drainable liquid remained. The flow rate at failure was 0.01 gpm (HNF-SD-RE-TI-178).

Figure 5.3-3 depicts a mosaic of the waste surface in tank TY-103 as of September 1987, indicating a dry surface and no superannuate present in this tank. As of September 1987 the tank is estimated to contain 94,000 gal of sludge and no saltcake (HNF-EP-0182 Rev 261).

Figure 5.3-3. 241-TY-103 In-Tank Photo Mosaic



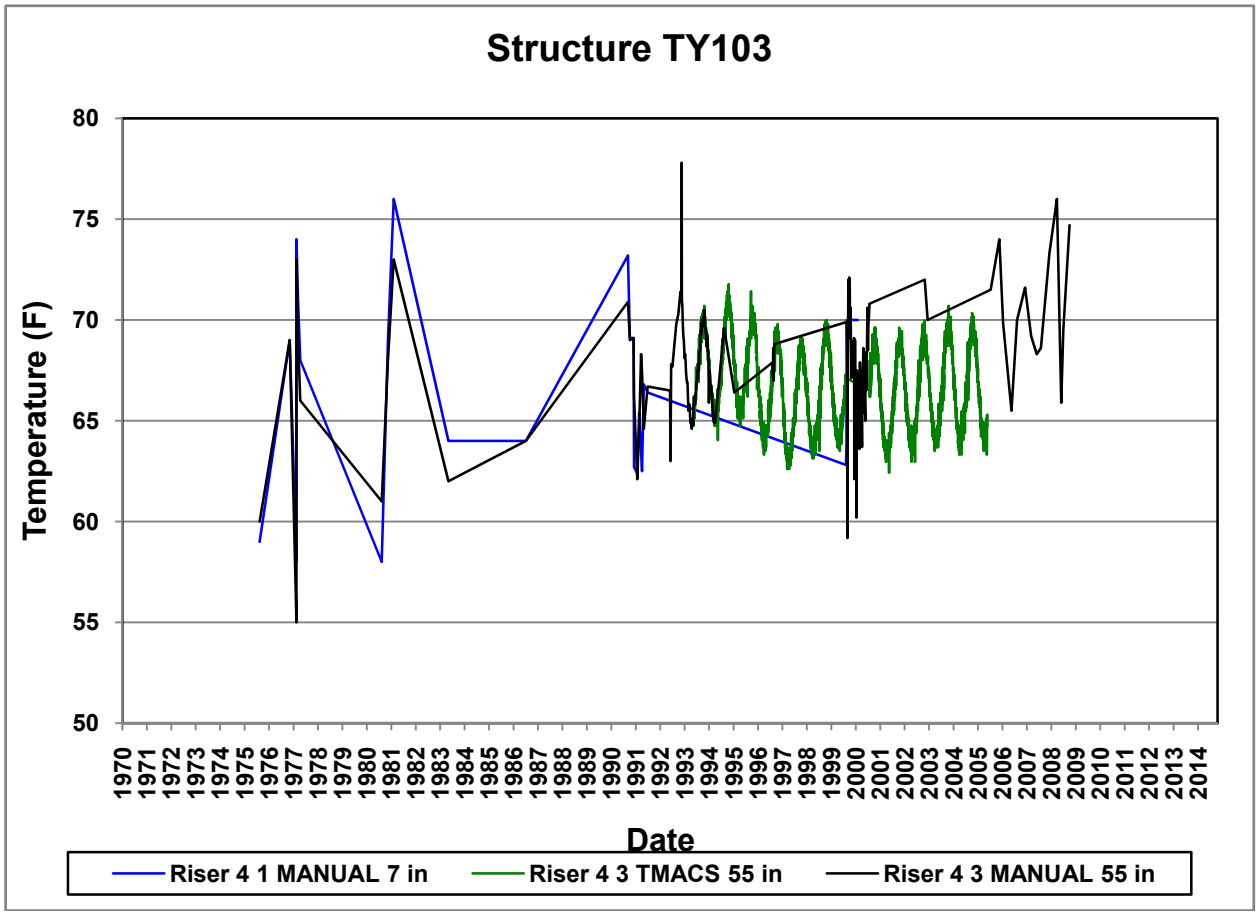
5.3.1.3 Tank 241-TY-103 Temperature History. The thermal history for tank TY-103, shown in Figure 5.3-4, was available starting in 1974 and continuing to present (SACS). During this period the waste temperature was between 55 and 75 °F.

5.3.2 Data Review and Observations

The liquid contents of tank TY-103 were pumped to tank TX-104 (ARH-2416 RD DEL p. 85). "This tank was pumped to a minimum heel, with a standard pump, on July 7 through 9, 1973. A salt well was subsequently installed, and the tank was pumped to the sludge level (approximately 150,000 gallons) the week of August 20, 1973" (ARH-2416 RD DEL p. 91).

5.3.2.1 Liquid Level Measurements. "Because of decreasing liquid levels in Tank TY-103, the tank was pumped to Tank TX-118 on August 22, and again on August 25 [1973]. The recorded TY-103 day shift liquid-level readings then remained essentially constant at 86.9 to 87.0 inches until September 15 [1973]. These readings have since decreased to 86.6 as of September 18 [1973]. Total liquid lost from the tank, to date, is estimated to 3,600 gallons" (ARH-2416 RD DEL p. 94).

Figure 5.3-4. Tank 241-TY-103 Waste Temperature Measurements



In official correspondence with the AEC-RL (Luening 1973 – Letter), ARHCO indicated tank TY-103 was suspected to have started leaking waste on May 28, 1973 due to a "… slow persistent leak …" and

> "After 200,000-gallons of superannuate were pumped out in early June, the radiation level in the dry wells appeared to have stabilized."…"However, in late June the tank developed a slow leak and lost 0.5 inch from June 21 through July 5. Correspondingly, the radiation level in the monitoring dry wells increased markedly.
>
> The tank was pumped down to a minimum heel on July 8, 1973, but the tank continued to leak, losing an additional 0.5 inch until the salt well was fabricated and installed on August 14, 1973.
>
> Salt well pumping has been continued and at present, the tank contains approximately 240,000 gallons of wet salt cake. The radiation level in the monitoring dry wells has stabilized. Design has been initiated for isolation of the tank.

> An estimated 3,000 gallons of liquid waste, containing approximately 660 curies of ^{137}Cs and 6 curies of ^{90}Sr, have leaked into the ground. A field study will be initiated to determine the location of the leak and extent of migration of the radionuclides."

The estimated quantity of ^{137}Cs leaked from tank TY-103 is 295 Ci, when decay corrected from July 1973 to July 2008 (or 352 Ci decay corrected to January 2001).

On October 26, 1973 a review was performed on tank TY-103 leak events. The review states that liquid level readings from January through December 1972 indicate a loss of 3 ½ in. (9,600 gal) near the end of 1972. An additional ~0.4-in. liquid loss was observed in 1973 along with increased radiation readings (Draft memo Compton 1973, "Tank 241-TY-103 Review").

LA-UR-97-311, *Waste Status and Transaction Record Summary (WSTRS Rev. 4)* and Chemical Processing Division Waste Status Summaries (ARH-2456 A, *Chemical Processing Division Waste Status Summary January 1, 1972 Through March 31, 1972*, ARH-2456 B, *Chemical Processing Division Waste Status Summary April 1, 1972 Through June 30, 1972*, ARH-2456 C, *Chemical Processing Division Waste Status Summary July 1, 1972 Through September 30, 1972*, ARH-2456 D, *Chemical Processing Division Waste Status Summary October 1, 1972 Through December 31, 1972* and ARH-2794 A, *Chemical Processing Division Waste Status Summary, January 1, 1973 through March 31, 1973*) show the liquid level decreased from 722 kgal to 712 kgal from January through December 1972, then show that it increased to 723 kgal in March 1973. There is no indication of transfers into or out of the tank during this time. The October 1973 draft memo appears to be incorrect.

5.3.2.2 Drywell Logging Data. Total gamma logging detected high ^{137}Cs activity in borehole 52-03-03 (Figure 5.3-5).

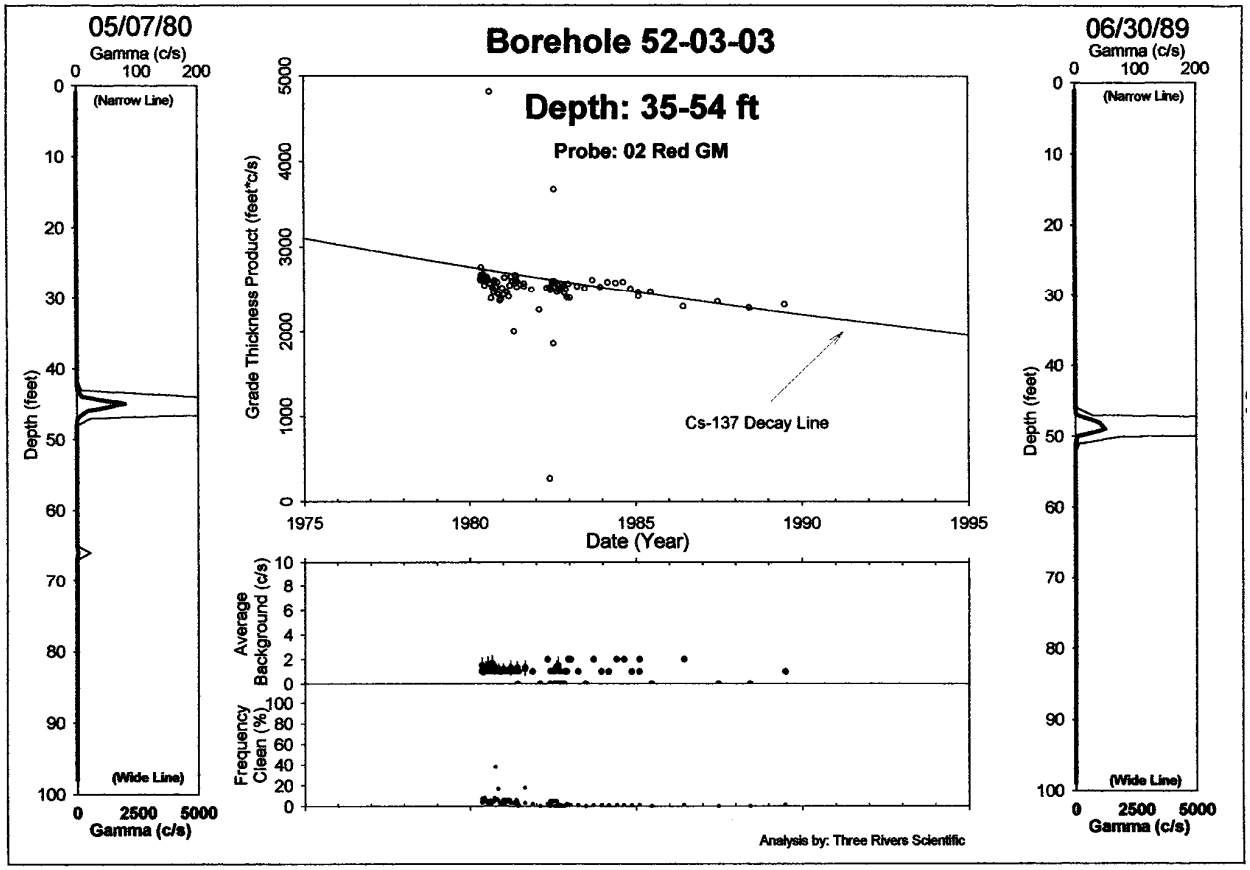
The characterization of the gamma-ray-emitting contamination in the vadose zone surrounding tank TY-103 was completed using the SGLS (Figure 5.3-6). From the data obtained using the SGLS and the geologic and historical information available from other sources, the designation of the tank in 1973 as an assumed leaker is supported.

High ^{60}Co concentrations detected in the middle portion of borehole 52-03-03 indicate that tank TY-103 leaked near the bottom of the tank, possibly at the bottom knuckle.

The continuous moderate concentrations of ^{60}Co detected in the lower half of borehole 52-03-06 occur within a contaminant plume that probably originated from the suspected leak from tank TY-103, but they may also have originated from a leak from another nearby tank. The ^{60}Co contamination detected in borehole 52-03-12 indicates that this borehole is probably completed near the periphery of the same plume that surrounds borehole 52-03-06.

Logging was conducted using the HRLS in borehole 52-03-03, where SGLS baseline results indicated a zone of detector saturation near the base of the tank. The HRLS showed 1E7 pCi/g peak ^{137}Cs activity.

Figure 5.3-5. Drywell 52-03-03 Total Gamma Measurements



In 2002 total gamma logging and SGLS in drywell 52-03-06 showed a decrease in ^{60}Co activity from 8 to 3 pCi/g and an increase in ^{137}Cs activity from 1 to 48 pCi/g at about 56 ft bgs (Figure 5.3-7).

Notifications were made and an occurrence report was issued (RP--CHG-TANKFARM-2002-0047, *Below Grade Spectral Gamma Scans on Drywell 52-03-06 Indicate Increased Levels of Cobalt and Cesium Between Tanks 241-TY-103 and 241-TY-105*). The possible causes of the increased activity were:

1) presence of a significant mobilizing force (e.g., water loss to the Vadose Zone from pressurized water lines);

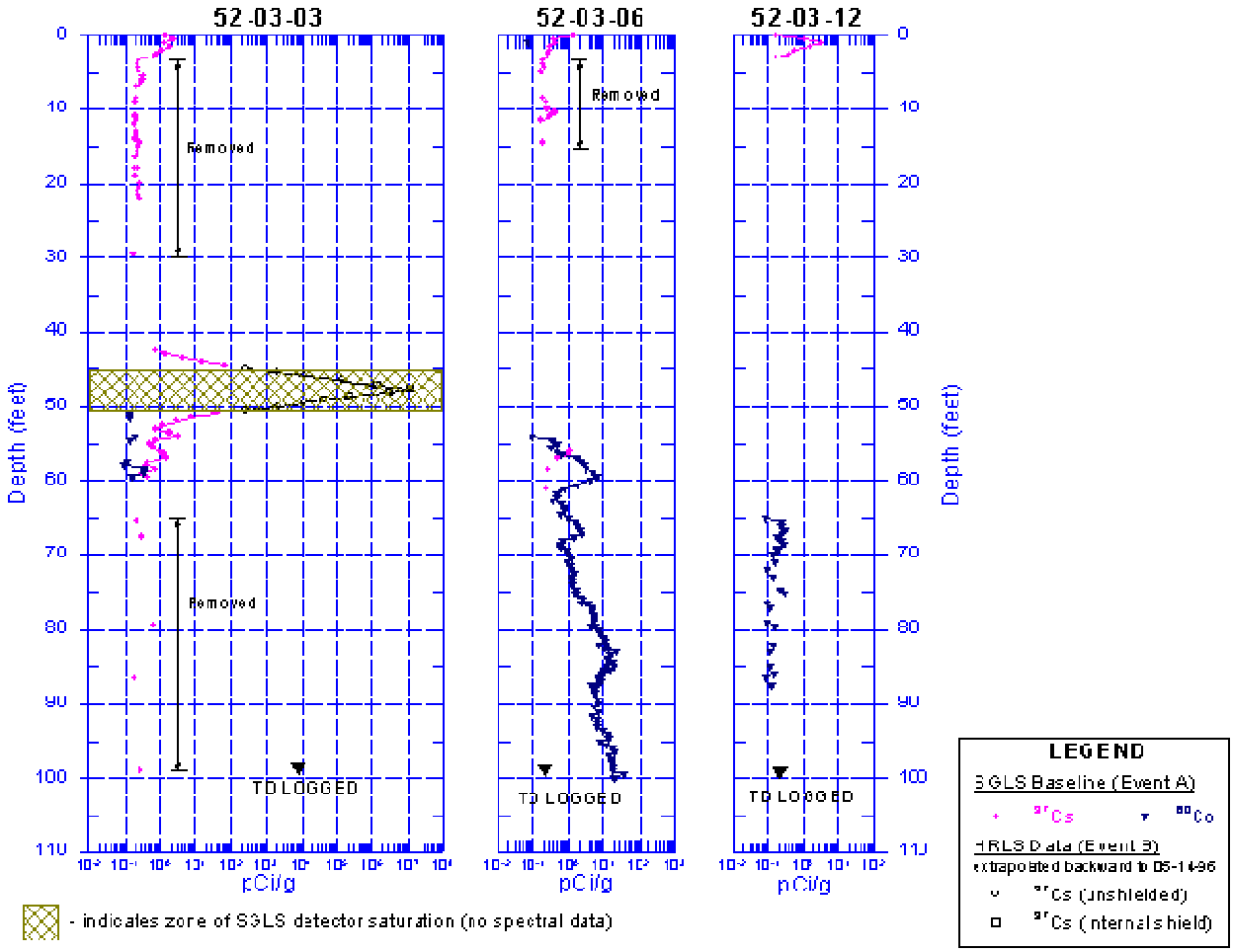
2) mobilization of existing contamination due to natural causes (e.g., precipitation); or

3) the very remote possibility of a new leak from an adjacent SST (e.g., TY-103 or TY-105).

The 4-in. raw water line servicing the 242-T Evaporator was leak-tested in early May 2002 and found to be leaking (PER-2002-2602, *241-TX Water Line Leaking*); this line was permanently removed from service on July 9, 2002. The line was estimated to have leaked 19 gal/hr

(PER-2002-2602). The increased activity and implied movement of isotopes was believed to be due to infiltration of water from both natural causes (e.g., precipitation and surface water run-on) and man-made causes (e.g., leaking pressurized water lines in or adjacent to the farm). Insufficient data exists to definitively understand what is driving the movement.

Figure 5.3-6. Tank 241-TY-103 Drywell Spectral Gamma Logging Measurements



In response to the occurrence report, additional characterization of TY farm was conducted, LOWs were installed in TY farm tanks, additional vadose monitoring was performed, and additional water lines in TY farm and other farms were leak tested, cut and capped as needed. Multiple log runs between May 2002 and May 2003 show no evidence of further changes in ^{137}Cs activity in drywell 52-03-06 (Figure 5.3-8). This suggests that the earlier movement has stabilized.

Direct push logging and sampling to further characterize the TY-103 leak was conducted in 2005 (RPP-RPT-34870, *Small Diameter Geophysical Logging in the 241-TY Tank Farm*) and in 2008 and 2009 (RPP-RPT-41100, *Completion Report for TY Single-Shell Tanks Direct Push Barrier Investigation*). The 2005 direct push logging locations and results are shown in Figure 5.3-9 and Table 5.3-2. The 2008 and 2009 results show high levels of ^{99}Tc and nitrate at 100 ft, just above

the Cold Creek Formation (low permeability layer) below TY-Farm (RPP-RPT-41429, *Final Report for the Tier One Analysis of the TY Barrier Soil Samples Received from September 2009 to January 2009*). Figure 5.3-10 shows the location of direct push holes and samples obtained.

Figure 5.3-7. Drywell 52-03-06 logging (1996 and 2002)

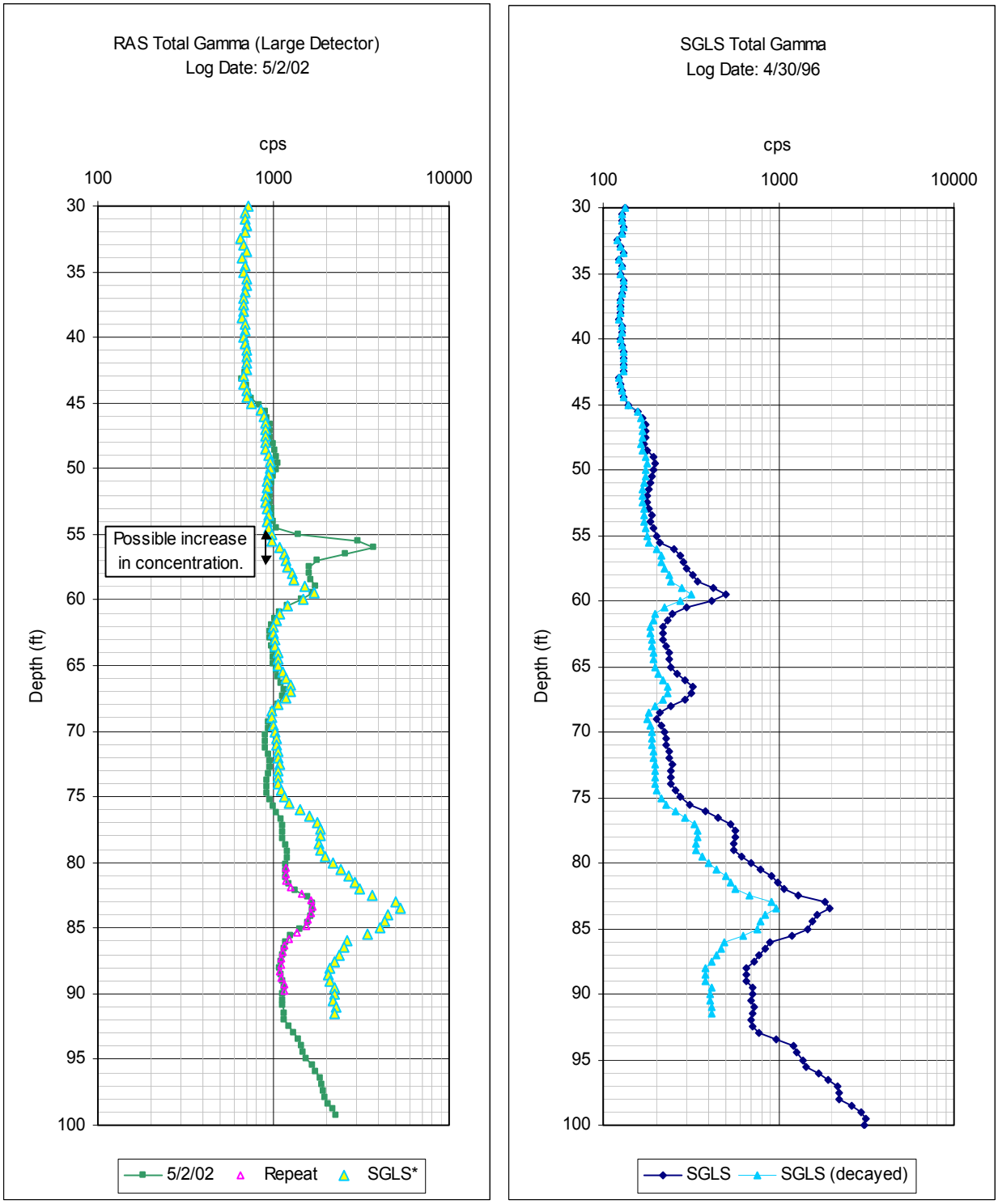


Figure 5.3-8. Drywell 52-03-06 Total Gamma logging 2002-2003

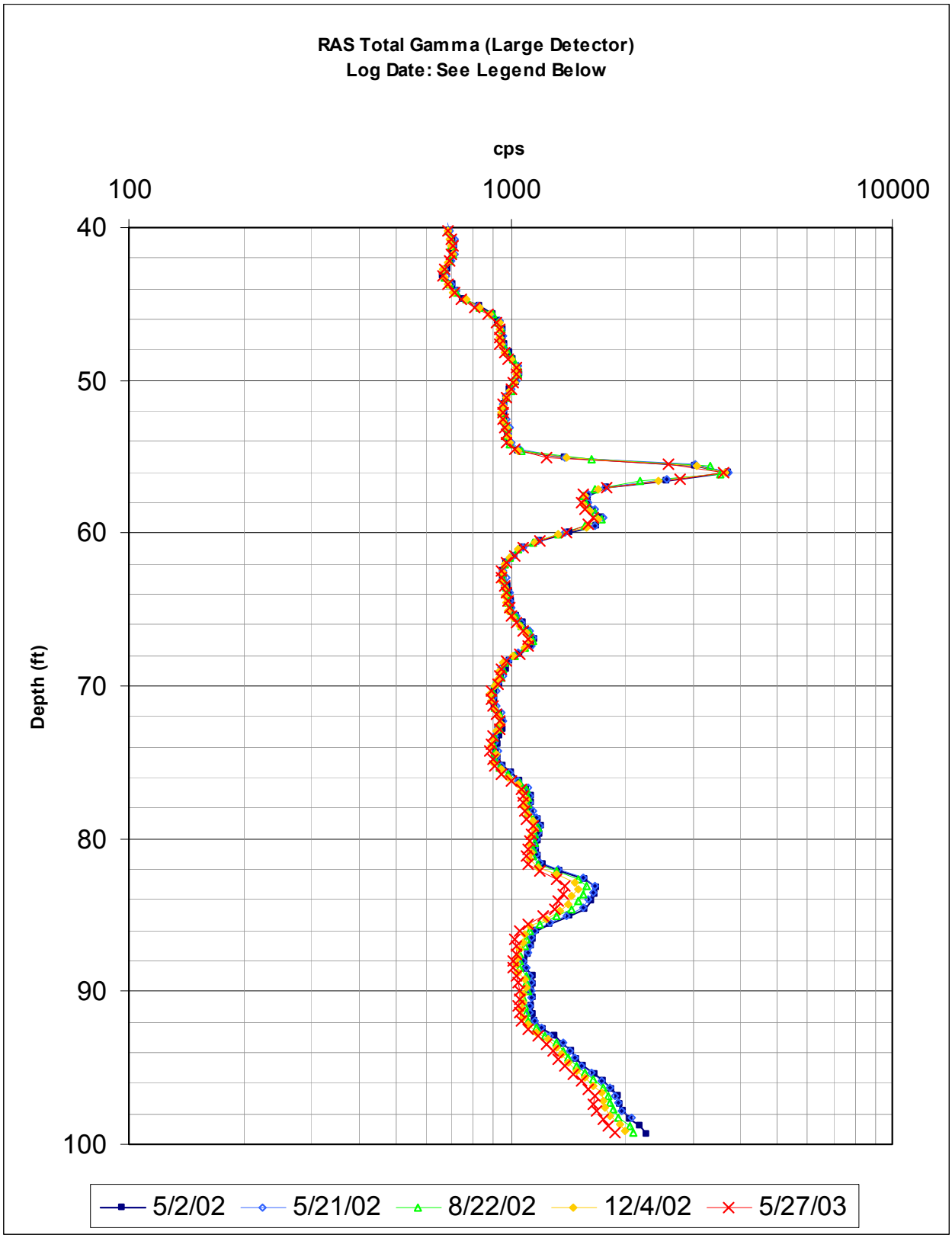
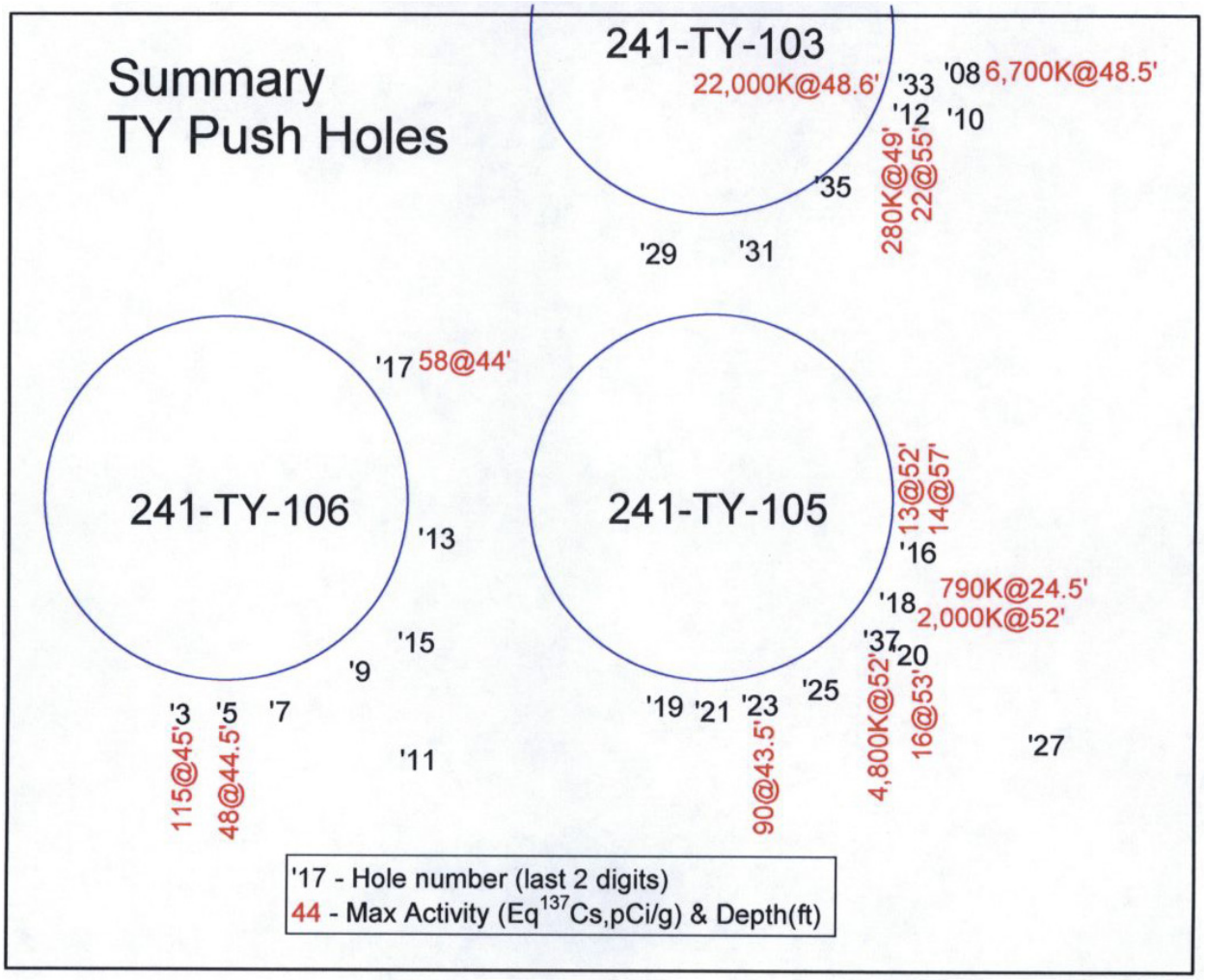


Figure 5.3-9. Maximum Activity for 2005 241-TY-Farm Direct Push Logging



5.3.3 Tank 241-TY-103 Leak Estimate

The SIM (RPP-26744) assumes the waste type present in tank TY-103 was T2-SltCk(P2') and the leak volume was 3,000 gal. The SIM estimated the mean quantities of ^{137}Cs and ^{99}Tc leaked from tank TY-103 were 3,024 and 1.65 Ci respectively, decayed to January 2001. The waste type T2-SltCk(P2') is defined as saltcake product from operation of the 242-T Evaporator from 1965 to 1976 (RPP-19822 p. 13). Based on the information presented in Table 5.3-1 and the ARHCO monthly reports for 1973, the supernate waste type in tank TY-103 in May 1973 was **not** T2-SltCk(P2'), but instead "… the tank contained a blend of non-boiling wastes, including B Plant low-level waste [BL], Purex organic wash waste [OWW], and ion exchange loading waste [RIX]". Clearly the waste type and inventories of constituents leaked from tank TY-103 are incorrect in the SIM.

Table 5.3-2. 2005 Direct Push Logging Summary (RPP-RPT-34870)

Hole	Gross Gamma	Spectral Gamma	Green GM	Initial Hole Depth (ft)	Extend Hole Depth	Depth Max Activity	Max eCs-137 (pCi/g)	Comment
C4603	X	**BGO**		47.1	61.3 ft	45 ft	115	Background not reached at bottom of first survey. Hole Deepened.
C4605	X	**BGO**		47.5	61 ft	44.5 ft	48	Minor count rate increase at bottom of first survey. Hole Deepened.
C4607	X			47		surface	13	Minor count rate increase at surface
C4609	X			46.5		surface	20	Count rate increase at surface
C4611	X			47.2			Background	
C4613	X			47.2		surface	19	Count rate increase at surface
C4615	X			46.6			Background	
C4617	X	**BGO**		47.5	61.4 ft	44 ft	58	Minor count rate increase at bottom of first survey. Hole Deepened.
C4619	X			47.2			Background	
C4621	X			47.1		surface	16	Minor count rate increase at surface
C4623	X	**BGO**		47.1		43.5 ft	90	
C4625	X			47.5			Background	
C4627	X			47.8		surface	13	Minor count rate increase at surface
C4629	X			47.3		surface	17	Minor count rate increase at surface
C4631	X			47.2			Background	
C4633	X	**BGO**	**GM**	61.5	69.5	48.6 ft	22,000,000	NaI Detector Saturated 47-51.5 and 53.5-56 ft
C4635	X			47.2		surface	16	Minor count rate increase at surface
C4637	X	**BGO**	**GM**	47.5	61.5	52 ft	4,800,000	NaI Detector Saturated 51.5-53 ft
C5008	X	**BGO**	**GM**	65		48.5	6,700,000	
C5010	X			65			Background	
C5012	X	**BGO**	**GM**	65		49 ft	280,000	
C5016	X			66		57 ft	14	
C5018	X	**BGO**	**GM**	65		24.5ft & 52ft	790,000 & 2,000,000	NaI Detector Saturated 23-26 and 51-53 ft
C5020	X	**BGO**		65		53 ft	16	

The supernate waste types present in tank TY-103 in May 1973 were the feeds to the 242-T Evaporator that after concentration became T2-SltCk(P2') waste type. Since ^{137}Cs and ^{99}Tc are both not significantly volatile at the operating conditions for the 242-T Evaporator, the ratio of ^{137}Cs in the feed (i.e., TY-103 superannuate) to the ^{137}Cs in concentrated product [i.e., T2-SltCk(P2') waste type] can be used to estimate the concentration factor (CF) for the evaporator feeds. This CF can then be used to estimate the inventory of ^{99}Tc contained in the 242-T Evaporator as follows:

^{137}Cs in 242-T feed (i.e., TY-103 leak) = 352 Ci / 3,000 gal
(decayed to January 2001) based on ARHCO letter to AEC-RL

^{137}Cs in 242-T concentrate (T2-SltCk(P2')) = 3,024 Ci / 3,000 gal
(decayed to January 2001) based on Soil Inventory Model

242-T CF = (^{137}Cs in T2-SltCk(P2')) / (^{137}Cs in feed)

242-T CF = 8.6

^{99}Tc in T2-SltCk(P2') = 1.65 Ci based on Soil Inventory Model

^{99}Tc in 242-T feed (i.e., TY-103 leak) = (^{99}Tc in T2-SltCk(P2')) / (242-T CF)

^{99}Tc in 242-T feed (i.e., TY-103 leak) = (1.65 Ci) / (8.6)

^{99}Tc in 242-T feed (i.e., TY-103 leak) = 0.19 Ci

Using the above assumptions, the estimated ^{99}Tc inventory in the estimated 3,000 gal of waste leaked from tank TY-103 in May through August 1973 is ~0.19 Ci.

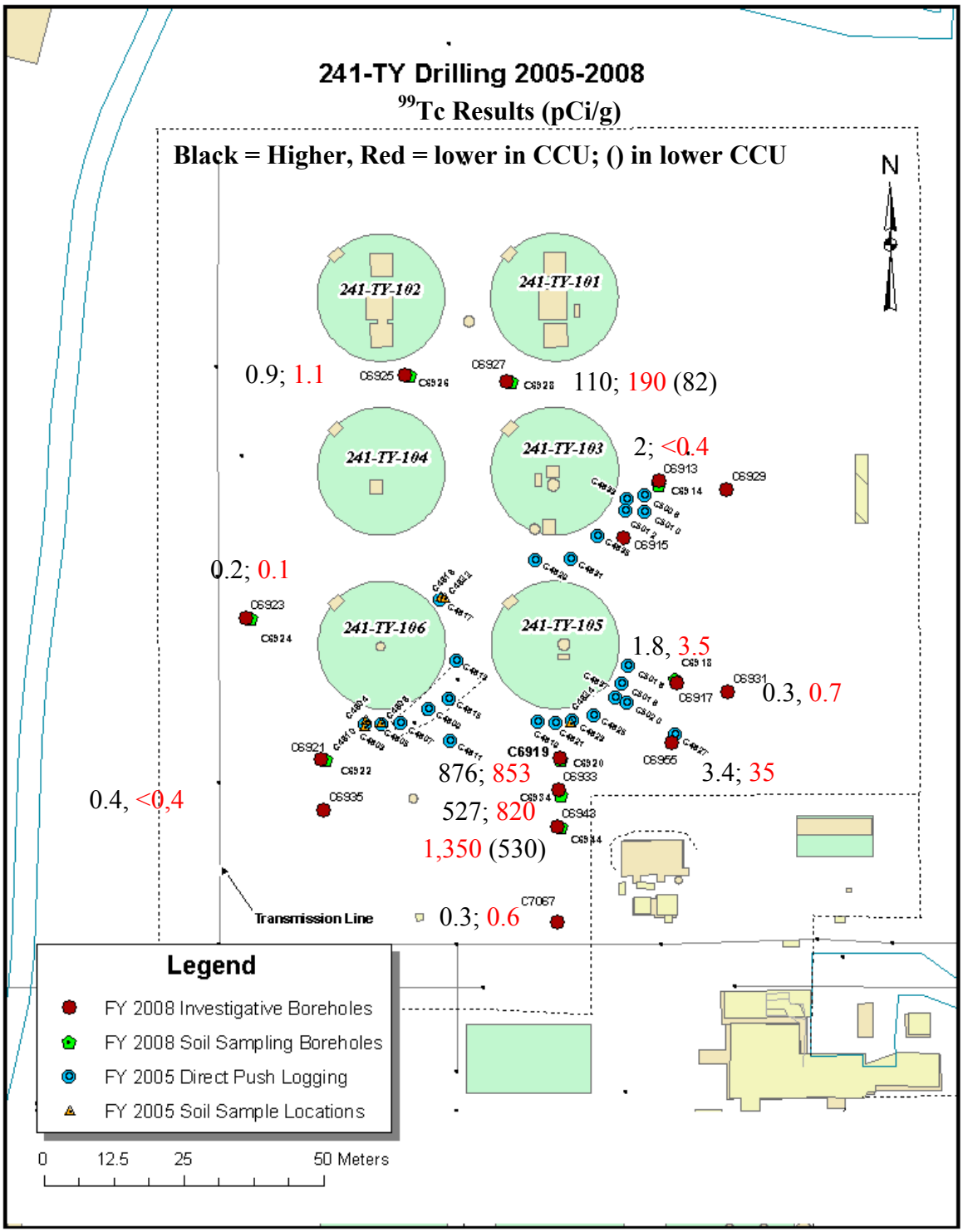
The volume of waste leaked from tank TY-103 in May through August 1973 may have been 3,600 gal instead of 3,000 gal, based on the ARHCO monthly report for September 1973 (ARH-2416 RD DEL p. 94). If the waste volume leaked from tank TY-103 was actually 3,600 gal, the inventories of ^{137}Cs and ^{99}Tc leaked to the soil would increase by a factor of 1.2 (i.e., 3,600 gal / 3,000 gal = 1.2) to 422 Ci (as of January 1, 2001) and 0.23 Ci, respectively. The corresponding concentrations of ^{137}Cs and ^{99}Tc in the leaked solution are 0.12 Ci/gal (as of January 2001) and 63 μCi/gal.

As a check on the estimated inventory of ^{99}Tc leaked from tank TY-103, the average ^{99}Tc concentration was 95 ± 34 μCi/gal in the drainable liquid from three core samples obtained in 1985 from tank TY-103 (SD-RE-TI-184, *Data Transmittal Package for 241-TY-103 Waste Tank Characterization*). The estimated ^{99}Tc concentration in the solution leaked from tank TY-103 is consistent with the average ^{99}Tc concentration in the drainable liquid from the 1985 core samples. However, the 1985 core is different for ^{137}Cs or other analytes and not representative.

5.3.4 Conclusion

Based on the information reviewed, it was concluded that tank TY-103 may have leaked up to 3,600 gal of 242-T evaporator feed with a ^{137}Cs inventory of 422 Ci (decayed to January 1, 2001). Current SIM inventory estimates should be divided by a factor of 7.2 (8.6/1.2) to account for a higher leak volume (increase by a factor of 1.2 from 3,000 gal) and a lower supernate composition in the tank in 1973 compared to the concentrated T2-Sltck used in SIM (factor of 8.6 decrease).

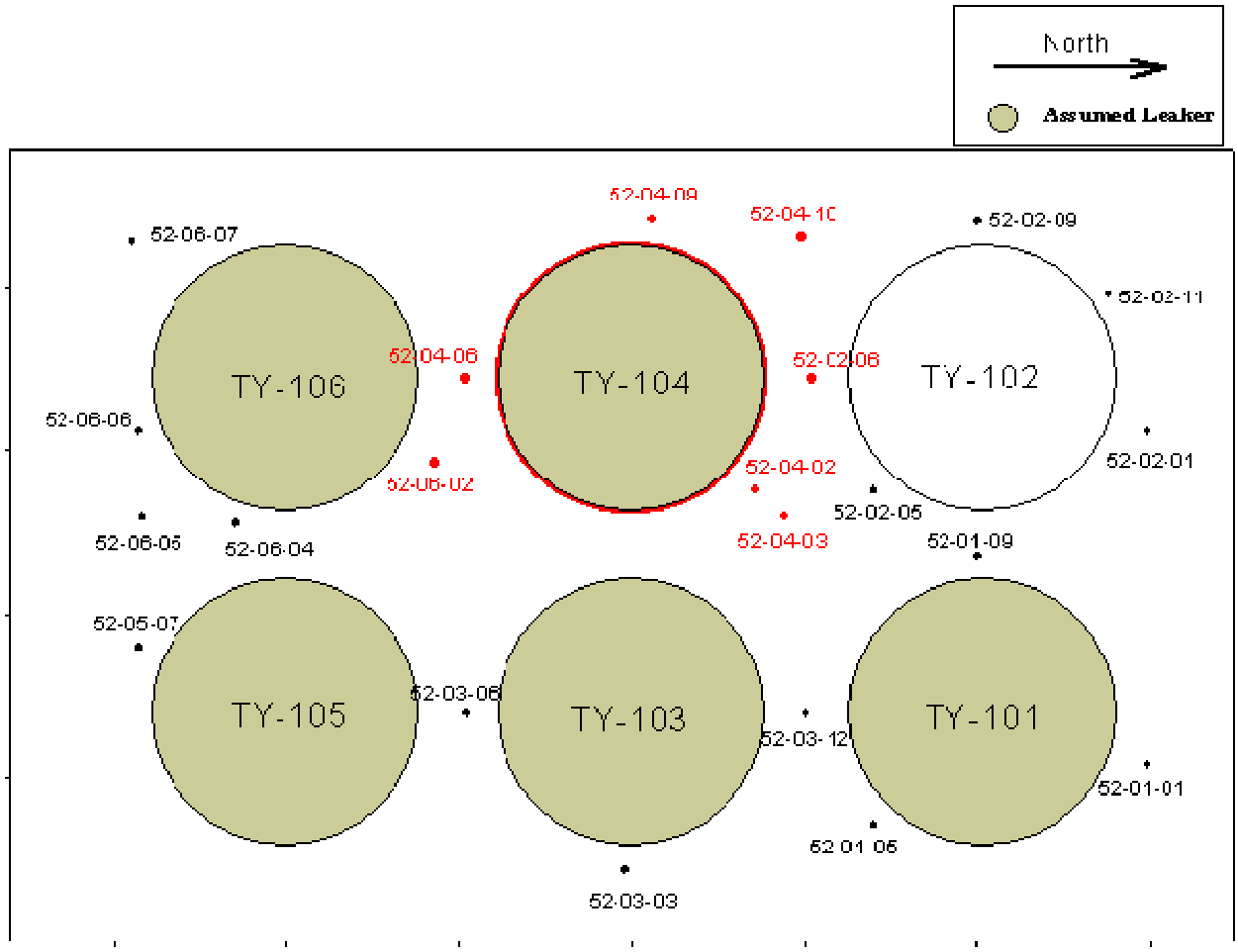
Figure 5.3-10. Quick-Turn-Around 2008 Technetium-99 Sample Results



5.4 TANK 241-TY-104 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-104. The following subsections summarize the waste operating history for tank TY-104. Figure 5.4-1 shows monitoring wells near tank TY-104. Figure 5.4-2 summarizes tank TY-104's waste operations. Figure 5.4-3 is a plan view of the tank.

Figure 5.4-1. 241-TY Tank Farm Drywells



5.4.1 Tank 241-TY-104 Waste History

Tank TY-104 began receiving TBP waste in 1953 and was part of the staging and distribution system for this waste through the fourth quarter of 1969 (SD-WM-TI-356). This tank received DW and 1C waste from 1955 through 1971, and REDOX waste, PUREX OWW, and PUREX low-level waste from 1970 through 1974. Table 5.4-1 shows waste transfer history for tank TY-104. Figure 5.4-4 depicts the surface level history.

Figure 5.4-2. Tank 241-TY-104 Waste Operations Summary

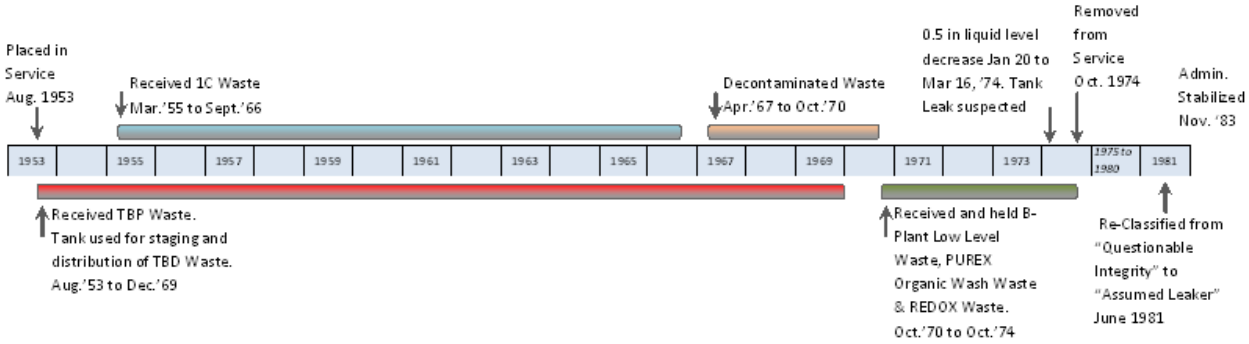


Figure 5.4-3. Tank 241-TY-104 Plan View

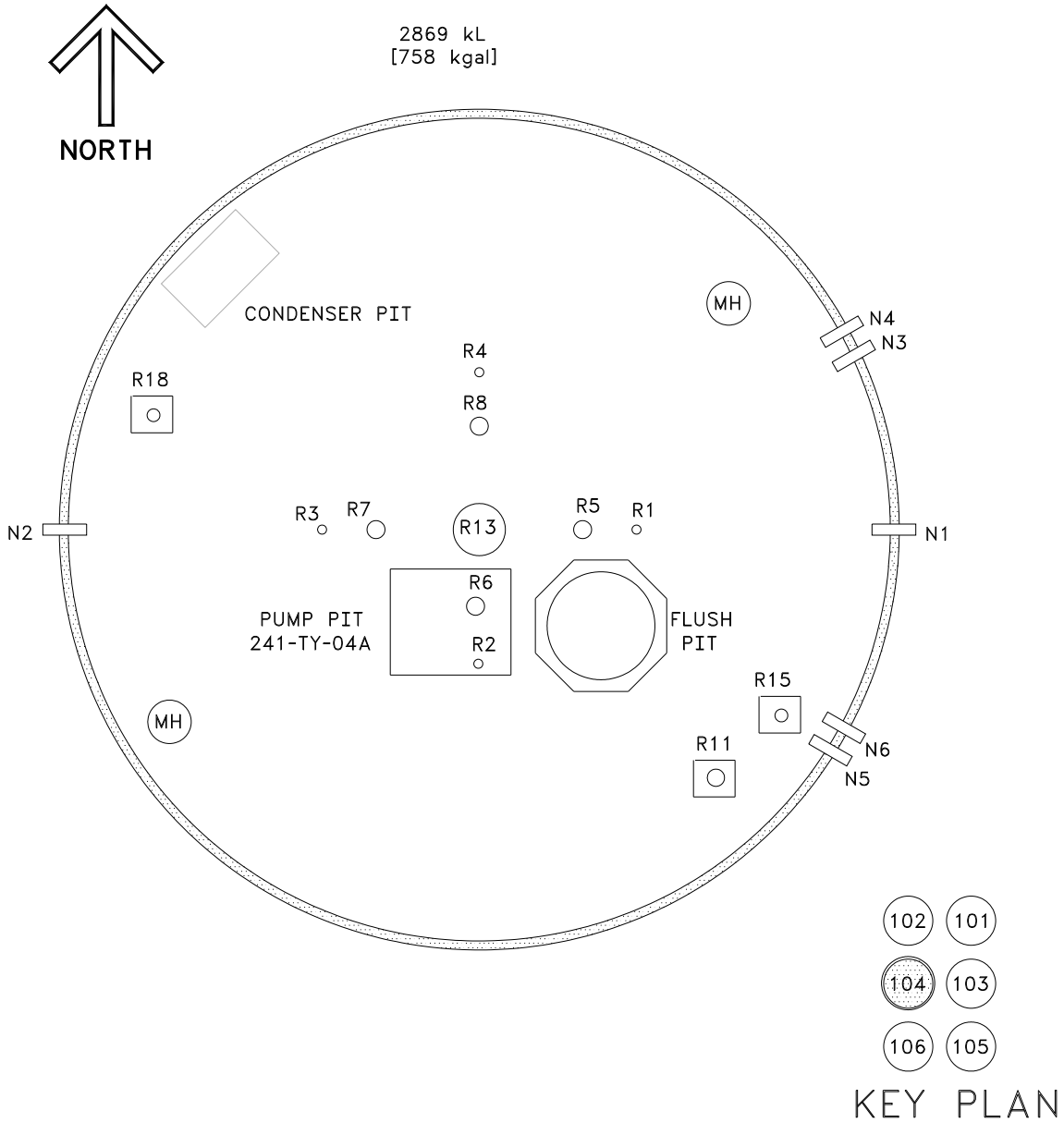


Table 5.4-1. Tank 241-TY-104 Waste Transfers (2 sheets)

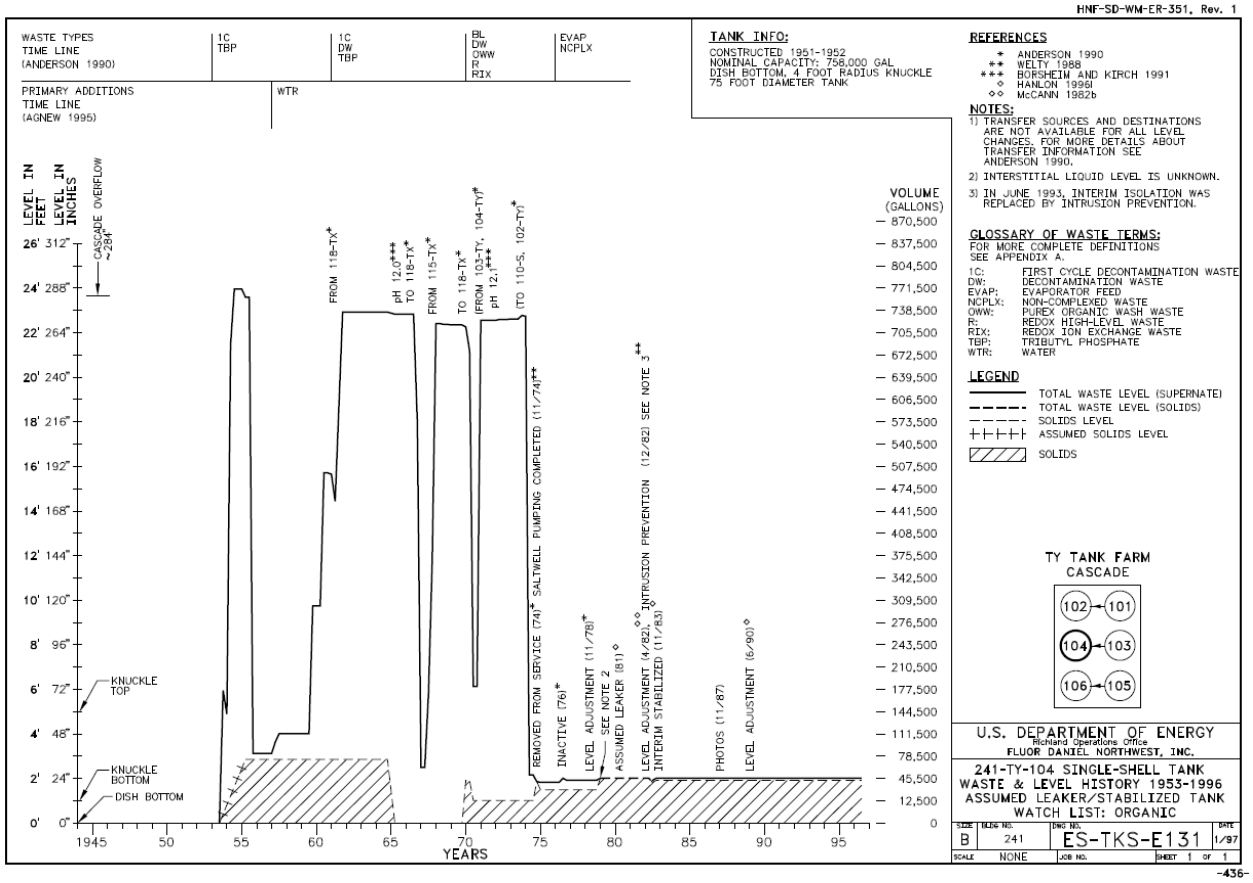
Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1000)	Total Vol. In Tank (gal*1000)[2]	Discrepancy with previous reading (gal*1000)[3]	Waste type[4]	Transfer tank from/to	Document Reference Number[5]
Aug.-1953	IN	176	176		TBP		HW-29242
Sept.-1953 to Nov.-1953	IN	582	758		TBP		HW-29624
Dec.-1953 to Feb.-1954	OUT	-617	141		TBP	118-TX	HW-30498
Mar.-1954	IN	547	688		TBP	103-TY	HW-31374
Apr.-1954	IN	70	758		TBP	103-TY	HW-31811
May-1954	IN	12	770 (Filled above normal capacity)		TBP	103-TY	HW-32110
Jun-1954 to Feb-1955	STAT		770				HW-35628
Mar 1955	OUT	-709			TBP	109-TX	LA-UR-97-311
Mar 1955	IN	700	758		1C, TBP	103-TY	HW-36001
Apr.-1955 to July-1955	STAT		758		1C, TBP		HW-36001
Aug.-1955	OUT	-675	83		1C, TBP	TY-Cavern	HW-38926
Sep-1955 to Dec-1956	STAT		83		1C, TBP		
Jan.-1957 to May-1957	IN	37	120		1C, TBP	Water	HW-48144
June-1957 to July-1959	STAT		112	-8	1C, TBP		HW-51348
Aug.-1959	IN	80	192		1C, TBP	118-TX	HW-51952
Sept.-1959 to Mar.-1960	IN	109	301		1C, TBP	118-TX	HW-62421
Apr.-1960 to Nov.-1960	IN	197	498		1C, TBP	118-TX	HW-65272
Dec.-1960	STAT		496	-2	1C, TBP		HW-68292
Jan.-1961 to June-1961	IN	160	656		1C, TBP	118-TX	HW-71610
July-1961 to June-1966	IN	80	736		1C, TBP, DW	118-TX	HW-72625
July-1966 to Sept.-1966	OUT	-162	574		1C, TBP	118-TX	ISO-538
Oct.-1966 to Mar.-1967	OUT	-512	62		TBP	118-TX	ISO-674
Apr.-1967 to June-1967	IN	109	171		TBP, DW	115-TX	ISO-967
July-1967 to Sept.-1967	IN	198	369		TBP, DW	115-TX	ARH-95
Oct.-1967 to Mar.-1968	IN	350	719		TBP, DW	115-TX	ARH-326
Apr.-1968 to June-1968	STAT		718	-1	TBP, DW		ARH-721
July-1968 to Sept.-1969	STAT		717	-1	TBP, DW		ARH-1061

Table 5.4-1. Tank 241-TY-104 Waste Transfers (2 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1000)	Total Vol. In Tank (gal*1000)[2]	Discrepancy with previous reading (gal*1000)[3]	Waste type[4]	Transfer tank from/to	Document Reference Number[5]
Oct.-1969 to Dec.-1969	IN	7		-3	WATER		ARH-1061
Oct.-1969 to Dec.-1969	OUT	-10	714		TBP, DW	118-TX	ARH-1061
Jan.-1970 to Mar.-1970	IN	333			DW, R	104-TY	ARH-1666 A
Jan.-1970 to Mar.-1970	OUT	-367	679 (Reported Value)		DW, R	118-TX	ARH-1666 A
Apr.-1970 to Sept.-1970	OUT	-498	182 (Reported Value)		DW	118-TX	ARH-1666 B
Oct.-1970 to Dec.-1971	IN	542	724		BL, OWW, RIX	103-TY	ARH-1666 D
Jan.-1972 to Sept.-1972	STAT		725	1	BL, OWW, RIX		ARH-2456 A
Oct.-1972 to June-1973	STAT		726	1	BL, OWW, RIX		ARH-2456 D
July-1973 to Sept.-1973	STAT		731	5	BL, OWW, RIX		ARH-2794 C
Oct.-1973 to Dec.-1973	STAT		730	-1	BL, OWW, RIX		ARH-2794 D
Dec.-1973 to Mar.-1974			*Estimated 1400 gal. leak*				RHO-CD-1193
Jan.-1974 to June-1974	OUT	-678	51 (Reported Value)		BL, OWW, RIX	110-S	ARH-CD-133A
July-1974 to Sept.-1974	OUT	-2	41 (Reported Value)	-8		102-TY	ARH-CD-133C
Oct.-1974 to Mar.-1976	OUT	-1	40 REMOVED FROM SERVICE		BL, OWW, RIX	102-TY	ARH-CD-133D
Apr.-1976 to Sept.-1976	STAT		46	6	BL, OWW, RIX		ARH-CD-702 B
Oct.-1976 to Oct.-1978	STAT		43	-3	BL, OWW, RIX		ARH-CD-702 I
Nov.-1978	STAT		46	3	BL, OWW, RIX		RHO-CD-14 NOV
June-1981			Reclassified from "Questionable Integrity" to "Confirmed Leaker"				SD-WM-TI-356 / RHO-CD-1193
Sept.-1983 to ……	STAT		46				RHO-RE-SR-14

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.
[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Transfer volumes are from references shown and LA-UR-97-311.
[3] Small discrepancies may be attributed to water additions or effects such as evaporation.
[4] Waste types: TBP = tributyl phosphate, 1C = First cycle waste, DW = decontamination waste, OWW = Organic wash waste, RIX = Ion exchange waste from supernate.
[5] For reference titles, see Section 6.0 REFERENCES.

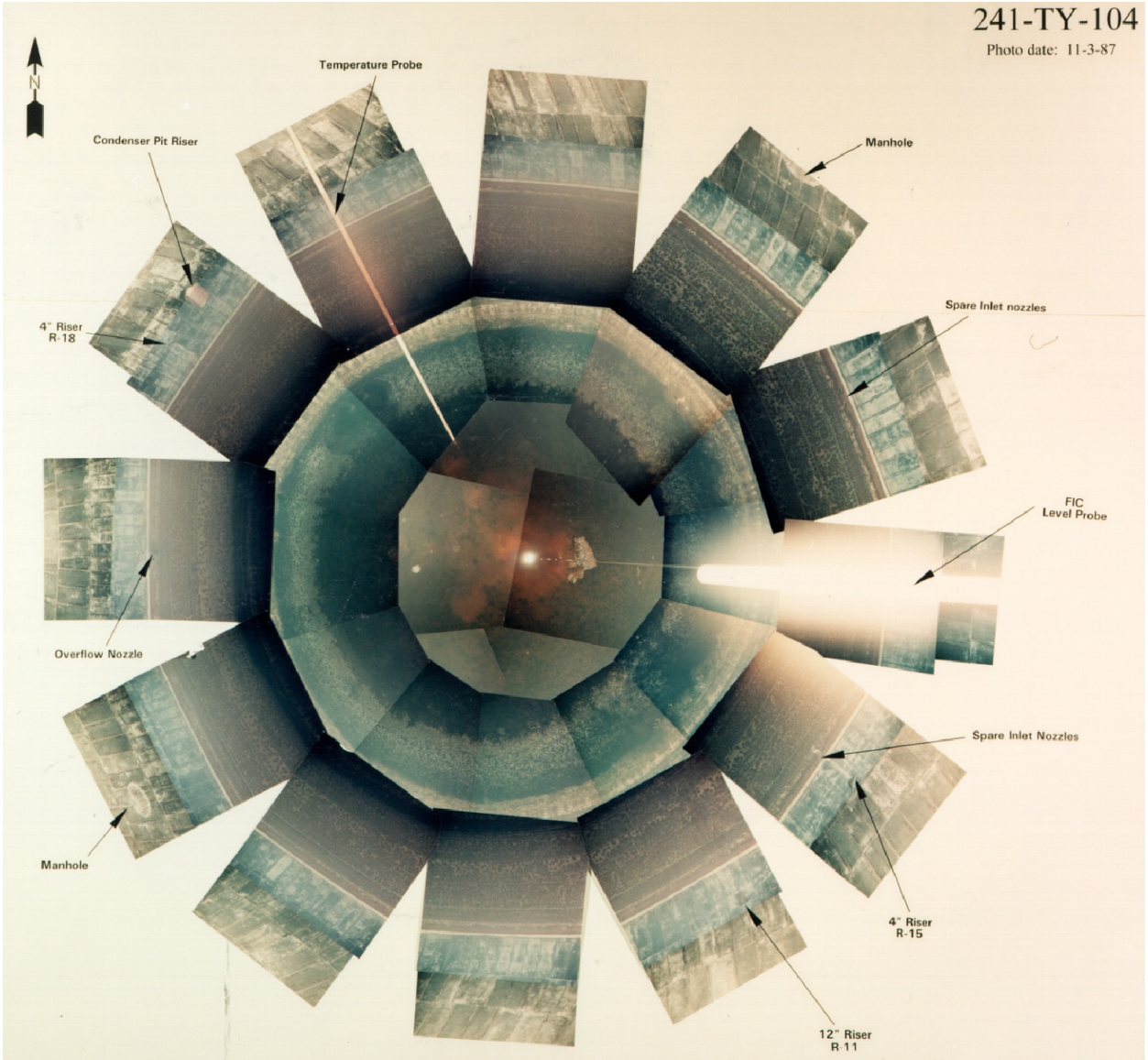
Figure 5.4-4. Tank 241-TY-104 Waste Fill History



5.4.1.1 Integrity of Tank 241-TY-104. This tank was declared an assumed leaker in 1981 with an estimated leak volume of 1,400 gal (HNF-EP-0182). Intrusion prevention was completed in December 1982, and the tank was administratively interim stabilized in February 1983 (HNF-EP-0182). SD-WM-TI-356 reports that the tank was removed from service in response to a liquid level decrease in 1974 that exceeded the 0.3-in. decrease criterion. Liquid level decreases and increases that exceeded reporting requirements were observed in 1975 and 1976, after the tank waste had been pumped out and the tank was removed from service.

5.4.1.2 Interim Stabilization. The tank was pumped to a heel of 24.1 inches from March to November 1974 (SD-WM-TI-356). The tank was administratively stabilized on November 1983. Video showed a supernatant pool ~45 ft in diameter in the center of the tank with an estimated volume of 3,000 gal. The drainable liquid remaining was initially estimated to be 14,700 gal based on a 21.5-in. solids level, 12-in. capillary height and estimated 45% drainable porosity. Figure 5.4-5 depicts a mosaic of the waste surface in tank TY-104 as of November 3, 1987. The present inventory for tank TY-104 is 43,000 gal consisting of 42,000 gal of sludge and 1,000 gal of supernatant liquid. The sludge contains an estimated 7,000 gal of drainable, interstitial liquid (HNF-EP-0182). The present level of the waste in tank TY-104 is about 12 in. above the lowest point of the dished tank base.

Figure 5.4-5. Tank 241-TY-104 Surface Mosaic Photo



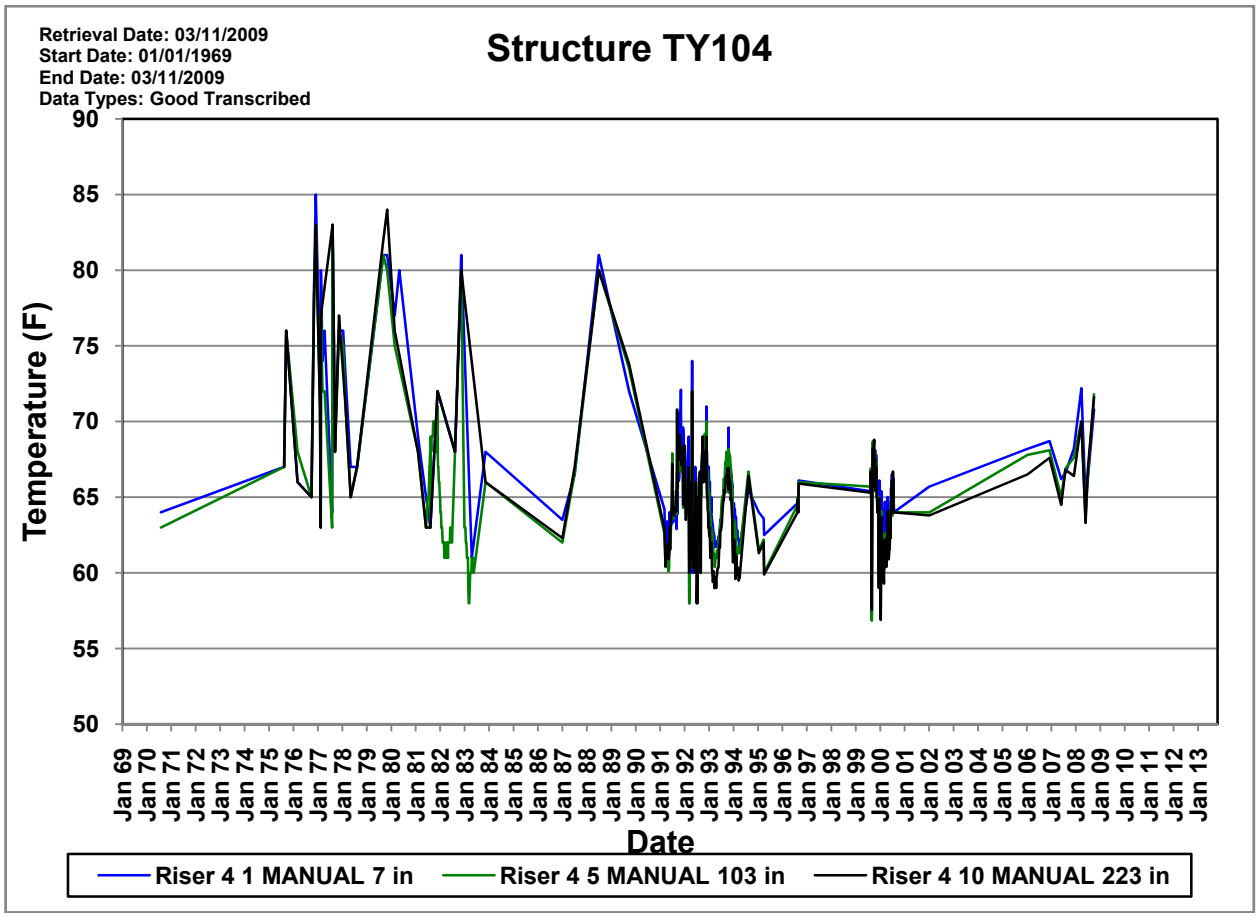
5.4.1.3 Tank 241-TY-104 Temperature History. Figure 5.4-6 shows a thermal history for thermocouples #1 (4 in. from tank bottom), #5 (8 ft 4 in. from tank bottom) and #10 (18 ft 4 in. from tank bottom) in Riser 4 of tank TY-104 from 1970 through 2009. The tank temperature for all thermocouples in Risers 3 and 4 varied between 55 and 85 °F during this time. These measurements are shown in SACS. No temperature information was found before 1970.

5.4.2 Data Review and Observations

5.4.2.1 Surface Level Data. Table 5.4-2 (SD-WM-TI-356) shows FIC surface level measurements between June 1973 and 1977. Table 5.4-2 shows three surface level measurements indicating a 0.5 in. leak: a liquid level measurement of 273.0 on January 20, 1974

showing continuation of a stable profile; a measurement of 272.5 in. on March 16, 1974 showing a 0.5 in. decrease from the January 20, 1974 measurement; and a measurement of 26.0 in. on March 26, 1974, after the tank liquid was pumped out. In 1973, saltwell pumping began in the tank. By 1974, the liquid-level measuring device was contacting the solid surface of the saltcake. No liquid level measurements other than process volume records were available before June 1973. Surveillance Analysis Computer System shows that an ENRAF was installed in the tank in 1995.

Figure 5.4-6. Tank 241-TY-104 Temperature Measurements



Letter 72730-80-097, "Review of Classification of Six Hanford Single-Shell "Questionable Integrity (QI)" Tanks" indicates multiple measurements were made between December 30, 1973 and March 16, 1974 and shows an abrupt change in the liquid surface in the tank between December 30 and December 31, characteristic of a tank leak.

5.4.2.2 Drywell Logging Data. A plot of the man-made radionuclide concentration profiles for the boreholes surrounding tank TY-104 is shown in Figure 5.4-7. This plot shows that at least trace amounts of ^{137}Cs contamination were detected by the SGLS in all the boreholes surrounding tank TY-104. In addition, ^{154}Eu contamination was detected in borehole 52-06-02 between depths of 1 and 4 ft.

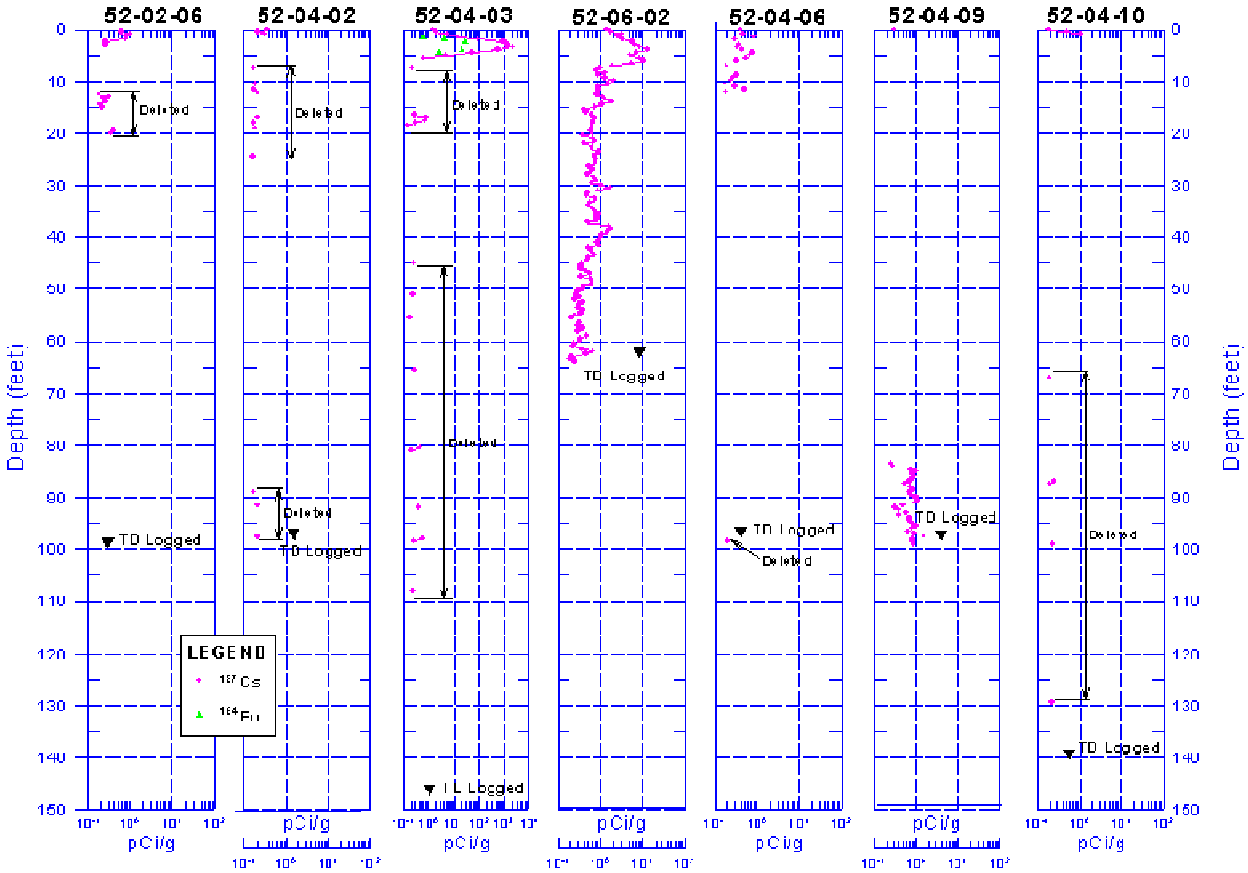
Table 5.4-2. 1973 to 1974 241-TY-104 Liquid Level Measurements (SD-WM-TI-356)

Date	Liquid Level (in.)	Change from previous reading	Cumulative Change	Comments
06/13/73	271.3			FIC gage
07/26/73	271.4	+0.10	+0.10	Slow increase
07/27/73	273.0		+0.10	Recalibration
01/20/74	273.0		+0.10	Stable
03/16/74	272.5	-0.50	-0.40	Slow decrease
03/26/74	26.0		-0.40	Transfer, baseline ref
09/15/74	26.0		-0.40	Stable
09/28/74	25.85	-0.15	-0.55	Slow decrease
09/30/74	22.2		-0.55	Saltwell transfer, baseline ref
10/11/74	20.4		-0.55	Saltwell transfer, baseline ref
10/17/74	23.3		-0.55	Flush valve leak, baseline ref
10/21/74	20.8		-0.55	Transfer, baseline ref
1/25/75	22.2	+1.40	+0.85	Slow increase
1/26/75	22.8		+0.85	Pump pit drained
6/22/75	21.6	-1.20	-0.35	Slow decrease
8/17/75	21.6		-0.35	Stable
8/18/75	21.95	+0.35	0.00	Unexplained rise
12/20/75	20.9	-1.05	-1.05	Slow decrease
1/8/76	21.35	+0.45	-0.60	Slow increase
1/9/76	22.5		-0.60	Pressure test
1/14/76	23.0		-0.60	Drainage, baseline ref
1/26/76	23.45	+0.45	-0.15	Slow increase
1/27/76	23.65		-0.15	FIC flushed
3/4/77	23.50	-0.15	-0.3	Stable
5/8/77	23.5		-0.3	Erratic readings from 22.5 to 23.5 in.
5/12/77	23.2		-0.3	FIC recalibrated

Reference: SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*.
FIC = Food Instrument Corporation

Except for boreholes 52-04-03 and 52-06-02, the measured ^{137}Cs concentrations were generally at or below 1 pCi/g. The ^{137}Cs concentrations in the upper 5 ft of borehole 52-06-02 ranged up to about 10 pCi/g; concentrations in borehole 52-04-03 were higher.

Figure 5.4-7. Spectral Gamma Logging System Monitoring Results near Tank 241-TY-104



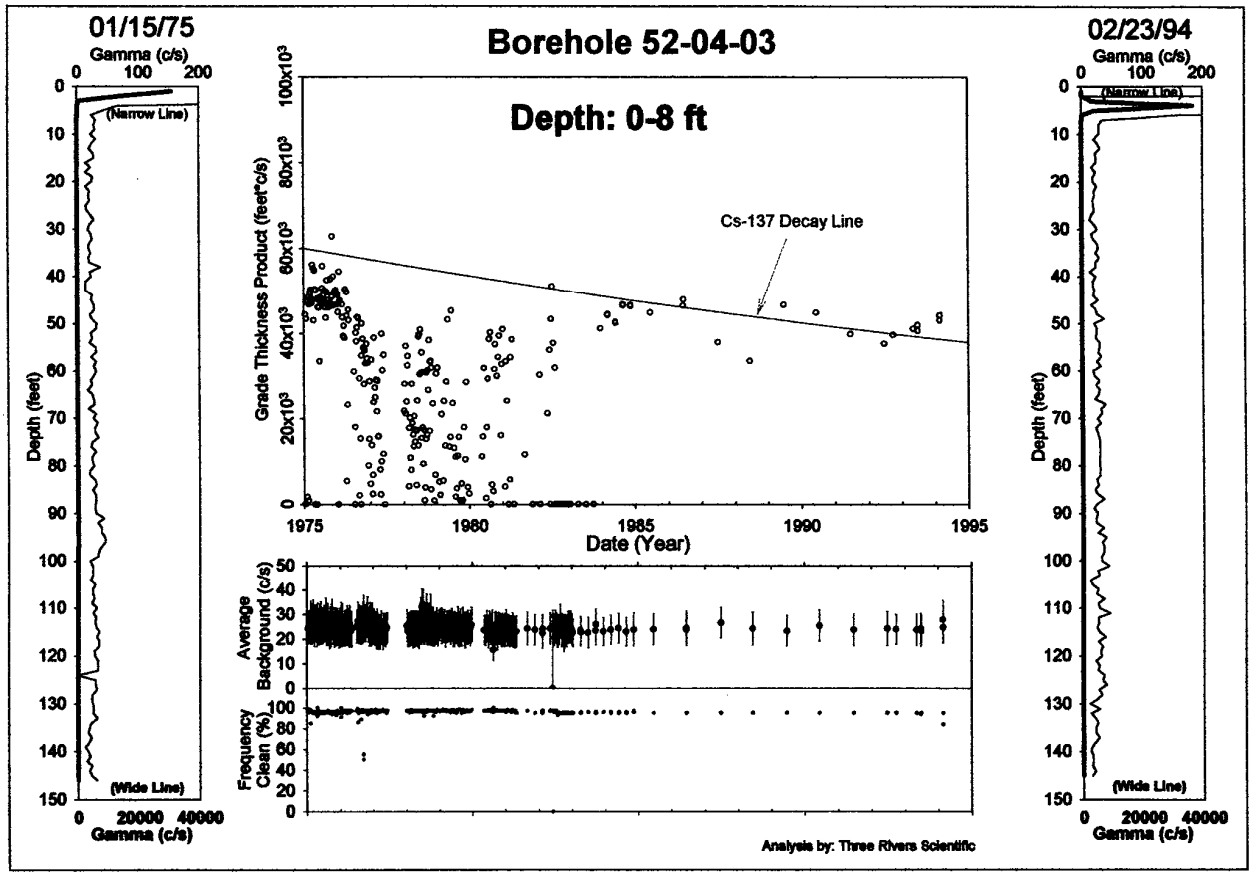
In the upper 5 ft of borehole 52-04-03, ^{137}Cs was detected at high concentrations and ^{154}Eu in moderate concentrations. This borehole is located near a transfer line that was used to connect with a nozzle located on the northeast side of tank TY-104. The low-level ^{137}Cs contamination (about 10 pCi/g) in the upper 5 ft of borehole 52-06-02 appears to be related to a surface spill or possibly a leak from a transfer line associated with tank TY-106.

A continuous zone of low-level ^{137}Cs contamination was observed below a depth of about 84 ft in borehole 52-04-09. The contamination was observed at the maximum accessible depth in this borehole (99 ft) and extends to some unknown depth below the bottom of the borehole.

The zone of anomalous gamma-ray activity evident in the SGLS gross gamma count-rate below a depth of 90 ft, and on historical gross gamma logs (Figures 5.4-8, 5.4-9 and 5.4-10), could be associated with the increased KUT (potassium, uranium, thorium) concentrations in this depth interval.

The minor concentrations of ^{137}Cs in boreholes 52-02-06, 52-04-02, 52-04-03, 52-04-09 and 52-04-10 are likely from a surface spill carried downward by drilling.

Figure 5.4-8. Drywell 52-04-03 Total Gamma Measurements



The SGLS data and historical gross gamma logs show no signs of contamination from a leak in tank TY-104. Likewise, the historical gross gamma logs do not indicate any anomalous gamma activity below the operating level of the tank.

5.4.3 Tank 241-TY-104 Assessment

Tank TY-104 was one of six "questionable integrity" tanks reviewed in 1981. In the review, four review teams concluded that at the 95% confidence interval (CI) tank TY-104 should be classified as a confirmed leaker (RHO-CD-1193, *Review of Classification of Hanford Single-Shell Tanks 110-B, 111-C, 103-T, 107-TX, 104-TY, and 106-U*, p. 11).

The 1981 findings (p. 53 and 54) were based on the following.

- The team identified a 0.6-in. liquid level decrease between December 30, 1973 and March 16, 1974 which exceeds the 0.5 in. measuring limit for FIC gages. No operations were identified during this period that could have caused the liquid level decrease.

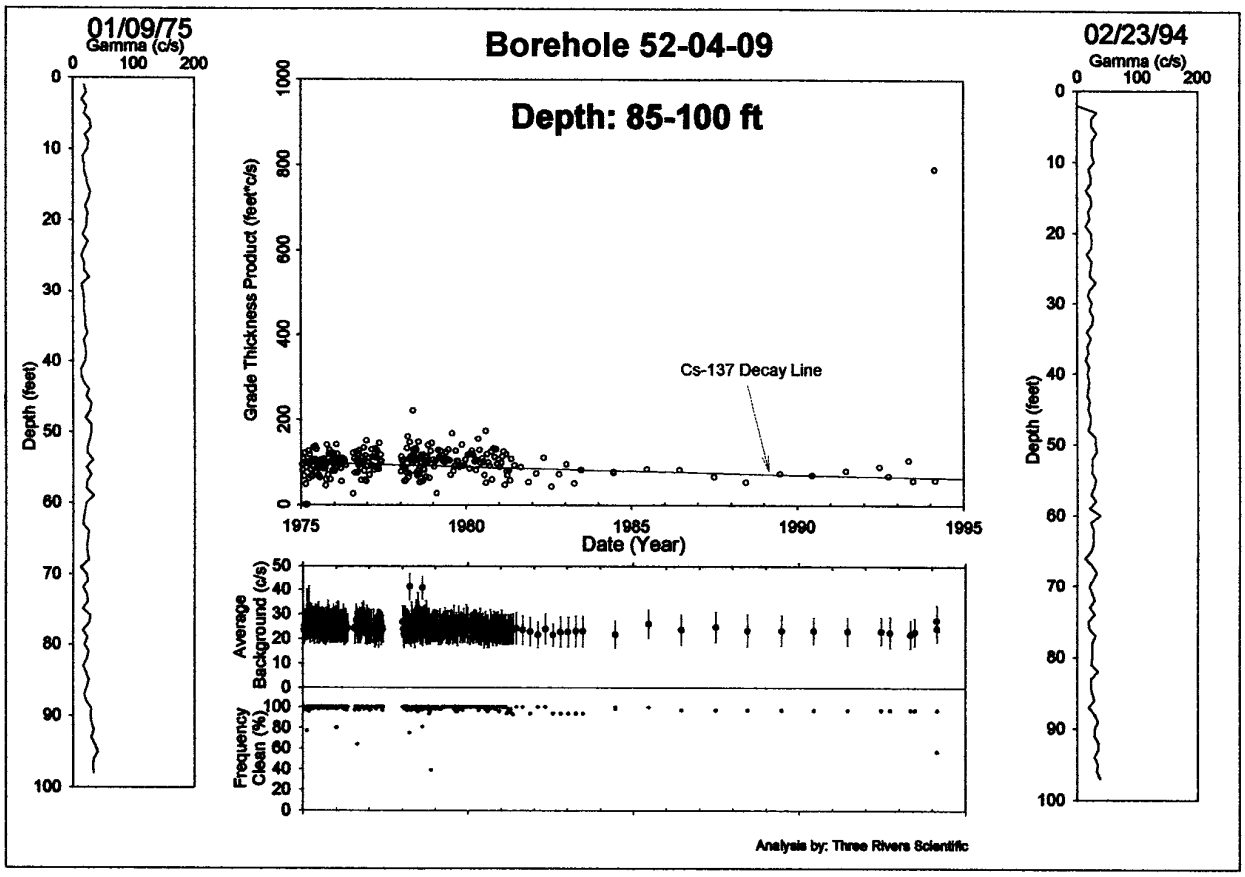
- Prior to the decrease the tank had remained dormant for over three years.

- The liquid level decrease cannot be satisfactorily explained except on the basis that the tank was leaking at the time it was pumped out.

- Although no drywell data confirm a leak, drywell spacing is inadequate to assure a leak of 1,400 gal would be detected.

- The trend of liquid level readings was consistently down during January to February 1974 with an apparent liquid loss of about 20 gal per day. Continuation of FIC readings for more days in March would have provided more evidence.

Figure 5.4-9. Drywell 52-04-09 Total Gamma Measurements

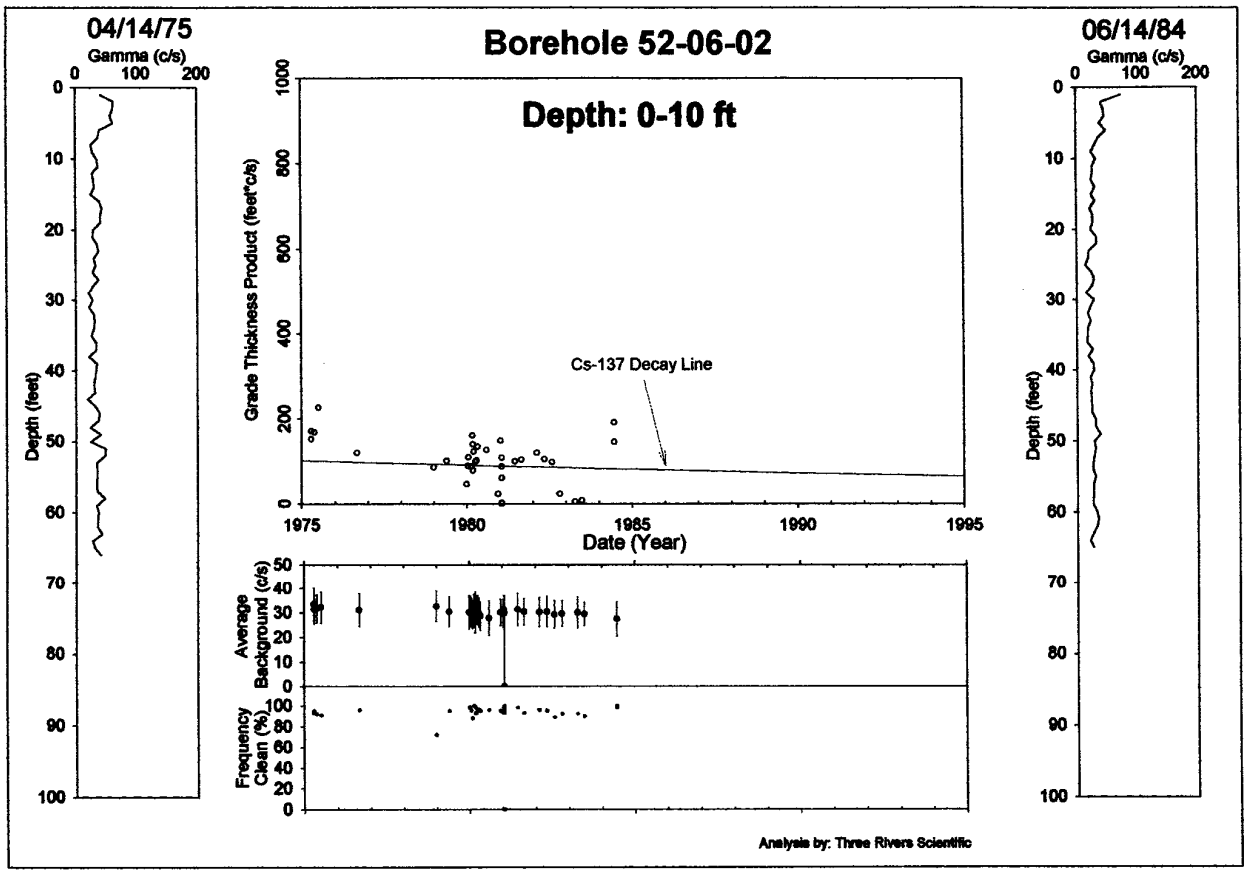


5.4.4 Conclusion

It was surmised that the pattern of the liquid level decrease shown on the plot reviewed was a strong indication of a leak and that the volume leaked was approximately 1,400 gal based on a 0.5-in. liquid level decrease. The SIM assumes the liquid waste present in tank TY-104 in 1974 was TBP-UR waste with a ^{137}Cs concentration of 11,500 Ci/M^3 or 43,400 uCi/gal decayed to January 2001. However, a memo dated May 6, 1974 (Internal memo MEM-010274 "Analysis of Tank Farm Samples 01/02/74 Thru 12/26/74") shows analysis results for TY-104 samples (#T-3069) that are likely representative of superannuate in the tank at the time of the leak. The memo shows a concentration for ^{137}Cs of 3.89×10^5 uCi/gal, decayed to January 2001 =

2.09×10^5 uCi/gal. These analytical results should replace SIM results. Hanford Soil Inventory Model results should be ratioed to ^{137}Cs differences for analytes where sample data is not available (ratio = $2.09\times10^5/4.34\times10^4 = 4.8$).

Figure 5.4-10. Drywell 52-06-02 Total Gamma Measurements



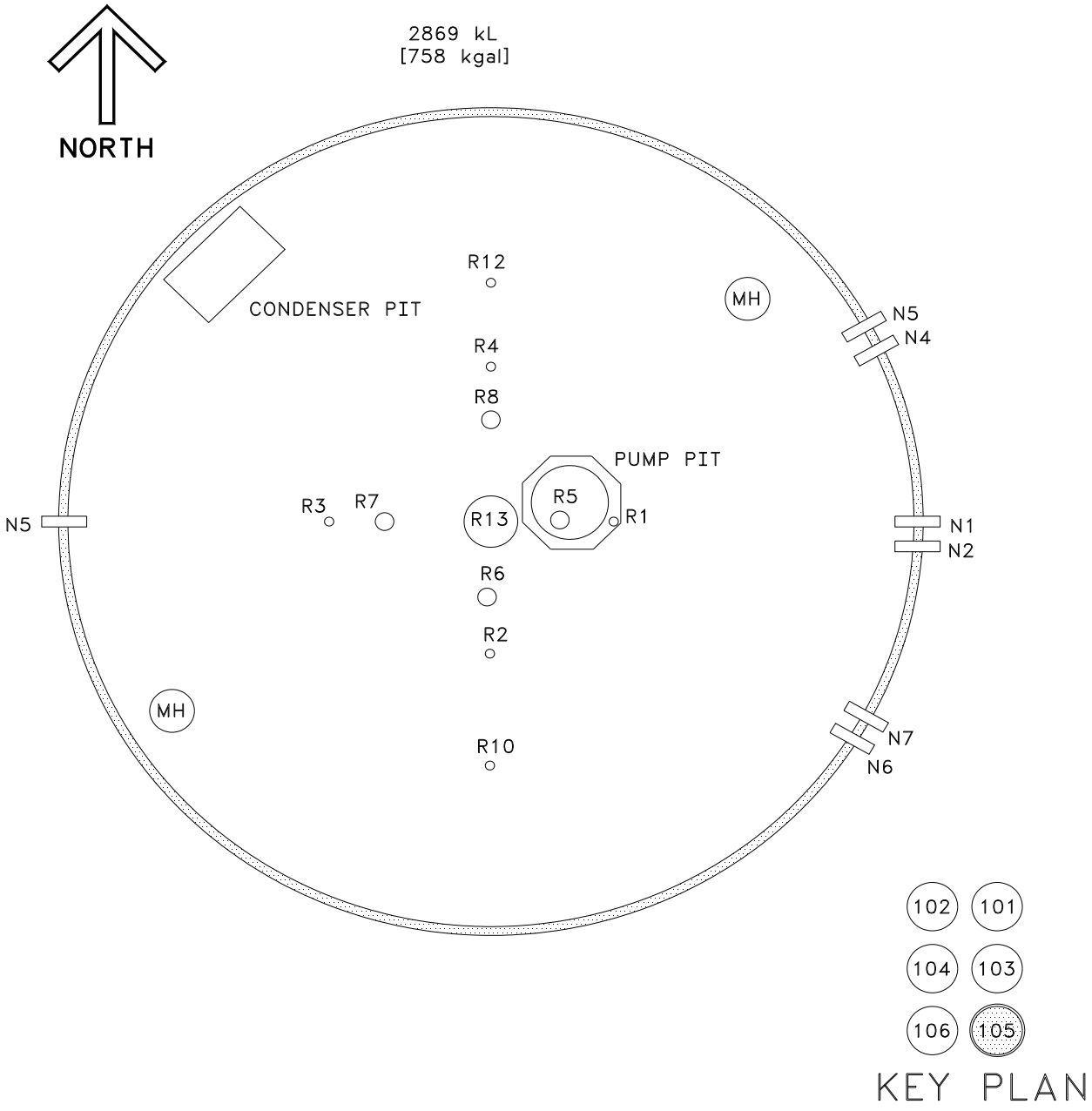
5.5 TANK 241-TY-105 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-105. The following subsections summarize the waste operating history for tank TY-105. Figure 5.5-1 is a plan view of the tank.

5.5.1 Tank 241-TY-105 Waste History

Single-shell tank TY-105 was placed in service in January 1953 and used to store waste from the 221-U TBP Plant (HW-27841, *Waste Status Summary Separations Section Period: January 1953*). Figure 5.5-2 provides a summary of tank TY-105 waste operations, while Table 5.5-1 shows waste transfer history for tank TY-105. Figure 5.5-3 depicts the surface level history.

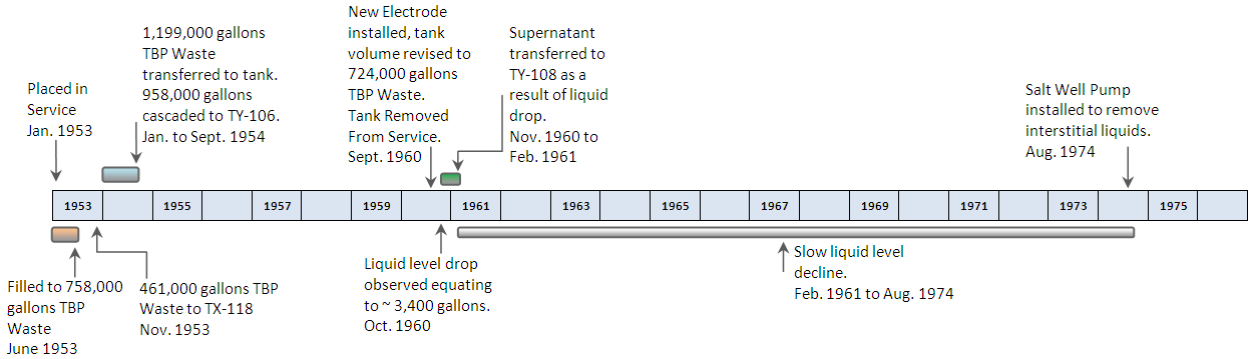
Figure 5.5-1. Plan View of Tank 241-TY-105



Tank TY-105 was filled to ~758,000 gal with TBP waste by June 1953 (HW-29242). An additional 1,128,000 gal of TBP waste was added to the tank between July and December 1953, 908,000 gal cascaded to TY-106 and 461,000 gal sent to TX-118, leaving 517,000 gal of TBP waste in the tank in January 1954 (HW-30498, *Separations Section Waste – Status Summary December 31, 1953*). From January through September 1954, 1,199,000 gal of TBP waste was added of which 958,000 gal cascaded to TY-106 leaving a full tank of 758,000 gal (HW-33396, *Separations Section Waste – Status Summary for Month of September 1954*). No transfer activity took place from October 1954 to September 1960. A new electrode was installed and the liquid waste level adjusted to 724,000 gal in September 1960, at which point the tank was

removed from service (SD-WM-TI-356). In October 1960 a 1 ¼-in. (3,400-gal) liquid level drop was observed (HW-67705, *Chemical Processing Department Waste Status Summary October 1, 1960 – October 31, 1960*). As a result, the remainder of the pumpable superannuate was transferred from tank 241-TY-105 to tank 241-TX-108 (TX-108) in December 1960 and February 1961, leaving approximately 312,000 gal of waste in this tank. There is a discrepancy in the records of the amount of superannuate sent to TX-108 in 1960. The waste summary reports (HW-68291, *Chemical Processing Department Waste Status Summary November 1, 1960 – November 30, 1960* and HW-68292, *Chemical Processing Department Waste – Status Summary December 1, 1960 – December 31, 1960*) show 93,000 gal was transferred in November and 24,000 in December. However, HW-83906 records 77,000 in November and 27,250 gal in December for a delta of 13,000 gal.

Figure 5.5-2. Tank 241-TY-105 Waste Operations Summary



The liquid level in tank 241-TY-105 continued to slowly decline from February 1961 through August 1974, when a saltwell pump was installed and pumping initiated to remove interstitial liquids (SD-WM-TI-356). The liquid level decline from February 1961 through August 1974 was approximately 27,000 gal. However, the manual tape used to measure liquid level was reported to be contacting solid waste surfaces within the tank, raising uncertainty about the actual liquid level decline from February 1961 through August 1974. Furthermore, evaporation may have contributed to the liquid level decline observed during this period.

5.5.1.1 Integrity of Tank 241-TY-105. This tank was declared a confirmed leaker and removed from service in 1960 with an estimated leak volume of 35,000 gal (HNF-EP-0182). Interim isolation was completed October 1984, and the tank was interim stabilized February 1983 (HNF-EP-0182). The leak volume estimate is based on waste transfer records which show an unaccounted-for liquid level decrease of TBP waste in 1959. The limited number of drywells around this tank indicates gamma contamination that is consistent with loss of TBP waste (GJO-97-30-TAR/GJO-HAN-16, *Hanford Tank Farms Vadose Zone: TY Tank Farm Report*). Both ^{137}Cs and ^{60}Co were found in drywells 52-03-06, 52-05-07, and 52-06-05.

5.5.1.2 Tank 241-TY-105 Interim Stabilization. A P-10 pump was installed and tank TY-105 superannuate was saltwell pumped beginning August 20, 1974. Tank TY-105 was jet pumped from November 4, 1982 to December 10, 1982 removing 3,600 gal of liquid. Pumping was halted after several attempts to flush the saltwell screen to increase flow rate resulted in only the flush water being pumped out again, indicating that remaining liquids in the sludge were

undrainable (HNF-SD-RE-TI-178). Tank TY-105 was declared interim stabilized in March 1983 after dip tube measurements showed that the liquid level had reached equilibrium.

Table 5.5-1. Tank 241-TY-105 Waste Transfers (2 sheets)

Date/Date Range	*Transfer Type*[1]	*Transfer Volume (gal*1000)*[1]	*Total Vol. In Tank (gal*1000)*[2]	*Discrepancy with previous reading (gal*1000)*[3]	*Waste type*[4]	*Transfer tank from/to*	*Document Number*[5]
Jan.-1953	IN	164	164		TBP	TBP Waste In	HW-27841
Feb.-Mar,1953	IN	90	254		TBP	TBP Waste In	HW-27775
Apr-May,1953	STAT		252	-2	TBP		HW-28377
June-1953 to Aug.-1953	IN	654			TBP	TBP Waste In	LA-UR-97-311
June-1953 to Aug.-1953	OUT	-150	758		TBP	TBP Waste In	HW-28712 LA-UR-97-311
Sept.-1953 to Dec.-1953	IN	1128			TBP		LA-UR-97-311
Sept.-1953 to Dec.-1953	OUT	-908				Cascaded to TY-106	LA-UR-97-311
Sept.-1953 to Dec.-1953	OUT	-461	517		TBP	TX-118	HW-30250 / HW-30498
Jan.-1954	IN	1199			TBP	TBP Waste In	HW-30851
Jan.-1954	OUT	-958	758		TBP	Cascaded to TY-106	HW-30851
Feb.-1954 to Sept.-1954	STAT		758		TBP	Cascaded to TY-106	HW-31126 / HW-33396
Oct.-1954 to Dec.-1956	STAT		758		TBP		HW-33544 / HW-47640
Jan.-1957 to May-1957	STAT		~705		TBP	QUESTIONABLE STAT READING	HW-48144
June-1957	STAT		750		TBP	NEW ELECTRODE READING	HW-51348
July-1957 to July-1959	STAT		750 ~752		TBP		HW-51858
Aug.-1959 to Aug.-1960	STAT		744	-6	TBP	NEW ELECTRODE READING	HW-61952 / HW-66827
Sept.-1960	STAT		724	-20	TBP	NEW ELECTRODE READING	HW-67696
Sept.-1960						REMOVED FROM SERVICE, TANK CLASSIFIED AS LEAKING	SD-WM-TI-356 pg. 52-05-06
Oct.-1960	STAT		721	-3	TBP		HW-67705
Nov.-1960	OUT	-93	628		TBP	TY-108	HW-68291
Dec.-1960	OUT	-24	609		TBP	TX-118	HW-68292

Table 5.5-1. Tank 241-TY-105 Waste Transfers (2 sheets)

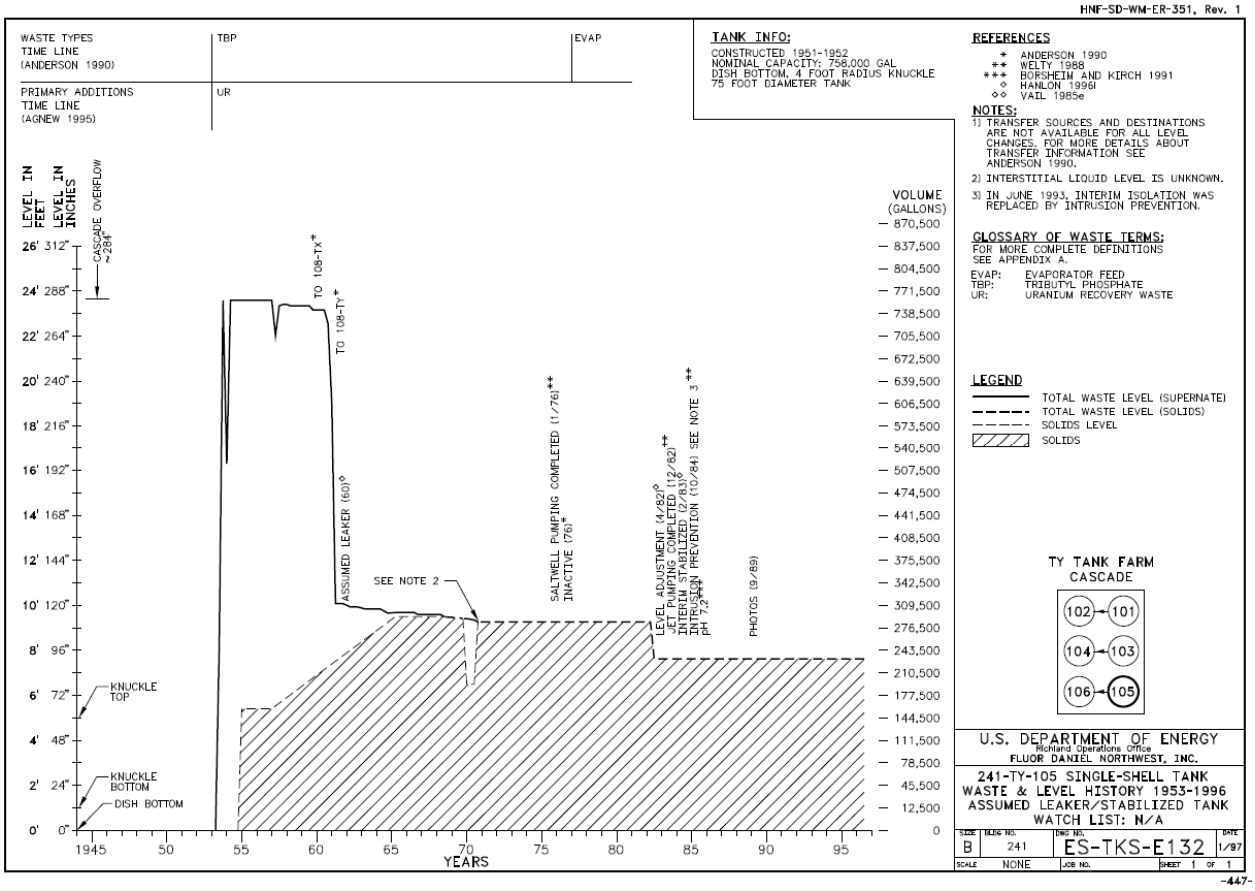
Date/Date Range	*Transfer Type*[1]	*Transfer Volume (gal*1000)*[1]	*Total Vol. In Tank (gal*1000)*[2]	*Discrepancy with previous reading (gal*1000)*[3]	*Waste type*[4]	*Transfer tank from/to*	*Document Number*[5]
Jan.-1961 to Dec.-1961	OUT	-294	312 (Reported Value)	-2	TBP	TX-108	HW-71610
Jan.1962-Dec.-1962	STAT		307	-5	TBP		HW-74647
Jan.-1963 to June.-1964	STAT		304	-3	TBP		HW-78279
July-1964 to Dec.-1964	STAT		298	-6	TBP		RL-SEP-260
Jan.-1965 to June-1966	STAT		299	1	TBP		RL-SEP-821
July-1966 to Mar.-1968	STAT		296	-3	TBP		ISO-538
Apr.-1968 to June-1968	STAT		293	-3	TBP		ARH-721
July-1968 to Dec.-1968	STAT		292	-1	TBP		ARH-871
Jan.-1969 to June-1969	STAT		291	-1			ARH 1200 A
July-1969 to Dec.-1969	STAT		290	-1			ARH 1200 C
Jan.-1970-Mar.-1970	STAT		289	-1			ARH-1666 A
Apr.-1970 to June-1970	STAT		288	-1			ARH-1666 B
July-1970 to Dec.-1970	STAT		285	-3			ARH-1666 C / ARH-1666 D

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.
[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Transfer volumes are from references shown and LA-UR-97-311.
[3] Small discrepancies may be attributed to water additions or effects such as evaporation.
[4] Waste type: TBP = tributyl phosphate.
[5] For reference titles, see Section 6.0 REFERENCES.

A photo mosaic of the tank dated September 7, 1989 (Figure 5.5-4) shows a cracked, mostly dry surface with small liquid pools. As of September, 2008 the tank contains an estimated 231 kgal of TBP sludge.

5.5.1.3 Tank 241-TY-105 Temperature. No temperature data were available before 1977 (Historical Tank Content Estimate). The maximum temperature in 1977 was 99 °F.

Figure 5.5-3. Tank 241-TY-105 Waste Fill History



5.5.2 Data Review and Observations

5.5.2.1 Surface Level Data. On November 1960 the "Varec", the new remotely-operated liquid level gage, detected a slow leak in tank TY-105. The increased sensitivity of this new instrument over the present electrode method of detecting the liquid level was credited with determining that the liquid level was steadily dropping about 1/8 in. in two days (an average rate of less than 200 gal per day). As a result, tank liquids were pumped to tank TX-108 (HW-67459-DEL, *Chemical Processing Department Monthly Report for November 1960*, p. F-3) and the tank was removed from service (SD-WM-TI-356).

It appears that a leak volume of 35,000 gal was assigned based on an unexplained liquid level decrease. LA-UR-97-311 shows a 35,000 gal decrease in 1959 and notes that the 35,000 gal was a correction for condensate transferred out of the tank (Table 5.5-1). At issue is that neither the document WHC-MR-0132 nor tank processing records show there was a 35,000 gal decrease. A 1 ¼-in. (3,400-gal) liquid level drop during October 1960 is noted in the transfer record (HW-67705) and in WHC-MR-0132 and the liquid level decreased from 312 kgal to 285 kgal from January 1961 through September 1970 totaling 30,400 gal. Adding the 13,000-gal discrepancy noted in November and December 1960, based on transfer records the leak volume could have been as large as 43,000 gal through September 1970.

Figure 5.5-4. Tank 241-TY-105 Surface Mosaic Photo

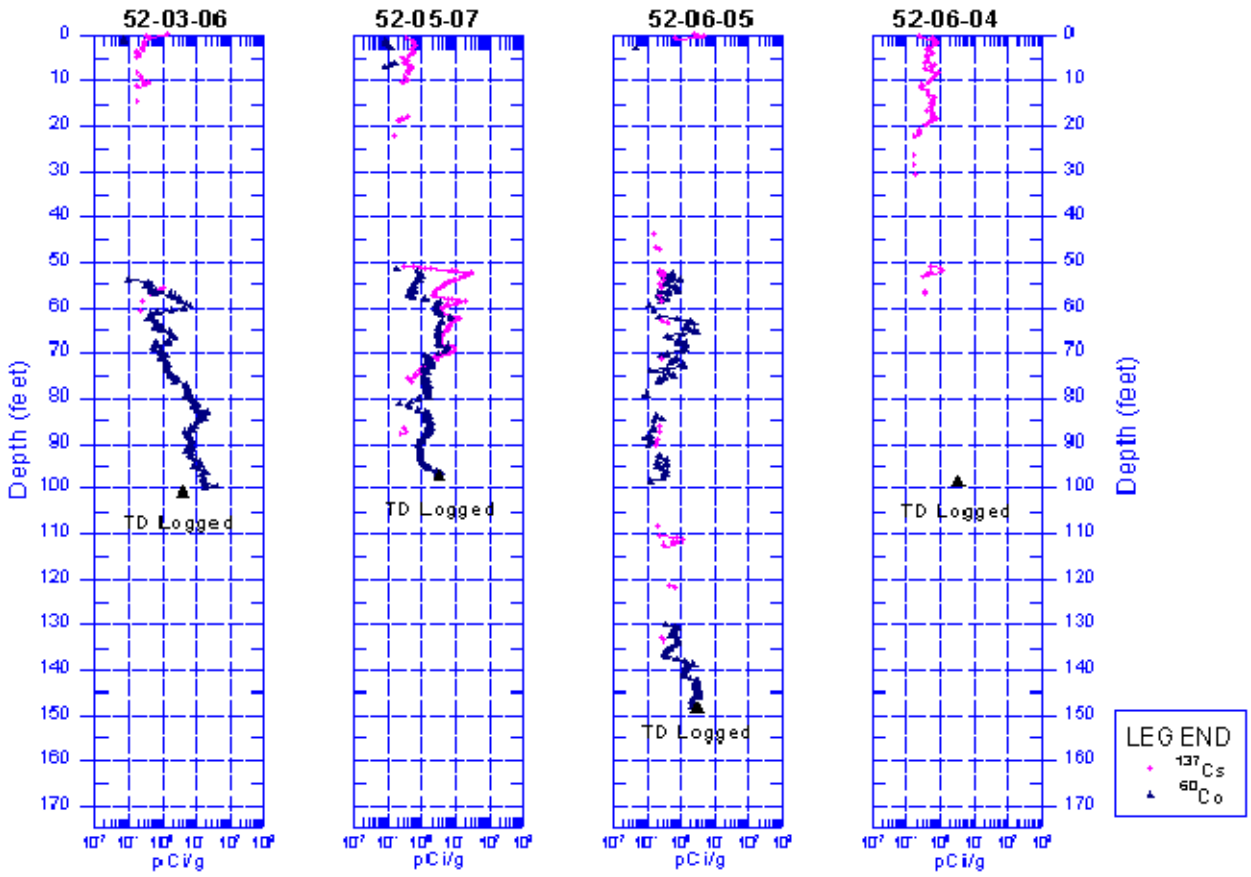
SD-WM-TI-356 also records several unexplained liquid level decreases in 1974 and continuing slow decreases through 1986. However, as noted the manual tape used to measure liquid level was reported to be contacting solid waste surfaces within the tank after 1961, raising uncertainty about the actual liquid level decline; the tank was saltwell pumped beginning August 20, 1974 (LA-UR-96-3860, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model*) and completing January 1, 1976 (SD-WM-TI-356). Although expected to be minimal based on tank temperature, evaporation may also have contributed to the liquid level decline observed during this period.

Occurrence report OR-74-102, *Occurrence Report 74-102 Leakage Symptoms As Indicated By Dry Well Activity At Waste Tank 105-TY* was issued in June 1974 documenting increased activity observed after logging drywells 52-03-05 and 52-03-06. The final report dated August 1974 concluded that "the radiation observed in the dry wells may have been the result of interstitial liquid seepage from tank 105-TY. Test hole auguring was inconclusive since holes could only penetrate to seven feet due to rock interference."

5.5.2.2 Drywell Data. GJ-HAN-68, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank TY-105* and GJO-97-30-TAR/GJO-HAN-16 describe drywell monitoring and results near tank TY-105. Four vadose zone monitoring

drywells surround tank TY-105. Spectral gamma-ray data were acquired in drywells 52-03-06, 52-05-07, 52-06-05, and 52-06-04 (Figure 5.5-5). Drywells 52-06-05 and 52-06-07 were the only drywells in this region of the tank farm in 1959 (SD-WM-TI-356). Figure 5.5-6 shows a note from Warren (1960) indicating data from drywell 52-06-05 showed elevated count rates as early as September 1959.

Figure 5.5-5. Tank 241-TY-105 Drywell Spectral Gamma Logging System Results



The SGLS detected ^{137}Cs in most of the drywells that surround tank TY-105. Cobalt-60 was detected in drywells 52-03-06, 52-05-07, and 52-06-05. Little or no activity was detected in drywell 52-06-07 (not shown in Figure 5.5-5). Low concentrations of ^{137}Cs and ^{60}Co were detected between 54 and 100 ft in drywell 52-03-06. The earliest available historical gross gamma log data shows 13,000 c/s activity was present at 55 ft at on July 16, 1973 (about 2 years after the drywell was constructed) (SD-WM-TI-356). Activity increased to 16,700 on February 28, 1974, then decreased gradually to about 1,000 counts by 1986 (Figure 5.5-7).

The SGLS detected ^{137}Cs and ^{60}Co between 51 and 97 ft in drywell 52-05-07. This drywell was drilled in August 1974 and the earliest available gross gamma log data shows a maximum of 1,700 c/s at 62 ft on September 13, 1974 (SD-WM-TI-356). The time-sequence plot for this drywell shows that the anomalous zone of activity remained stable and decayed at a constant rate through 1993 (Figure 5.5-8).

Figure 5.5-6. 1960 Memo-Tank 241-TY-105 Waste Storage Leak

DON'T SAY IT --- Write It!

DATE November 1, 1960

TO W. K. Mcready

FROM J. H. Warren

105-TY WASTE STORAGE TANK LEAK

A leak in the 105-TY waste storage tank was suspected in early September when measurements obtained by FEO (with a recently installed remote electronic measuring instrument) did not agree with electrode measurements. Daily checks were instituted and have confirmed a small (approx. 180 gal/day) but consistent loss from the tank. Readings obtained with the electronic device are in excellent agreement with electrode measurements. Total loss from the tank is indicated to be somewhere between 8,000 and 27,000 gallons.

Monitoring of the four wells in TY farm has not disclosed any significant evidence to substantiate the leak. Activity (up to 6,000 counts per minute) has been present in one of the wells since September, 1959, at which time it was concluded that the 106-TY tank was leaking. After transferring the 106-TY waste to another tank, the activity level began to drop and has now decreased to 2500 counts per minute (October 1960).

In addition to 106-TY, other waste storage tanks which have been adandoned because of a suspected leak are: 113-SX, 104-U, and 101-U.

We are planning to transfer the contents of 105-TY to 108-TX.

:lbp

cc: File (2)

"WATCH IT - ACCIDENTS DON'T ALWAYS HAPPEN TO SOMEONE ELSE"

Drywell 52-06-05 was drilled in August 1952 to a depth of 148 ft using 8-in casing. The note from Warren (1960) (Figure 5.5-6) indicates that contamination was present as early as 1959. The earliest available data for review were from 1973, showing a peak of 1,120 c/s at 62 ft on July 16, 1973 which increased to 1,580 c/s on September 11, 1973 (SD-WM-TI-356), then gradually decreased to less than 100 counts by 1982 (Figure 5.5-9).

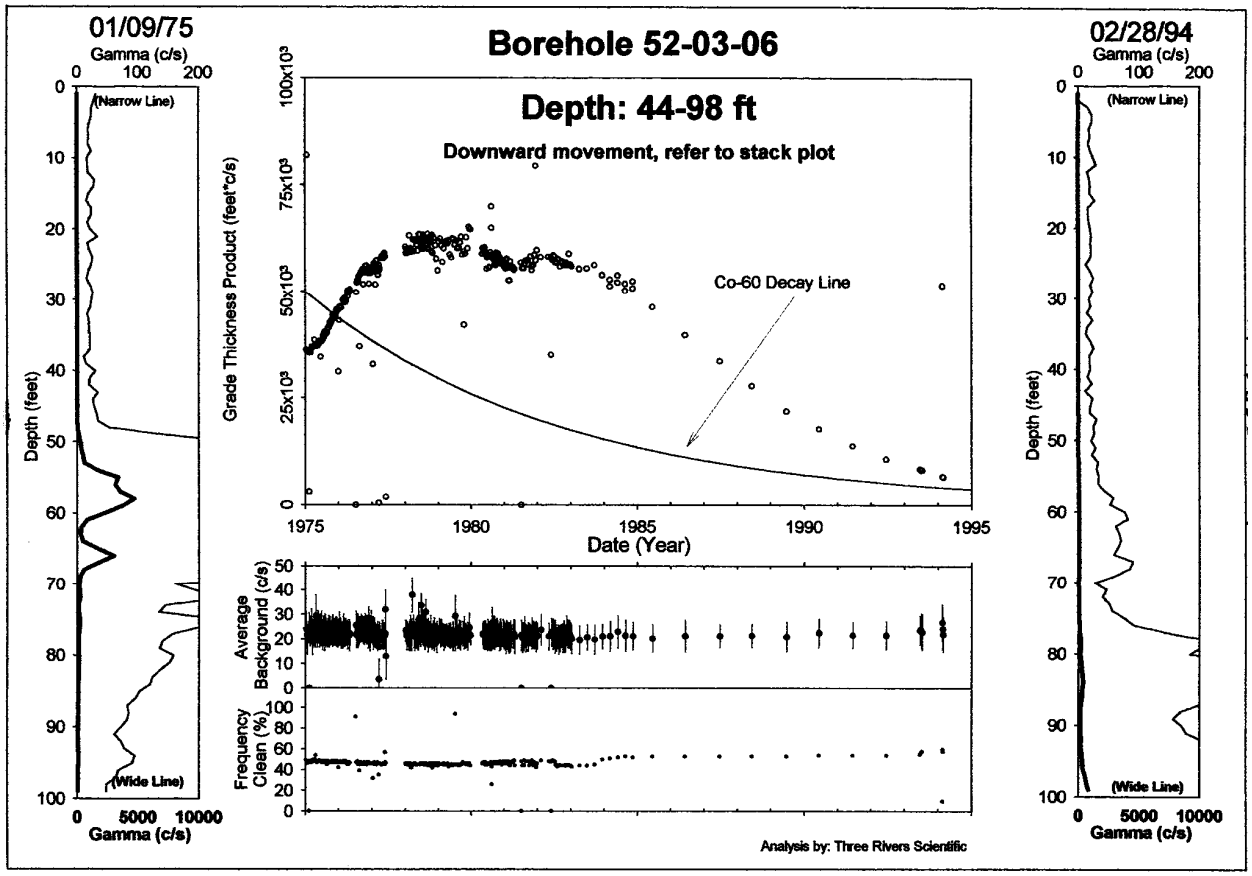
The SGLS detected low concentrations of ^{137}Cs between 51 and 57 ft around drywell 52-06-04. The earliest available gross gamma log data (1974) for this drywell establish that the contamination between 51 and 57 ft was present before the drywell was installed in August 1974. The time-sequence plot for this drywell shows the activity decayed steadily until 1979, at which time the levels were below the minimum detection level of the detector (Figure 5.5-10).

The SGLS detected contamination in the upper sections of all the drywells. This contamination is interpreted to be from surface spills that have migrated, in some undetermined manner, down around the outside of the drywells or contamination that has migrated vertically down natural pathways into the backfill material.

On the basis of comparison of baseline and repeat logging in five drywells, no definitive evidence of contaminant movement exists. Drywell 52-06-05 indicates potential concentration increases that suggest movement. However, the difference in calculated concentration values is within the measurement uncertainty and no definitive conclusion can be drawn

(GJO-96-2-TAR/GJO-HAN-6, *Vadose Zone Characterization Project at the Hanford Tank Farms: BY Tank Farm Report*).

Figure 5.5-7. Drywell 52-03-06 Historical Gamma Logging Results



5.5.2.3 Direct Push/Samples. In addition to the spectral logging, direct push logging and sampling to further characterize the TY-105 leak was conducted in 2005, 2008 and 2009. The 2005 direct push logging locations and summary of results are shown in Figure 5.5-10 and Table 5.5-2 (RPP-RPT-34870). The 2008 and 2009 results (RPP-RPT-41100) show high levels of ^{99}Tc and nitrate at 100 ft, just above the Cold Creek Formation (low permeability layer) below TY-Farm and extending 100 to 200 ft south of tank TY-105. Figure 5.5-11 shows the location of direct push holes and samples obtained. Preliminary sample results (Figure 5.5-11) indicate that the largest concentration of ^{99}Tc was the furthest from the tank. This indicates that some of the ^{99}Tc, particularly ^{99}Tc located over 100 ft south of tank TY-105, may come from other sources such as pipe leaks, the TY-153 diversion box or double contained receiver tank (DCRT).

The amount of ^{99}Tc measured from direct push samples, assuming a contaminated area of 5,000 ft^2, 10 ft depth and average concentration of 800 pCi/g were about 0.6 Ci. This is close to the SIM estimate for a 35,000 gal leak of TBP waste from tank TY-105 (0.5 Ci). A larger plume or higher concentration as indicated by the 1,350 pCi/g sample result 200 ft south of tank TY-105 would further indicate multiple leak sources.

Figure 5.5-8. Drywell 52-05-07 Historical Gamma Logging Results – 51 to 57 feet and 57 to 66 feet

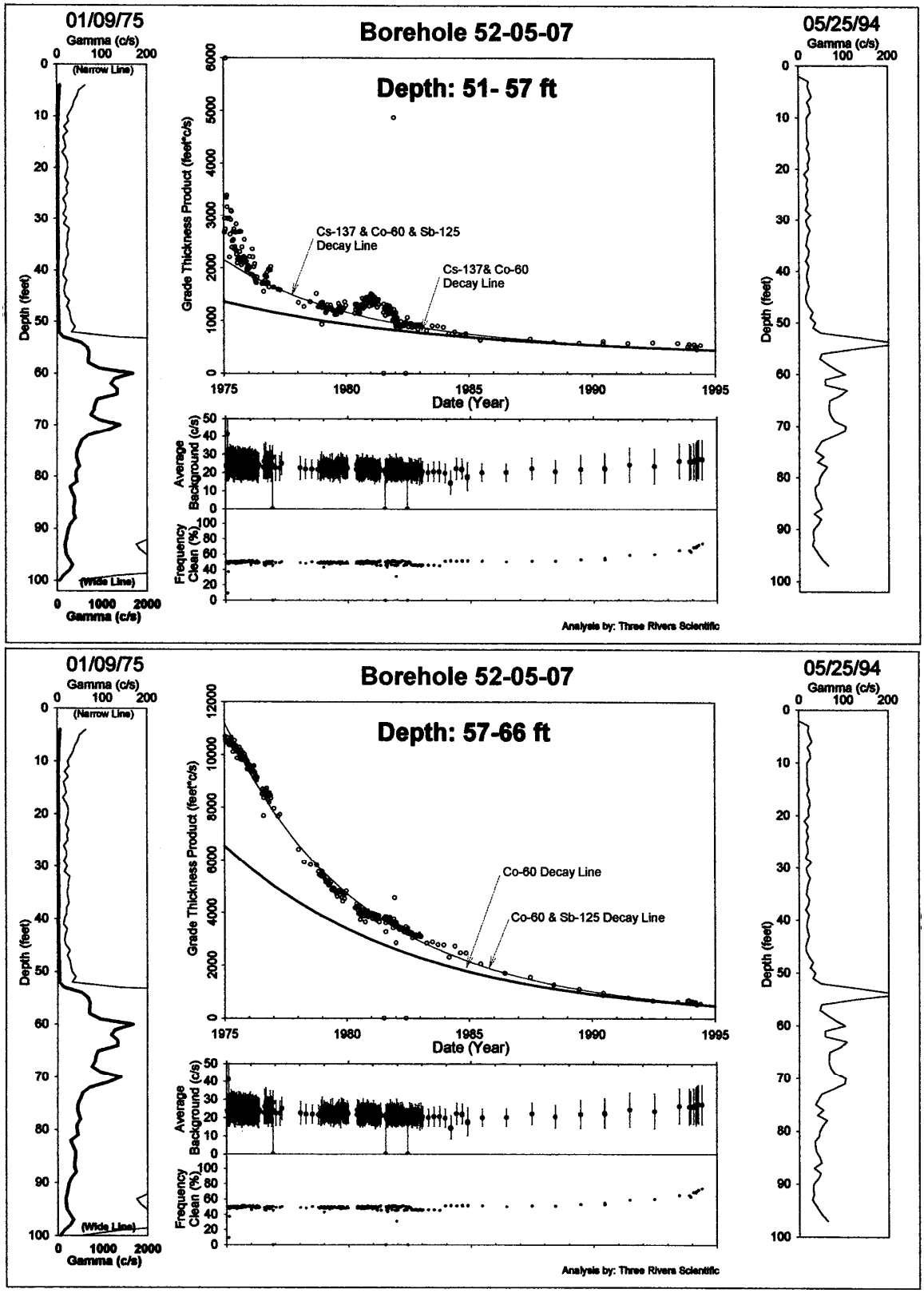


Figure 5.5-9. Drywell 52-06-05 Historical Gamma Logging Results

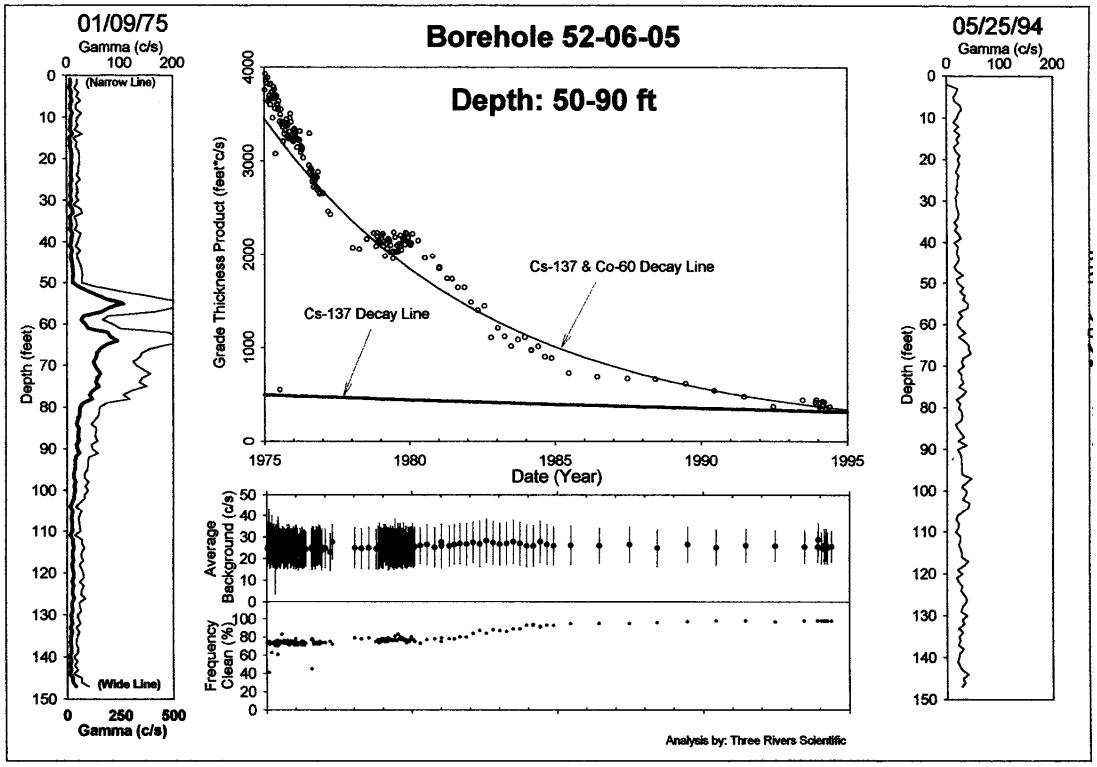


Figure 5.5-10. Maximum Activity for 2005 241-TY Tank Farm Direct Push Logging

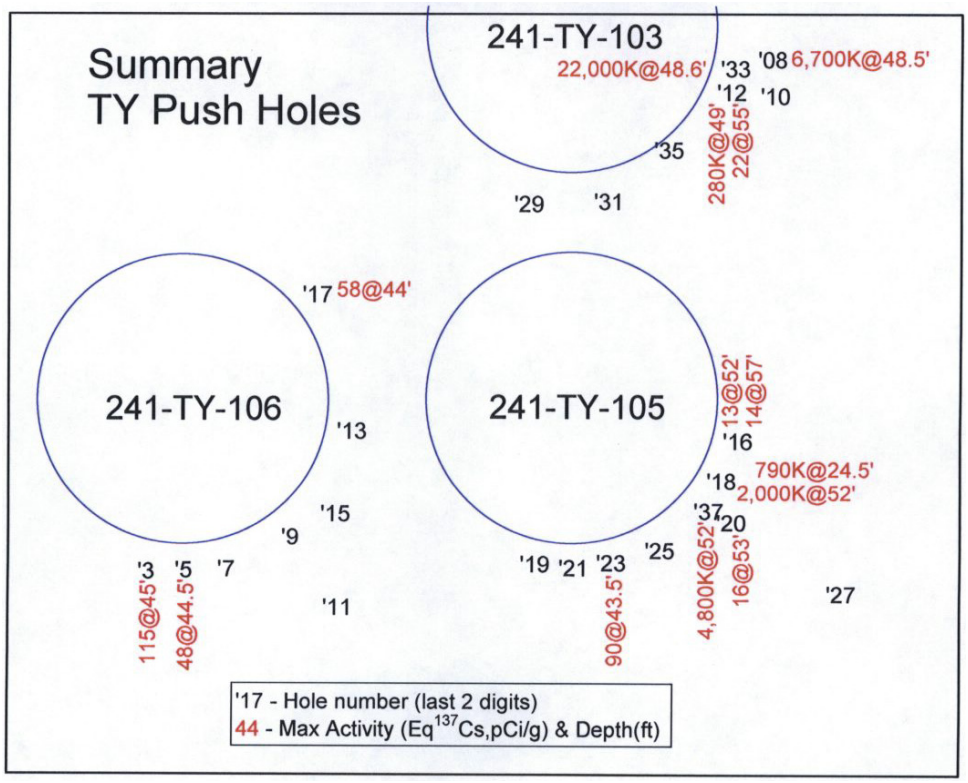


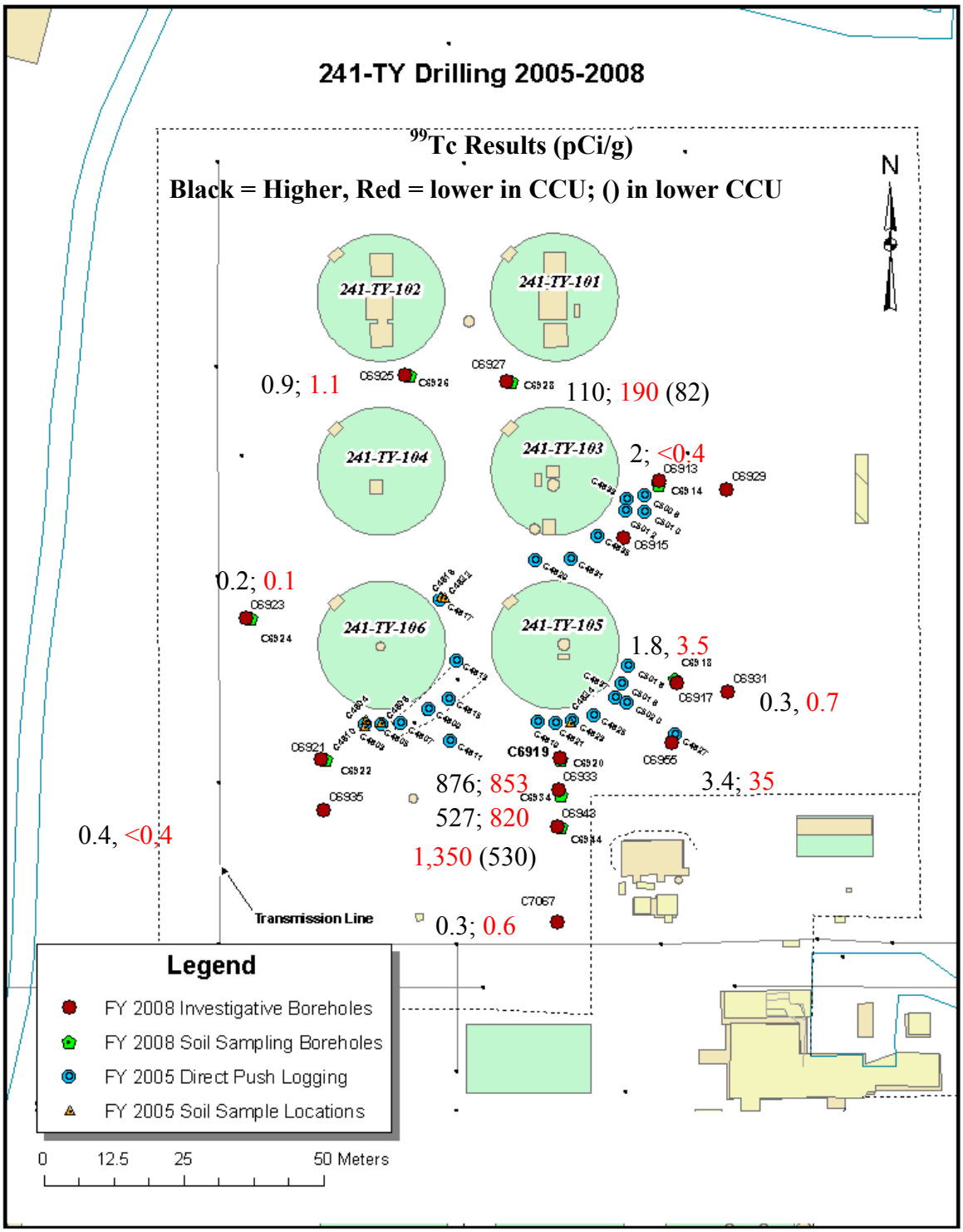
Table 5.5-2. 2005 Direct Push Logging Summary (RPP-RPT-34870)

Hole	Gross Gamma	Spectral Gamma	Green GM	Initial Hole Depth (ft)	Extend Hole Depth	Depth Max Activity	Max eCs-137 (pCi/g)	Comment
C4603	X	**BGO**		47.1	61.3 ft	45 ft	115	Background not reached at bottom of first survey. Hole Deepened.
C4605	X	**BGO**		47.5	61 ft	44.5 ft	48	Minor count rate increase at bottom of first survey. Hole Deepened.
C4607	X			47		surface	13	Minor count rate increase at surface
C4609	X			46.5		surface	20	Count rate increase at surface
C4611	X			47.2			Background	
C4613	X			47.2		surface	19	Count rate increase at surface
C4615	X			46.6			Background	
C4617	X	**BGO**		47.5	61.4 ft	44 ft	58	Minor count rate increase at bottom of first survey. Hole Deepened.
C4619	X			47.2			Background	
C4621	X			47.1		surface	16	Minor count rate increase at surface
C4623	X	**BGO**		47.1		43.5 ft	90	
C4625	X			47.5			Background	
C4627	X			47.8		surface	13	Minor count rate increase at surface
C4629	X			47.3		surface	17	Minor count rate increase at surface
C4631	X			47.2			Background	
C4633	X	**BGO**	**GM**	61.5	69.5	48.6 ft	22,000,000	NaI Detector Saturated 47-51.5 and 53.5-56 ft
C4635	X			47.2		surface	16	Minor count rate increase at surface
C4637	X	**BGO**	**GM**	47.5	61.5	52 ft	4,800,000	NaI Detector Saturated 51.5-53 ft
C5008	X	**BGO**	**GM**	65		48.5	6,700,000	
C5010	X			65			Background	
C5012	X	**BGO**	**GM**	65		49 ft	280,000	
C5016	X			66		57 ft	14	
C5018	X	**BGO**	**GM**	65		24.5ft & 52ft	790,000 & 2,000,000	NaI Detector Saturated 23-26 and 51-53 ft
C5020	X	**BGO**		65		53 ft	16	

5.5.3 Conclusion

Tank TY-105 was assumed to have leaked 35,000 gallons between 1959 and 1961 derived through a waste transfer discrepancy estimate. The SIM (RPP-26744) assumes the liquid waste leaked from TY-105 was TBP-UR waste with a ^{137}Cs concentration of 0.04 Ci/gal decayed to January 1, 2001. Tributyl phosphate was the only waste type received by tank TY-105 and no representative liquid sample results are available from the time of the leak. The SIM results are assumed to provide the best estimate, but should be adjusted for a range of 30,000 to 43,000 gal.

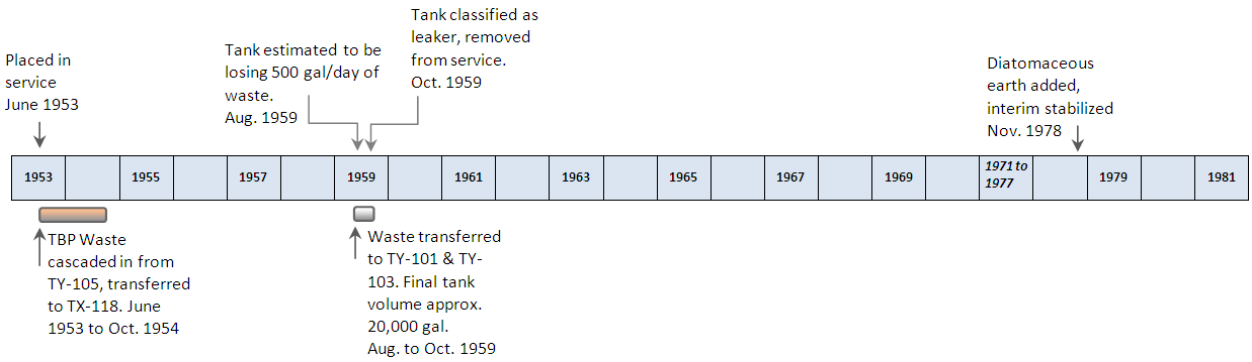
Figure 5.5-11. Quick-Turn-Around 2008 Technetium-99 Sample Results



5.6 TANK 241-TY-106 WASTE LOSS EVENT

This section provides information on the historical waste loss event associated with tank TY-106. The following subsections summarize the waste operating history for tank TY-106. Figure 5.6-1 summarizes waste operations for tank TY-106. Figure 5.6-2 is a plan view of the tank.

Figure 5.6-1. Tank 241-TY-106 Waste Operations Summary



5.6.1 Tank 241-TY-106 Waste History

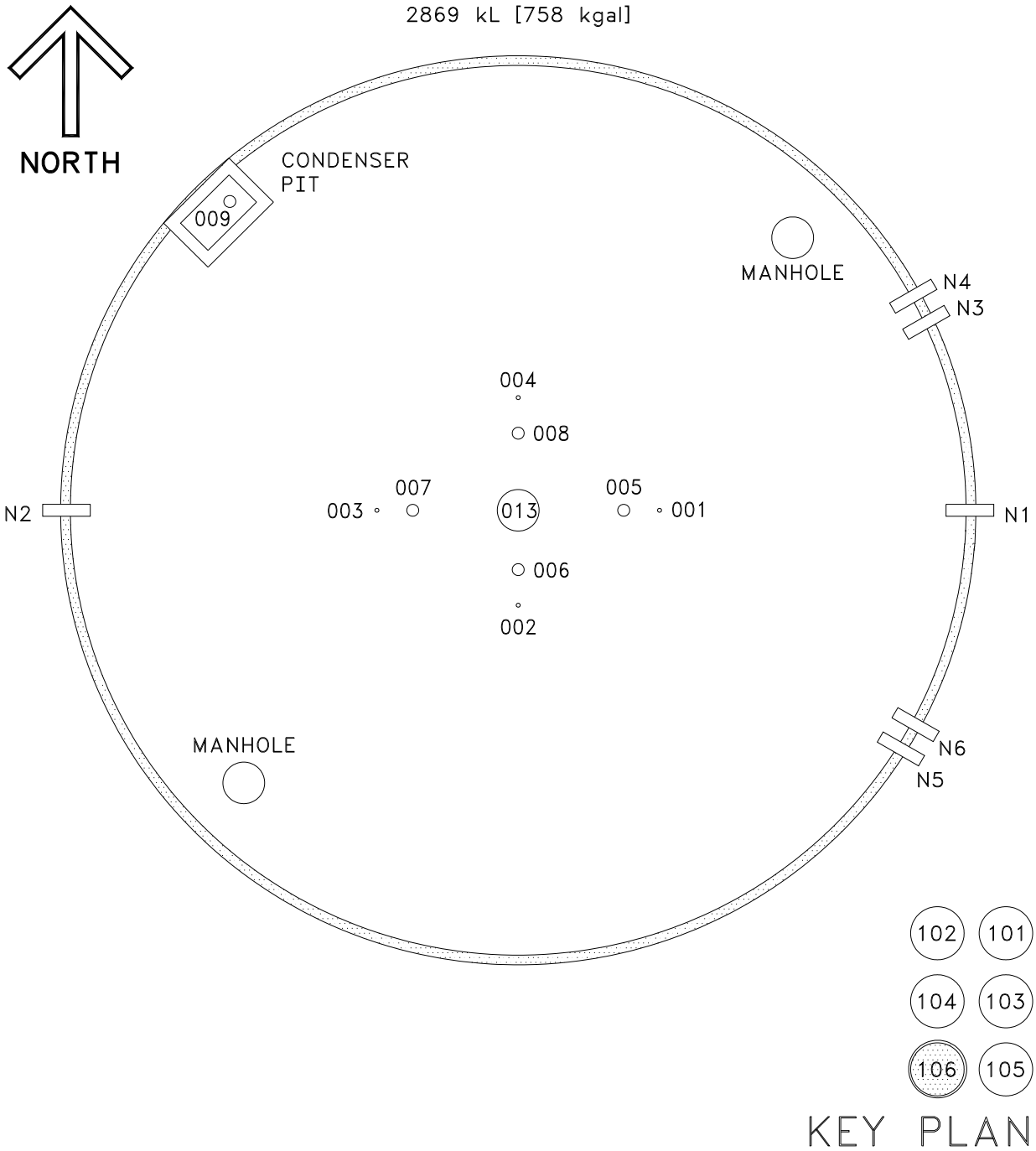
Single-shell tank TY-106 was placed in service in June 1953 and used to store waste from the 221-U TBP Plant (HW-27841). Table 5.6-1 shows waste transfer history for tank TY-106. Figure 5.6-3 depicts the surface level history.

During the second quarter of 1953, the tank began receiving TBP waste cascaded from tank TY-105. No other waste was added after the second quarter of 1959. Most of the supernate was removed from the tank during that time period. In 1972, 30 tons of diatomaceous earth (DE) was added to tank TY-106 in an apparent attempt to stabilize the contents of any remaining liquid (WHC-SD-WM-ER-482, *Tank Characterization Report for Single-Shell Tank 241-TY-106*).

5.6.1.1 Integrity of Tank 241-TY-106. This tank was declared a confirmed leaker and removed from service in 1959 with an estimated leak volume of 20,000 gal (HNF-EP-0182). Interim isolation was completed December 1982, and the tank was interim stabilized November 30, 1978 (HNF-EP-0182). The leak volume estimate is based on liquid level decreases between August and October 1959 (HW-83906 D RD, *Chemical Processing Department 200 West Area Tank Farm Inventory and Waste Reports January 1959 Through June 1961*, p. 40-80).

5.6.1.2 Tank 241-TY-106 Interim Stabilization. The tank was stabilized in November 1978 by the addition of 30,000 gal of DE (SD-WM-TI-356). Photographs showed that after adding DE no surface liquid remained in the tank and the waste surface was 100% dry cracked solids. No saltwell casing was installed for this tank (HNF-SD-RE-TI-178).

Figure 5.6-2. Plan View of Tank 241-TY-106



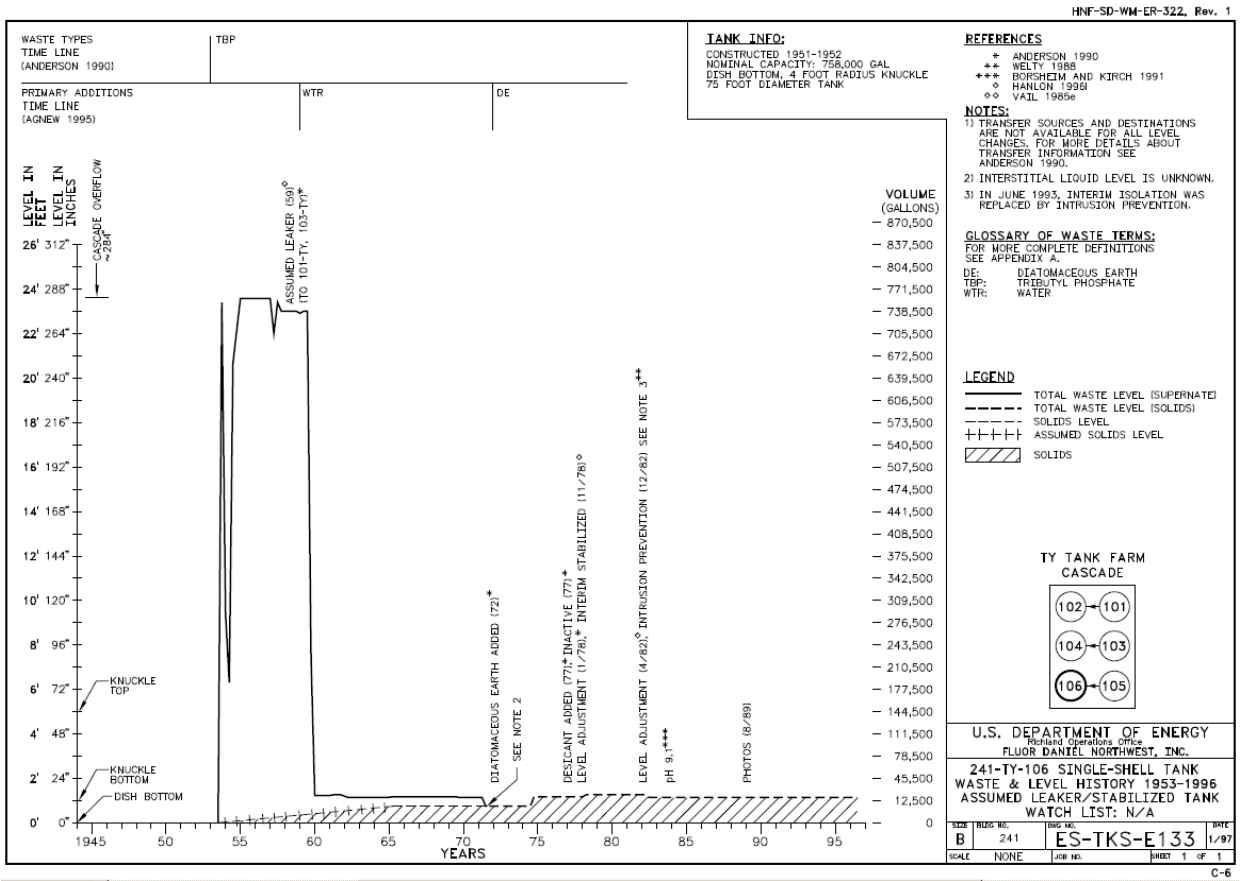
A photo mosaic of the tank dated August 22, 1989 (Figure 5.6-4) shows a cracked dry surface. As of December, 2008 the tank contained an estimated 4 kgal of TBP sludge and 12 kgal of DE. The DE is assumed to have compacted over time and the total volume is based on surface level measurements.

Table 5.6-1. Tank 241-TY-106 Waste Transfers (2 sheets)

Date/Date Range	Transfer Type[1]	Transfer Volume (gal*1000)[1]	Total Vol. In Tank (gal*1000)[2]	Discrepancy with previous reading (gal*1000)[3]	Waste type[4]	Transfer tank from/to	Document Number[5]
June-1953	IN	150	150		TBP	Cascade from TY-105	HW-28712
July-1953	IN	597	747		TBP	Cascade from TY-105	HW-29054
Aug-1953 to Sept.-1953	IN	256			TBP	Cascade from TY-105	LA-UR-97-311
Aug-1953 to Sept.-1953	OUT	-714	289		TBP	TX-118	HW-29624
Oct.-1953 to Dec.-1953	IN	55			TBP	Cascade from TY-105	LA-UR-97-311
Oct.-1953 to Dec.-1953	OUT	-55	289		TBP	TX-118	HW-30498
Jan.-1954 to Mar.-1954	IN	958			TBP	Cascade from TY-105	LA-UR-97-311
Jan.-1954 to Mar.-1954	OUT	-1059	188		TBP	TX-118	HW-31374
Apr.-1954 to June-1954	IN	1578			TBP	Cascade from TY-105	LA-UR-97-311
Apr.-1954 to June-1954	OUT	-1104	662		TBP	TX-118	HW-32389
July-1954 to Sep.-1954	IN	1424			TBP	Cascade from TY-105	LA-UR-97-311
July-1954 to Sep.-1954	OUT	-1328	758		TBP	TX-118	HW-33396
Oct-1954 to Dec 1956	STAT		758				HW-47640
Jan.-1957 to May-1957	STAT		705~706		TBP	LIKELY BAD READING	HW-48144 / HW-50617
June-1957 to Aug.-1957	STAT		752	-6	TBP		HW-51348 / HW-52414
Sept.-1957 to Sept.-1958	STAT		739	-13	TBP		HW-52932 / HW-57711
Oct.-1958 to Feb.-1959	STAT		736	-3	TBP		HW-58201 / HW-59586
Mar.-1959 to June-1959	STAT		739	3	TBP		HW-60065 / HW-60738
July-1959	STAT		722	-17	TBP	NEW ELECTRODE INSTALLED	HW-61582
Aug.-1959	OUT	-74	647 (Reported Value)	-1	TBP	101-TY - estimated loss of about 500 gal/day	HW-61952
Sept.-1959	OUT	-421	224 (Reported Value)	-2	TBP	101-TY, 103-TY	HW-62421
Oct.-1959	OUT	-207	17		TBP	103-TY (TY-106 removed from service)	HW-62723
Nov-Dec 1959	STAT		20		TBP		HW-63559

[1] IN defines a transfer into the tank, OUT defines a transfer out of the tank, STAT refers to a volume reading where no transfer occurred.
[2] "Total Volume In Tank" refers to measured STAT values following the transfers shown. Transfer volumes are from references shown and LA-UR-97-311.
[3] Small discrepancies may be attributed to water additions or effects such as evaporation.
[4] Waste type: TBP = tributyl phosphate.
[5] For reference titles, see Section 6.0 REFERENCES.

Figure 5.6-3. Tank 241-TY-106 Waste Fill History



5.6.1.3 Tank 241-TY-106 Temperature. No temperature data were available before 1974 (SACS). The maximum temperature in 1977 was 78 °F in September 1975 and the temperature range generally varied between 55 and 75 °F (Figure 5.6-5).

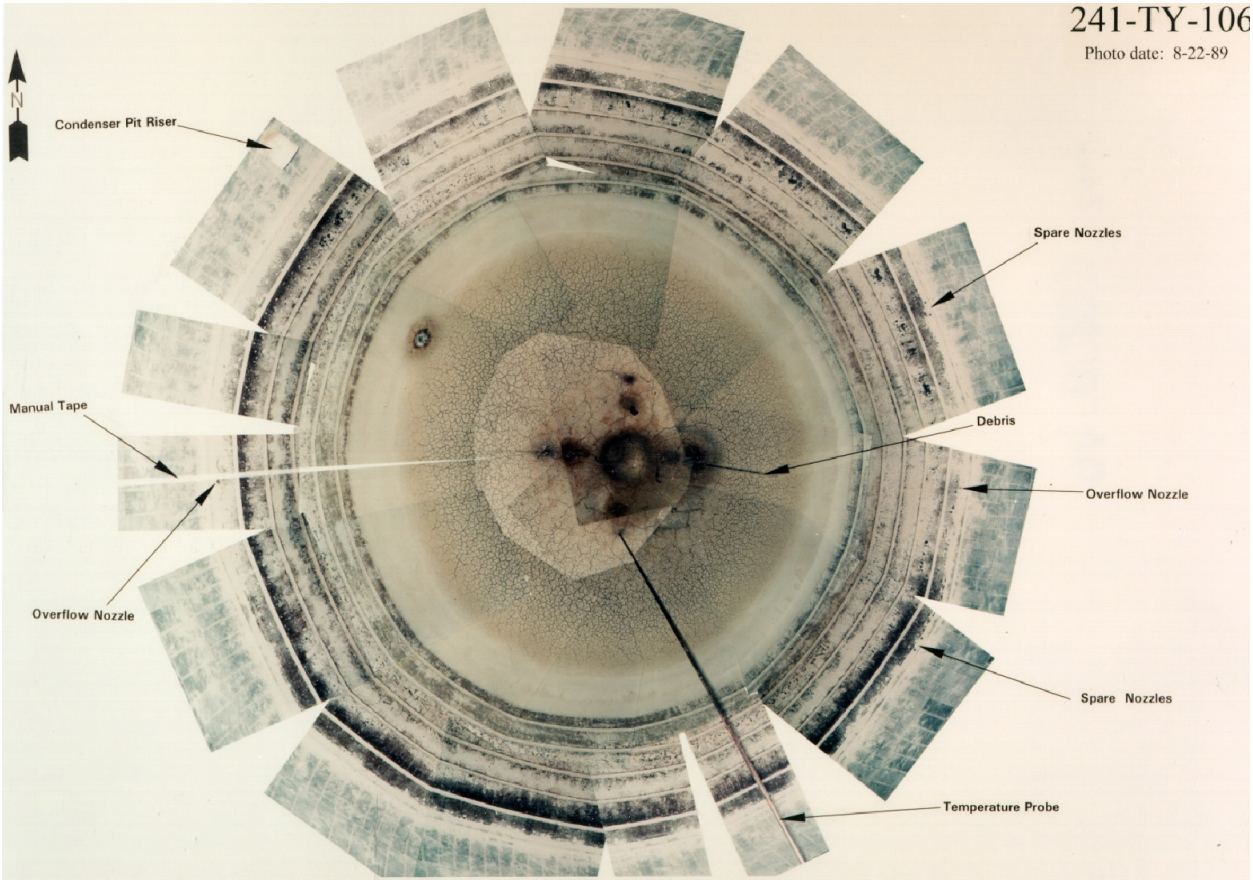
5.6.2 Data Review and Observations

5.6.2.1 Surface Level Data. The 20,000 gal leak estimate for tank TY-106 is likely based on liquid level measurements reported in HW-83906 D RD (p. 40-80) showing that 18,150 gal of waste were unaccounted for in tank TY-106 from August through October 1959 (Table 5.6-2).

Table 5.6-3 shows additional information regarding tank TY-106 and the tank leak (RPP-RPT-29191, *Supplemental Information Hanford Tank Waste Leaks*).

5.6.2.2 Drywell Data. GJ-HAN-69, *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank TY-106* and GJO-96-2-TAR/GJO-HAN-6 describe drywell monitoring and results near tank TY-106. Six vadose zone monitoring drywells surround tank TY-106. Figure 5.6-6 shows SGLS results for each of the drywells. The near-surface contamination (0 to 12 ft) probably resulted from surface spills that have migrated down into the backfill surrounding the drywell or contamination that was carried down during the drilling of drywells.

Figure 5.6-4. Tank 241-TY-106 Surface Mosaic Photo

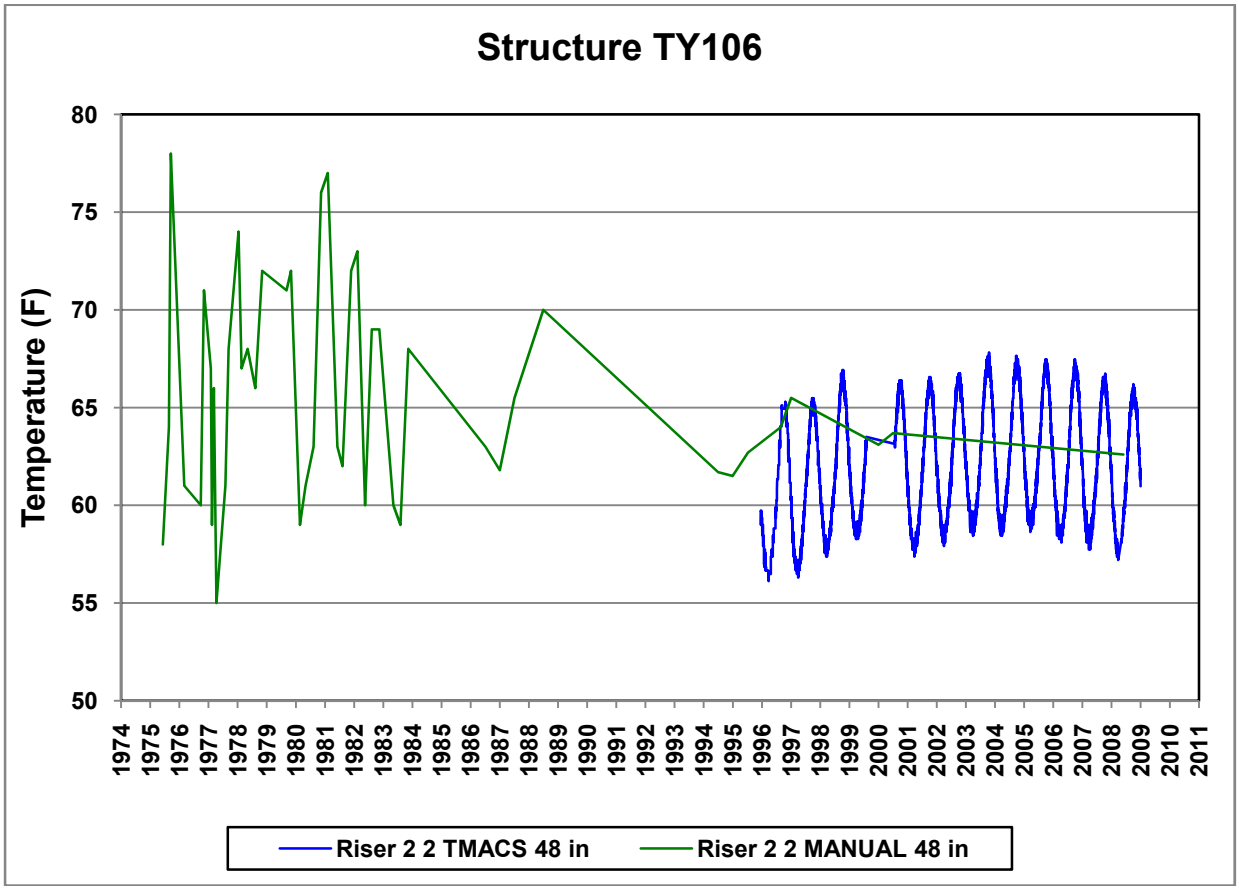


Drywell 52-04-06 was completed in December 1971 to a depth of 100 ft using 6-in. casing. Measurable ^{137}Cs was detected from the ground surface to 12 ft and at the bottom of the drywell. The maximum ^{137}Cs concentration was 0.79 pCi/g at 1.5 ft. No anomalous activity was observed in historical gross gamma log data from 1975 to 1994 (SD-WM-TI-356). The ^{137}Cs contamination at the bottom of the drywell is likely drawdown inside the drywell casing.

Drywell 52-06-02 is located approximately 10 ft from the northeast side of tank TY-106. This drywell was completed in December 1971 to a depth of 66 ft using 6-in. casing. Measurable ^{137}Cs contamination was detected continuously from the ground surface to 65 ft. The maximum ^{137}Cs concentration was 13.1 pCi/g at 4 ft. No anomalous activity was observed in historical gross gamma log data from 1975 to 1994 (SD-WM-TI-356).

Drywell 52-06-04 is located approximately 3 ft from the east side of tank TY-106. This drywell was completed in August 1974 to a depth of 100 ft using 6-in. casing. Measurable ^{137}Cs concentrations were detected continuously from the ground surface to about 20 ft, intermittently from 20 to 51 ft, continuously from 51 to 53.5 ft, and at 57 ft. The maximum ^{137}Cs concentration was 1.2 pCi/g at 52 ft.

Figure 5.6-5. Tank 241-TY-106 Temperature Measurements



A time-sequence plot generated from the historical gross gamma logs shows a small anomalous zone of activity at about 53 ft starting in 1975 (Figure 5.6-7, HNF-3831). From 1975 to 1979, the activity appears to have decayed steadily to below the minimum detectable level of the gross gamma logging tool. The SGLS detected ^{137}Cs contamination between 51 and 57 ft that correlates well with the activity shown on the historical gross gamma logs.

Drywell 52-06-05 is located approximately 19 ft from the southeast side of tank TY-106. This drywell was completed in August 1952 to a depth of 148 ft using 8-in. casing; the casing was perforated between 40 and 100 ft but not grouted. Measurable ^{137}Cs was detected continuously from the ground surface to 1 ft, intermittently from 1 to 52 ft, almost continuously from 52 to 55 ft, intermittently from 55 to 110 ft, continuously from 110.5 to 112.5 ft, and intermittently from 112.5 to 133.5 ft. The maximum ^{137}Cs concentration was 1.2 pCi/g at 111.5 ft. The presence of ^{60}Co was detected at 2.5 ft, continuously from 52 to 76.5 ft, intermittently from 76.5 to 90 ft, continuously from 92.5 to 98.5 ft, and continuously from 130 to 148 ft. The maximum ^{60}Co concentration was 3.2 pCi/g at 144.5 ft.

A time-sequence plot of the historical gross gamma logs between 1975 and 1994 (Figure 5.6-8, HNF-3831) shows activity in 1975. Warren (1960) (Figure 5.5-6) suggests contamination was present near this drywell as early as September 1959 (see section 5.5.2.2). Anomalous zones of activity were measured at about 53 and 65 ft in late 1973 (SD-WM-TI-356). The earliest

available gross gamma logs (1975) show three zones of elevated activity from 50 to 58 ft, 61 to 67 ft, and 67 to 78 ft. The zone from 50 to 58 ft appears to decay at a faster rate than the zones from 61 to 67 ft and 67 to 78 ft.

Table 5.6-2. Tank 241-TY-106 Liquid Level Measurements (HW-83906 D RD)

Date	Measurement (in)	Meas. Volume (kgal)	Pumped Volume (gal)	Unaccounted for Vol (gal)	Comment
1-31-59	276	739	0	0	
2-28-59	276	739	0	0	
3-31-59	276	739	0	0	
4-30-59	276	739	0	0	
5-31-59	276	739	0	0	
6-30-59	276	739	0		
7-31-59	270	722	0	17,000	New electrode installed. Electrode readings indicate loss of ~ 500 gal/day for 34 days
8-31-59	243	647	74,250	750	
9-30-59	89	224	19,250 403,163	590	
10-31-59	15	20	204,187	-190	
11-30-59	15	20		0	
12-31-59	15	20		0	
SUM				18,150	

Two occurrence reports were written for increased activity in drywell 52-06-05 (OR-74-102 and OR-74-88, *Symptoms Of Leakage As Indicated By Activity In Dry Well 52-06-05 At 106-TY Waste Tank*). Drywells 52-06-04 and 52-06-06 were installed to determine the source of the activity in drywell 52-06-05 (OR-74-102). One occurrence report identifies the source of the contamination as tank TY-105 (OR-74-88).

Two occurrence reports were written for increased activity in drywell 52-06-05 (OR-74-102 and OR-74-88). Drywells 52-06-04 and 52-06-06 were installed to determine the source of the activity in drywell 52-06-05 (OR-74-102). One occurrence report identifies the source of the contamination as tank TY-105 (OR-74-88).

Drywell 52-06-06 is located approximately 12 ft from the south side of tank TY-106. The drilling was completed in August 1974 to a depth of 100 ft using 6-in. casing. Cesium-137 was detected continuously from the ground surface to 25 ft and almost continuously from 29 to 37 ft. The maximum ^{137}Cs concentration was 6.1 pCi/g at 19 ft. Measurable ^{60}Co concentrations were

detected at 86 ft and almost continuously from 95.5 to 100 ft. The maximum ^{60}Co concentration was 0.29 pCi/g at 100 ft (the total depth logged). Anomalous activity was not identified in historical gross gamma logs (SD-WM-TI-356). The SGLS detected ^{60}Co contamination at 86 ft and from 95.5 to 100 ft.

Table 5.6-3. Tank 241-TY-106 Leak Information (2 sheets)

Date	Event as Described in Reference	Reference
8-1959	The July month end inventory of static waste tanks indicated that a possible leak existed in the 106-TY, since measurements revealed a **decrease of approximately 14,000 gallons during the month.** Daily checking of the tank contents, which was started immediately, continued to show a loss of approximately 500 gallons per day. The decision to pump the contents of the 106-TY tank, containing unscavenged TBP waste with an activity of approximately 0.2 curies per gallon, to other tanks was made on August 27, 1959 and pumping was actually started on August 28, 1959. To date approximately 75,000 gallons have been pumped to the 101-TY tank.	HW-61736-DEL, page D-3
9-1959	Page A-4: Pumping of the unscavenged TBP waste from the 106-TY waste storage tank was discontinued at approximately the twelve foot level [371,136 gallons] on September 6, 1959 and the tank allowed to remain undisturbed through September 14, 1959. Although no further leakage was detected, pumping was resumed so that a thorough inspection of the inner lining can be made. Page D-3: Pumping of the unscavenged TBP waste from the 106-TY tank was discontinued at approximately the 12 foot level on 9-6-59 and the tank allowed to remain undisturbed through 9-14-59. No change in the liquid level was detected during this period, indicating that the leak was either above the 12 foot level or that the leak had sealed itself. Although no further leakage was detected, pumping has been resumed and the tank is to be emptied so that a thorough inspection of the inner lining can be made.	HW-62179-DEL Note: HW-83906 D RD, pages 68 - 72 indicates 403,163 gallons of waste were pumped from tank TY-106 to tank TY-101 and 19,250 gallons of waste were pumped from tank TY-106 to tank TY-103 during September 1959, leaving 224,000 gallons of waste in tank TY-106.
10-1959	Pumping of the unscavenged TBP waste from the 106-TY tank continued this month and 204,187 gallons of waste was transferred to the 103-TY tank, leaving a heel of approximately 20,000 gallons in the tank. A thorough inspection of the inner tank lining is planned and will include: (1) Photographs of the tank interior, (2) inspection by periscope, (3) detailed photographing with a telephoto lens, if damage is indicated by standard lens, (4) inspection by closed circuit TV. Step (1) was completed this month and step (2) is scheduled for the early part of November.	HW-62593-DEL, page D-3 Note: HW-83906 D RD, pages 76 - 80 confirm 204,187 gallons of waste were pumped from tank TY-106 to tank TY-103 during October 1959, leaving 20,000 gallons of waste in tank TY-106.
11-1959	A periscope was installed in the 106-TY tank (suspected of leaking) on 11-20-1959. However, more light is needed for a thorough inspection of the inner tank lining and the Facilities Engineering Operations is currently making up a light bar for this purpose.	HW-62864-DEL, page D-3

Table 5.6-3. Tank 241-TY-106 Leak Information (2 sheets)

Date	Event as Described in Reference	Reference
11-1960	The closed circuit TV equipment was used to inspect the 106-TY waste tank. The interior side wall and bottom of the tank were scanned for several days. Although considerable knowledge of the tank interior was obtained, it is not possible to detect positively, corrosion of the liner. **Portions of the lead flashing at the spring line of the dome were gone**. Picture quality was good; however, close-up viewing with the "Zoom" lens does not have good definition due to imperfections in the plastic dome used to protect the equipment from contamination. A design change has been made to eliminate the use of the plastic dome on future installations. In supplemental work, a telephoto 35 mm camera was used to photograph subjects selected by the TV monitor in this tank. The camera can be in this tank's internal radiation field only 15 minutes without film over exposure. This time limit does not permit adequate time to de-fog the moisture from the camera lens during cold weather.	HW-67459-DEL, page F-6

References:
HW-61736-DEL, *Chemical Processing Department Monthly Report for August, 1959*.
HW-62179-DEL, *Chemical Processing Department Monthly Report for September, 1959*.
HW-62593-DEL, *Chemical Processing Department Monthly Report for October, 1959*.
HW-62864-DEL, *Chemical Processing Department Monthly Report for November, 1959*.
HW-67459-DEL, *Chemical Processing Department Monthly Report for November 1960*.

Figure 5.6-6. Tank 241-TY-106 Drywell Spectral Gamma Logging System Results

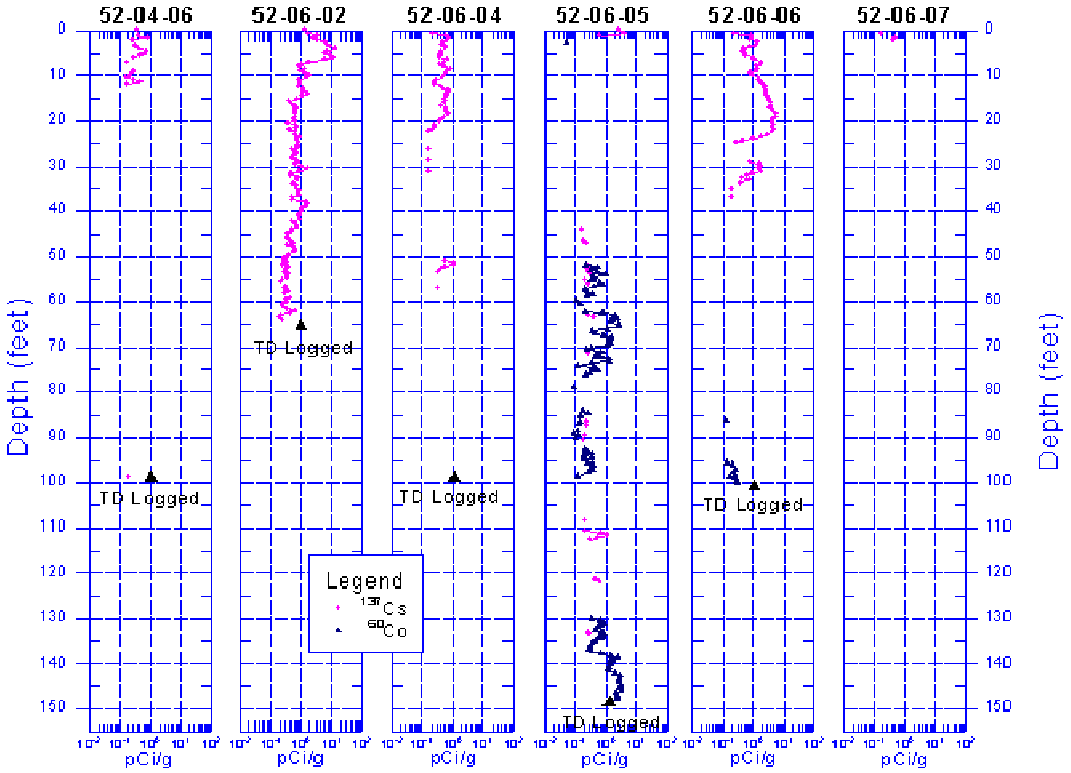


Figure 5.6-7. Drywell 52-06-04 Historical Gamma Logging Results

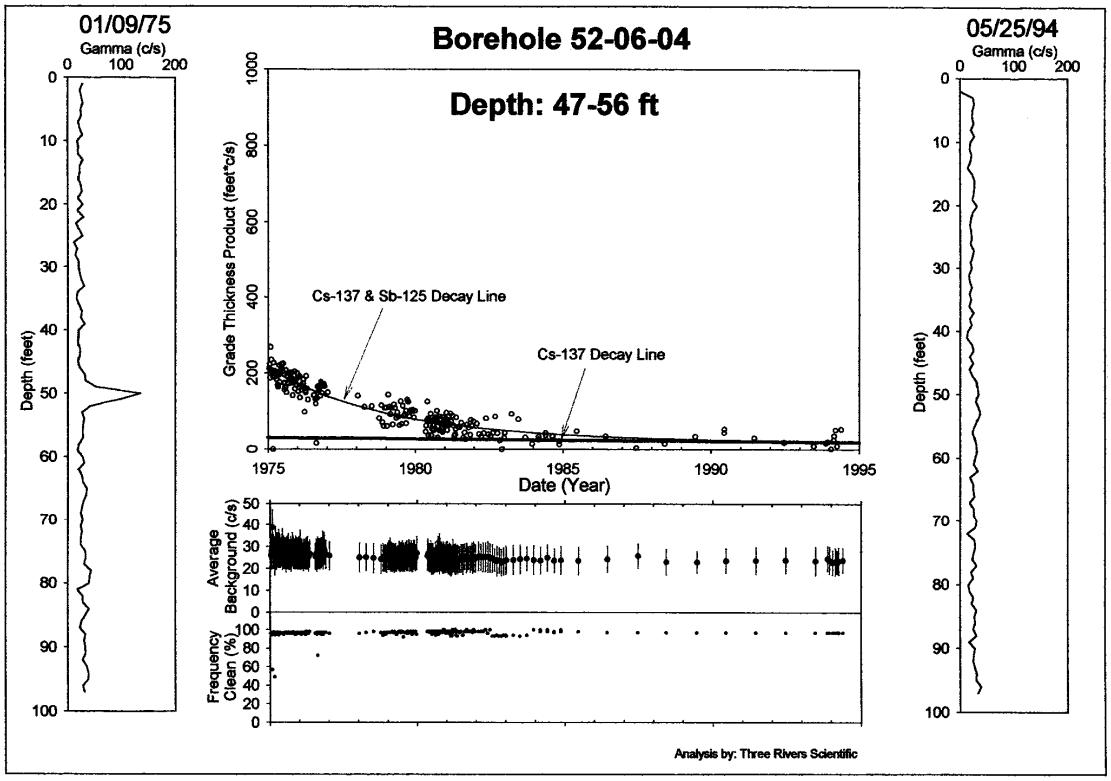
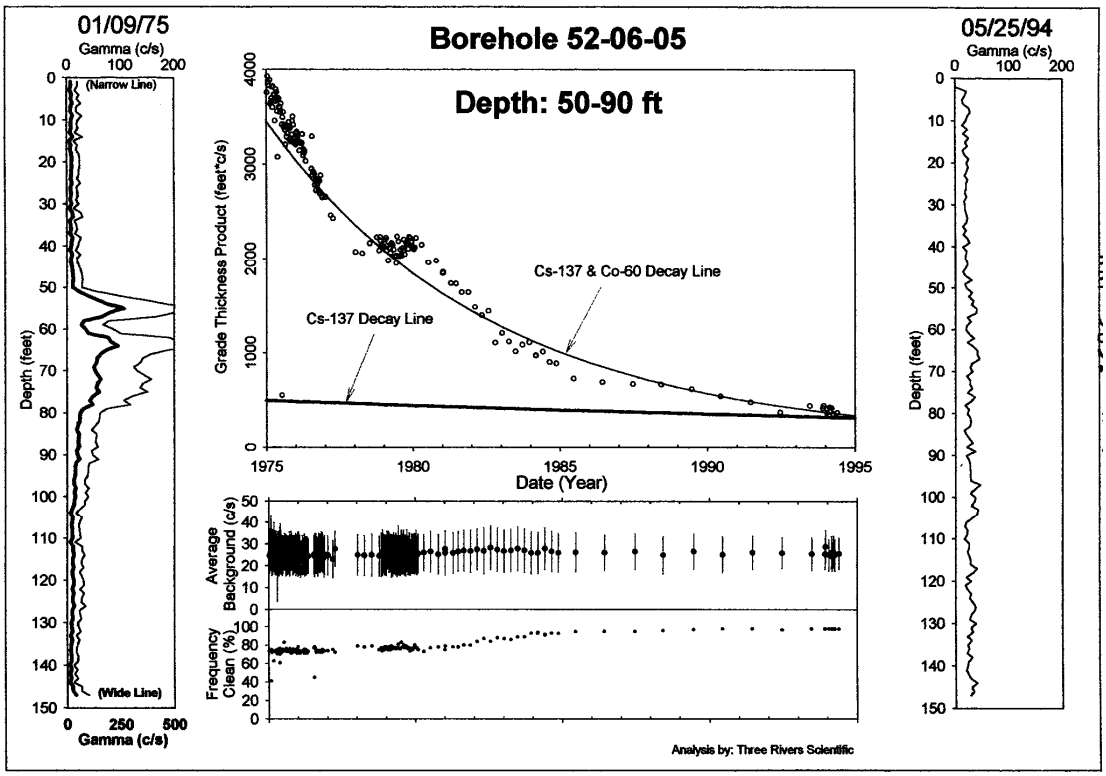


Figure 5.6-8. Drywell 52-06-05 Historical Gamma Logging Results (50 to 90 ft)



Drywell 52-06-07 is located approximately 19 ft from the southwest side of tank TY-106. This drywell was originally drilled in 1952 to a depth of 245 ft using 8-in.-inside-diameter casing. The 8-in. casing was perforated between 200 and 245 ft. In 1975 the drywell was backfilled with gravel and cement to a depth of 236 ft. In 1976, the 8-in. casing was perforated from the surface to 209 ft, a 4-in. inner casing was installed inside the 8-in. casing, and grout was injected into the annulus between the two casings. Since the outer casing was perforated, grout flowed through the perforations to fill any gaps that may have existed between the outer casing and the formation. Cesium-137 was measured almost continuously from the ground surface to 3 ft and intermittently from 195.5 to 198.5 ft. The maximum ^{137}Cs concentration was 0.5 pCi/g at 1.5 ft. Measurable ^{60}Co concentrations were detected almost continuously from 200 to 213 ft. The maximum ^{60}Co concentration was 0.43 pCi/g at 204.5 ft, which is near the bottom of the double-cased interval of the drywell. Handwritten notes on the file copy of Warren (1960) (see Figure 5.5-6) indicate that the contamination detected by the SGLS between 191 and 211 ft was present as early as 1960.

Repeat logging of this drywell, the deepest monitoring drywell in the 241-TY Tank Farm, was performed to confirm the presence of ^{60}Co and to investigate the drywell interval below 213 ft (GJO-96-2-TAR/GJO-HAN-6). The repeat logging detected low levels of nearly continuous ^{60}Co contamination between 199 and 237 ft. This ^{60}Co contamination occurs above and below the groundwater level at 220.4 ft. Repeat values tend to be slightly higher than the decayed baseline values, but the differences are within the range of the measurement uncertainty. Historical gross gamma readings from drywell 52-06-07 between 1975 and 1994 showed anomalous gamma activity from 86 to 100 ft, attributed to ^{60}Co (Figure 5.6-9, HNF-3831). This interval appears to be stable. Cobalt-60 levels have since decayed to levels below the minimum detectable level for the SGLS.

Figure 5.6-9. Drywell 52-06-07 Historical Gamma Logging Results (86 to 100 ft)

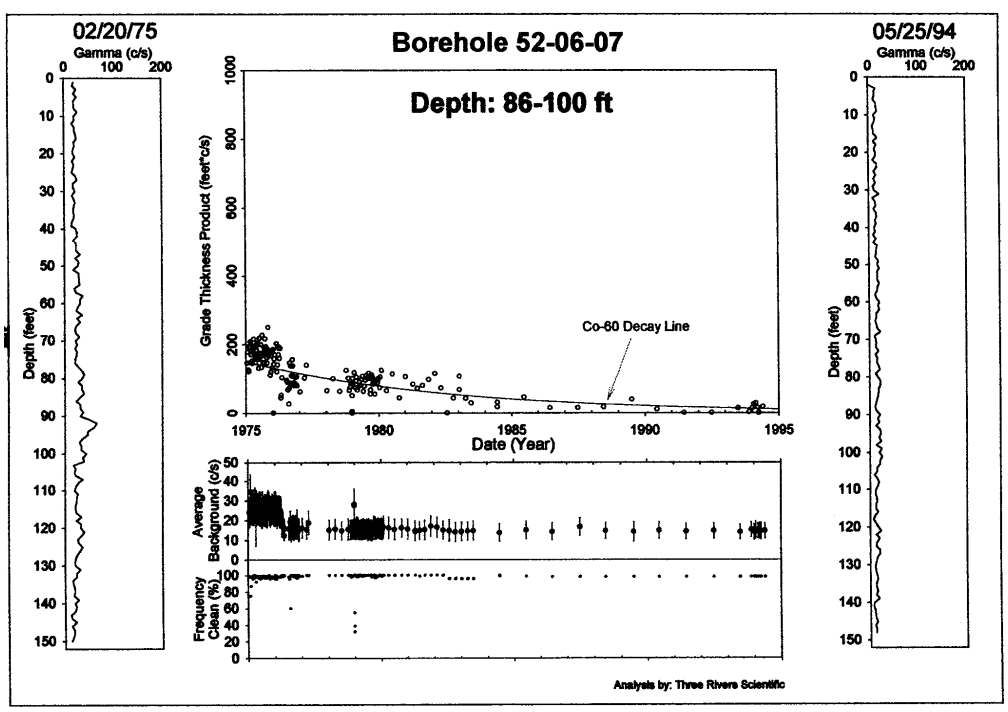
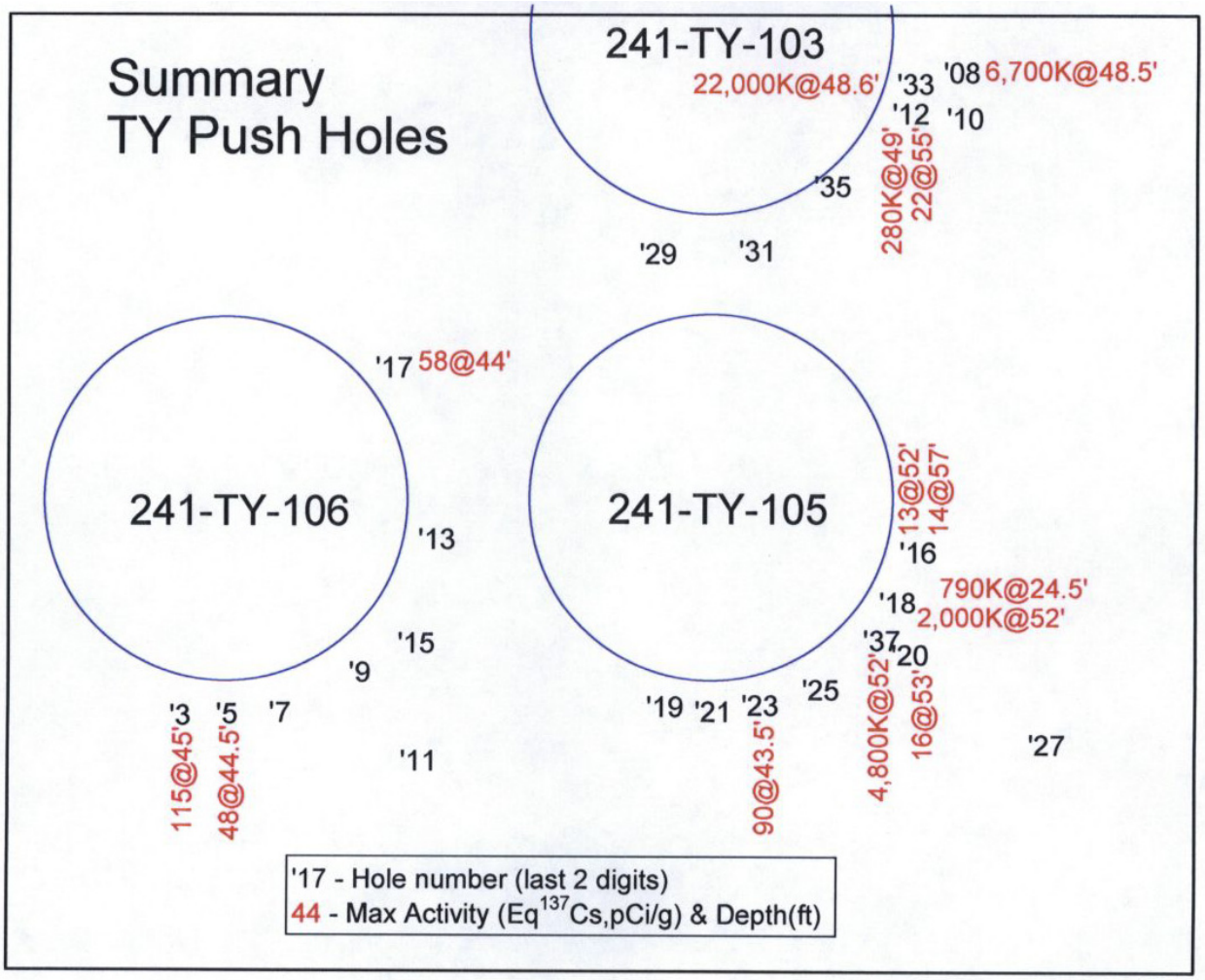


Table 5.6-4. 2005 Direct Push Logging Summary (RPP-RPT-34870)

Hole	Gross Gamma	Spectral Gamma	Green GM	Initial Hole Depth (ft)	Extend Hole Depth	Depth Max Activity	Max eCs-137 (pCi/g)	Comment
C4603	X	**BGO**		47.1	61.3 ft	45 ft	115	Background not reached at bottom of first survey. Hole Deepened.
C4605	X	**BGO**		47.5	61 ft	44.5 ft	48	Minor count rate increase at bottom of first survey. Hole Deepened.
C4607	X			47		surface	13	Minor count rate increase at surface
C4609	X			46.5		surface	20	Count rate increase at surface
C4611	X			47.2			Background	
C4613	X			47.2		surface	19	Count rate increase at surface
C4615	X			46.6			Background	
C4617	X	**BGO**		47.5	61.4 ft	44 ft	58	Minor count rate increase at bottom of first survey. Hole Deepened.
C4619	X			47.2			Background	
C4621	X			47.1		surface	16	Minor count rate increase at surface
C4623	X	**BGO**		47.1		43.5 ft	90	
C4625	X			47.5			Background	
C4627	X			47.8		surface	13	Minor count rate increase at surface
C4629	X			47.3		surface	17	Minor count rate increase at surface
C4631	X			47.2			Background	
C4633	X	**BGO**	**GM**	61.5	69.5	48.6 ft	22,000,000	NaI Detector Saturated 47-51.5 and 53.5-56 ft
C4635	X			47.2		surface	16	Minor count rate increase at surface
C4637	X	**BGO**	**GM**	47.5	61.5	52 ft	4,800,000	NaI Detector Saturated 51.5-53 ft
C5008	X	**BGO**	**GM**	65		48.5	6,700,000	
C5010	X			65			Background	
C5012	X	**BGO**	**GM**	65		49 ft	280,000	
C5016	X			66		57 ft	14	
C5018	X	**BGO**	**GM**	65		24.5ft & 52ft	790,000 & 2,000,000	NaI Detector Saturated 23-26 and 51-53 ft
C5020	X	**BGO**		65		53 ft	16	

5.6.2.3 Direct Push/Samples. In addition to the spectral logging, direct push logging and sampling to further characterize the TY-106 leak was conducted in 2005, 2008 and 2009. The 2005 direct push logging locations and summary of results are shown in Figure 5.6-8 and Table 5.6-4 (RPP-RPT-34870). The 2008 and 2009 results are in process, but show high levels of ^{99}Tc and nitrate at 100 ft, just above the Cold Creek Formation (low permeability layer) below TY-Farm and extending 100 to 200 ft south of tank TY-106. Figure 5.6-10 shows the location of direct push holes and samples obtained. Preliminary sample results (Figure 5.6-11) indicate that the largest concentration of ^{99}Tc was the furthest from the tank. This indicates that some of the ^{99}Tc, particularly ^{99}Tc located over 100 ft south of tank TY-106, may come from other sources such as pipe leaks, the TY-153 diversion box or DCRT.

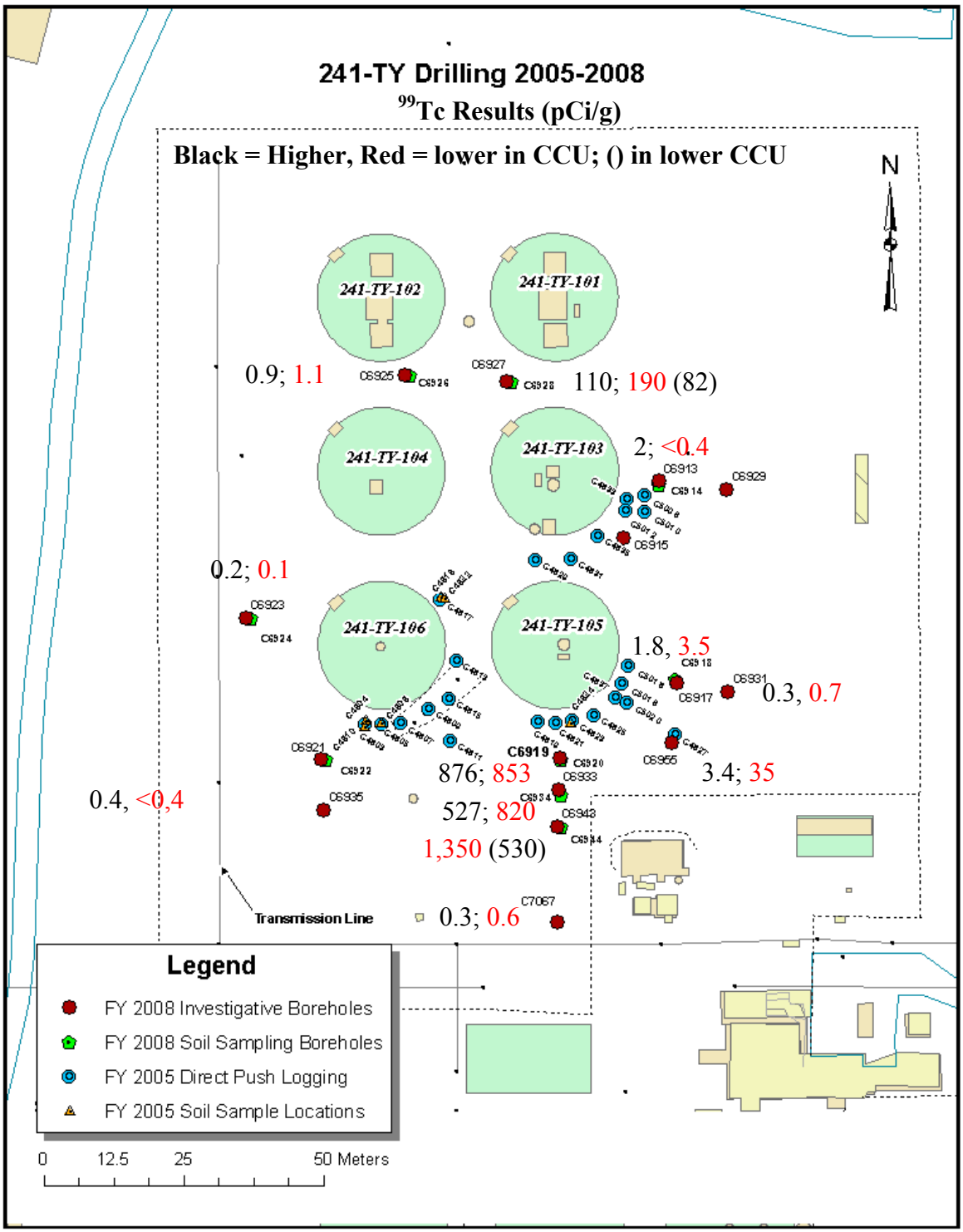
Figure 5.6-10. Maximum Activity for 2005 241-TY-Farm Direct Push Logging



5.6.3 Conclusion

Based on liquid level observations (Table 5.6-2) tank TY-106 is estimated to have leaked 18,000 gal of TBP waste in 1959. The estimate of 20,000 gal in HNF-EP-0182 appears to be rounded up from 18,000. No liquid sample data was identified for tank TY-106; consequently, SIM (RPP-26744) concentration estimates of 0.04 Ci/gal for ^{137}Cs decayed to January 1, 2001 should be used.

Figure 5.6-11. Quick-Turn-Around 2008 Technetium-99 Sample Results



5.7 POTENTIAL PIPELINE FAILURES AND OTHER UNPLANNED RELEASES

DOE/RL-88-30, *Hanford Site Waste Management Units Report*, contains the official listing of UPRs identified at the Hanford Site. Unplanned releases, pipeline failures and near surface releases summarized in Table 5.7-1 were identified through review of operational histories for the 241-TY Tank Farm. Most of these releases are not currently included in Waste Information Data System (WIDS) as UPRs. Hanford drawings H-2-44511, *Area Map 200 West "T" Plant Facilities*, Sheets 118 and 126, and H-2-73901, *Piping Plan and Details*, Sheet 1, show TY-Farm pipelines. Unplanned releases 200-W-150, 200-W-151, 200-W-152 and 200-W-153 are associated with tank leaks from 241-TY-103, 241-TY-104, 241-TY-105 and 241-TY-106 respectively and were described in the previous sections. UPR-150 is attributed to both a 1973 tank leak and a 1976 overflow of the 241-TX-155 diversion box catch tank that flowed back into tank TY-103 depositing 1.3 in. of sludge waste. Drywells near tank TY-103 showed no significant increase that was attributable to this flooding event (UPR-200-W-150) (BHI-00177, *T Plant Aggregate Area Management Study Technical Baseline Report*).

In addition, Figure 5.7-1 (GJO-97-30-TAR/GJO-HAN-16) shows ^{137}Cs activity was observed in the top 2 ft to the north and south of tank TY-106 and northwest of TY-103. This activity is attributed to UPRs or spills during tank farm operations and is not documented in WIDS. The measured ^{137}Cs activity level for these releases was less than 100 pCi/g.

Except as noted, information available was insufficient to estimate a leak volume or inventory for pipeline failures and surface releases. Additional near surface data needs will be determined through data quality objective workshops in support of TY-Farm performance assessments and corrective management studies.

Line SN402 failed in March 1982 during saltwell pumping. This line connects to the encasement adjacent to diversion box 241-TY-153 and 244-TX (RHO-WM-EV-1, *Jet Pumping Review*, p. B-2; drawings H-2-73903, *Piping Plan* and H-2-2231, *Diversion Box Piping Layout*). Drawing H-2-73901, Sheet 1 (zone F-4) shows the location of line SN402. Lines V402 and V406 also connect to 241-TY-153 and are reported to have failed because of chloride pitting.

Four cave–ins were observed near the 244-TX DCRT and its associated vault. The two cave-ins near the 244-TX DCRT were repaired by backfilling the voids, but one of the holes was again discovered in a 2008 walk-down of TY-Farm. One cave–in was observed near the 244-TX DCRT vault. It was 1 ft in diameter and at least 4 ft deep, over the eastern edge of the vault (buried 13 ft below). The other cave-in was 1.5 ft in diameter and 1 ft deep and was located 8 ft west of the vault (CH2MHILL 1997, *West Tank Farms Soil Subsidence Action Plan*).

Facilities in 241-TY Tank Farm (Descriptions in BHI-00177)

The 241-TX-Double Contained Receiver Tank is located north of 241-TX Tank Farm inside the 241-TY Tank Farm fence. It is an underground, horizontal cylindrical vessel set in a reinforced concrete steel-lined vault designed to contain leaks from transfers and drainage from operations within the 241-TX/T Tank Farms. The DCRT began operation in 1981 and received waste from PFP, T-Plant and T-Farm. It continued in operation until June 2005.

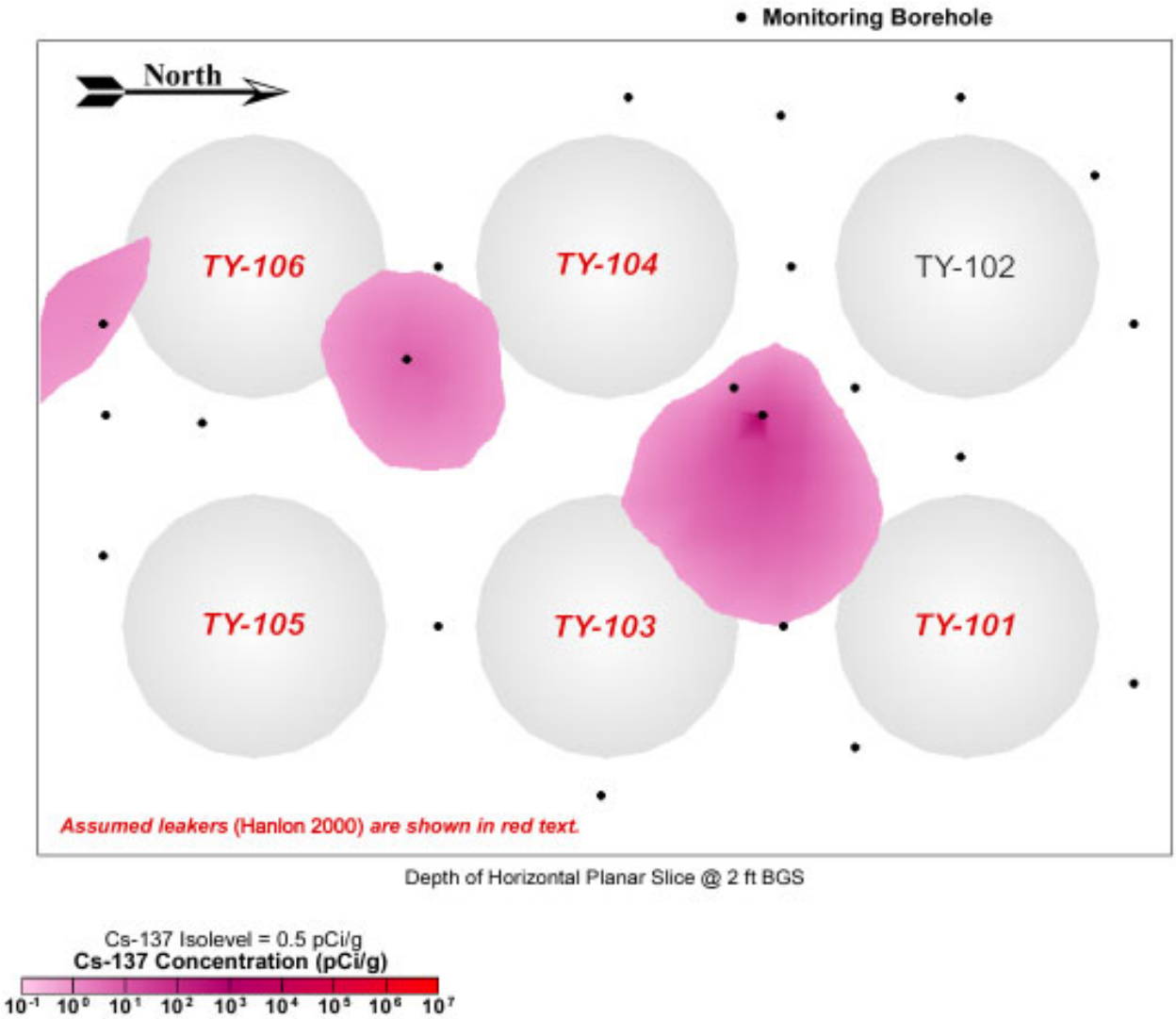
Table 5.7-1. Potential Pipeline Failures and Other Unplanned Waste Releases

Date	Event	Reference	Comments
1954	UPR-200-W-100: 118 TX process line leak. HW-60807 shows the leak was NE of TY farm outside the fence. However, all reference documents imply the leak was between TX-105 and TX-118. First Cycle waste max. dose rate 4.5 rad/hr covered an area 100 ft X 125 ft. Approx 10 Ci.	HW-60807 ARH-2757 Pt. 4 HW-33979	Location of the leak uncertain. Based on HW-33979: 3450 gal leak, 1,000 gal discharged to the ground. Leakage was hosed down to prevent wind borne contamination and are covered with gravel.
1/1982	V402 and V406 line failed because of chloride induced pitting. 3.5 in stainless steel connects at 241-TX-155 L-9	Known piping failures (7G410-MEJ-004) H-2-843, H-2-2231 Diversion box piping layout 241-TY-153	Cut and capped at 241-TX-155 and 241-TY-103-12 and -9
Before 3/1982	Line SN402 failed during saltwell pumping. 3 in carbon steel line connects to an encasement adjacent to 241-TY-103 that traverses to 241-TX-155.	RHO-WM-EV-1 H-2-73901, Piping Plan and Details H-2-2231 Diversion Box Piping Layout	Known piping failures (7G410-MEJ-004)
1985	UPR-200-W-167: Soil contamination area 630 ft X 140 ft East side of TY-Farm. Migration of contamination from TY-Tank Farm over a period of time.	A. Conklin 8-9-85 Basic Data for Rockwell Unplanned release Sites.	Scraped and removed and covered with clean gravel in 1986.
2000 and 2004	200-W-78-PL, East of TY Farm fence. 3 posted surface areas due 2000 discovery of contaminated biological intrusion into underground transfer lines. A fourth area was identified April, 2001. 200-W-78-PL runs parallel a few feet to the east. Either line is potential source of contamination.	WIDS report for 200-W-78-PL Site	Areas containing contaminated vegetation stabilized and covered with bio-barriers and soil and surveyed annually.

References:
Interoffice memorandum 7G410-MEJ-07-004, "Information on Process Pipeline Failures Due to Corrosion."
ARH-2757 Pt. 4, *Radioactive Contamination in Unplanned Releases to Ground Within the Chemical Separations Area Control Zone through 1972 (Exclusive of Liquid Waste Storage Tank Farms)*.
H-2-843, *Diversion Box Piping Layout 241-TX-155 Proj. C-163*, Sheet 1, Rev. 5.
H-2-2231, *Diversion Box Piping Layout*, Sheet 1, Rev. 1.
H-2-73901, *Piping Plan and Details*, Sheet 1, Rev. 4.
HW-33979, *Manufacturing Department Radiation Incident Investigation Incident Number: 393*.
HW-60807, *Unconfined Underground Radioactive Waste and Contamination in the 200 Areas–1959*.
RHO-WM-EV-1, *Jet Pumping Review*.

The 241-TY-153 Diversion Box is located in the southeast corner of the 241-TY Tank Farm, just inside the chain-link fence barricade, southeast of tank TY-105 and south of the 241-TY-302A catch tank. It is an inactive waste site that was used between 1953 and May 1981. The unit was used for transfer of waste solution from processing and decontamination operations. This diversion box interconnects the 241-TX Tank Farm diversion boxes (241-TX-153 and 241-TX-155) with the 241-TY Tank Farm. The unit has been isolated and stabilized with a spray covering to prevent infiltration of rain water.

Figure 5.7-1. Cesium-137 Activity in the top 2 feet at 241-TY Tank Farm



The 241-TY-302A Catch Tank is located approximately 63 ft north of the 241-TY-153 diversion box, inside the chain-link fence barrier of the 241-TY Tank Farm. It was used for the transfer of waste solutions from processing and decontamination operations, and is connected to the 241-TY-153 diversion box and the 241-TY Tank Farm (Hanford drawing H-2-44511, *Area Map 200 West "T" Plant Facilities*, Sheet 118). Waste volumes handled by the 241-TY-302A catch tank were variable, depending on plant operation. The unit has been isolated and stabilized with a spray covering to prevent infiltration of precipitation.

The 241-TY-302B Catch Tank is located approximately 170 ft east of tank TY-101. It was used for the transfer of waste solutions from processing and decontamination operations, and is connected to the 241-T-151 diversion box and the 241-TY encasements (Hanford drawing H-2-44511, Sheet 118). Waste volumes handled by the 241-TY-302B catch tank were variable, depending on plant operation. The unit has been isolated and stabilized with a spray covering to prevent infiltration of precipitation.

The 2607-WT Septic Tank is located east of the evaporator, between the 241-TX and 241-TY Tank Farms. This active sanitary wastewater and sewage septic tank generates approximately 0.02 m^3/d of waste. The unit is connected to a sanitary tile field (Hanford drawing H-2-1902). The site started operating in 1952 (Hanford drawing H-2-44511, Sheet 118).

Neither the septic tank nor the drain field could be definitively identified from outside the chain-link fence barrier. Drawings suggest that the septic tank is beneath the 241-T-601 building. The area around the building is covered with gravel.

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

WHC-SD-WM-ER-351, 1996, *Historical Tank Content Estimate for the Northwest Quadrant of the Hanford 200 West Area*, Rev. 0, ICF Kaiser Hanford Company, Richland, Washington.

WHC-SD-WM-ER-482, 1998, *Tank Characterization Report for Single-Shell Tank 241-TY-106*, Rev. 0D, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX A

TY- FARM TANK LEAK ASSESSMENT MEETING SUMMARIES

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MEETING SUMMARY

From: J. G. Field
Phone: 376-3753
Location: Ecology Office,
Date: March 3, 2009
Subject: Tank Farm Leak Evaluation

To: Distribution/Attendees

Attendees: Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, ECOLOGY
Paul Henwood, S. M. Stoller
Marcus Wood, CHPRC

PURPOSE:
Begin TY Farm assessments and assess tanks 241-TY-101 and TY-103.

Review of Previous Meeting Summary:
The February 13, 2009 meeting summary was reviewed and approved with minor changes.

TY-101 Assessment
Information about tank TY-101 to be included in the assessment report was presented. Tank TY-101 was categorized "questionable integrity" due to a liquid level decrease of 0.35 inches between June 13, 1973 and August 6, 1973. Evidence of increased activity in drywells 52-01-05 and 52-01-09 was also observed about the same time. The increased activity in these wells near TY-101 was observed shortly after tank TY-103 was determined to be leaking.

TY-101 was one of nine "questionable integrity" tanks reviewed in *Review of Classification of nine Hanford single-shell "questionable integrity" tanks* (RHO-CD-896). The assessment concluded that the tank should remain classified as "questionable integrity" at a 95% confidence level, meaning there was insufficient evidence to conclude that the tank leaked, but also insufficient evidence to verify it did not leak at a 95% CI. Results of the RH-CD-896 assessment were reviewed.

The surface level measurements appear to have been drifting and out of calibration and the 0.35 inch liquid level decrease is suspect and considered to be within the margin of uncertainty. A graph was shown that compared a steady decrease in liquid level from March 20, 1973 to May 15, 1973 that coincided with increases in drywell 52-01-09 from April to the end of the year. A cascade line overflow was identified as a possible source

of the liquid level decrease and increasing activity in drywell 52-01-09. However, no contamination was detected in the drywell at the depth of the cascade line.

The SGLS and total gamma logs indicate that activity observed in drywells 52-01-05, 52-01-09 and 52-03-12 was primarily ^{106}Ru and ^{60}Co. Less than 10 pCi/g ^{137}Cs was observed by SGLS in 52-01-05 at 40 ft bgs. This level of drywell activity was considered insufficient to conclude TY-101 leaked and suggests the TY-103 leak as a possible source. However, the general immobility of ^{137}Cs would suggest the source is closer to the drywell. Activity in 52-01-09, 52-03-12, and 52-01-05 appeared about the same time and increased and decreased in similar patterns. It was noted that the available drywell data begins in July 1973, several months after the liquid level decrease. Consensus for the team suggested TY-103 as a possible source for the activity in all three wells or an overflow from tank TY-102 as the source for activity in drywell 52-01-09. Alternatively, based on drywell activity, a possible leak from tank TY-101 was discussed.

By consensus it was determined that there is no basis for a leak inventory estimate for tank TY-101 and the tank is a candidate for sluicing. It was recommended that TY-101 be reassessed per TFC-ENG-CHEM-D-42.

TY-103 Assessment
Information about tank TY-103 to be included in the assessment report was also presented.
On July 9, 1973, TY-103 was classified as a confirmed leaker based on liquid level decreases. The leak volume was estimated to be 3,000 gallons. High Cs-137 activity was detected near the base of the tank in drywell 52-03-03 and ^{60}Co activity was observed in 52-03-06 and 52-03-12. Recent direct push logging and sampling also showed high activity near these wells. HRLS results showed ^{137}Cs activity levels greater than 10E7 pCi/g at 52-03-03 between 45 and 50 ft bgs.

A September 15 ARCHO reports suggests the leak was 3,600 gallons (ARH-2416 RD page 94).
The ARHCO monthly reports for 1973 also show that the supernatant waste in tank TY-103 in May 1973 was a blend of non-boiling wastes, including B Plant low-level waste [BL], Purex organic wash waste [OWW], and ion exchange loading waste [RIX]". Consequently, the Soil Inventory Model Revision 1 waste type description and leak inventories should be corrected. The concentrations for the leaked solution decayed to 1/2001 were determined to be 0.12 Ci/gal for ^{137}Cs and 63 μCi/gal for ^{99}Tc. The basis for these estimates will be included in the assessment report. The leak volume was determined to be 3,600 gallons.

NEXT MEETING
Assess tanks TY-102 and TY-104.

ACTIONS:
1. All: Review meeting summary
2. J. Field: Prepare and distribute March 3, 2009 Meeting Summary.

3. J. Field/P. Henwood: Prepare TY-102 and TY-104 dry well information and leak summaries.

NEXT MEETING:

Date: March 17, 2009
Time: 3:00-4:30
Location: ECOLOGY Office

MEETING SUMMARY

From: J. G. Field
Phone: 376-3753
Location: Ecology Office,
Date: March 24, 2009
Subject: Tank Farm Leak Evaluation

To: Distribution/Attendees

Attendees: Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, ECOLOGY
Paul Henwood, S. M. Stoller

PURPOSE:
Begin TY Farm assessments and assess tanks 241-TY-102 and TY-104.

Review of Previous Meeting Summary:
The March 3, 2009 meeting summary was reviewed. Additional discussion in the summary was suggested re. drywell data and potential implications for TY-101. Changes will be made and discussed in the next meeting.

TY-102 Assessment
Information about tank TY-102 to be included in the assessment report was presented. Tank TY-102 is classified a sound tank. However, this classification continues to be questioned.
A ^{137}Cs peak of 54 pCi/g was measured at 43 ft in drywell 52-02-11 near the base of the tank. Total gamma activity increased about 1980 and the level stayed relatively constant through 1995. Surface contamination was detected in all the dry wells around the tank. In 1973 activity was detected in dry well 52-01-09 at 45 to 55 ft bgs. The activity increased to a peak conc. of 600 cps in 1974, then decreased following a ^{106}Ru decay curve and was not detected by 1996 SGLS measurements. SGLS measurements did detect ^{60}Co contamination at the bottom of the borehole (95-100) ft. This has previously been attributed to the leak from Tank TY-103. Previous assessments and data were reviewed. As in previous assessments it was concluded that liquid level data provided no indication of a tank leak. Several potential sources for the low activity at dry well 52-02-11 were discussed including surface spills or barometric condenser releases that may have migrated down the side of the tank, a spare inlet overflow, overflow over the steel liner down the inside edge of the concrete, and a tank leak.

Flooding in the farm about the time the contamination was first observe could have provided a driving source to move contamination downward. Injection of sodium nitrate

when drywell 52-02-11 was first constructed also could drive surface contamination downward. Evidence of surface contamination was observed in drywells around TY-Farm. No evidence of contamination was observed between the surface (top 0-4 feet and 10 ft) and the base of the tank. A spare inlet overflow was ruled out as the source for contaminants in 52-02-11 because the spare inlet is on the opposite side of the tank from the drywell. However, a spare inlet overflow could be a source or contribute to the 1974 ^{106}Ru contamination and deep ^{60}Co contamination observed in drywell 52-01-09.

Additional information was requested regarding an explanation for the continued increase in the tank surface level measurements and to try to find additional information about the leak injection test referred to in the GJO-HAN-65 report and in Welty (SD-WM-TI-356). This will be discussed next meeting.

NEXT MEETING
Assess additional information for tank TY-102 and assess tank TY-104.

ACTIONS:
1. All: Review meeting summary
2. J. Field: Prepare and distribute March 24, 2009 Meeting Summary.
3. P. Henwood: Mark up TY-101 discussion in March 3 meeting summary.
4. J. Field: Prepare TY-105 and TY-106 information.

NEXT MEETING:
Date: March 31, 2009
Time: 3:00-4:30
Location: ECOLOGY Office

MEETING SUMMARY

From: J. G. Field
Phone: 376-3753
Location: Ecology Office,
Date: March 31, 2009
Subject: Tank Farm Leak Evaluation

To: Distribution/Attendees

Attendees: Dave Barnes, WRPS
Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, ECOLOGY
Paul Henwood, S. M. Stoller

PURPOSE:
Assess tanks 241-TY-102 and TY-104.

Review of Previous Meeting Summary:
Changes to the March 3, 2009 meeting summary provided by S.M. Stoller were discussed and accepted. The March 24 meeting summary was also reviewed and approved with minor changes.

TY-102 Assessment
Additional information was found regarding the leak injection test referred to in the GJO-HAN-65 report and in Welty (SD-WM-TI-356). The injection test was part of a Boeing resistivity technology test, documented in *Nuclear Waste Tank and Pipeline External Leak Detection Systems* (ARH-LD-120). A total of 3520 L of 3M $NaNO_3$ solution were injected into drywell 52-02-11 in 1975. There was no indication in the well log or the test report of any contamination in the drywell before the test. At the time of the test the well was 45 ft in depth with the bottom 3 ft perforated. The injection test provides yet another driver to move contaminants to the base of the tank. This drywell (52-02-11) was then deepened to its current depth of 100 ft.

Previous assessment results were again discussed and concerns about previous TY-102 assessments identified by Heart of America Northwest (*Recent Leaks From Hanford's High-Level Nuclear Waste Tanks: USDOE's Failure to Monitor, Report or Characterize Tank Leaks*, J. Brodeur, Priscilla Coe, 2006) were discussed. The concerns raised and responses discussed will be included in the assessment report.

Dave Barnes then provided an explanation for the continued increase in the tank surface level measurements for TY-102. Plots were presenting showing that the surface level has

continued to increase at a slow consistent rate. This was shown to be consistent with the behavior for many of the single-shell tanks and is attributed to gas build up in the waste. There was no correlation between surface level increases and weather events as is typically observed with intrusions into a tank and no correlation with barometric pressure.

As for previous assessments, participants concluded that there is little evidence of a leak from tank TY-102 and several more probable explanations for activity in drywell 52-02-11 near the base of the tank.

TY-104 Assessment

Information for tank TY-104 was then presented and discussed. Tank TY-104 was determined to be a leaking tank in 1974 based on a 0.5 in. liquid level decrease. The FIC gage measurements show a relatively stable liquid level from June 13, 1973 to December 30, 1973. An abrupt liquid level decrease was then observed, followed by a gradual decrease through March 16, 1974. TY-104 was one of six "questionable integrity" tanks reviewed in 1981. In the review, all 4 review teams concluded that the liquid level measurements indicated the tank was leaking (RHO-CD-1193, p. 11). The trend of liquid-level readings was consistently down during January/February 1974 with an apparent liquid loss of about 20 gal/day.

Although gamma activity remained below background levels in all of the drywells) drywell spacing is inadequate to assure a leak of 1,400 gal would be detected.

Participants in the March 31, 2009 inventory assessment concurred that the pattern of the liquid level decrease shown on the plot reviewed was a strong indication of a leak. An action was taken to verify what surface level data were available and how many data points were obtained to generate the surface level sketch reviewed (letter from Lindsay 1980, IDMS D194052482). The sketch indicates that multiple measurements were made between Dec. 30, 1973 and March 16, 1974 and shows the abrupt change in the liquid surface in the tank between Dec. 30 and Dec. 31, characteristic of a tank leak. However, Welty (SD-WM-TI-356) shows only three surface level measurements: a liquid level measurement of 273.0 on 1/20/74 indicating continuation of a stable profile, a measurement on of 272.5 in on 3/16/74 showing a 0.5 in decrease and a measurement of 26.0 in on 3/26/74, after the tank liquid was pumped out.

A memo dated May 6, 1974 (IDMS D196216654) shows analytical results for TY-104 samples (#T-3069) that are likely representative of supernatant in the tank at the time of the leak. These analytical results should replace SIM results where available and SIM results should be ratioed to ^{137}Cs differences for analytes where sample data is not available.

NEXT MEETING

Assess information for tanks TY-105 and TY-106.

ACTIONS:

1. All: Review meeting summary
2. J. Field: Prepare and distribute March 31, 2009 Meeting Summary.
3. D. Barnes: Review TY-104 surface level data.
4. J. Field: Prepare TY-105 and TY-106 information.

NEXT MEETING:

Date: April 14, 2009
Time: 3:00-4:30
Location: ECOLOGY Office

MEETING SUMMARY

From: J. G. Field
Phone: 376-3753
Location: Ecology Office,
Date: April 14, 2009
Subject: Tank Farm Leak Evaluation

To: Distribution/Attendees

Attendees: Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, ECOLOGY
Paul Henwood, S. M. Stoller
Marc Wood, CHPRC

PURPOSE:
Assess tanks 241-TY-105 and TY-106.

Review of Previous Meeting Summary:
The March 31, 2009 meeting summary was reviewed and approved.

SX-Farm Assessment Status
The SX-Farm assessment report is in progress. Two sections yet to be completed are the revised heat load model and a write up for TX/TY complex groundwater data and discussion. Both are expected by the end of April. Participants agreed that these sections should be completed before sending the SX-Farm assessment report for review.
A completed draft for review is expected in May.

TY-105 Assessment
Tank TY-105 was determined to be a leaking tank and was removed from service in 1960 based on liquid level decreases. Increased drywell activity was also observed near TY-105. Warrent (1960, a note found in Stoller files to be included in the assessment report) indicates that activity was found in drywell 52-06-05 as early as September 1959. More recent direct push data encountered high ^{137}Cs activity near the south edge of tank TY-105 and a large ^{99}Tc plume at 100 ft bgs (above the low permeability Cold Creek unit).

LA-UR-96-3860 shows a 35,000 gallon discrepancy in the transfer record in the 4th quarter of 1959 and notes that the 35,000 gallons was a correction for condensate transferred out of the tank. However neither Anderson (WHC-MR-0132) nor tank processing records record the 35,000 gal decrease. The process records show a 1 ¼ inch liquid level decrease during October 1960 (3,400 gal) and a further decrease of

27,000 gal between Jan 1961 and September 1970 adding to 30,400 gal. There is also a discrepancy of 13,000 gal in the transfer records in November and December 1960 for a total of 43,000 gal. However, the manual tape used for liquid level measurements was contacting solids after 1961, raising uncertainty about liquid level decrease measurements. Given the uncertainty and lacking better information, the 35,000 gallon estimate in HNF-EP-0182 should continue to be used for inventory estimates unless better information is found. No sample analyses were available that were considered representative of supernatant in tank TY-105 at the time of the leak. Therefore, the Soil Inventory Model, based on a TBP-UR waste stream, provides the best available estimate for the composition of the leak.

As a side note: It was observed that the composition of ^{137}Cs in BBI for tank TY-105 is a factor of 20 lower than for TY-106. This seemed strange given that TY-105 cascaded to TY-106 and process records indicate that all of the waste in TY-106 was from TY-105. An action was taken to further look into the reasons for the difference in BBI inventories.

TY-106 Assessment

Tank TY-106 was determined to be a leaking tank and was removed from service in 1959 based on liquid level. Liquid level measurements in HW-83906-D RD show a decrease of 18,150 gallons from August through October 1959. This was determined to be close enough to continue to use the current estimate of 20,000 gallons. Drywell data and direct push data also showed activity near TY-106. As for TY-105, Warrent (1960) indicates that activity was observed in drywells in 1959. No liquid sample data was available for tank TY-106. Therefore, the Soil Inventory Model, based on a TBP-UR waste stream, provides the best available estimate for the composition of the leak. SIM assumes that the composition of the TY-105 and TY-106 leaks were the same.

NEXT MEETING

Assess information for TY-farm Unplanned Releases and Surface Contaminants.

ACTIONS:

1. All: Review meeting summary
2. J. Field: Prepare and distribute April 14, 2009 Meeting Summary.
3. J. Field: Investigate BBI estimates for TY-105 and TY-106.
4. J. Field: Prepare TY-Farm UPR information.
5. P. Henwood: Review Drywell data for near surface releases information for TY-Farm
6. M. Wood: Prepare SX-Farm assessment groundwater write-up.

NEXT MEETING:

Date: April 21, 2009
Time: 3:00-4:30
Location: ECOLOGY Office

MEETING SUMMARY

From: J. G. Field
Phone: 376-3753
Location: Ecology Office,
Date: April 21, 2009
Subject: Tank Farm Leak Evaluation

To: Distribution/Attendees

Attendees: Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, ECOLOGY
Beth, Rochette, ECOLOGY
Marc Wood, CHPRC

PURPOSE:
Assess TY-Farm surface contamination, unplanned releases and groundwater

Review of Previous Meeting Summary:
The April 14, 2009 meeting summary was reviewed and approved.

TY-Farm Unplanned Releases
Information on unplanned releases and surface contamination was presented and discussed. Releases and surface contamination in TY-Farm are summarized in Table 1. The inventory and exact locations of TY Farm releases are largely unknown. However, there is clear evidence of leaking pipelines east of TY-Farm. Several locations are posted showing underground radioactivity along the line (Table 1) and surface geophysics exploration (SGE) and direct push probe data suggest activity on the East/South East side of TY Farm along the pipeline. Additional characterization is needed to further assess surface contamination in TY-Farm, especially on the East side of the farm. Characterization will be performed in accordance with data quality objectives to be developed in support of WMA- T/TX/TY Corrective Measures.

Crib Discharges and Groundwater
Marc Wood discussed discharges to 216-T-18, 216-T-26, 216-27 and 216-28 East of TY-Farm and groundwater monitoring results. Millions of gallons of waste were discharged to the cribs between 1953 and 1966. It was noted that iodine concentrations in groundwater monitoring well 299 W14-13 East of TY-Farm indicate that 216-T-27 crib discharges of laboratory waste from the 340 building have reached the groundwater. High levels of ^{99}Tc were found in wells 299-W14-13, 299-W14-11 and 299-W14-15. Regarding Crib 216-T-28, WIDS states that "a breakthrough of radioactive strontium and cesium to the groundwater beneath the crib occurred in 1965." Because the volume of

TY-farm tank leaks and unplanned releases is small in comparison with crib discharges, it is questionable whether TY-Farm leaks were sufficiently large to reach groundwater. However, contributions of TY-Farm tank or pipeline leaks cannot be discounted.
A discussion of groundwater monitoring near TX and TY-Farms will be included in the assessment report.

Table 1. Potential Pipeline Failures and Other Unplanned Waste Releases

Date	Event	Reference	Comments
1954	UPR-200-W-100: 118 TX process line leak. HW-60807 includes a hand drawn sketch that shows the leak was NE of TY farm outside the fence. However, all reference documents imply the leak was between TX-105 and TX-118. First Cycle waste max. dose rate 4.5 rad/hr covered an area 100 ft X 125 ft. RPP-26744 estimates a leak of 2,540 gal of first cycle waste. The waste leak was estimated at 3,450 gal based on inventory readings at tanks 105-T and 118-TX. The 302-B catch tank was reported to retain 3,300 gallons of the leaked waste and rain water intrusion. The estimated volume of waste discharged to the ground was 1,000 gallons. Leakage was hosed down to prevent wind borne contamination and the area was covered with gravel.	HW-60807 ARH-2757 HW-33979	Included for completeness, this UPR is probably not in TY-Farm. Location of the leak is uncertain.
11/1969	After a transfer from Tank 107-Ty to 103-TY about 5 gallons leaked to ground when a flange was loosened after flushing and air blowing a line. Maximum dose was 2000 mrad/hr. 20 cu ft of dirt were removed for burial.	11-14-69 Radiation Occurrence Report	
1/1982	V402 and V406 lines failed because of chloride induced pitting. 3.5 in stainless steel connects at 241-TX-155 L-9	H-2-843 and H-2-2231 Diversion box piping layout 241-TY-153	Cut and capped at 241-TX-155 and 241-TY-103-12 and -9
3/1982	Line SN402 failed during saltwell pumping. This 3 in carbon steel line connects to an encasement adjacent to 241-TY-103 and 244-TX that traverses to 241-TX-155.	RHO-WM-EV-1 H-2-7903, Piping plan and layout H-2-2231 Diversion box piping layout	

Table 1. Potential Pipeline Failures and Other Unplanned Waste Releases			
Date	**Event**	**Reference**	**Comments**
1985	UPR-200-W-167: The original site posted in 1985 was a soil contamination area 630 ft X 140 ft on the East side of TY-Farm. Migration of contamination from TY-Tank Farm over a period of time. In 2000, contaminated ant hills and growing contaminated vegetation was found on top of a transfer line outside the eastern farm fence and 3 areas on the East and NE sides of TY-Farm were posted as contamination areas (CA). In November 200, the CA's were covered the bio-material and gravel and reposted as "underground radioactive material." Further description is given in the 200-W-78-PL site description.	Waste Information Data System (WIDS) UPR-200-W-167	Scraped and removed and covered with clean gravel in 1986.
NA	200-W-94: This site encompasses all of the individual UPR's and otherwise contaminated soil in 241-TX/TY farm and is defined as the soil surrounding the tanks inside and adjacent to the unbroken chain link fence surrounding the 241-TX/TY Farms. The only specific UPRs for TY Farm associated with this site are the UPRs	Waste Information Data System (WIDS) 200-W-94	Consolidated WIDS site
2000 and 2004	200-W-78-PL, East of TY Farm fence. 3 posted surface areas due 2000 discovery of contaminated biological intrusion into underground transfer lines. A fourth area was identified April, 2001. 200-W-78-PL runs parallel a few feet to the east. Either line is potential source of contamination.	WIDS 200-W-78-PL Site	Areas containing contaminated vegetation were stabilized and covered with bio-barriers and soil and surveyed annually.

NEXT MEETING
Begin to assess information for BY-farm Tanks.

ACTIONS:
1. All: Review meeting summary
2. J. Field: Prepare and distribute April 21, 2009 Meeting Summary.
3. J. Field: Prepare BY-Farm UPR information and start TY report.
4. P. Henwood: Review Drywell data for BY-Farm
5. M. Wood: Prepare SX-Farm assessment groundwater write-up.

NEXT MEETING:
Date: June 9, 2009
Time: 3:00-4:30
Location: ECOLOGY Office

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