RPP-ASMT-42278
Revision 0

Tank 241-A-103 Leak Assessment Report

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EXECUTIVE SUMMARY

Tank A-103 is a 1,000,000 gallon capacity, 75-foot diameter, steel-lined, concrete shell tank located in the southeast corner of the six-tank 241-A Tank Farm. The tank was constructed during 1954 - 1955, and placed in service in May, 1956. It was removed from service in August, 1980, and declared interim stabilized in June, 1988 with a remaining waste inventory of 4,600 gallons of supernatant and 12,000 gallons of drainable interstitial liquid.

In May, 1987, a tank integrity assessment of the previous six years' surface level behavior was conducted. The surface level would slowly rise over a period of nine to twelve months, then drop rapidly over a one to two day period. Three out of the five members of the tank integrity assessment panel concluded that tank A-103 was sound – that the surface level fluctuations were attributable to waste properties. The other two panel members stated that there was inconclusive evidence to relate the surface level fluctuations to some waste phenomena. In accordance with the integrity decision rules in place at the time, tank A-103 was reclassified as an "Assumed Leaker."

In 2007, CH2M HILL Hanford Group Inc., with the U. S. Department of Energy – Office of River Protection and the Washington State Department of Ecology, developed a process to re-assess selected tank leak volume and inventory estimates, and to update single-shell tank leak and unplanned release volumes and inventory estimates as emergent field data are obtained. The process is described in RPP-32681, *Process to Estimate Tank Farm Vadose Zone Inventories*.

In August, 2008, a leak integrity review of tank A-103 was conducted in accordance with the RPP-32681 process. The review concluded that there was no evidence of a leak from the tank. The conclusion was based on information that was not available during the 1987 investigation, including an understanding of the mechanism of episodic gas release events (GREs) that present themselves as periods of gradual surface level increase followed by rapid decreases. The 2008 leak integrity review concluded that the 1987 panel's recommendation to classify tank A-103 as an assumed leaker may have been incorrect. Data collected from spectral gamma logging of the laterals beneath the tank corroborated the review's conclusion.

Based on the 2008 review, a formal leak assessment of tank A-103 was performed during May, 2009. The method of analysis used for the formal leak assessment process is Engineering Procedure TFC-ENG-CHEM-D-42, Rev. B-1, *Tank Leak Assessment Process*. The formal leak assessment process is based on probabilistic analysis to assess the mathematical likelihood (probability) that a tank is leaking or has leaked. The technical basis for the process and additional details and examples of the methodology for implementing the process can be found in HNF-3747 Rev. 0, *Tank Leak Assessment Technical Background.*

The leak assessment used a panel of experienced Washington River Protection Solutions, LLC engineers and managers to review the tank A-103 historical data and evaluate the tank's leak integrity. The panel consisted of: D. J. Washenfelder (Assessment Coordinator, Technical Integration Program Manager); M. A. Fish (Single-Shell Tank System Engineer, West System Engineering); D. A. Barnes (Surveillance System Engineer, In-tank and Ex-tank Surveillance); J.

W. Ficklin (Operations – Base Operations); J. G. Field (Operations Support – Vadose Zone); and B. N. Hedel (Operations Support – Vadose Zone). The team met between May 12, 2009 and May 28, 2009 to gather and review information, develop the Leak and Non-Leak Hypotheses, and reach a consensus recommendation for tank A-103.

Based on review of the in-tank and ex-tank data, the panel developed plausible hypotheses for the observed tank behavior:

> **Leak Hypothesis:**
>
> "The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak."
>
> **Non-Leak Hypothesis:**
>
> "The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface."

The consensus of the assessment team is that the "non-leak" hypothesis is consistent with the in-tank and ex-tank data from the 1977 – 1988 period, and that tank A-103 did not leak.

The most likely causes of the surface level changes observed during the 1977 – 1988 period were the episodic accumulation and release of trapped gas in the waste, combined with waste evaporation, and measurement errors created by the irregular waste surface. Although slurry growth in 242-S Evaporator/Crystallizer concentrated waste had already been observed in 200-West Area tanks, it is clear that in the late 1980's there was no technical consensus on the cause. The mechanism for creating gas release events was not understood until the 1990's.

Although there is evidence of low levels of Cs-137 soil contamination around some of the tank A-103 drywells, there is no evidence of soil contamination at the base of the tank. An increase in the number of the contamination intervals, and the dates of highest measured contamination, seem to coincide with the 1978 drilling campaign to deepen the drywells, indicating contamination drag-down may have been a factor. Radiation monitoring in the three laterals beneath the tank from 1977 to 1991, and again in 2005, detected no evidence of tank leakage.

The recommendation of the assessment team is that the existing "Assumed Leaker" integrity classification for tank A-103 be changed "Sound."

The results of this assessment were presented to the Executive Safety Review Board on September 8, 2009. The Board accepted the recommendation of the assessment team.

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Abbreviations and Acronyms

BDGRE	buoyant displacement gas release event
CASS	Computer Automated Surveillance System
CC	Complexed Concentrate
CY	Calendar Year
DIL	drainable interstitial liquid
DLR	drainable liquid remaining
DOE-GJO	U.S. Department of Energy Grand Junction Office
DOE-RL	U.S. Department of Energy Richland Operations Office
DOE-ORP	U.S. Department of Energy Office of River Protection
DSSF	double-shell slurry feed
FY	Fiscal Year
GRE	gas release event
IDMS	Integrated Data Management System
PCSACS	Personal Computer Surveillance Analysis Computer System
PSS	PUREX Sludge Supernate
SGLS	Spectral Gamma Logging System
SST	single-shell tank

Units

Ci	curies
ft	foot
gal	gallon
in	inch
kgal	kilogallon (10^3 gallons)
pCi	picocuries (10^{-12} curies)

1.0 INTRODUCTION

This document provides the results of a formal leak assessment performed on tank 241-A-103 (tank A-103). The leak assessment process is described in Engineering Procedure TFC-ENG-CHEM-D-42, Rev. B-1, *Tank Leak Assessment Process*.

Tank A-103 is a 1,000,000 gallon capacity, 75-foot diameter, steel-lined, concrete shell tank located in the southeast corner of the six-tank 241-A Tank Farm. The tank was constructed during 1954 - 1955, and placed in service in May, 1956. It was removed from service in August, 1980, and declared interim stabilized in June, 1988 with a remaining waste inventory of 4,600 gallons of supernatant and 12,000 gallons of drainable interstitial liquid. The tank was classified as a "Assumed Leaker" in 1987 following seven years of cyclical surface level changes.

Prior to 1977 tank A-103 was used to store a wide variety of wastes, including self-boiling PUREX high-level waste, and sludge waste retrieved from other single-shell tanks. In 1977 it was converted to a 242-A Evaporator/Crystallizer slurry receiver, and began receiving concentrated waste, including double-shell slurry feed and complexant concentrate.

Fluctuations in the waste surface level were noticed shortly after the tank began receiving concentrated waste from the 242-A Evaporator/Crystallizer. Between 1974 when the Hanford occurrence reporting system was implemented, and 1976 there were no reported occurrences for tank A-103. From 1977 to 2009, there were eight reported occurrences. Seven of the eight addressed surface level fluctuations during the period 1977 – 1987.

In May, 1987, a tank integrity assessment of the previous six years' surface level behavior was conducted. The surface level would slowly rise over a period of nine to twelve months, then drop rapidly over a one to two day period. Three out of the five members of the tank integrity assessment panel concluded that tank A-103 was sound – that the surface level fluctuations were attributable to waste properties. The other two panel members stated that there was inconclusive evidence to relate the surface level fluctuations to some waste phenomena. In accordance with the integrity decision rules in place at the time, tank A-103 was reclassified as an assumed leaker.

In 2007, CH2M HILL Hanford Group Inc. with the U. S. Department of Energy – Office of River Protection and the Washington State Department of Ecology developed a process to re-assess selected tank leak volume and inventory estimates, and to update single-shell tank leak and unplanned release volumes and inventory estimates as emergent field data are obtained. The process is described in RPP-32681, *Process to Estimate Tank Farm Vadose Zone Inventories*.

In August, 2008, a leak integrity review conducted under the auspices of the RPP-32681 process concluded that there was no evidence of a leak from the tank. The conclusion was based on information that was not available during the 1987 investigation, including understanding the mechanism of episodic gas release events (GREs) that present themselves as periods of gradual surface level increase followed by rapid decrease. The 2008 leak integrity review concluded that the 1987 panel's recommendation to classify this tank as an assumed leaker may have been incorrect. Data collected from spectral gamma logging of the laterals beneath the tank corroborated the review's conclusion. The 2008 leak integrity review is summarized in RPP-ENV-37956 Rev. 1, *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Releases.*

A formal leak assessment of tank A-103 was performed during May, 2009. The method of analysis used for the formal leak assessment process is Engineering Procedure TFC-ENG-CHEM-D-42, Rev. B-1, *Tank Leak Assessment Process.* The formal leak assessment process is based on probabilistic analysis to assess the mathematical likelihood (probability) that a tank is leaking or has leaked. The technical basis for the process and additional details and examples of the methodology for implementing the process can be found in HNF-3747 Rev. 0, *Tank Leak Assessment Technical Background.*

This report provides the results of the formal leak assessment.

Figure 1-1. 241-A Tank Farm Plan

Tank A-103 is located in the southeast corner of 241-A Tank Farm. There are seven drywells surrounding around the tank, identified by their associated tank number and clock position from North. (GJO-HAN-23 [GJO-98-64-TAR] "Vadose Zone Characterization Project at the Hanford Tank Farms: A Tank Farm Report.")

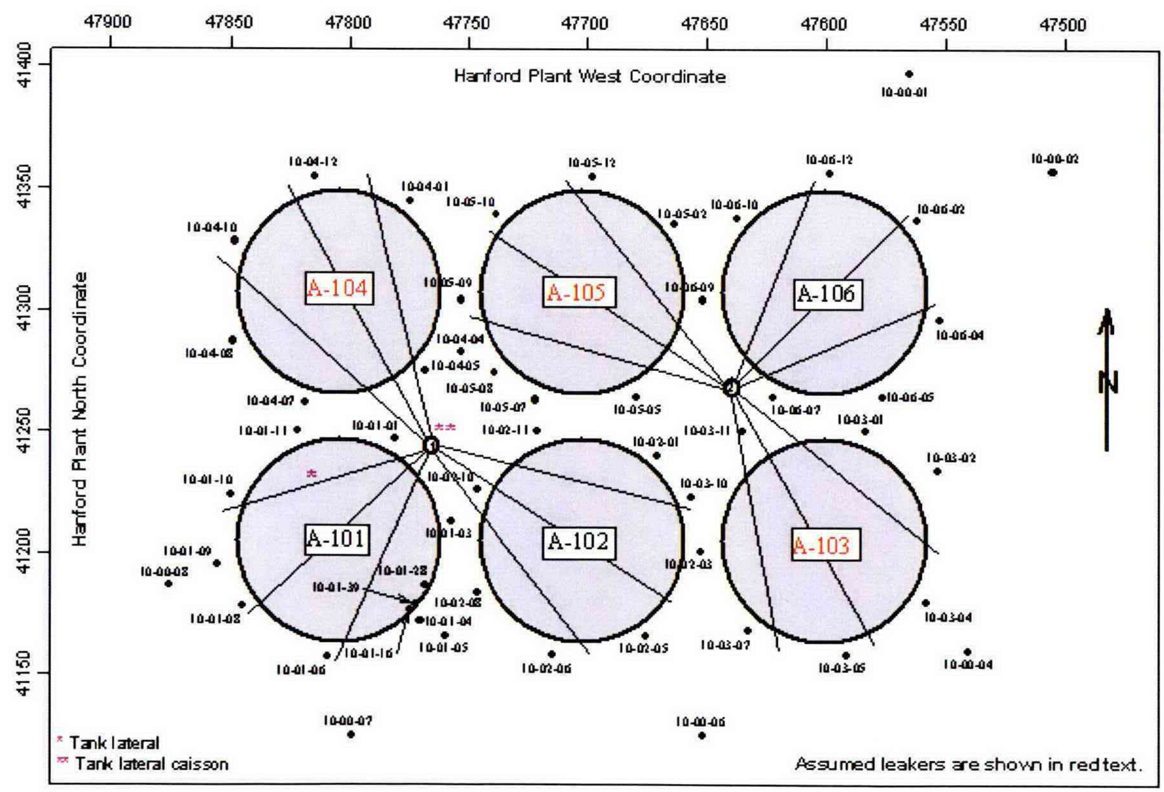
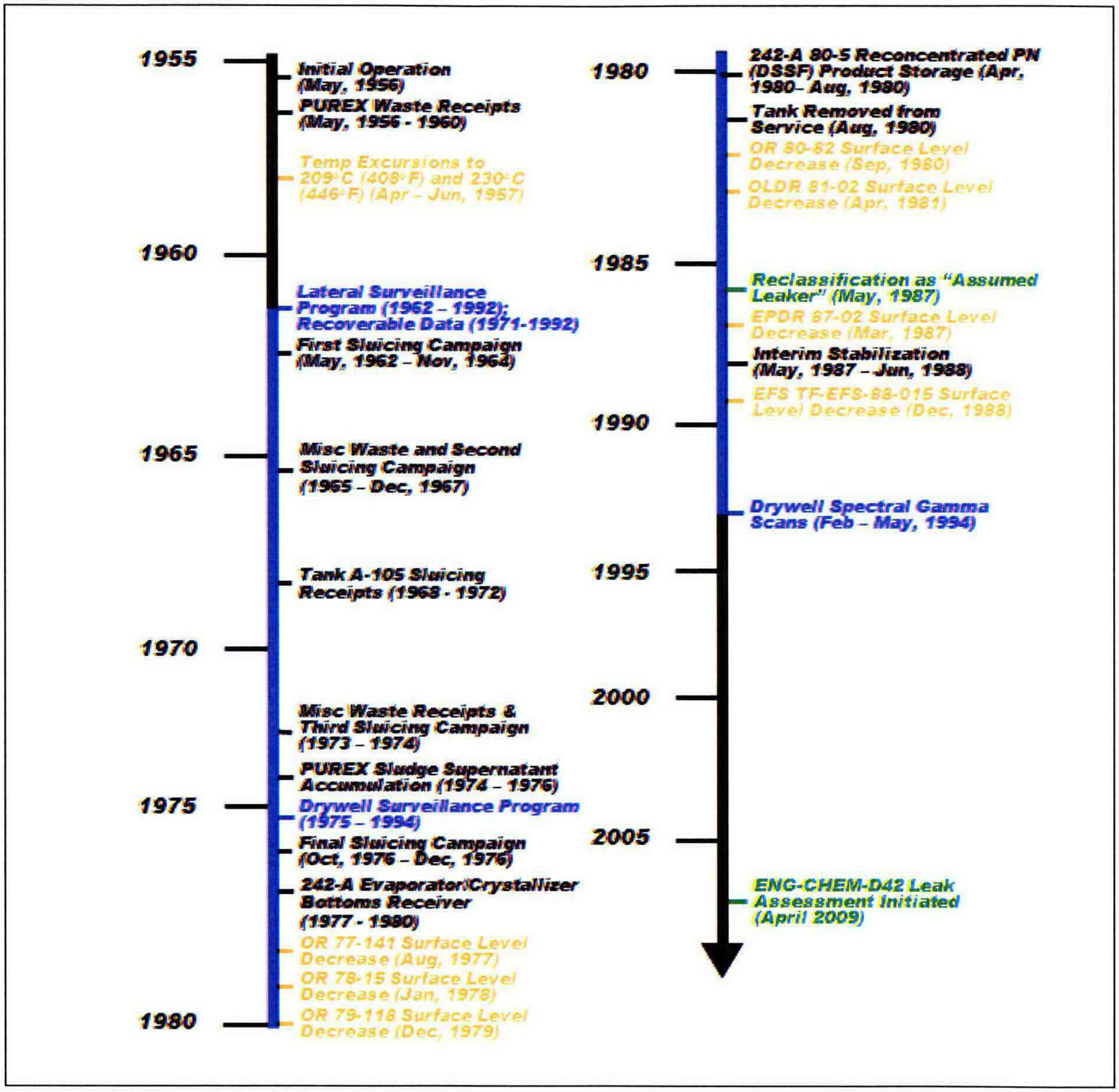


Figure 1-2. Tank A-103 Event Time Line



2.0 METHOD OF ANALYSIS

The method of analysis used for the formal leak assessment process is Engineering Procedure TFC-ENG-CHEM-D-42, Rev. B-1, *Tank Leak Assessment Process*. The formal leak assessment process is based on probabilistic analysis to assess the mathematical likelihood (probability) that a specific tank is leaking or has leaked. The technical basis for the process and additional details and examples of the methodology for implementing the process can be found in HNF-3747 Rev. 0, *Tank Leak Assessment Technical Background.* For each step, a description of the process, products, and responsibilities is provided.

The leak assessment used a panel of experienced Washington River Protection Solutions, LLC engineers and managers to review the tank A-103 historical data and evaluate the tank's leak integrity. The panel consisted of: D. J. Washenfelder (Assessment Coordinator, Technical Integration Program Manager); M. A. Fish (Single-Shell Tank System Engineer, West System Engineering); D. A. Barnes (Surveillance System Engineer, In-tank and Ex-tank Surveillance); J. W. Ficklin (Operations – Base Operations); J. G. Field (Operations Support – Vadose Zone); and B. N. Hedel (Operations Support – Vadose Zone). The team met between May 12, 2009 and May 28, 2009 to gather and review information, develop the Leak and Non-Leak Hypotheses, and reach a consensus recommendation for tank A-103.

3.0 TANK A-103 OPERATING HISTORY

Tank A-103 is a 1,000,000 gallon capacity, 75-foot diameter, mild steel-lined concrete shell tank located at the southeast corner of the six-tank 241-A Tank Farm. The tank was constructed during 1954 - 1955, and placed in service on May 17, 1956.

The following description of tank A-103's operating history is from RPP-ENV-37956, *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Releases*.

PUREX Waste Receipts (1956 - 1960): In May 1956, the tank received 72 kgal of organic wash waste from the 202-A PUREX Plant (HW-43420 page 8). Then in June 1956, tank A-103 received 99 kgal of PUREX P1 HLW supernate (HW-43895 page 8). The waste began to self-boil (102°C) on June 25, 1956 (HW-44506 page 9). Tank A-103 continued to receive PUREX HLW and periodic additions of water and organic wash waste through July. 1960 (HW-66557 page 8) to maintain the volume of self-concentrating waste at approximately 500 kgal. No waste additions were reported for 1961.

Mild pressure surges were reported in tank A-103 as early as July, 1956 (HW-44580 page Fc-13). Three consecutive bumps occurred in September 1956, that blew the by-pass seal pot water seal (60-in) and forced steam directly out the tank farm stack. The air-lift circulators were started to prevent reoccurrence of this event (HW-45707 page J-7).

First Sluicing Campaign (May, 1962 - November, 1964): Approximately 330 kgal of supernate were transferred from tank A-103 to tank A-105 in May, 1962, and additional 180 kgal were transferred in July, 1962 (ARH-78 page 8). These transfers were made in order to prepare the tank to demonstrate sludge sluicing capability. Water was added to tank A-103 to soften the sludge and the sludge was sluiced to tank A-102 from March, 1964 (HW-81620 page G-2) through November 17, 1964 (RL-SEP-112 page B-2).

Miscellaneous Waste Receipts and Second Sluicing Campaign (1965 - December, 1967): Tank A-103 received 244-CR vault, tank C-103, and PUREX organic wash wastes in 1965 and 1966. The supernate in tank A-103 was transferred to tank A-101 in March, and April, 1966 (ISO-75 page 53 and 70) to flush the tank. A new sluicer was installed in May ,1966 (ISO-75 page 85) and sluicing was again conducted intermittently between October 20, 1966 (ISO-75 page 174).and February 16, 1967 (ISO-651 page 30). Following completion of sluicing, the sludge and supernate volumes in tank A-103 were reported as 0 gal and 55 kgal, respectively, as of March 31, 1967 (ISO-806 page 8). The sludge volume was later revised in December 31, 1967 to 22,000 gallons (ARH-326 page 9).

Tank A-105 Sluicing Receipts and Associated Transfers (1968 - 1972): From February, 1968 through November, 1968, tank A-103 received the PUREX HLW supernate from tank A-105, subsequent flushes of tank A-105 with cesium denuded ion exchange waste, and sludge sluiced from tank A-105 (Interoffice Memo 7G420-06-004). Supernatants collected in tank A-103 were periodically transferred to other single-shell tanks. Tank A-103 received sludge from a second sluicing campaign conducted in tank A-105 July 31 – August 1, 1969 (ARH-1023-3-DEL pages 33-34) and August 25 – November 18, 1970 (Interoffice Memo 7G420-06-005).

The sludge slurry collected in tank A-103 from the second tank A-105 sluicing campaign was allowed to settle. Approximately 302 kgal of supernatant were transferred to tank C-105 in the second quarter of calendar year (CY) 1972, leaving 244 kgal of supernate and 102 kgal gallons of sludge in the tank (ARH-2456 B page 9).

Miscellaneous Waste Receipts and Third Sluicing Campaign (1973 - 1974): Tank A-103 was next used in the second quarter of CY 1973 to receive ~19 kgal of sludge slurry from sluicing tank A-102 (ARH-2794 B page 9). Tank A-103 then received 71 kgal of waste from B Plant in the fourth quarter of CY 1973 (ARH-2794 D page 9). Approximately 244 kgal of supernate were transferred to tank A-104 in the first quarter of CY 1974, leaving 125 kgal of supernate and 102 kgal of sludge in the tank (ARH-CD-133 A page 9). The sludge in tank A-103 was sluiced to 244-AR Vault beginning in the first quarter of CY 1974 (ARH-CD-133 A page 9) and completed in September 1974 (SD-WM-TI-302 page 166).

PUREX Sludge Supernatant Accumulation (1974 - 1976): Tank A-103 was used to collect PUREX Sludge Supernate (PSS) from various single-shell tanks and B Plant waste in the fourth quarter CY 1974 (ARH-CD-133 D page 9) through first quarter CY 1976 (ARH-CD-702 A page 9). The PSS waste was generated from washing sludges either in 244-AR Vault or in a single-shell tank, then decanting the supernatants. Approximately 920 kgal of supernate were transferred to tank C-104 and 13 kgal were transferred to tank A-106 in the second quarter of CY 1976, leaving 20 kgal of supernate and 16 kgal of sludge in tank A-103 (ARH-CD-702 B page 9).

Final Sluicing Campaign (October, 1976 - December, 1976): From October 13, 1976 (ARH-LD-222 B page 13) through early December, 1976 (ARH-LD-224 B page 11) the sludge in tank A-103 was sluiced to tank A-106 (SD-WM-TI-302 page 166). This final sluicing in tank A-103 was conducted to prepare the tank to receive saltcake from operation of the 242-A Evaporator/Crystallizer. Tank A-103 was reported to contain 2,080 gallons of sludge following completion of this last sluicing campaign (SD-WM-TI-302 page 166).

242-A Evaporator/Crystallizer Bottoms Receiver (1977 - 1980): The 242-A Evaporator/Crystallizer used tank A-103 as a slurry receiver and feed tank from early 1977 through April 1980 (RHO-CD-80-1045 5 page 8). Tank A-103 received both double-shell slurry feed (DSSF) and Complexed Concentrate (CC) waste. Both of these wastes generated gas that was retained and episodically release. The episodic releases were accompanied by decreases in the waste surface level. This rise and fall cyclical behavior was experienced in single-shell tank bottoms receivers in both 200-E and 200-W areas, and was not unique to tank A-103. At the time the phenomenon was explained by a variety of mechanisms, including waste settling, and waste mixing. Gas retention was alluded to, but retained gas and retained gas release events were not yet understood.

Deactivation (1980): The tank was removed from active service August 14, 1980. Pumpable supernate was removed to meet the deactivation criterion of < 33 kgal free supernatant (SD-WM-TI-356).

Interim Stabilization (May, 1987): Pumping of interstitial liquid and supernate from tank A-103 was started on May 16, 1987 and completed on May 24, 1987. A total of 111 kgal gallons of liquid waste were removed from tank A-103 to stabilize this tank (HNF-SD-RE-TI-178 page 15 -18).

Tank A-103 was declared interim stabilized in June, 1988 with a 4,600 gal of supernatant and 12 kgal drainable interstitial liquid (DIL) for a total drainable liquid volume of 16.4 kgal, according to HNF-SD-RE-TI-178, *Single-Shell Tank Interim Stabilization Record.* The total liquid inventory remaining in the tank at the time of stabilization was 19.4 kgal which included the 4,600 gal of supernatant and 14.8 kgal of interstitial liquid. The 14.8 kgal of interstitial liquid was estimated from the volume of drained liquid recovered from core sample segments taken in 1986. The average volume of liquid recovered for eight segments was 3.5%. HNF-SD-RE-TI-178 assumed the waste to be sludge but does not explain why 2,800 difference between the total interstitial liquid volume and the reported DIL volume. However based on review of the core sample drained liquid data included in the report, it appears that liquid in the bottom 18 inches of sludge was assumed to be capillary held.

In 2000, RPP-5556, *Updated Drainable Liquid Volume Estimates for 119 Single-Shell Tanks Declared Stabilized*, reiterated the assumption that the waste was sludge. Then using a sludge volume of 366 kgal and a tank average sludge porosity of 0.15, the tank was estimated to contain 5,000 gal of supernatant and 54.9 kgal of total interstitial liquid. A capillary height of 24-in was assumed for the sludge waste which resulted in a drainable interstitial liquid volume of 45 kgal. The total drainable liquid remaining (DLR) volume of 50 kgal was the sum of the supernatant (5,000 gal) and the DIL (45 kgal).

In 2001, the Best Basis Inventory determined that much of the waste in tank 241-A-103 was saltcake based on the composition of the 1986 core samples.

In 2002, the drainable liquid volumes were re-evaluated (Internal letter 7G300-02-JGF-001 R1, *Addition of Best-Basis Inventory Baseline Volumes to Waste Tank Summary Report*, Revision 1). This calculation used the following values to calculate the DIL volume: 364 kgal saltcake, 2 kgal sludge, 0.15 tank average sludge porosity, 0.25 tank average saltcake porosity, and a capillary height of 6-in. The tank was estimated to contain 4,000 gal of supernatant and 87 kgal of DIL for a total of 91 kgal.

In 2005, the DIL and DLR calculations for tank A-103 were updated with a new tank average saltcake porosity of 0.24 and a new tank average sludge porosity of 0.17 according to HNF-2978, *Updated Pumpable Liquid Volume Estimates and Jet Pumping Durations for Interim Stabilization of Remaining SSTs*. Using a capillary height of 6-in for saltcake, the DIL volume was 86 kgal and the DLR was 90 kgal.

The April 1, 2005 BBI estimated 4,000 gal of supernatant, 89 kgal of interstitial liquid in the saltcake and 0.4 kgal interstitial liquid in the sludge. The 4,000 gal of supernatant is from the HNF-SD-RE-TI-178. The 89 kgal of interstitial liquid is based on 372 kgal saltcake with 24% porosity. The waste was determined to be mostly saltcake based on the composition of the 1986 core samples. The total liquid volume is 93 kgal.

4.0 TANK LEAK ASSESSMENT HISTORY

The leak integrity status of tank A-103 was reviewed in May, 1987, and again in June, 2008. The following discussion of the leak assessments is from RPP-ENV-37956, *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Releases*.

May, 1987 Leak Assessment: An integrity assessment of the previous six years' (i.e., 1981 – 1987) surface level behavior was conducted in May,1987 following the procedures and rules for other tank integrity assessments documented in RHO-CD-1193 (Internal Letter 65000-WWS-87-033). The integrity assessment panel reviewed information supporting the notion that the observed surface level decrease was attributable to slurry growth (i.e., retained gas accumulation and release). The surface level would slowly rise over a period of nine to twelve months, then drop rapidly over a one to two day period (Internal Letter 65950-87-291). Core samples obtained from tank A-103 in April, 1986 showed no interstitial liquid and were laced with air pockets or void spaces large enough to be clearly visible in photographs (IDMS Accession # D196165963). Drywell and lateral radiation readings were unchanged during the six year period.

Three out of the five members of the tank integrity assessment panel stated at the 95% confidence level that tank A-103 was sound; that the surface level fluctuations (both increases and decreases) were attributable to waste properties, and additional study of this phenomenon should be conducted. The other two panel members stated there was inconclusive evidence to relate the liquid level fluctuations to some waste phenomena. The assessment panel concluded tank A-103 should be classified as an assumed leaker, although there was no increase in activity detected in the laterals or drywells associated with this tank. The volume of waste leaked from tank A-103 was estimated to be 0 gallons to 5,500 gallons, with the variability in the leak volume due to uncertainty whether the tank actually leaked, and the upper bound on the surface level decrease of 2-in from the last established 186.0-in baseline to 184.0-in, the most commonly reported Computer-Automated Surveillance System (CASS) reading (IDMS Accession # D199126708).

The phenomenon of retained gas release has also been observed in other tanks (e.g. SY-101, SY-103, AW-101, AN-103, AN-104, and AN-105) and is now referred to as a gas release event (GRE). During the 1990's, significant technical work was performed to understand the GRE behavior. However, the gas release event (GRE) process and mechanisms were not understood in 1987 when the tank integrity assessment for tank A-103 was conducted. A mechanism had not yet been identified that could explain the liquid level fluctuations observed in the tank. If the GRE phenomenon had been understood it is likely that the panel would not changed the tank's status to an assumed leaker.

Requirement that a single-shell tank leak integrity had to be assured with 95% confidence, or else the tank reclassified is stated in Letter, D. J. Cockeram, President, Atlantic Richfield Hanford Company, Richland, Washington, to Those Listed, *Tank Status Nomenclature*, January 9, 1980. The letter is reproduced in SD-WM-TI-356, *Waste Storage Tank Status and Leak Detection Criteria*, Volumes 1 and 2, pages 00-00-20 through 00-00-22:

"...In this letter I define that these three [integrity] categories are: sound tank with a 95 percent or better confidence that it is sound, confirmed leaker with 95 percent or better confidence that it is a leaker, and questionable integrity that covers all other tanks...

"I believe that we could all easily agree on the following sets of definitions. (1) Sound Tank: This would be a tank for which we had no indication of potential loss of liquid containment integrity. This is not to say, however, that all such tanks are necessarily indeed sound. One can imagine small aberrations in the containment quality that do not leak to a measureable indication of loss of integrity. From a subjective standpoint, I would assume that if we have no indication of loss of integrity we could say that a tank is sound with about a 95 percent confidence that we are correct..."

August, 2008 Leak Assessment: In 2007, CH2M HILL Hanford Group Inc. with the U. S. Department of Energy – Office of River Protection and the Washington State Department of Ecology developed a process to re-assess selected tank leak volume and inventory estimates, and to update single-shell tank leak and unplanned release volumes and inventory estimates as emergent field data are obtained. The process is described in RPP-32681, *Process to Estimate Tank Farm Vadose Zone Inventories.*

In August, 2008, a leak integrity review of tank A-103 was published in RPP-ENV-37956, *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Waste Releases*. The review concluded that:

"... based on available information, there is no evidence tank A-103 lost containment and no leak volume or inventory was assigned to this tank."

The leak assessment team based their conclusion on data that were not available to the 1987 integrity investigation:

"The phenomenon of retained gas release is now referred to as buoyant displacement gas release events (BDGRE). During the 1990s, significant technical work was performed to understand the BDGRE behavior. The current tank farm safety basis relies upon a process developed from the culmination of this work to categorize waste tanks for BDGRE hazard. The process is described in RPP-10006, *Methodology and Calculations for the Assignment of Waste Groups for the Large Underground Waste Storage Tanks at the Hanford Site*. However, the BDGRE process and mechanisms were not understood in 1987 when the integrity investigation for tank A-103 was conducted. Therefore, a mechanism does exist that could explain the liquid level fluctuations observed in tank A-103. The 1987 tank integrity assessment panel's recommendation to classify this tank as an assumed leaker may have been incorrect.

"Spectral gamma data for several drywells (10-03-01, 10-03-05, 10-03-07, 10-02-03, and 10-03-11) around tank A-103 measure small amounts of Cs^{137} (about 0.1 pCi/g) at 80 ft bgs and below, which is thought to be associated with drag-down of contamination when the well depths were extended (RPP-35484 page 2-11). Spectral gamma logging of the laterals beneath tank A-103 was conducted in March 2005 and also shows only small amounts of Cs^{137} (less than 10 pCi/g) beneath the tank (RPP-RPT-27605 pages B-4 thru

B-9). The spectral gamma loggings do not show any evidence of waste loss from tank A-103. The interstitial liquid in tank A-103 was sampled in April 1986 and results for Cs^{137} were an average of 3.97E+05 μCi/ml (SD-WM-TI-198). If tank A-103 had leaked 5,500 gallons, then about 8,260 Ci of Cs^{137} (as of April 1986) would have leaked to the soil. The spectral gamma loggings do not show any evidence of waste loss from tank A-103 and certainly not this level of Cs^{137} in the laterals or drywells.

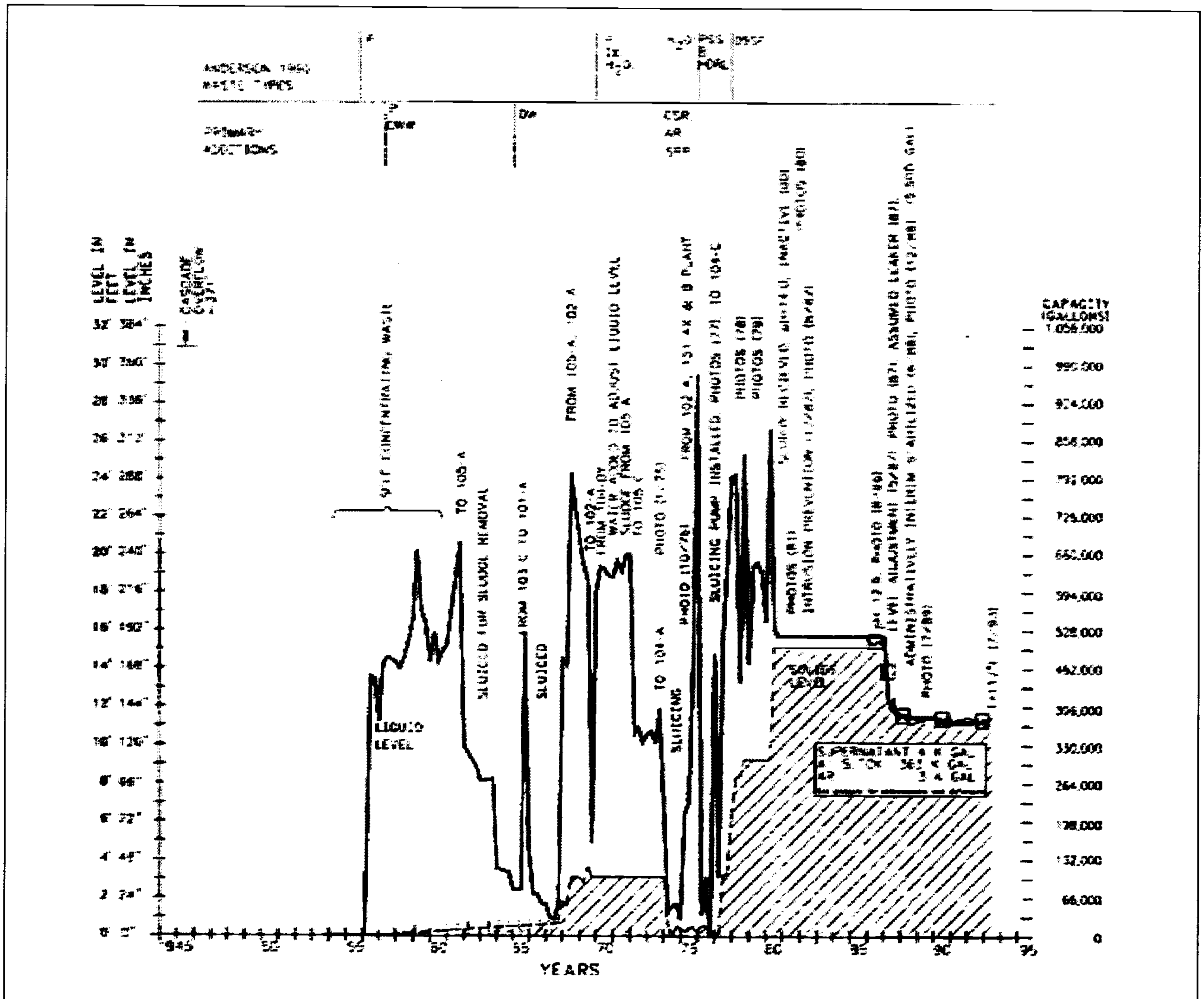
"Another notable liquid level decline in tank A-103 was reported on November 16, 1987. The liquid level declined from a reference of 143.4-in to 140.6-in during a three day period. However, the FIC liquid level monitor readings fluctuated up and down between 143-in to 140.6-in during this time frame (Vermeulen 1987). Inspection of photographs taken inside tank A-103 on December 28, 1988 showed that the [Food Industries Corporation] FIC plummet was contacting dry solids in a deep depression of multiple elevations, leading to erratic readings (Baumhardt 1989). Therefore, no waste loss from tank A-103 is associated with this event."

5.0 IN-TANK DATA

5.1 SURFACE LEVEL BEHAVIOR

During the 1956 – 1974 period when tank A-103 experienced high operating temperatures, and repeated filling and sluicing, there are no reports of suspect surface level behavior indicating a leak from the tank was occurring. In-tank photographs show that the tank was not overfilled. Evidence of overfilling includes waste deposits on the lead flashing located above the lip of the steel flashing on the sidewall, or waste deposits inside the sidewall spare inlet and outlet nozzles. None of these conditions is evident in the photographs (see Section 5-3).

Figure 5-1. Tank A-103 Surface Level History 1955 – 1994



The first report of anomalous surface level behavior occurs after tank A-103 was converted to a slurry receiver for the 242-A Evaporator/Crystallizer in early 1977. Between 1977 and 1980 the tank received double-shell slurry feed and complexant concentrate from the evaporator. Both of these waste types are now known to generate and retain gas, and are subject to periodic GREs. These phenomena cause cyclic increases and decreases in the waste surface as gas accumulates in the waste, and is then released. The GRE behavior was not understood at the time tank A-103 was filled, although it is clear from correspondence and from the surface level evaluations that some of the technical staff already suspected gas accumulation and release was responsible for the fluctuations.

During 1980 tank A-103 received reconcentrated, partially-neutralized waste that had been diluted and transferred cross-site. This material was product from the second partial neutralization campaign – the "Nitric Acid Partial Neutralization/Acid Injection Process Test" – at the 242-S Evaporator/Crystallizer. Tank SX-104 was the slurry receiver for the 242-S concentrate.

In 1988 and again in 1998 the interstitial liquid in tank SX-104 was sampled. Both sets of samples gelled at laboratory temperature, leaving only ~10 volume percent free liquid. The gel was composed of sodium phosphate and sodium nitrate crystals. The chemical composition of the waste was similar to that of the Window 'E' supernatant present in double-shell tank SY-101 during the December, 1991 waste rollover event (RPP-ASMT-38450, *Tank 241-SX-104 Leak Assessment Report*). The tank SY-101 waste experienced predictable gas accumulation and release cycles, and similar waste resided in tank A-103 after the 242-A Campaign 80-05.

Figure 5-2 illustrates the impact of storing 242-A Evaporator/Crystallizer concentrate in tank A-103. The earliest occurrence reporting records at Hanford are from 1974. From 1974 until 1977, when tank A-103 was converted to an evaporator bottoms tank and began receiving double-shell slurry feed and complexant concentrate, there are no reported occurrences. After the bottoms conversion and the storage of 242-A Evaporator/Crystallizer concentrate began, seven of the eight reported occurrences address surface level changes that exceed surveillance baselines. Since the occurrences began coincident with the use of the tank to store gas-retaining, concentrated evaporator waste, it is very likely that the occurrences reflect waste properties, rather than a loss of tank integrity.

Occurrence Report 77-141, August 1977: The allowable rate of surface level decrease exceeded the 0.5-in/week criterion; between August 9, 1977 and August 16, 1977, the surface level decreased from 194.5-in to 193.6-in. The apparent cause of the decrease was dissolution of surface foam that had been observed after the last slurry transfer into the tank on August 6, 1977. A sample of the tank's surface taken on August 10, 1977 was comprised solely of foam (IDMS Accession # D194052856 and SD-WM-TI-356).

Occurrence Report 78-15, 1978: Following receipt of 242-A Evaporator/Crystallizer slurry on November 29, 1977, the FIC surface level measurement became erratic, with readings varying from 232.80-in to 236.10-in. Between January 18, 1978 and January 22, 1978, the surface level decreased from 234.7-in to 233.95-in exceeding the allowable decrease rate of 0.50-in/week. Photographs on January 27, 1978 showed the FIC suspended over a uneven crust varying several inches in height within a 1-ft radius. Drywells and laterals showed no significant changes (IDMS Accession #D194035034).

<u>Occurrence Report 79-118, December 1979</u>: A surface level baseline of 235.20-in was established for tank A-103 on October 5, 1979. On November 29, 1979, the FIC measurement decreased 4-in to 231.40-in in ~5 hours. The manual taped dropped 3.5-in. The drop exceeded the allowable -0.5-in decrease criterion. The apparent cause of the decrease was crust slumping.

The tank had been filled with concentrated complexant waste from the 242-A Evaporator/Crystallize during March, and April, 1979. Almost immediately the surface level began to rise. An investigation revealed that the waste exhibited a slurry growth phenomenon similar to growth patterns that had been observed in the 241-SX tanks and tank SY-103. Three surface level baseline changes had been authorized between July, and October, 1979 to compensate for the slurry growth (IDMS Accession # D196216216 and SD-WM-TI-356).

<u>Occurrence Report 80-82, September 1980</u>: A surface level baseline of 193.40-in had been established for tank A-103 on August 14, 1980. On September 4, 1980, the FIC surface level measurement dropped 3.30-in, down to a level of 190.00-in in 11 hours. The manual tape dropped a total of 3.50-in during the same period. The FIC drop exceeded the allowable -1.0-in decrease criterion. The FIC subsequently stabilized at 187.40 $\pm$ 0.1 inches.

Tank A-103 supernatant had been transferred to tank AX-101 between August 7, and August 12, 1980 in order to deactivate the tank. The decrease was eventually attributed to the mixing of dissimilar solids in the tank, causing a net volume decrease (IDMS Accession # D197183104 and SD-WM-TI-356).

<u>Operating Limit Deviation Report 81-02, April 1981</u>: A surface level decrease of -2.30-in occurring during the period September 9, 1980 and May 8, 1981 was attributed to slurry growth followed by collapse of the surface crust. Drywells and laterals remained stable during the review period and were the primary means of leak detection because of surface solids. Surface level measurement fluctuations ranged from 185.10-in to 190.35-in, and remained within the allowable decrease criterion (SD-WM-TI-356).

<u>Environmental Protection Deviation Report 87-02</u>: Over a span of approximately 5.5 years (October 8, 1981 to March 5, 1987), the surface level in tank A 103 was observed to have decreased from 187.5 inches (517,520 gallons) to 184 inches (507,860 gallons). As of March 5, 1987, tank A-103 contained an estimated 8,800 gallons of supernate, 208 kgal drainable interstitial liquid, and 499 kgal of solids. In-tank photographs showed the FIC plummet contacting liquid, and this raised questions about the tank's leak integrity.

<u>Event Fact Sheet TF-EFS-88-0151 Rev. 1, December 30, 1988</u>: Following recalibration of the FIC on December 22, 1988, a surface level reading of 135.10-in was obtained, -2.3-in from the 137.40-in baseline for the tank, which exceeded the -2.00-in decrease criterion. A slow decrease of -0.7-in over a 6 month period had been observed since the baseline was established. Both December 28, 1988 and May 24, 1988 photos showed the FIC plummet to be contacting solids in a depression, and the later photos showed the depression to have multiple elevations. The conclusion was that plummet contacts at different elevations were the cause of the erratic readings. The FIC was converted to the intrusion mode, and the installed LOW became the primary interstitial liquid level surveillance device. Drywell, and LOW data were stable. Tank A-103 had been declared interim stabilized in June, 1988.

Occurrence Report WHC-TANKFARM-1991-070, December 4, 1991: Quarterly surveillance of one of the three laterals identified a 76 count/second peak; the baseline was 5 counts/second. The radiation logging was repeated and the same results obtained. Subsequent evaluation showed that the detector had not been correctly positioned at the end of the lateral to begin logging; when the logging was correctly performed there was no change from the baseline readings.

Figure 5-2. Influence of 242-A Evaporator/Crystallizer Campaigns on Tank A-103 Surface Level Behavior

Prior to the storage of 242-A Evaporator/Crystallizer concentrated waste in tank A-103, the tank had no reported occurrences. In the eleven years after the tank began receiving 242-A concentrated waste seven occurrence reports were generated for waste surface level decreases.

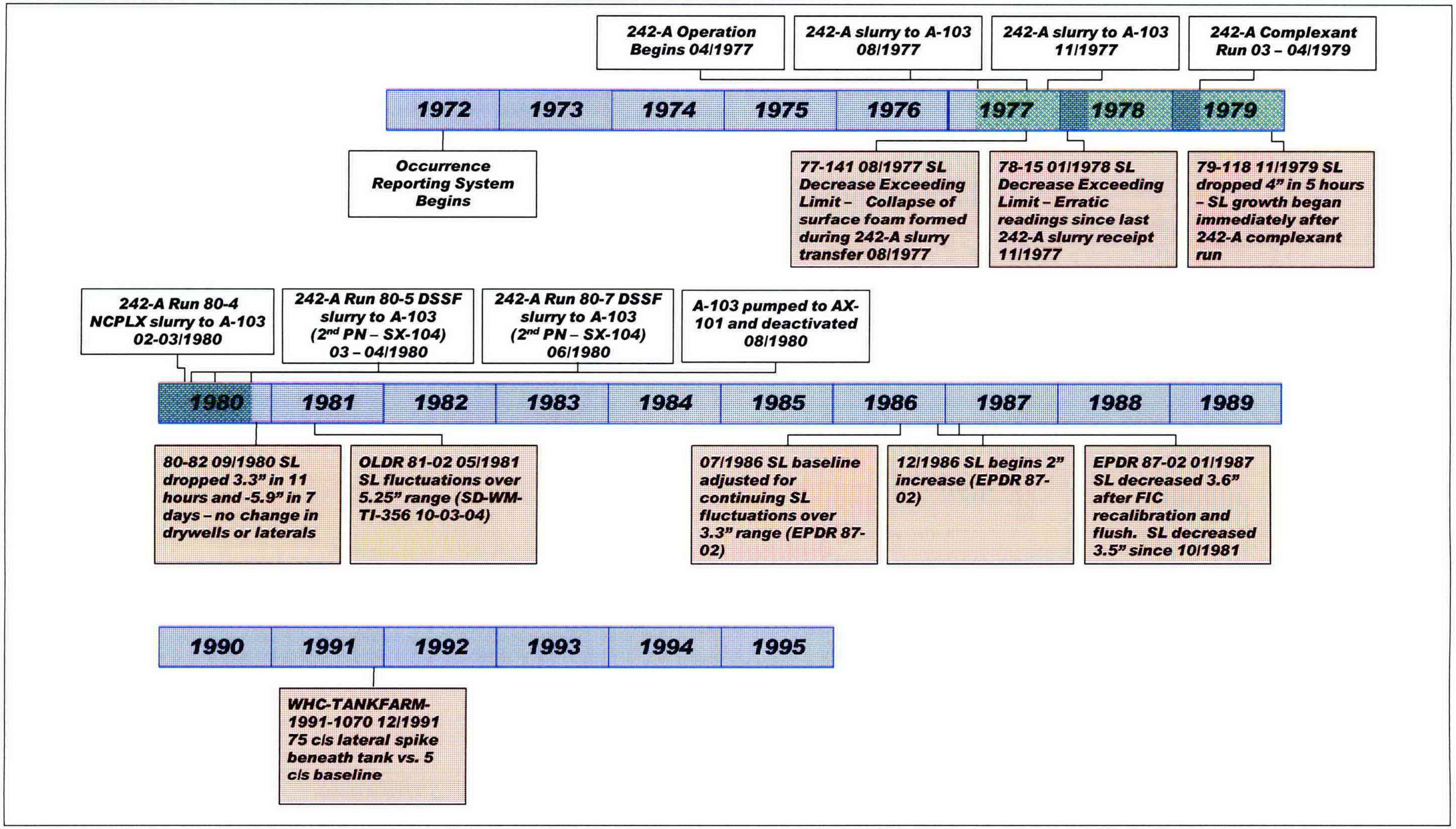


Figure 5-3. Tank A-103 Waste Surface Gas Retention and Release Behavior 1981 - 1987

Data from Personal Computer Surveillance Analysis Computer System (PCSACS), July 15, 2009; PNL-10821, "Screening the Hanford Tanks for Trapped Gas;" PNNL-11391, "Gas Retention and Release Behavior in Hanford Single-Shell Waste Tanks;" and WHC-SD-WM-ER-526 Rev. 1, "Evaluation of Hanford Tanks for Trapped Gas."

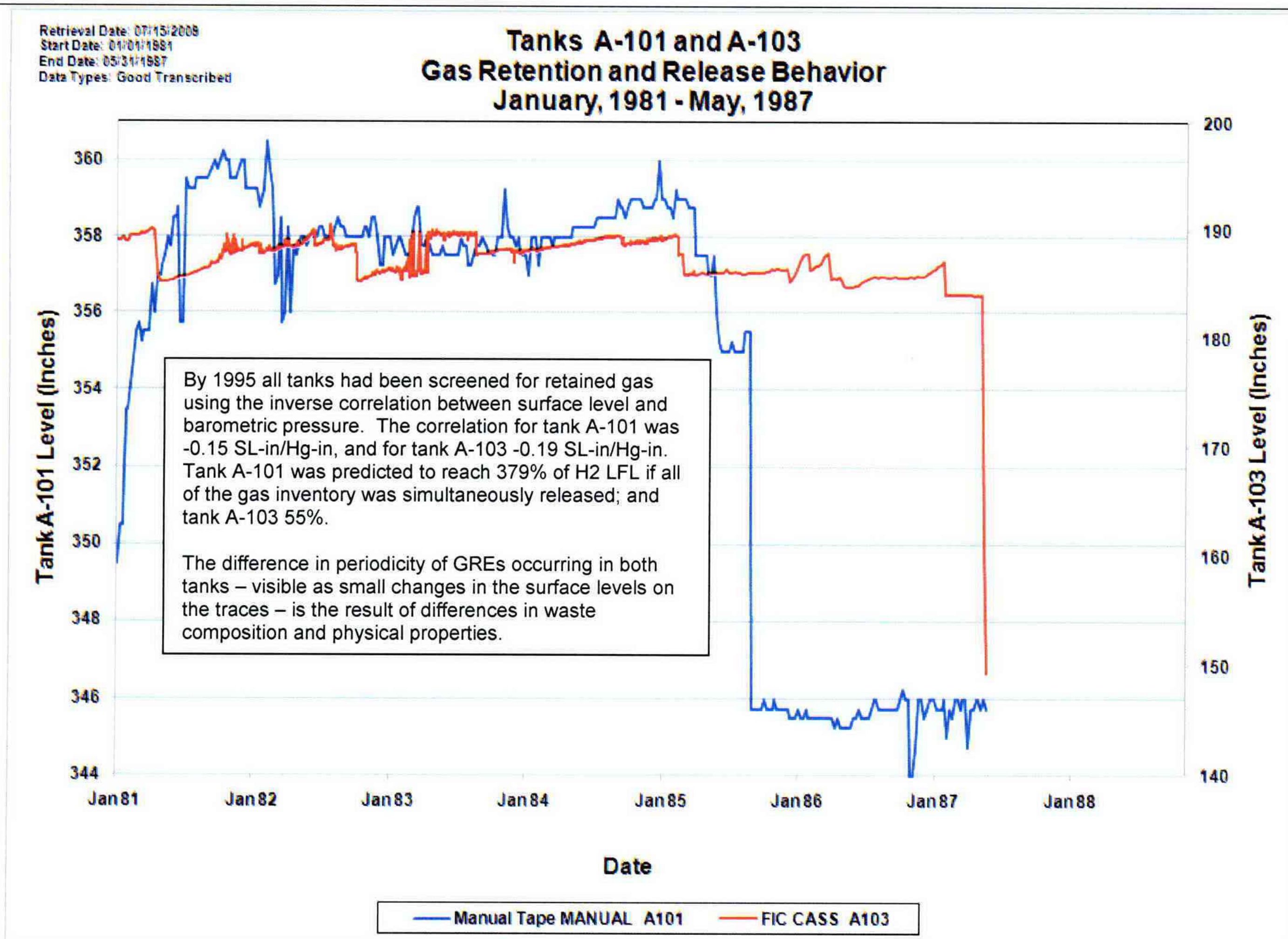
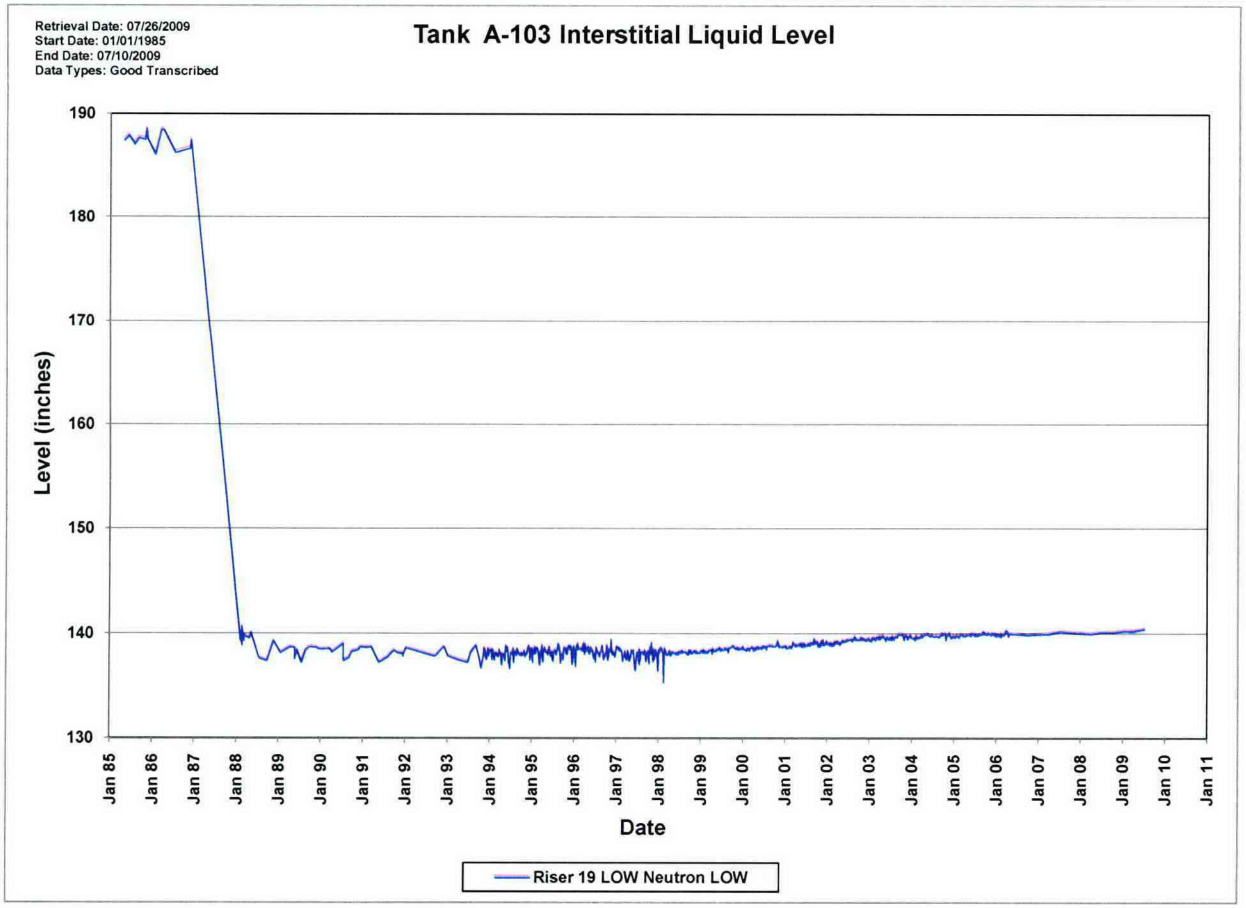


Figure 5-4. Tank A-103 Interstitial Liquid Interface Behavior 1985 - 2009

A total of 111 kgal gallons were removed from tank A-103 during interim stabilization pumping in May, 1987. The interstitial liquid level stabilized after pumping, and remained stable until about mid-1998. A slow rise occurred from mid-1998 until mid-2005, when the liquid level restabilized (HNF-SD-RE-TI-178 page 15 -18). Data from Personal Computer Surveillance Analysis Computer System, July 26, 2009.



5.2 WASTE TEMPERATURE BEHAVIOR

Tank temperatures up to 240°F and pressure excursions occurred during the 1950's - 1960's according to RHO-CD-1172, *Survey of the Single-Shell Tank Thermal Histories*. There is no evidence of any tank leakage during this period. The thermal history available on PCSACS for the period 1980 - present shows a cooling trend with the earliest temperatures ranging up to ~ 130°F, and cooling to a maximum of ~ 110°F currently.

According to a partial copy of a report titled, *History – 241-A Tank Farm*, tank A-103 experienced two thermal excursions during the initial period when it was receiving PUREX Plant waste. The tank A-103 waste began to self-boil (102°C) in June, 1956, and the tank continued to receive PUREX HLW and periodic additions of water and organic wash waste through July 1960 to maintain the tank volume.

The "History" describes the thermal excursions:

> "In the first excursion the temperature increased from 143°C on April 5, 1957 to 230°C on April 22, 1947. During this period the Na molarity increased from 8.2 to 9.0. The liquid level was increased from 123-in on April 22, 1957 to 149-in on May 3, 1957. The Na molarity decreased to 8.5 and the temperature fell to 111°C.
>
> "In the second excursion the temperature increased steadily from 115°C on May 30, 1957 to 140°C on June 15, 1957. There was then a rapid rise to 209°C on June 17, 1957. The liquid level was increased from 146-in to 162-in during the three days after the excursion, and the temperature fell to 130°C. By the tenth day after the excursion, the liquid level was up to 174-in, and the temperature was down to 118°C. During this excursion, the Na molarity reached 9.4, and was down to 8.2 when the temperature fell to 118°C."

Thermal excursions were normally controlled by increasing both the liquid level and the air to the airlift circulators. However these measures sometimes failed to limit the temperature rise. This was believed to result from accumulation of additional sludge layers that insulated the lowest layer in the tank where the temperature element was located.

This theory was somewhat confirmed during by aborted attempts to penetrate and sample the sludge in tank A-103 between August, 1957 and the summer of 1961. In August, 1957 the installation of a thermocouple tree indicated a layer of hard sludge existed about 3-ft above the tank bottom. The tree had to be dropped several feet in order to penetrate the layer.

Then in 1961 two attempts were made to push sample the sludge using a 7,000 psi hydraulic ram. During the attempt, the metal pipe sample tube was broken off the connecting rod, and later when the sampling apparatus was withdrawn from the tank, the 8-in guide tube was found to be bend. The sludge was eventually sample using rotary core drilling, but the down-force needed to drive the sampler was still 1,000 psig.

In spite of the thermal excursions experienced when tank A-103 was self-boiling, and chronic waste temperatures extremes as high as 220°F through at least 1970, there is no detectable indication in the drywells or the tank laterals of any leakage from the tank.

Figure 5-5. Tank A-103 Waste Temperature History 1956 - 1966

Data from RHO-CD-1172, "Survey of the Single-Shell Tank Thermal Histories." In spite of chronically high waste temperatures in tank A-103 through at least 1970, there was no detectable indication in the drywells or in the tank lateral of any leakage from the tank.

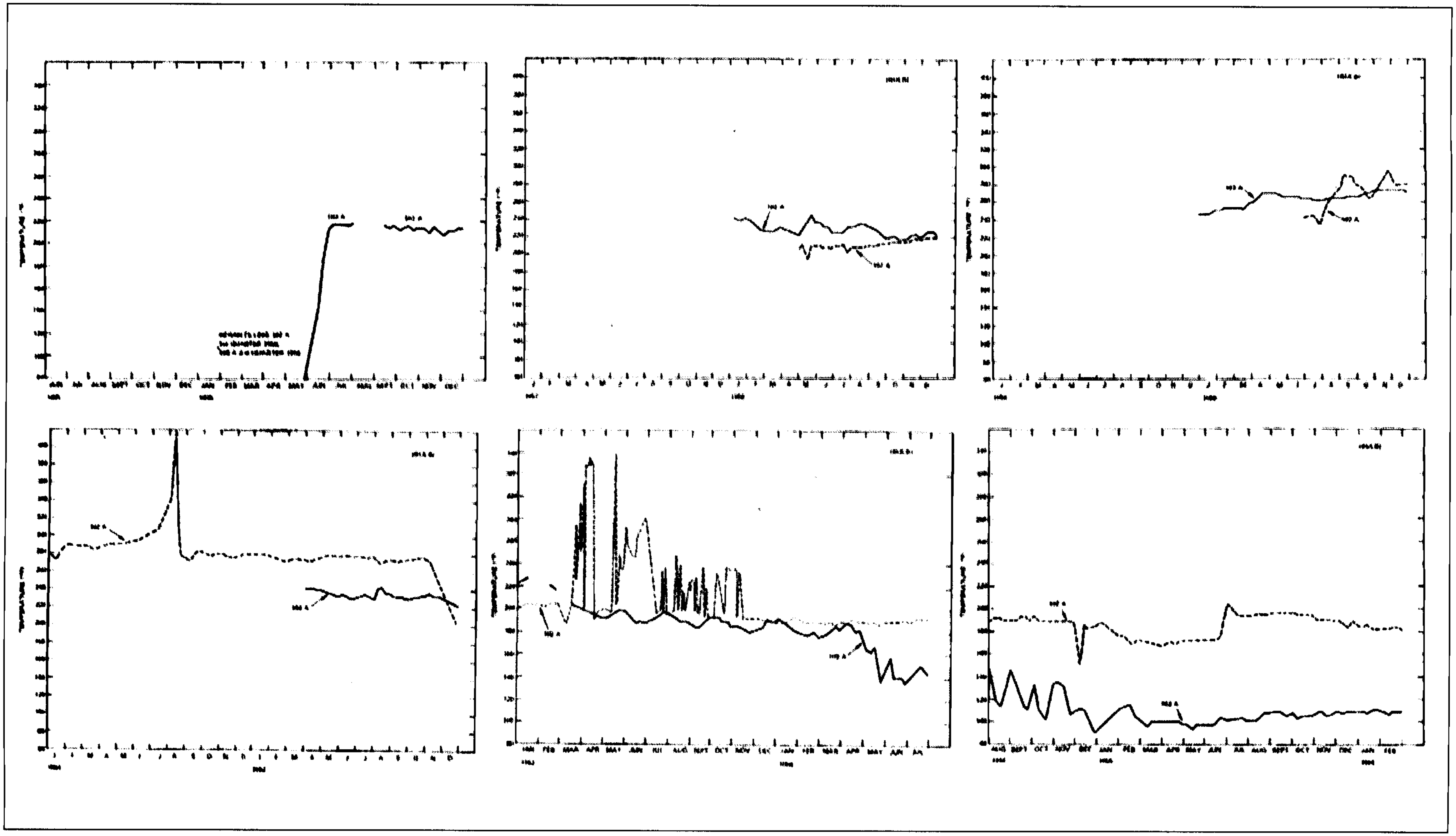


Figure 5-6. Tank A-103 Waste Temperature History 1967 - 1970

Data from RHO-CD-1172, "Survey of the Single-Shell Tank Thermal Histories."

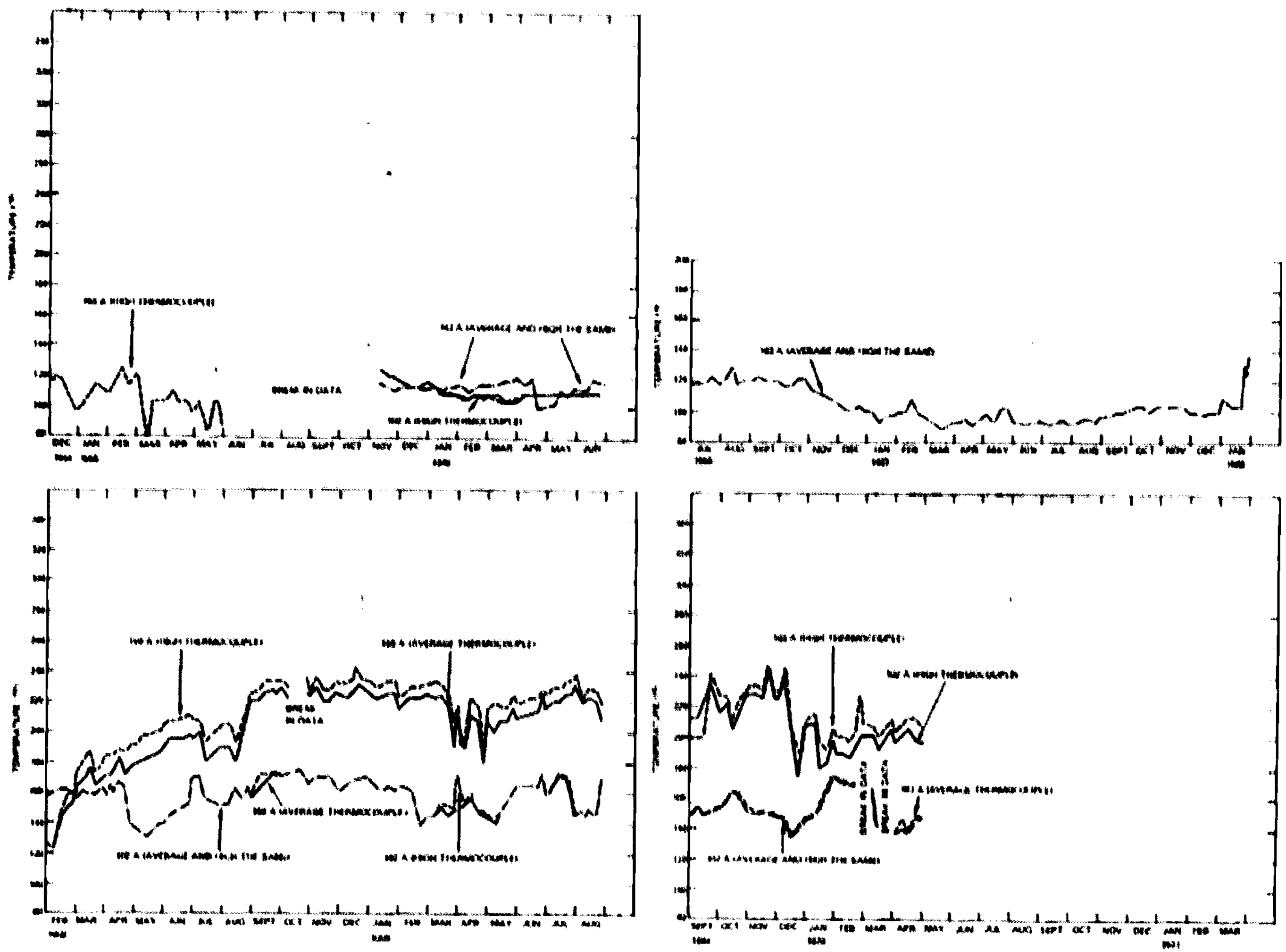
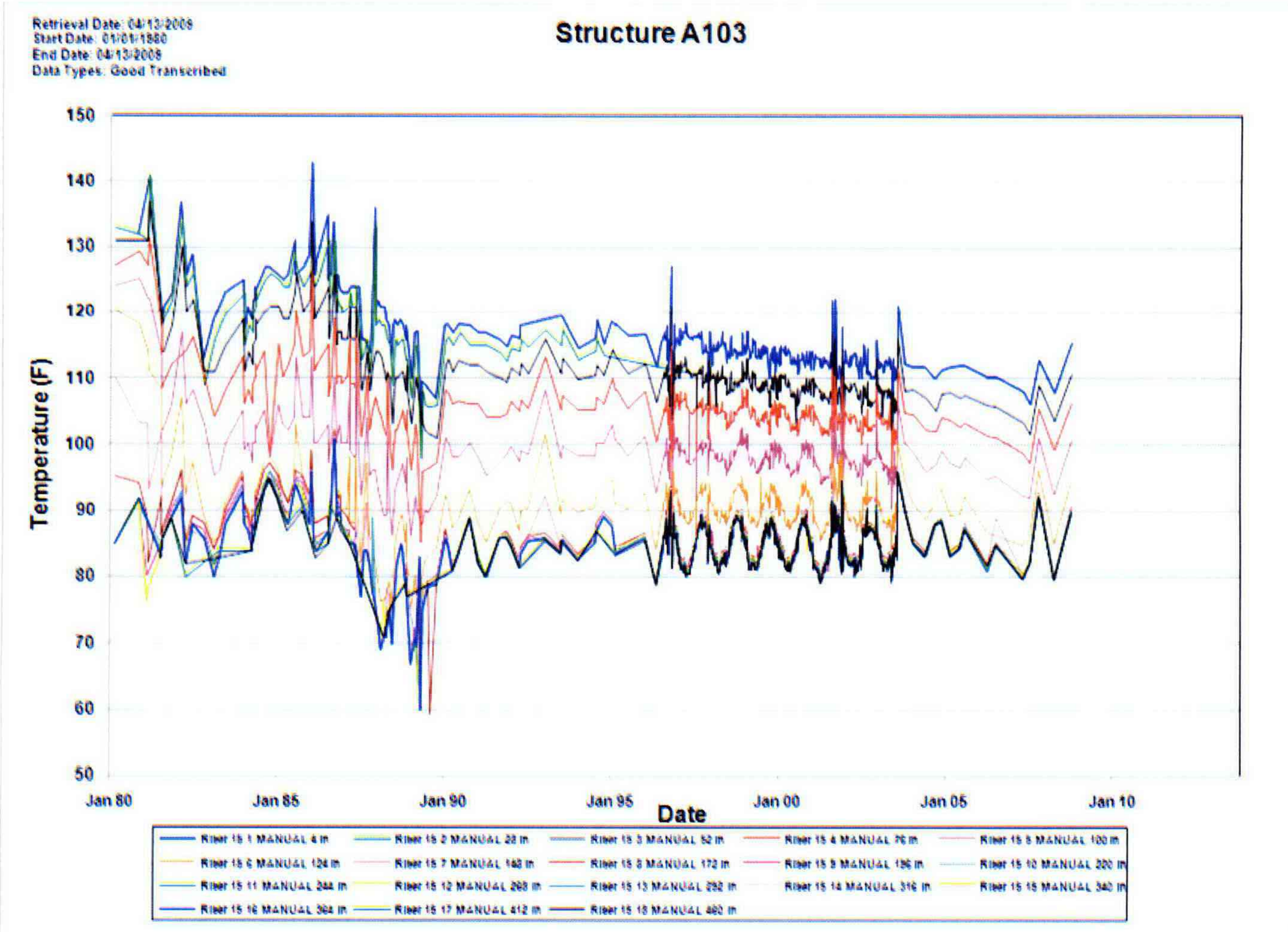


Figure 5-7. Tank A-103 Waste Temperature History 1980 - 2009

Data from Personal Computer Surveillance Analysis Computer System (PCSACS), April 13, 2009.



Temperature records from the period 1970 - 1980 could not be recovered. However, the operating history indicates that the waste temperatures should have fallen dramatically in the ten years. Between 1968 – 1974 the tank received sludge waste from tanks A-102 and A-105; in 1974 the sludge was sluiced from tank A-103 to the 244-AR Vault for Sr-90 recovery; and in 1976 the remaining sludge was sluiced from the tank to prepare it as a 242-A Evaporator/Crystallizer bottoms receiver. Removal of most of the high-heat PUREX HLW sludge by the end of 1974 would have dramatically lowered the waste temperature in the tank. By 1980 the waste temperature was ~ 100°F – 110°F, less than half of the 1970 value.

5.3 IN-TANK PHOTOS

In-tank photographs show no evidence that tank A-103 was overfilled. Evidence of overfilling includes waste deposits on the lead flashing located above the lip of the steel liner, and waste deposits inside the sidewall spare inlet and outlet nozzles. None of these conditions is evident in the photographs.

Figure 5-8. Tank A-103 Interior Photograph – 1981

There are no waste deposits or waste "beachlines" near the top of the steel liner that would indicate that tank may have been overfilled. (Negative 7800972-1CN [N1984178] January 27, 1978)

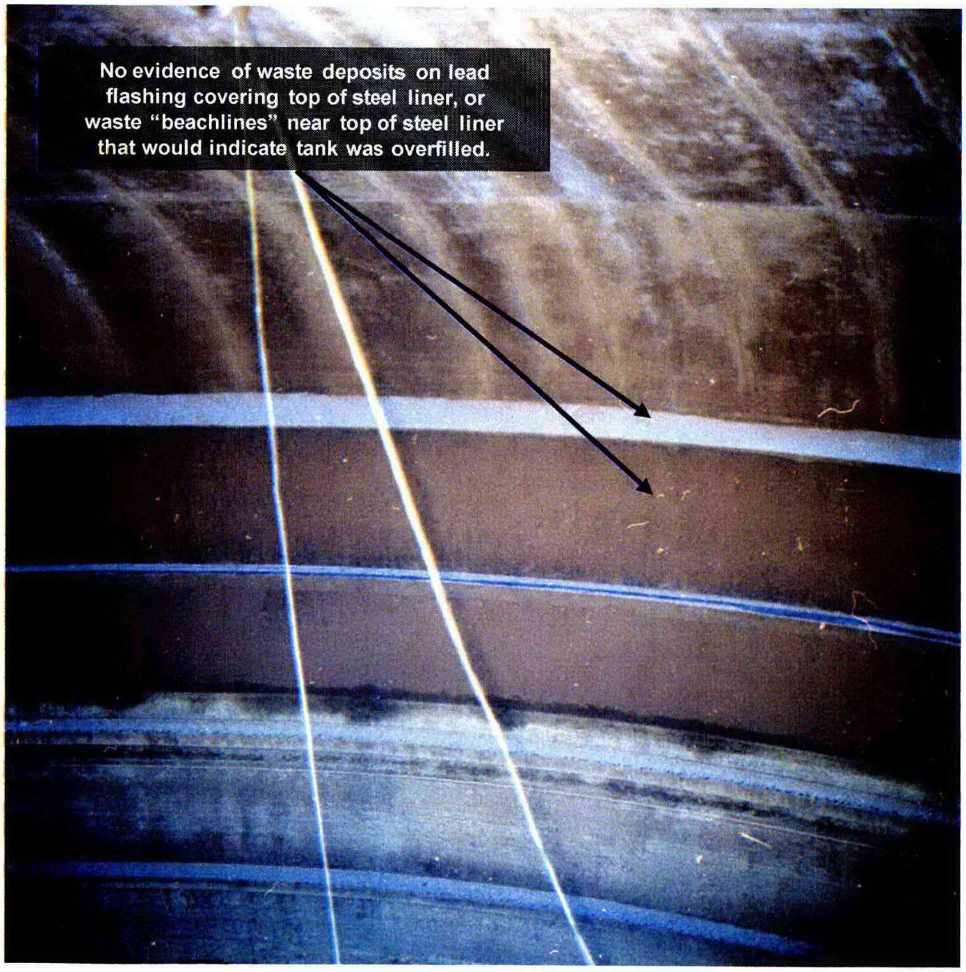
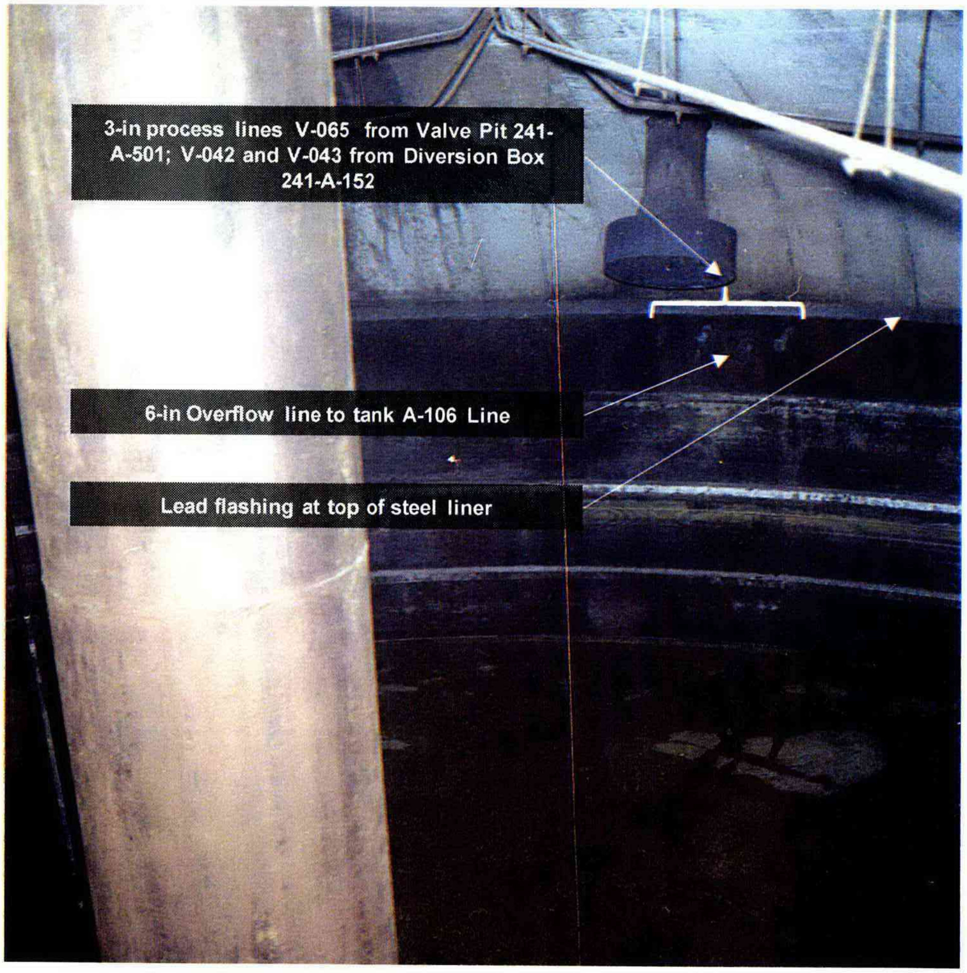


Figure 5-9. Tank A-103 Interior Photograph – 1979

In tank A-103 the centerline of the 6-in overflow line is 15-in below the top of the liner, and 5-1/2-in below the centerline of the 3-in process lines (Drawing H-2-55911). The mouth of the overflow line appears to be free of waste deposits confirming that tank A-103 was not overfilled. The absence of waste beachlines high on the liner supports the conclusion that the tank was not overfilled. (Negative 88963-2CN [N2043532] December 3, 1979)



6.0 EX-TANK DATA

6.1 TANK A-103 DRYWELLS

6.1.1 Tank A-103 Gross Gamma Logs

There are seven drywells surrounding tank A-103. Until 1975, gross gamma ray logging data from the drywells were collected in non-digital format. In 1975 the surveillance program was upgraded to a digital logging system, and gross gamma ray logs were captured utilizing several types of detectors. Gross gamma logs were collected for the period between January, 1975 and mid-1994, depending on the drywell.

Figure 6-1. Plan Map of Tank A-103 Drywells

Drywell 10-03-10 was drilled in 1955. The other six drywells were drilled in 1962. The increased drilling was likely prompted by the confirmed leak in high heat tank SX-113, and coincided with the 1962 – 1963 laterals installation in the tank farm. Drywells 10-03-01, 10-03-02, 10-03-04, 10-03-05, 10-03-07, 10-03-10 were deepened in 1978; 10-03-11 was deepened in 1964. There is no indication that soil contamination was encountered during any of the drilling activities. (GJ-HAN-107, "Vadose Zone Characterization Project at the Hanford Tank Farms: Tank Summary Data Report for Tank A-102")

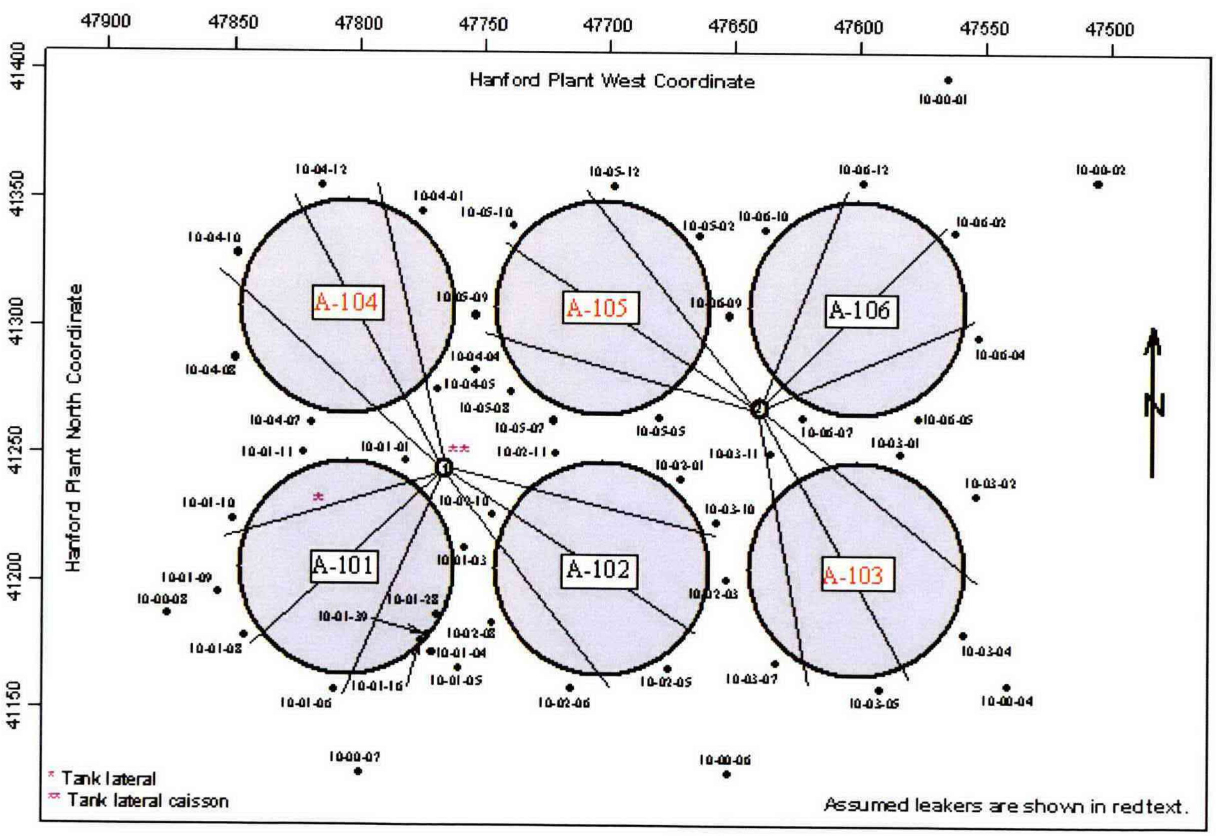


Figure 14-19. Plan Map of the A Tank Farm Showing the Location of the Tank Monitoring Boreholes and Leak Detection Laterals

Gross gamma drywell logs detected radiation plumes in the soil, and evaluated time-based changes in radiation level compared to a baseline log. Prior to 1995 the identity of radionuclides in the soil was determined by repetitive logging over a period of time in order to evaluate the rate of radioactive decay. This worked well for stable soil plumes, but was ineffective for active plumes because of constant or increasing recharge. Figures 6-2 and 6-3 show the gross gamma logs for the tank A-103 drywells.

Figure 6-2. Tank A-103 Historical Gross Gamma Drywell Logs as Soil Concentrations

The logs presented in the figure are from GJ-HAN-108, "Vadose Zone Characterization Project at the Hanford Tank Farms: Tank Summary Data Report for Tank A-103." Between 1974 and 2009 nine Occurrence Reports and Environmental Protection Deviation Reports documented tank A-103 measurements that exceeded surveillance criteria. None of the reports describes a drywell surveillance criteria violation.

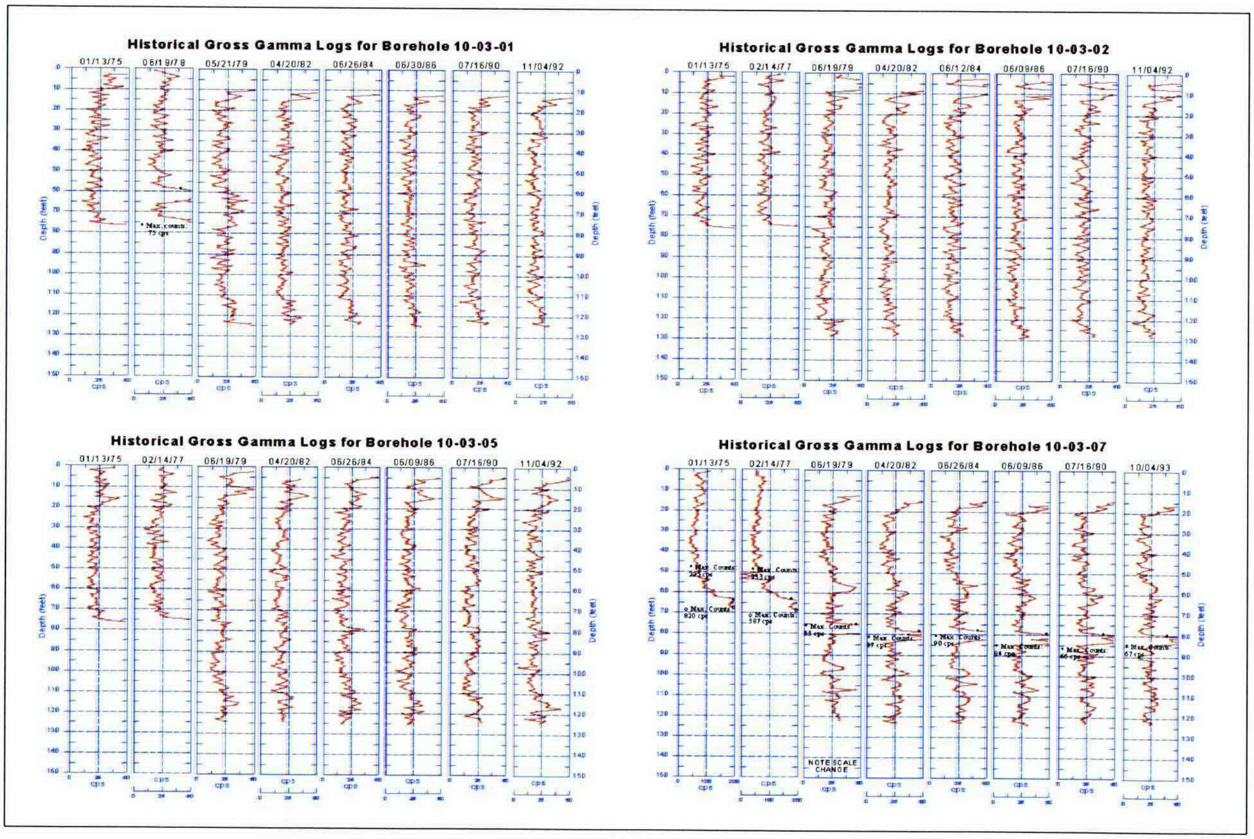


Figure 6-3. Tank A-103 Historical Gross Gamma Drywell Logs Shown as Relative Count Rates

Historical gross gamma logs from RPP-8820, "Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East."

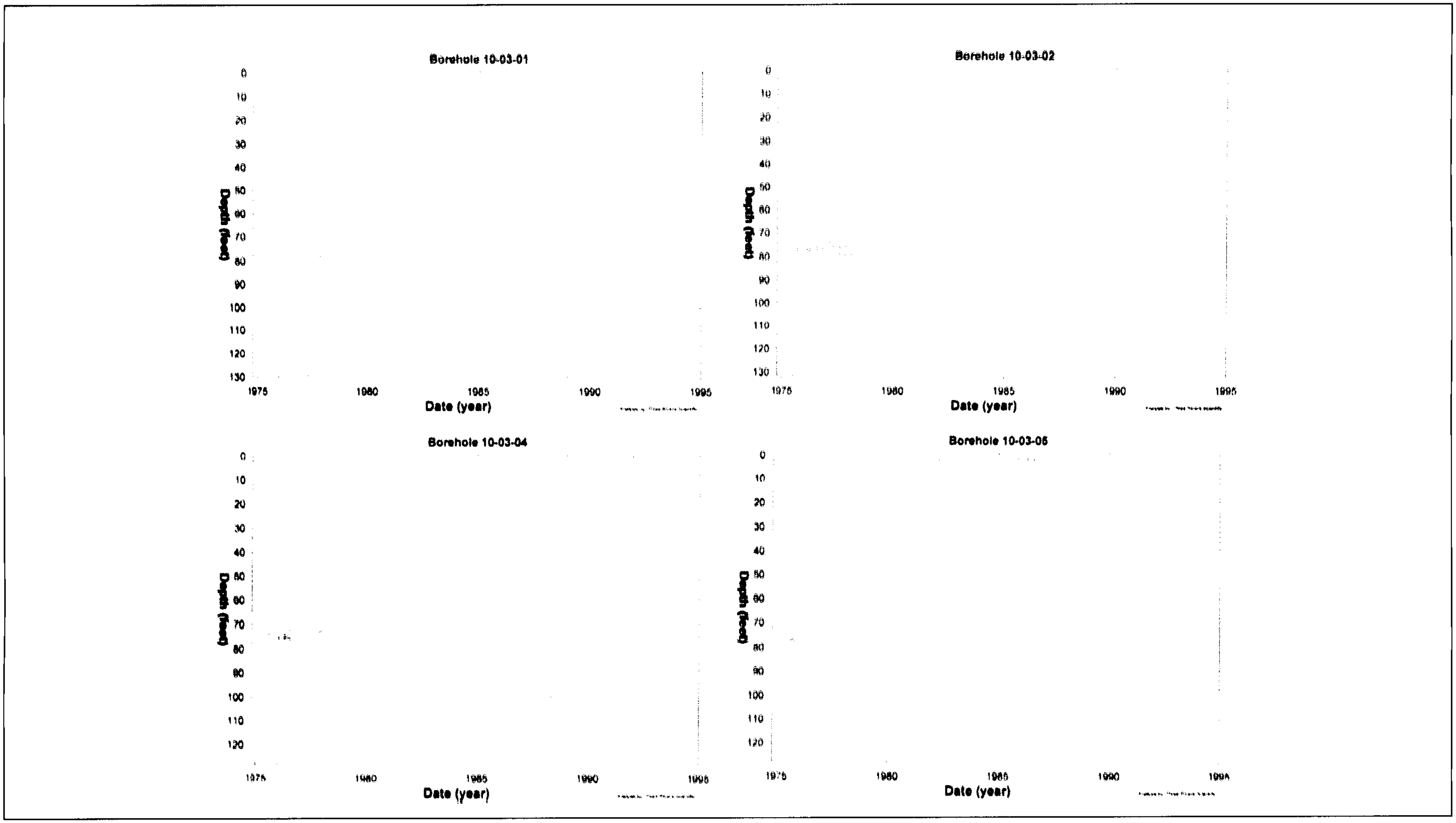
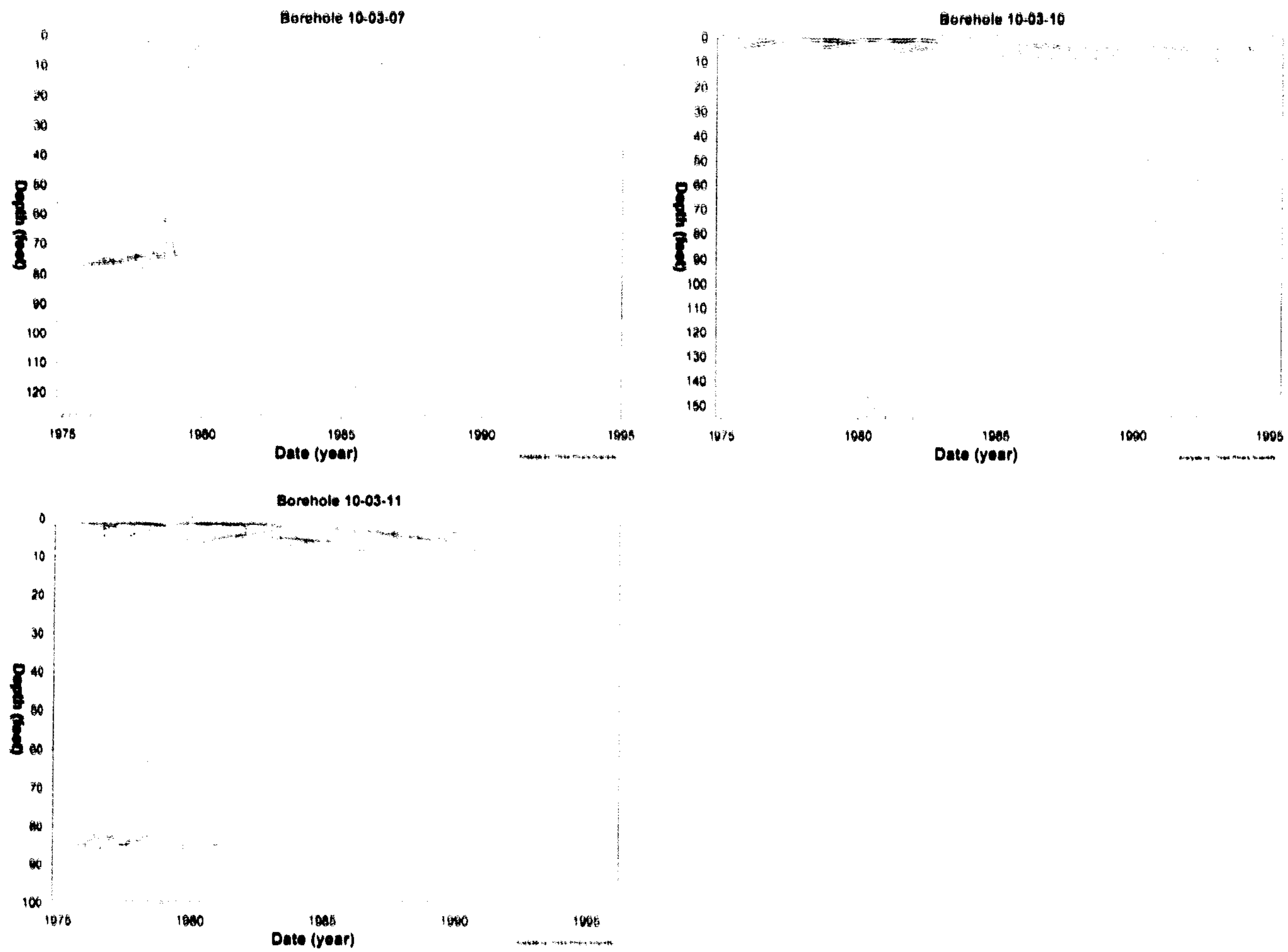


Figure 6-3. Tank A-103 Historical Gross Gamma Drywell Logs Shown as Relative Count Rates (cont.)

Historical gross gamma logs from RPP-8820, "Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East."



Between 1974 and mid-1994 between 430 and 485 gross gamma logs were completed on each of the tank A-103 drywells.[1] In 2001 all of the historical gross gamma logs were reviewed and the conclusions published in RPP-8820, *Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East.*

The report grouped drywell log results by [radio]activity categories as follows:

> "Tank Farm Activity: erratic log response at the bottom of dry wells or at shallow depths result[ing] from logging procedure changes, radioactive waste transfer operations, surface or near surface leaks/spills, and/or clean up of surface contamination; specifically, and irregular change is observed in gross gamma-ray log values between successive surveys at or near the surface and/or at the bottom of the dry well. These rapid and inconsistent log changes suggest that contamination may be the result of tank farm operational activities (e.g., waste transfers) or logging procedure changes, and are not related to vadose zone mechanics.
>
> "Undetermined: no specific conclusion can be reached with the available data; specifically, stability cannot be determined due to: 1) insufficient data, 2) exceeding the system design criteria (both upper and lower limits) for recording gross gamma ray data, or 3) possible effects of depth shift or surface activities."

Table 6-1 summarizes the RPP-8820 review for tank A-103 drywells. The review provides no direct evidence of a leak from tank A-103 based on the historical gross gamma drywell logs. This is consistent with results from the gross gamma and spectral gamma logs of the tank's leak detection laterals conducted 1977 – 1991, and in 2005 that showed no evidence of leakage under the tank's foundation (see Section 6.2.1).

It is interesting to note that the soil contamination interval detected in all of the drywells from surface to ~ 20-ft generally peaked in 1984 or 1985. The surface contamination interval for drywells 10-03-10 and 10-03-11 peaked earlier, in 1976 and 1980, respectively. The peaking data are at odds with know 241-A Tank Farm field activity. The single-shell tanks were deactivated by November, 1980. The frequency of field activity in the tank farm would have steadily diminished after that date.

The soil contamination interval peaking data also present some date conflicts – for example, drywell 10-03-05 data indicate that the soil contamination interval from 70-ft – 88-ft peaked in 1975, yet the drywell was extended beyond its original 75-ft depth until 1978 according to records cited in the RPP-8820 document. Similarly drywell 10-03-11 data indicate that the soil contamination interval from 80-ft – 90-ft peaked in 1976, yet the drywell wasn't extended its original 75-ft depth until 1978.

In the decade following deactivation of the 241-A single-shell tanks, interim stabilization and core sampling activities were conducted in the tank farm. These activities could have contributed to the tank A-103 drywells' 0 ft - ~ 20-ft soil contamination interval peaking

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[1] Drywell (Logs): 10-03-01 (461), 10-03-02 (435), 10-03-04 (430), 10-03-05 (454), 10-03-07 (438), 10-03-10 (485), 10-03-11 (453) according to RPP-8820

reported in RPP-8820 as occurring between 1976 and 1985. Table 6-3 provides the dates for interim stabilization and core sampling activities in tank A-103, and the surrounding tanks A-102, A-105, and A-106. Neither interim stabilization activities nor core sampling activities occurred during the peaking period, so could not have contributed to the 0 - ~ 20-ft soil contamination interval peaking. An unidentified source of surface contamination capable of recharging the interval from 1976 through 1985 seems unlikely. Possibly drag-down during the 1978 deepening of the drywells is responsible for the peaking. Logging techniques, radiation background, and counting instrument variability may also have contributed, since most of the reported peaking occurred in 1984 and 1985.

Table 6-1. Tank A-103 Historical Gross Gamma Drywell Logs Summary

Data from Historical gross gamma logs from RPP-8820, "Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East."

Drywell	Interval Depth – ft	Number of Logs	Activity Category	Year of Max Counts	Radionuclides Present
10-03-01	0 – 16	461	TF Activity	1985	Cs-137
10-03-02	0 – 25	435	TF Activity	1984	Cs-137
10-03-04	0 – 20	430	TF Activity	1984	Cs-137
10-03-05	0 – 20	454	TF Activity	1984	Cs-137
	70 – 85		Undetermined	1975	Cs-137
10-03-07	0 – 20	438	TF Activity	1984	Cs-137
	50 – 75		Undetermined	1975	Cs-137
	75 – 88		Undetermined	1978	Cs-137
10-03-10	0 – 14	485	TF Activity	1980	Cs-137, Eu-154
10-03-11	0 – 12	453	TF Activity	1976	Cs-137
	80 – 90		Undetermined	1976	Cs-137

Table 6-2. Tank A-103 Drywell Construction History

Data from RPP-8820, "Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East, and S. M. Stoller Corporation, "Vadose Zone Characterization Project at the Hanford Tank Farms, A Tank Farm: Log/Data Reports" at *\\hanford\data\Sitedata\HLANPlan\Geophysical_Logs\index.html*.

Drywell	Initial Drilling	Initial Depth - ft	Extension Drilling	Extension Depth - ft	Comments
10-03-01	1962	75	1978	130	8-in casing drilled over original 6-in casing to 18-ft; 6-in casing extended from 75-ft to 130-ft with bottom 5-ft grouted Annular space between casings was grouted and 8-in casing backpulled.
10-03-02	1962	75	1978	130	8-in casing drilled over original 6-in casing to 16-ft; 6-in casing extended from 75-ft to 130-ft with bottom grouted. Annular space between casings was grouted and 8-in casing backpulled.
10-03-04	1962	75	1978	130	8-in casing drilled over original 6-in casing to 18-ft; 6-in casing extended from 75-ft to 130-ft with bottom 5-ft grouted Annular space between casings was grouted and 8-in casing backpulled.
10-03-05		75	1978	125	Data from RPP-8820. Drywell extension was probably completed similar to the other tank A-103 drywells, grouting the bottom of the 6-in casing extension, the annulus between the 6-in and 8-in casings, and backpulling the 8-in casing.
10-03-07	1962	75	1978	130	8-in casing drilled over original 6-in casing to 18-ft; 6-in casing extended from 75-ft to 130-ft with bottom grouted. Annular space between casings was grouted. Driller's log does not indicate if 8-in casing backpulled but that was common practice.

Table 6-2. Tank A-103 Drywell Construction History

Data from RPP-8820, "Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-A Tank Farm – 200 East, and S. M. Stoller Corporation, "Vadose Zone Characterization Project at the Hanford Tank Farms, A Tank Farm: Log/Data Reports" at
\\hanford\data\Sitedata\HLANPlan\Geophysical_Logs\index.html.

Drywell	Initial Drilling	Initial Depth - ft	Extension Drilling	Extension Depth - ft	Comments
10-03-10	1955	151			Driller's log not available.
10-03-11	1962	75	1964	85	Driller's logs from 1962 and 1964 not available.

Table 6-3. Post-1980 241-A Tank Farm Field Activities Near Tank A-103

For about a decade following deactivation of the single-shell tanks in 241-A Tank Farm interim-stabilization and core-sampling were the principal activities conducted in the tank farm.

Tank	Deactivation	Interim Stabilization Activity	Sampling Activity
A-102	1980	1989 – Submersible Pump	1986, 1989 Cores 1995, 1996 Augers
A-103	1980	1987 – 1988 – Jet Pump	1986 Cores
A-105	1965 (?) – Post-Steam Eruption	1978 – Water Addition stopped 1979 - Evaporation	1972 (Sludge-Grab)
A-106	≤ 1980	1982 - Evaporation	1986 Cores

6.1.2 Tank A-103 Spectral Gamma Logs

After 1994 gross gamma logging was replaced by spectral gamma logging. Spectral gamma logging used gamma energy analysis to identify specific radionuclides as well as determine soil contamination levels, whereas gross gamma logging reported net counts. Prior to 1995 the identity of radionuclides in the soil was determined by repetitive logging over a period of time in order to evaluate the rate of radioactive decay. This worked well for stable soil plumes, but was ineffective for active plumes because of constant or increasing recharge.
In 1996 the drywells surrounding tank A-103 were rebaselined using the Spectral Gamma Logging System (SGLS). The results were reported in 1998 in GJ-HAN-108, *Vadose Zone Characterization Project at the Hanford Tank Farms: Tank Summary Data Report for Tank A-103*. The report conclusions from the SGLS logging are provided below.

> "The Cs-137 contamination detected in boreholes 10-03-01, 10-03-04, 10-03-05, 10-03-07, and 10-02-03 from 75 to 80 ft appears to be correlatable and probably represents a continuous plume. In boreholes 10-03-04, 10-03-05, 10-03-07, and 10-02-03, where Cs-137 concentrations were high enough to support shape factor analysis, the analysis results indicate that the Cs-137 contamination is distributed in the formation sediments around the boreholes. The Cs-137 contamination in these boreholes near 75 to 80 ft probably

resulted from a tank leak that migrated downward into the formation materials around the tank to these depths. The source of this tank leak could be tank A-103, but other tanks in the vicinity could also be the source of this leak. It is difficult to attribute this contamination to a specific tank source because the vertical pathway whereby the contamination reached the 80-ft depth has not been identified.

"The man-made log plots for boreholes 10-03-10 and 10-03-11 show an anomalous interval of contamination between the ground surface and a depth of about 10 ft. The contamination in this interval consists of the gamma-ray-emitting radionuclides Cs-137, Co-60, and Eu-154. Some of the contamination is most likely contained in a near-surface pipeline that runs near these boreholes while other contamination in this interval may be the result of a leak from that pipeline.

"Cs-137 contamination was detected in the upper 10 to 20 ft in boreholes 10-03-01, 10-03-02, 10-03-04, 10-03-05, 10-03-07, and 10-02-03. On the basis of the historical gross gamma logs available for these boreholes, anomalously high gamma activity was present in this interval of these boreholes prior to borehole deepening activities in 1978, but increased in many in these intervals following borehole deepening. It is thought that the contamination in this interval comes both from surface spills that infiltrated the backfill material and contamination carried down during borehole deepening activities. Contamination was most likely placed around the boreholes when the temporary 8-in. starter casing was installed, or the contamination was mixed in with the grout.

"The SGLS also detected near-surface and shallow subsurface Cs-137 contamination around the rest of the boreholes. This contamination could have resulted from surface spills, airborne contamination releases, or a combination of these. The contamination may have migrated, in some undetermined manner, down around the outside of the boreholes. It is also possible, and more likely, that the contamination was carried downward into the backfill material by precipitation infiltration."

Examination of the spectral gamma drywell logs in Figure 6-6 shows that the Cs-137 pCi/gm concentrations in the soil at the same depth as the base of tank A-103 range from non-detectable to about 5 pCi/gm. These low concentrations are generally inconsistent with plumes from known leaks. The gamma logs from the laterals beneath the tank foundation show no evidence of a tank leak, and support an argument that the Cs-137 soil concentrations measured in the drywells at the 50-ft – 55-ft depth are from a different source than a leak from tank A-103.

Figure 6-4. Cs-137 Soil Contamination Visualizations for 241-A Tank Farm

Figures are from GJO-HAN-23 [GJO-98-64-TAR], "Vadose Zone Characterization Project at the Hanford Tank Farms: A Tank Farm Report," and GJO-HAN-23 [GJO-98-64-TARA], "Vadose Zone Characterization Project at the Hanford Tank Farms: Addendum to the A Tank Farm Report." For visualization purposes contamination plumes are assumed to be continuous between drywells. This is an unproven working assumption made to render the graphic.

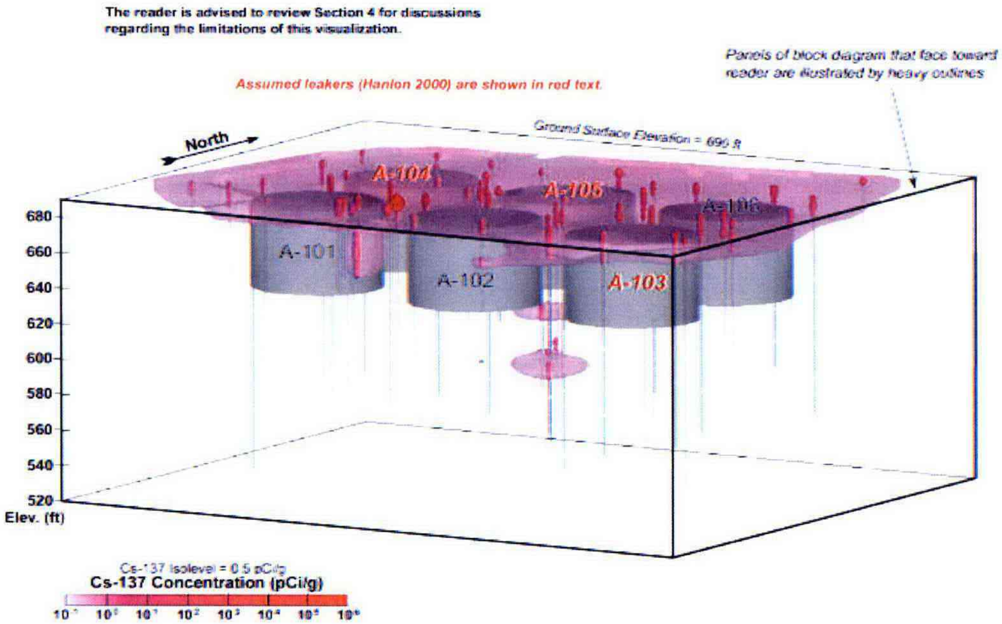


Figure D-14. A Tank Farm Visualization

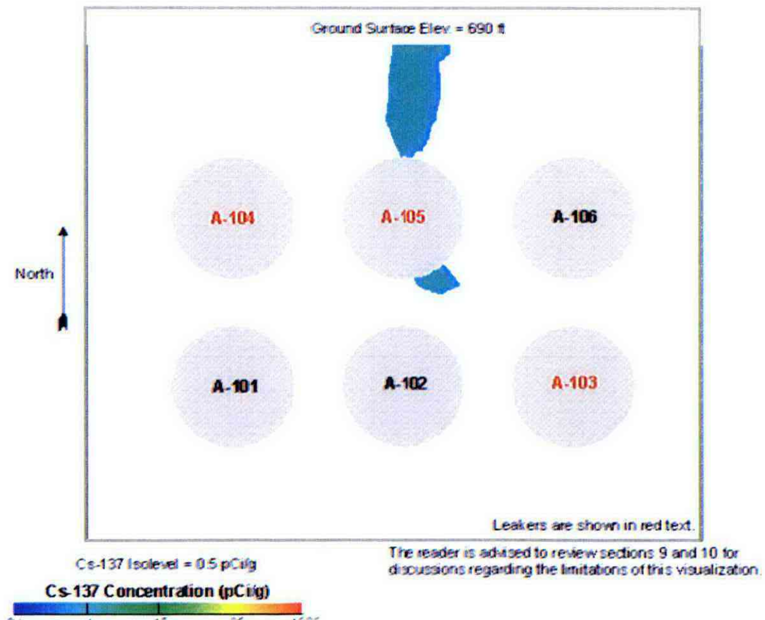


Figure 14-47. Visualization of Cs-137 Contamination at the Bases of the A Tank Farm Viewed From Above the Tanks

Figure 6-5. Spectral Gamma Logs for Tank A-103 Drywells

Spectral gamma logs from GJ-HAN-108, "Vadose Zone Characterization Project at the Hanford Tank Farms: Tank Summary Data Report for Tank A-103."

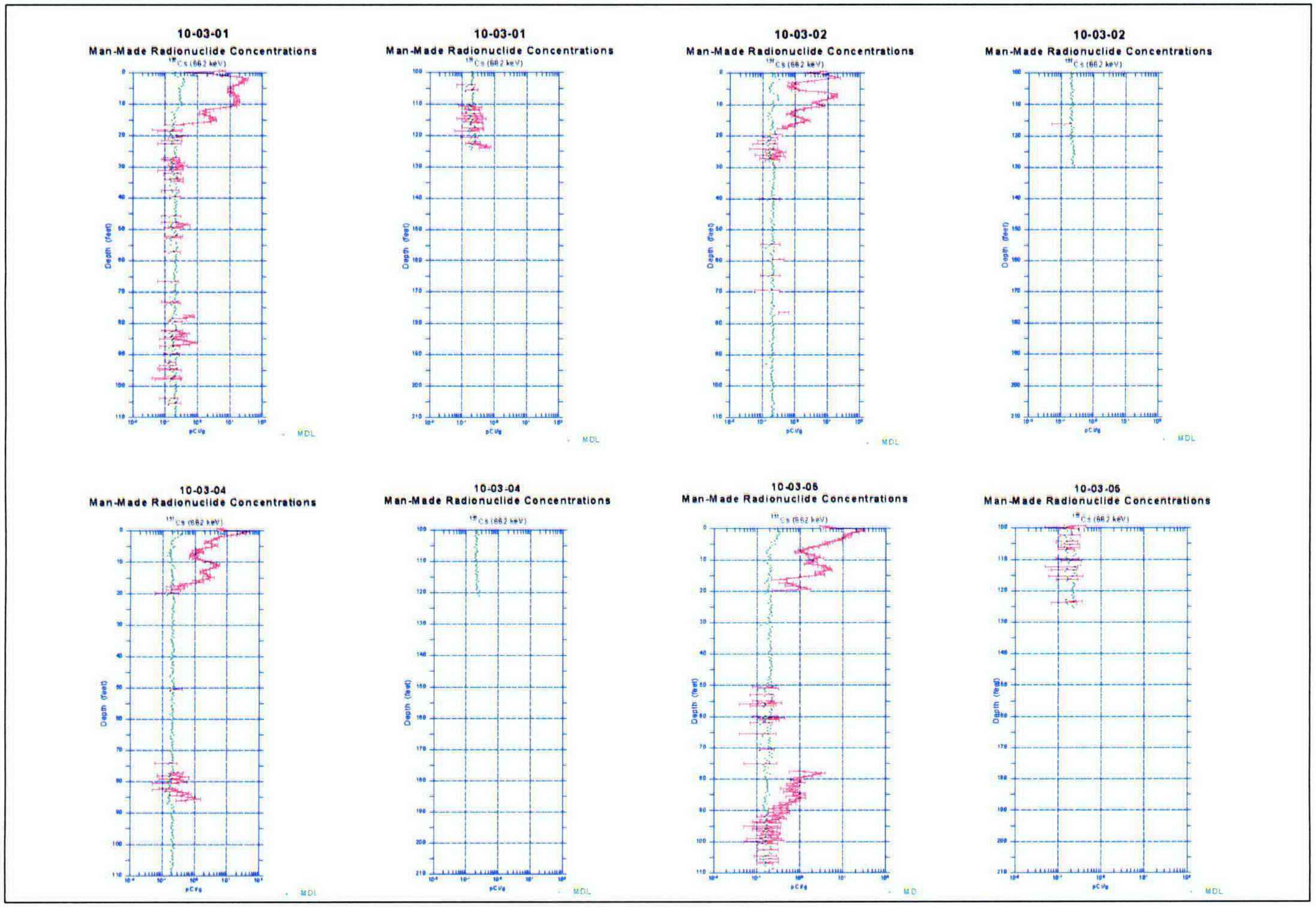
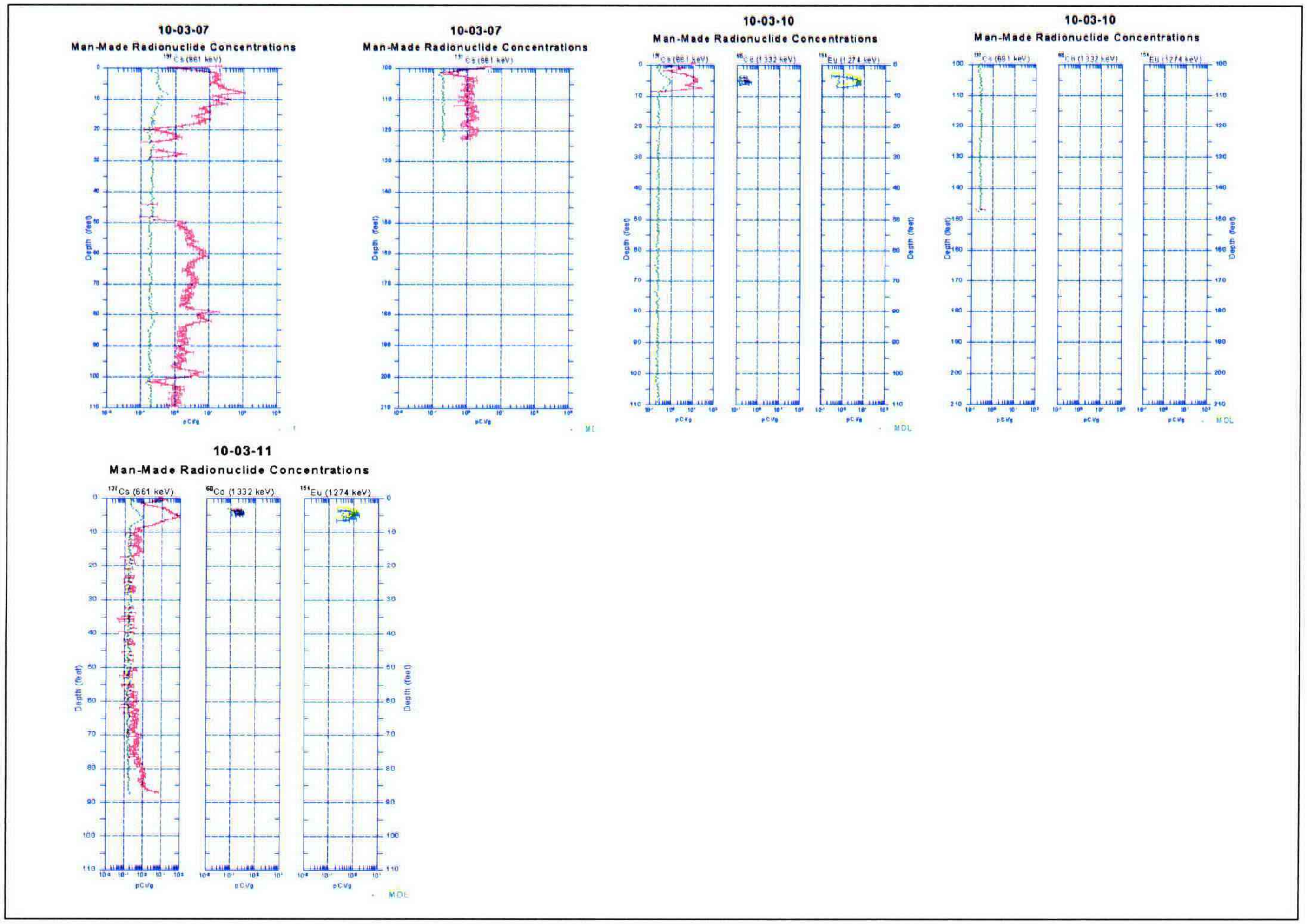


Figure 6-5. Spectral Gamma Logs for Tank A-103 Drywell (cont.)

Spectral gamma logs from GJ-HAN-108, "Vadose Zone Characterization Project at the Hanford Tank Farms: Tank Summary Data Report for Tank A-103."



6.2 TANK A-103 LEAK DETECTION LATERALS

In the 1962 – 1963 period, each of the six tanks in the 241-A Tank Farm was retrofitted with three leak detection laterals extending beneath the tank foundations to monitor for waste leakage. These were installed after leakage was detected from tank SX-113 in 1958 and confirmed in 1962. The laterals radiate outward from two 12-ft diameter vertical caissons that are about 69 ft deep.

The laterals were installed by augering horizontally from a location about 3 ft above the bottoms of the caissons. Each augered hole was lined with a 4-in diameter, schedule-40 steel pipe. The nine laterals were augered outward from each of the two caissons in fan-like patterns, resulting in three laterals grouped beneath each tank. The laterals are located about 66-ft below the ground surface, which is about 11-ft below the bases of the tanks. The laterals extend outward from the caissons and beneath the tank to a location outside the outer edge of the tanks. The portion of the lateral covered by the tank is referred to as the "tank shadow."

Monitoring access to the laterals is provided through a 3-in diameter tubing. The tubing extends from the ground surface, down the caisson, through a 90-degree curving bend, and to the end of the horizontal 4-in diameter steel pipe. A cross section view of the lateral construction would show the lateral is essentially an L-shaped monitoring well. The horizontal portion of the L is the lateral section beneath the tank while the vertical portion or the L is within the caisson. In the horizontal section, the lateral is double-encased where the 3-in.-diameter tubing is contained within the 4-in.-diameter steel pipe.

To perform lateral monitoring, the radiation detector was inserted in the vertical portion of the lateral and blown with compressed air to the end of the 3-in tubing. The detector count was started and the detector slowly withdrawn from the lateral using marks on the retrieval cable to record distance.

6.2.1 Tank A-103 Leak Detection Laterals Gross Gamma Logs

Radiation logs from the laterals beneath tank A-103 are available for the 1977 – 1991 period, and for 2005 when spectral gamma logging was performed. None of the gamma logs from the three laterals beneath the tank show evidence of soil contamination in the horizontal portion beneath the tank shadow.

Representative examples of the tank A-103 lateral radiation logs are presented in Figure 6-10. For comparison example lateral radiation logs from a known leaking tank, tank A-104 tank, are presented in Figure 6-11.

Both sets of figures show that soil contamination exists along the vertical section of the laterals before they bend to horizontal and enter the tank shadow beneath the foundation. The soil contamination could indicate a tank leak, especially if it was at the same depth as the tank foundation (where a leak would tend to accumulate because of the underlying, undisturbed soil). However, it seems likely that at least one of the three laterals under the tank foundation would have to show confirming soil contamination if tank A-103 was leaking, and this is not the case.

Figure 6-6. 241-A Tank Farm Laterals

Leak detection laterals were retrofitted to the six 241-A tanks during 1962 – 1963 following discovery of a leak from tank SX-113. (H-2-31880 Rev. 2, "241-A Tank Farm Leak Detection System Plan-Section-Detail")

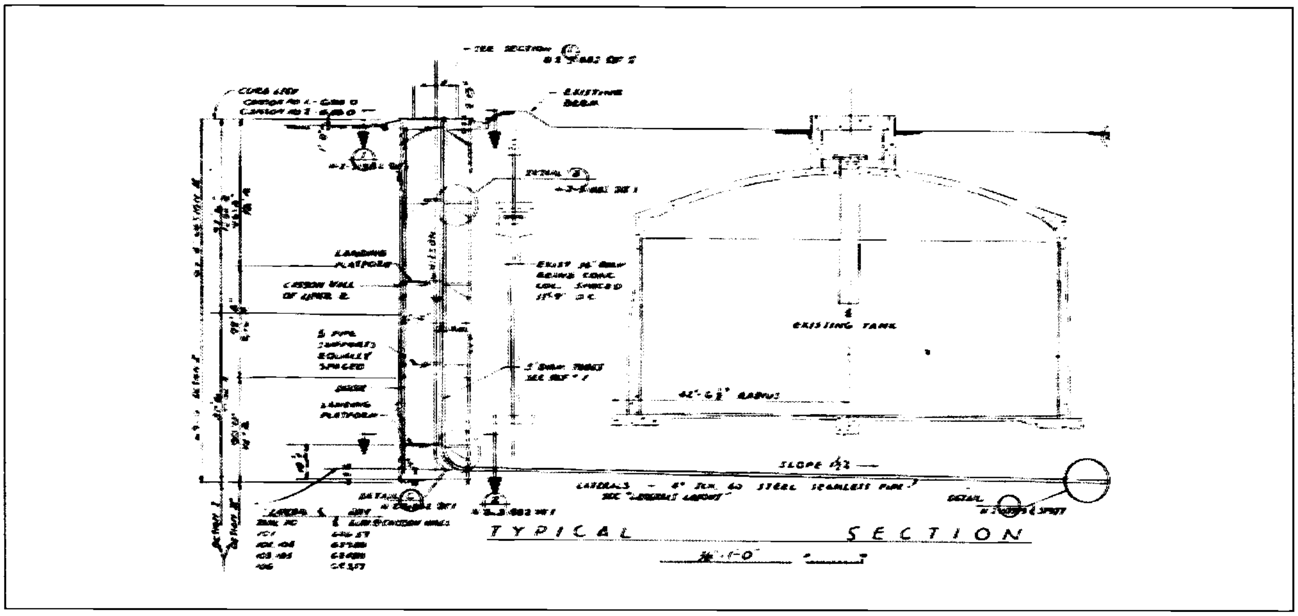


Figure 6-7. 241-A Tank Farm Laterals Plot Plan

The two vertical caissons in 241-A Tank Farm each provide access to the laterals for three tanks. (H-2-31880 Rev. 2, "241-A Tank Farm Leak Detection System Plan-Section-Detail)

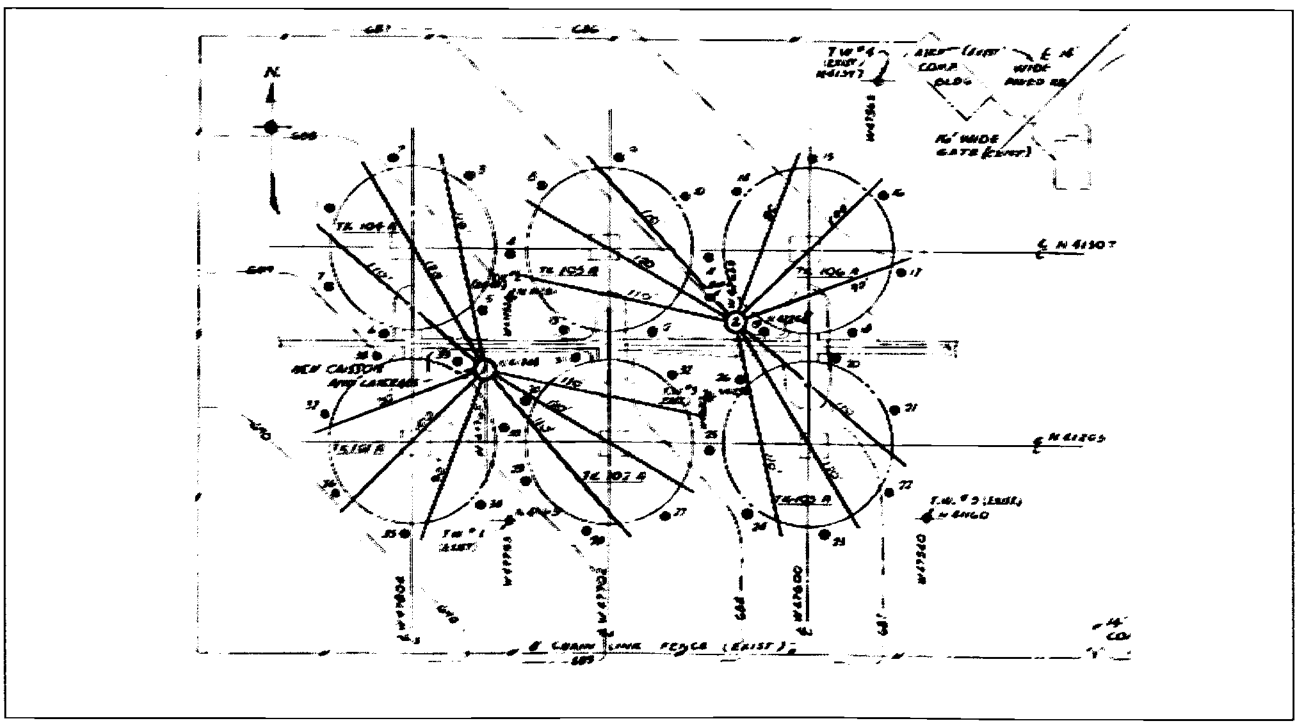


Figure 6-8. Photograph of 241-SX Tank Farm Lateral Shack Floor

The photograph shows the open, vertical termination of laterals for tanks SX-112 and SX-115 (RPP-RPT-27605 Rev. 0 Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms). To perform lateral monitoring, the radiation detector was inserted into the opening and blown with compressed air to the end of the 3-in tubing. The detector count was started and the detector slowly withdrawn from the lateral using marks on the retrieval cable to record distance. (H-2-31880 Rev. 2, "241-A Tank Farm Leak Detection System Plan-Section-Detail")

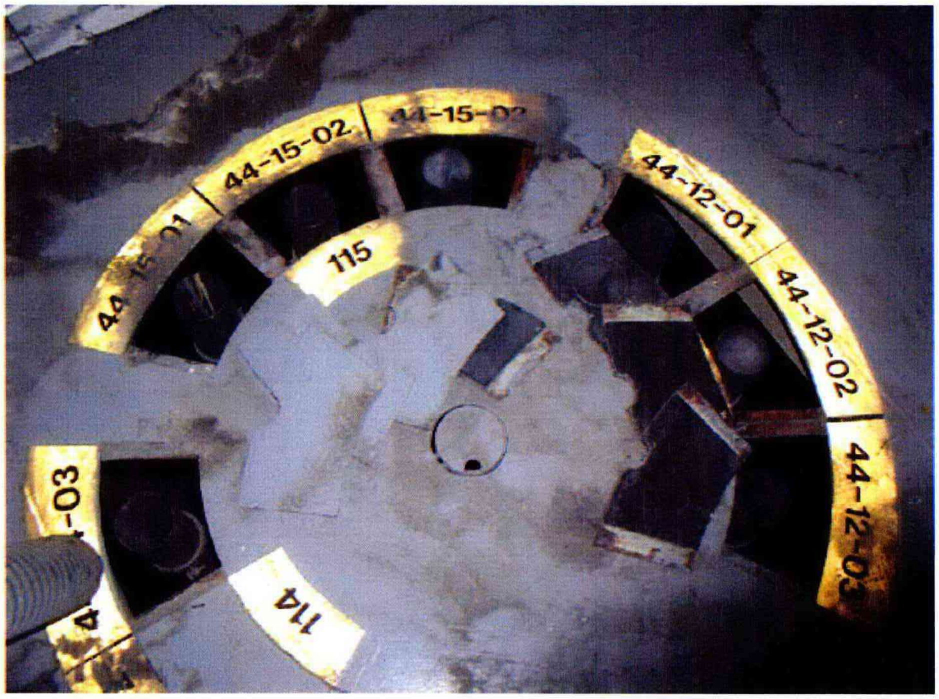


Figure 6-9. Tank A-103 Lateral Radiation Logs 1977 - 1991

The figure shows a representative sample of tank A-103 lateral radiation logs in both linear and logarithmic scale. The vertical lines on the charts are the lateral distance from grade to the beginning of the horizontal run; the distance from grade to the point where the lateral begins travel beneath the tank shadow; and the distance from grade to the point where the lateral exits the tank shadow. The horizontal run for Lateral #1 begins at 65.4-ft, the lateral enters the tank shadow at 104.2-ft, and exits the shadow at 163.4-ft;. For Lateral #2, the horizontal run starts at 65.4-ft, the lateral enters the tank shadow at 99.8-ft, and exits the shadow at 175.7-ft. For Lateral #3 the horizontal run starts at 65.4-ft, the lateral enters the tank shadow at 104.4-ft, and exits the shadow at 163.6-ft. (RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms," page 5)

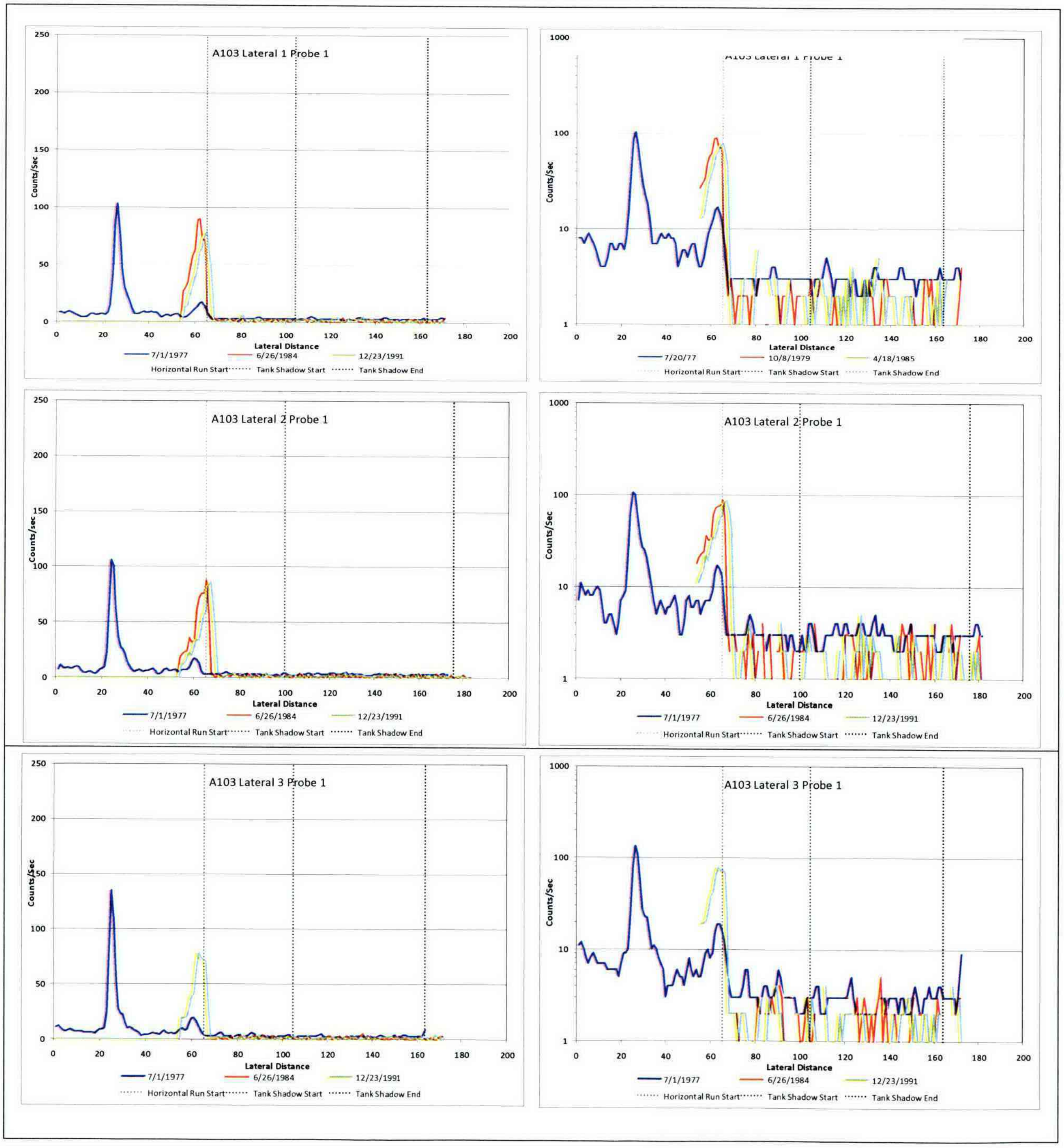
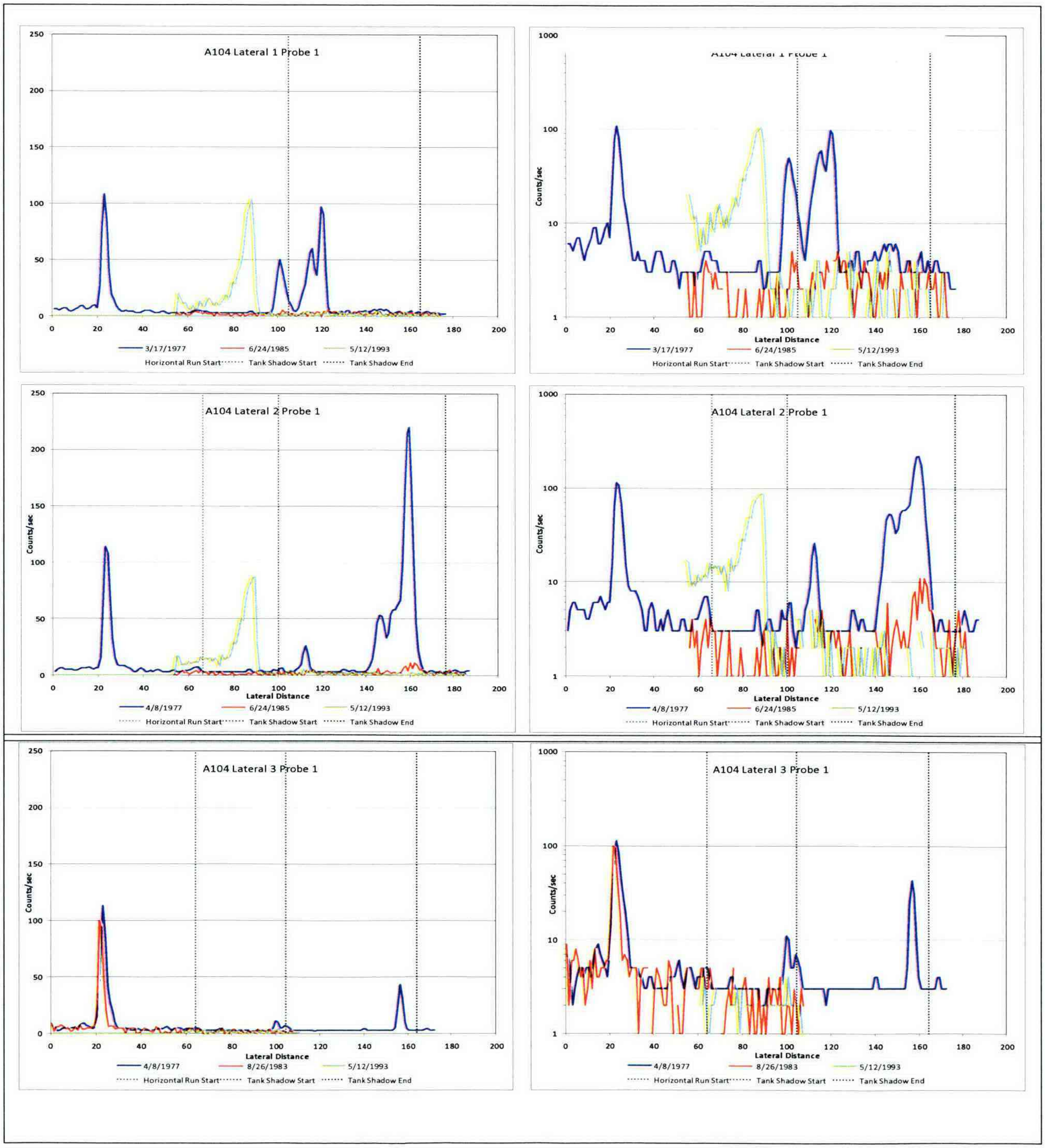


Figure 6-10. Tank A-104 Lateral Radiation Logs 1977 – 1993

The figure shows a representative sample of tank A-104 lateral radiation logs in both linear and logarithmic scale. Tank A-104 is an assumed leaking tank, with an estimated leak volume of 500 – 2,500 gallons. The horizontal run for Lateral #1 begins at 66.4-ft, the lateral enters the tank shadow at 105-ft, and exits the shadow at 164.8-ft;. For Lateral #2, the horizontal run starts at 66.4-ft, the lateral enters the tank shadow at 100.2-ft, and exits the shadow at 176.5-ft. For Lateral #3 the horizontal run starts at 64.1-ft, the lateral enters the tank shadow at 104.4-ft, and exits the shadow at 164.2-ft (RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms," page 5). Note the significant radiation readings under the tank shadow for the tank A-104 radiation logs versus tank A-103.



6.2.2 Tank A-103 Leak Detection Laterals Spectral Gamma Logs

In 2005, the 241-A and 241-SX laterals were relogged using a sodium iodide spectral gamma logging system capable of identifying individual radionuclides for laterals with historically low count rates; and Geiger-Muller detectors for laterals with known high count rates.

In addition to radiation logging, temperature profiles were collected from the laterals, and a visual inspection completed using a remote camera. There were no consequential observations reported for the tank A-103 lateral temperature profiling or the visual inspection. All of the results are reported in RPP-RPT-27605 Rev. 0 *Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms.*

The spectral gamma radiation logs for the laterals beneath tanks A-103 and A-105 are shown in Figure 6-13 and Figure 6-14, respectively. Tank A-105 is used for the spectral gamma radiation log comparison because the 2005 logs of tank A-104 showed no radiation above background. The 2005 report notes that the historical gross gamma logs had shown rapidly decreasing levels of contamination.

Tank A-105 is a known leaking tank, with an estimated leak volume of 10,000 – 270,000 gallons. The tank experienced a violent steam eruption in January, 1965 that tore about three-quarters of the circumference of the bottom liner away from the sidewall. The void space created beneath the liner by the steam eruption was estimated to be about 80,000 gallons (ARH-78 *PUREX TK-105-A Waste Storage Tank Liner Instability and Its Implications on Waste Containment and Control*). The tank was estimated to have leaked between 10,000 and 45,000 gallons from the time of the initial leak until waste sluicing was completed in November, 1970. The rest of the leak volume range estimate is dependent on assumptions about the extent of cooling water added to the tank between November 1970 and December 1978 evaporated instead of leaking into the soil (HNF-EP-0182 Rev. 230 *Waste Tank Summary Report for Month Ending October 31, 2008,* Table 4-3. Single-Shell Tank Leak Volume Estimates).

The tank A-103 spectral gamma logs show that soil contamination was detected along the vertical section of the laterals similar to the 1977 and later gross gamma logs. The soil contamination could indicate a tank leak. As with the earlier tank A-103 logs, there is no corroborating evidence from beneath the tank foundation. The logs show no soil contamination above background. If tank A-103 had leaked, it seems likely that the spectral gamma log of at least one lateral would have shown soil contamination. This is not the case.

Tank A-105, by comparison, shows soil contamination both along the vertical section of the laterals and on the horizontal runs of all three laterals where they enter and exit the tank's shadow. The laterals had to be relogged with the high count rate "Green" and "Red" Geiger-Muller detectors to reduce detector saturation; the twin peak shape where Lateral #3 enters the tank shadow indicates that even the high rate "Red" detector was saturated in this area. There is significant soil contamination in the tank shadow as well as at the shadow entry and exit points.

Figure 6-11. Tank A-103 Spectral Gamma Lateral Radiation Logs 2005

Data from RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms, Appendix B. Gamma Survey Plots."

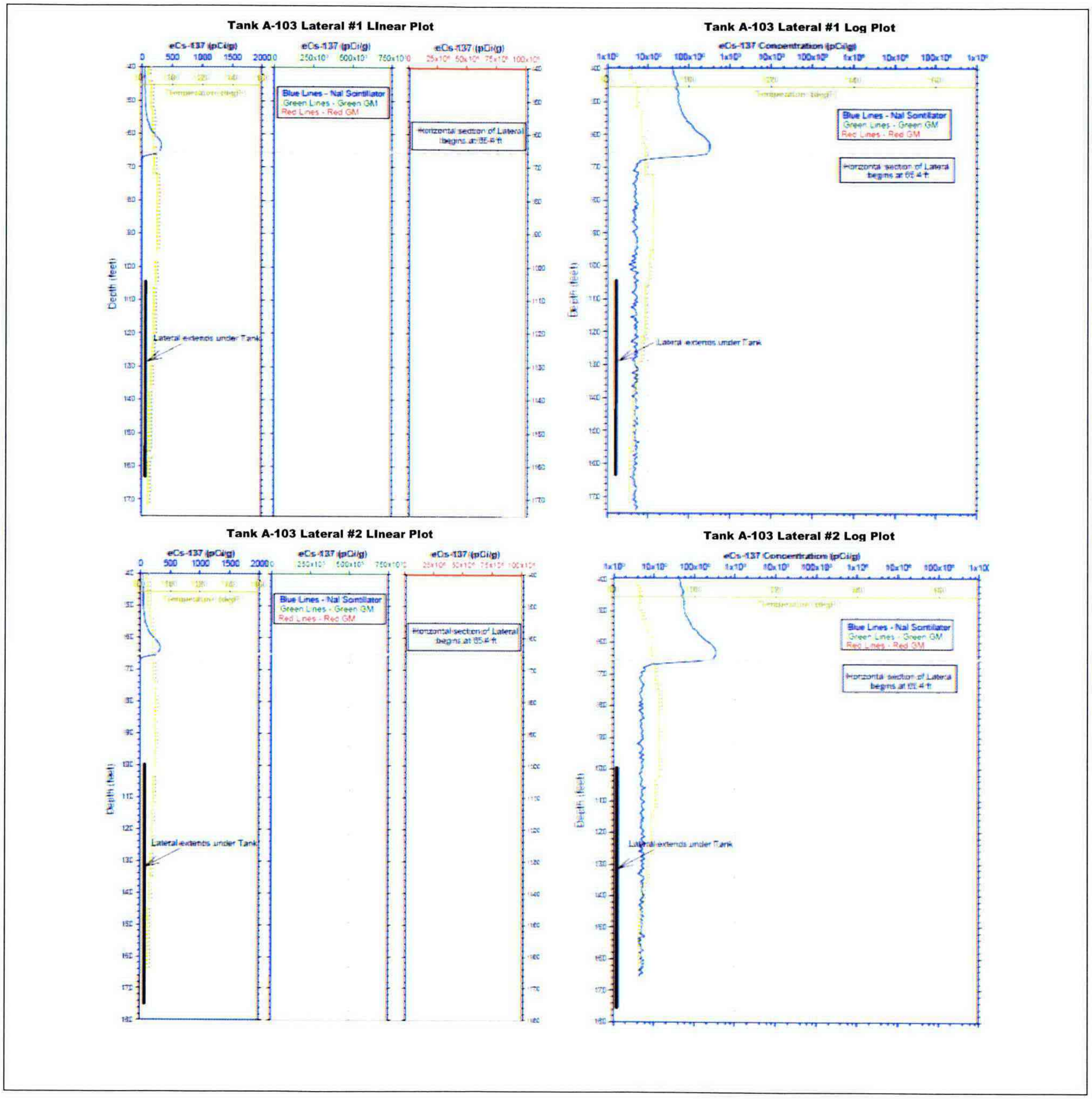


Figure 6-12. Tank A-103 Spectral Gamma Lateral Radiation Logs 2005 (cont.)

Data from RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms, Appendix B. Gamma Survey Plots."

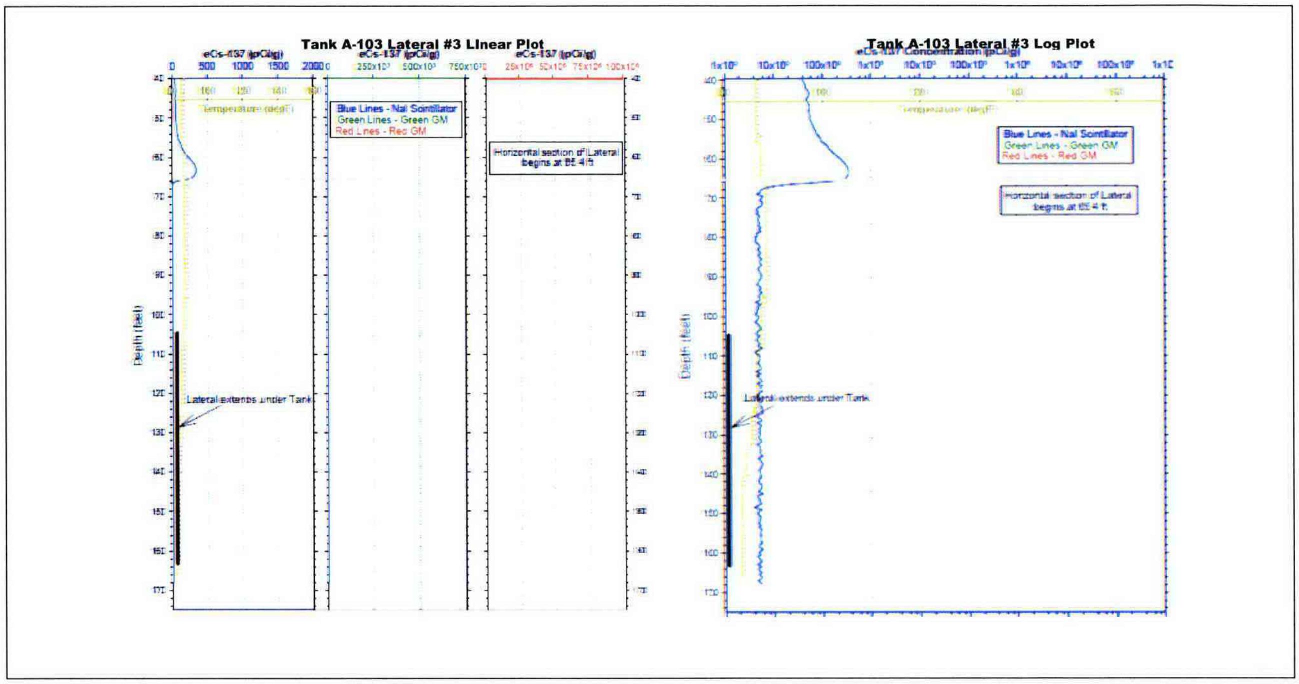


Figure 6-12. Tank A-105 Spectral Gamma Lateral Radiation Logs 2005

Data from RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms, Appendix B. Gamma Survey Plots".

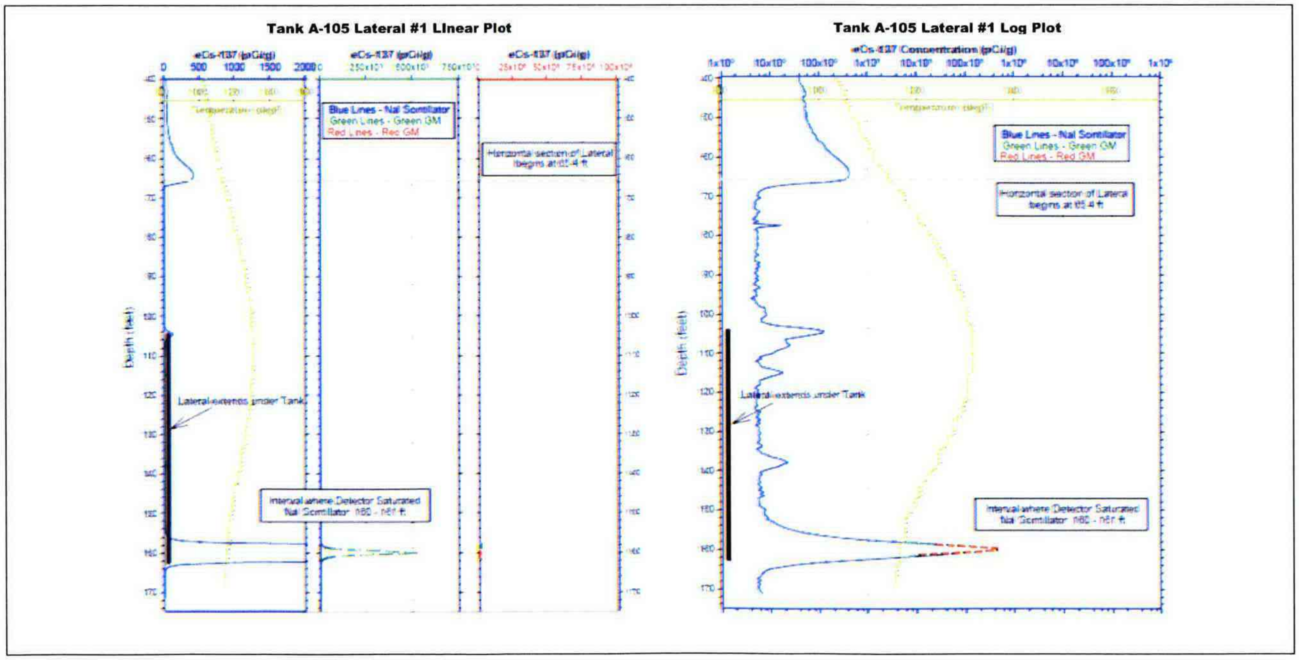
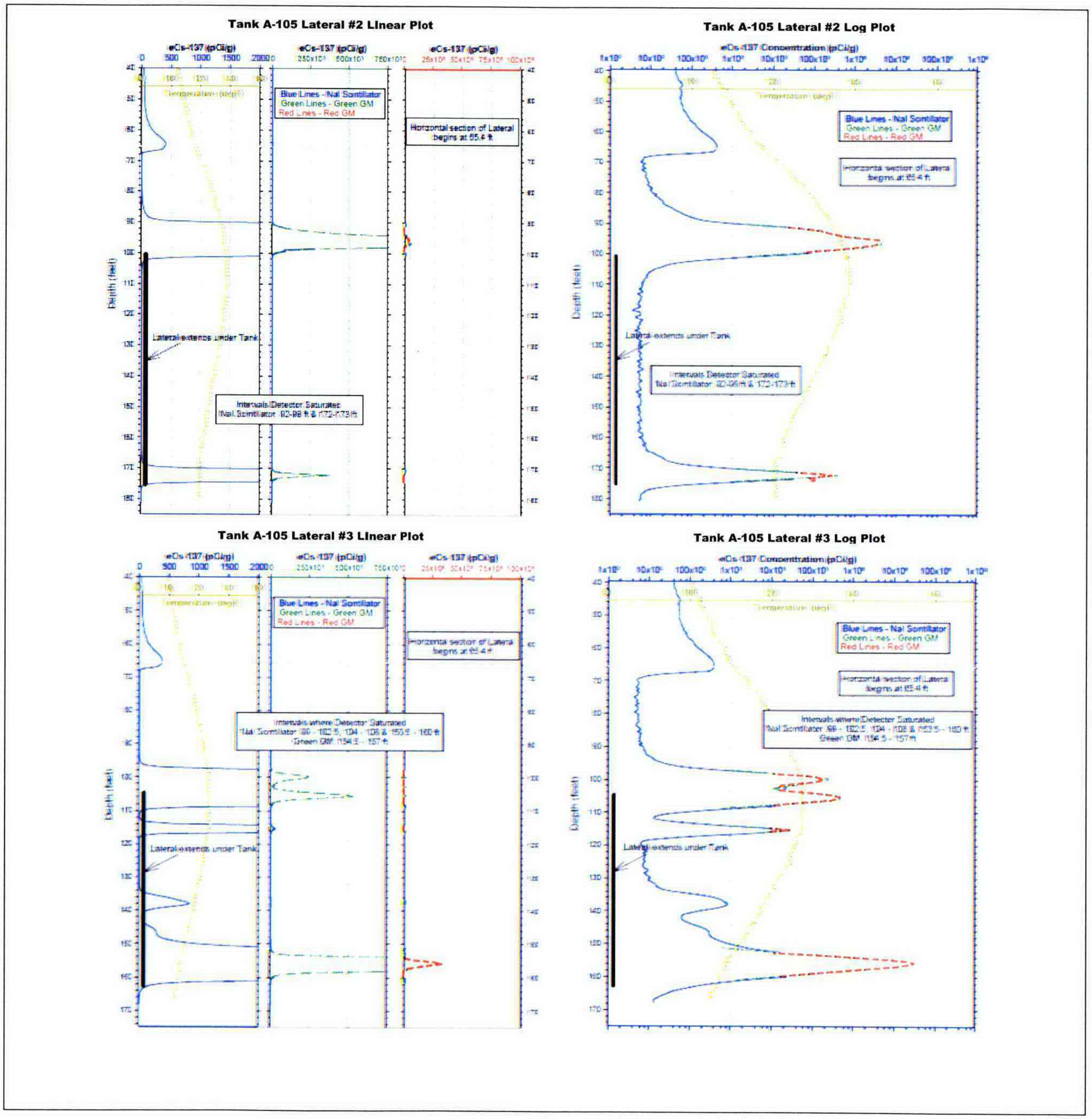


Figure 6-12. Tank A-105 Spectral Gamma Lateral Radiation Logs 2005 (cont.)

Data from RPP-RPT-27605 Rev. 0, "Gamma Surveys of the Single-Shell Laterals for A and SX Tank Farms, Appendix B. Gamma Survey Plots."



The available lateral radiation log records show that tank A-103 has different gamma log signature than those of leaking tanks A-104 and A-105; there is no soil contamination present under tank A-103; by comparison the other tanks show the presence of significant amounts of soil contamination, in some cases enough contamination to saturate the high count rate detectors.

7.0 LEAK – NON-LEAK HYPOTHESES

Based on review of the in-tank and ex-tank data, the leak assessment panel developed plausible hypotheses for the observed tank behavior:

Leak Hypothesis:

"The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak."

Non-Leak Hypothesis:

"The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface."

8.0 CONCLUSIONS

The process for assessing the leak status of a tank is designed to estimate a leak probability. Probability is defined as a measure of the state of knowledge or belief about the likelihood that a specific state of nature (e.g., a tank has leaked or is leaking) is true. Probability must be between 0 (absolute certainty that the state of nature is not true) and 1 (absolute certainty that the state of nature is true). The process starts with a prior probability independent of the available data. This establishes any pre-evaluation bias and is typically established at 0.5 that the tank is leaking or has leaked without consideration of the specific data initiating this process (i.e., no pre-evaluation bias, either for or against a leak). Then reviews of in-tank data and ex-tank data are used to establish conditional probabilities for whether the leak hypothesis or the non-leak hypothesis is supported by the data. The conditional probabilities are used to adjust the leak probability toward a leak hypothesis (probability > 0.5) or a non-leak hypothesis (probability < 0.5).

There was consensus among the members of the assessment team is that the available in-tank and ex-tank data indicate that the non-leak hypothesis is more consistent with the data, and that tank A-103 did not leak during the 1977 – 1988 period when the tank experienced anomalous surface level changes.

The most likely causes of the surface level changes were the episodic accumulation and release of trapped gas in the waste, combined with waste evaporation, and measurement errors created by the irregular waste surface. Although slurry growth in 242-S Evaporator/Crystallizer concentrated waste had already been observed in 200-West Area tanks, it is clear that in the late 1980's there was no technical consensus on the cause. The mechanism for creating gas release events was not understood until the 1990's.

Although there is evidence of low levels of Cs-137 soil contamination around some of the tank A-103 drywells, there is no evidence of soil contamination at the base of the tank. An increase in the number of the contamination intervals, and the dates of highest measured contamination, seem to coincide with the 1978 drilling campaign to deepen the drywells, indicating contamination drag-down may have been a factor. Radiation monitoring in the three laterals beneath the tank's foundation from 1977 to 1991, and again in 2005 detected no evidence of tank leakage.

The recommendation of the assessment team is that the existing "Assumed Leaker" integrity classification for tank A-103 be changed "Sound."

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RPP-RPT-27605, 2006, “Gamma Surveys of the Single-Shell Tank Laterals for A and SX Tank Farms,” Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington. (IDMS Accession #NA01745043)

SD-WM-TI-198, 1988, “Data Transmittal Package for 241-A-103 Waste Characterization,” Westinghouse Hanford Company, Richland, Washington.

SD-WM-TI-356, 1988, “Waste Storage Tank Status and Leak Detection Criteria,” Rev. 0, Westinghouse Hanford Company, Richland, Washington. (IDMS Accession #D197006832)

SD-WM-ER-526, 1995, “Evaluation of Hanford Tanks for Trapped Gas,” Rev. 1, Westinghouse Hanford Company, Richland, Washington. (IDMS Accession #NA04097010)

APPENDIX A.
TANK A-103 LEAK ASSESSMENT TEAM
EXPERT ELICITATION FORMS

TABLE A-1. IN-TANK DATA

Tank 241-A-103 Leak Assessment In-Tank Data Form 2009-05-27
(from HNF-3747, Rev. 0)

SURFACE LEVEL MEASUREMENTS (SLM)	Observation

ENRAF

Unexplained, repeatable drop>tolerance	Yes	No	NA
Significant drop	Yes	No	NA
Significant trend change	Yes	No	NA

FIC

Unexplained, repeatable drop>tolerance **RPP-ENV-37956 Rev. 1:** **1977 - 1979**: Various reports describe surface level decreases that occurred in 1977 (IDMS Accession #D194052856), 1978 (IDMS Accession #D194035034), and 1979 (IDMS Accession #D194053459). The decreases were attributed to the properties of the DSSF and CC wastes; namely foam, irregular waste surface, slurry growth and collapse (i.e. gas retention and release). No activity was detected in the three laterals and drywells associated with tank A-103 during these events, indicating no leakage of waste. **March - April, 1980**: After slurrying the last batch of DSSF to tank A-103 in March – April 1980 (RHO-CD-80-1045 5), there was a reported liquid level decrease from 193.4 inches (533,807 gallons) to 190.1 inches (524,698 gallons) on September 4, 1980 over 11-hours (IDMS Accession #D197183104). The cause of this liquid level decrease was attributed to mixing of dissimilar solids within the tank and a net volume decrease. In tank photographs revealed foam and floating yellow masses and a definite decline in liquid level. Tank temperature data indicated a mixing of the bottom and upper layers of solids within tank A-103. Again, there was no activity detected in the laterals or the drywells, indicating tank A-103 was not leaking waste (IDMS Accession #D196215974). **October, 1981 - March, 1987**: Over a span of approximately 5.5 years (October 8, 1981 to March 5, 1987), the surface level in tank A 103 was observed to have decreased from 187.5 inches (517,520 gallons) to 184 inches (507,860 gallons). As of March 5, 1987, tank A-103 contained an estimated 8,800 gallons of supernate, 208 kgal drainable interstitial liquid, and 499 kgal of solids. In-tank photographs showed the FIC plummet contacting liquid, and this raised questions about the tank's leak integrity (EPDR 87-02). Evaporation may have been a contributing cause to the 3.5 in surface level drop betweeen October, 1981 and March, 1987 reported in Environmental Protection Deviation Report 87-02. The tank was originally connected to the 702-A ventilation system, and was reported to have been disconnected in the early 1980's according to RPP-ENV-37956 Rev. 1. Even after active ventilation was stopped, the tank could have breathed passively. Several 1990's studies measured passive breathing in SSTs. RPP-5660 Rev. 0 *Collection and Analysis of Selected Tank Head Space Parameter Data* indicates a passive breathing rate of 10cfmTable 4-1). **November 16, 1987**: On November 16, 1987, the surface level in the tank decreased from the baseline of 143.4 inches to 140.6 inches during a three day period. However, the FIC liquid level monitor readings fluctuated up and down between 143 inches to 140.6 inches during this time frame (Vermeulen 1987). Inspection of photographs taken inside tank A-103 on December 28, 1988 showed that the FIC plummet was contacting dry solids in a deep depression of multiple elevations, leading to erratic readings (Baumhardt 1989).	Yes	No	NA
Significant drop	Yes	No	NA
Significant trend change	Yes	No	NA

MANUAL GAUGE

Unexplained, repeatable drop>tolerance Manual tape readings confirm the FIC readings. See for example, OR 79-118, below.	Yes	No	NA
Significant drop	Yes	No	NA
Significant trend change	Yes	No	NA

LIQUID OBSERVATION WELL (LOW) MEASUREMENTS	**Observation**		
Unexplained, repeatable drop>tolerance At the coarse resolution available on PCSACS, the ILL measured from the LOW follows the changes in surface level from the period 1980 - present. The data do not provide an useful information regarding the leak status of tank A-103.	Yes	No	NA
Significant drop	Yes	No	NA
Significant trend change	Yes	No	NA

CORROBORATING EVIDENCE	**Corroborates SLM or LOW Data Given**		
Thermocouple Tank temperatures up to 240°F and pressure excursions occurred during the 1950's - 1960's per RHO-CD-1172 Rev. 0 *Survey of the Single-Shell Tank Thermal Histories*. There is no evidence of any tank leakage during this period. The thermal history available on PCSACS for the period 1980 - present shows a cooling trend with the earliest temperatures ranging up to ~ 130°F, and cooling to a maximum of ~ 110°F currently.	Leak	Alt. Hypoth.	NA
Salt well screen	Leak	Alt. Hypoth.	NA
Standard Hydrogen Monitoring System	Leak	Alt. Hypoth.	NA
Photos/Videos Photos of record taken during surface level decrease investigations show the FIC on a solid, irregular surface. See Event Fact Sheet TF-EFS-88-0151 Rev. 1, December 30, 1988 below, for example.	Leak	Alt. Hypoth.	NA
Weather conditions	Leak	Alt. Hypoth.	NA
Barometric pressure	Leak	Alt. Hypoth.	NA
Precipitation	Leak	Alt. Hypoth.	NA
Temperature	Leak	Alt. Hypoth.	NA
Surface flooding	Leak	Alt. Hypoth.	NA

Process history	Leak	Alt. Hypoth.	N/A
Process history **RPP-ENV-37956 Rev. 1:** **PUREX Waste Receipts (1956 - 1960)**: Tank A-103 construction was completed in 1955 but remained empty until May,1956. In May 1956, the tank received 72 kgal of organic wash waste from the 202-A PUREX Plant (HW-43420 page 8). Then in June 1956, tank A-103 received 99 kgal of PUREX P1 HLW supernate (HW-43895 page 8). The waste began to self-boil (102°C) on June 25, 1956 (HW-44506 page 9). Tank A-103 continued to receive PUREX HLW and periodic additions of water and organic wash waste through July 1960 (HW-66557 page 8) to maintain the volume of self-concentrating waste at approximately 500 kgal. No waste additions were reported for 1961. Mild pressure surges were reported in tank A-103 as early as July, 1956 (HW-44580 page Fc-13). Three consecutive bumps occurred in September 1956, that blew the by-pass seal pot water seal (60 inches) and forced steam directly out the tank farm stack. The air-lift circulators were started to prevent reoccurrence of this event (HW-45707 page J-7). **First Sluicing Campaign (May, 1962 - November, 1964):** Approximately 330 kgal of supernate were transferred from tank A-103 to tank A-105 in May, 1962, and additional 180 kgal were transferred in July, 1962 (ARH-78 page 8). These transfers were made in order to prepare the tank to demonstrate sludge sluicing capability. Water was added to tank A-103 to soften the sludge and the sludge was sluiced to tank A-102 from March, 1964 (HW-81620 page G-2) through November 17, 1964 (RL-SEP-112 page B-2). **Miscellaneous Waste Receipts and Second Sluicing Campaign (1965 - December, 1967)**: Tank A-103 received 244-CR vault, tank C-103, and PUREX organic wash wastes in 1965 and 1966. The supernate in tank A-103 was transferred to tank A-101 in March, and April, 1966 (ISO-75 page 53 and 70) to flush the tank. A new sluicer was installed in May ,1966 (ISO-75 page 85) and sluicing was again conducted intermittently between October 20, 1966 (ISO-75 page 174).and February 16, 1967 (ISO-651 page 30). Following completion of sluicing, the sludge and supernate volumes in tank A 103 were reported as 0 gal and 55 kgal, respectively as of March 31, 1967 (ISO-806 page 8). The sludge volume was later revised in December 31, 1967 to 22,000 gallons (ARH-326 page 9). **Tank A-105 Sluicing Receipts and Associated Transfers (1968 - 1972)**: From February, 1968 through November, 1968, tank A-103 received the PUREX HLW supernate from tank A-105, subsequent flushes of tank A-105 with cesium denuded ion exchange waste, and sludge sluiced from tank A-105 (Interoffice Memo 7G420-06-004). Supernates collected in tank A-103 were periodically transferred to other single-shell tanks. Tank A-103 received sludge from a second sluicing campaign conducted in tank A-105 July 31 – August 1, 1969 (ARH-1023-3-DEL pages 33-34) and August 25 – November 18, 1970 (Interoffice Memo 7G420-06-005). The sludge slurry collected in tank A-103 from the second tank A-105 sluicing campaign was allowed to settle. Approximately 302 kgal of supernate were transferred to tank C-105 in the second quarter of calendar year (CY) 1972, leaving 244 kgal of supernate and 102 kgal gallons of sludge in the tank (ARH-2456 B page 9). **Miscellaneous Waste Receipts and Third Sluicing Campaign (1973 - 1974)**: Tank A-103 was next used in the second quarter of CY 1973 to receive ~19 kgal of sludge slurry from sluicing tank A-102 (ARH-2794 B page 9). Tank A-103 then received 71 kgal of waste from B Plant in the fourth quarter of CY 1973 (ARH-2794 D page 9). Approximately 244 kgal of supernate were transferred to tank A-104 in the first quarter of CY 1974, leaving 125 kgal of supernate and 102 kgal of sludge in the tank (ARH-CD-133 A page 9). The sludge in tank A-103 was sluiced to 244-AR Vault beginning in the first quarter of CY 1974 (ARH-CD-133 A page 9) and completed in September 1974 (SD-WM-TI-302 page 186).			

PUREX Sludge Supernatant Accumulation (1974 - 1976): Tank A-103 was used to collect PUREX Sludge Supernate (PSS) from various single-shell tanks and B Plant waste in the fourth quarter CY 1974 (ARH-CD-133 D page 9) through first quarter CY 1976 (ARH-CD-702 A page 9). The PSS waste was generated from washing sludges either in 244-AR Vault or in a single-shell tank, then decanting the supernates. Approximately 920 kgal of supernate were transferred to tank C-104 and 13 kgal were transferred to tank A-106 in the second quarter of CY 1976, leaving 20 kgal of supernate and 16 kgal of sludge in tank A-103 (ARH-CD-702 B page 9). **Final Sluicing Campaign (October, 1976 - December, 1976):** From October 13, 1976 (ARH-LD-222 B page 13) through early December, 1976 (ARH-LD-224 B page 11) the sludge in tank A-103 was sluiced to tank A-106 (SD-WM-TI-302 page 166). This final sluicing in tank A-103 was conducted to prepare the tank to receive saltcake from operation of the 242-A Evaporator. Tank A-103 was reported to contain 2,080 gallons of sludge following completion of this last sluicing campaign (SD-WM-TI-302 page 166). **242-A Evaporator/Crystallizer Bottoms Receiver (1977 - 1980)**: The 242-A Evaporator/Crystallizer used tank A-103 as a slurry receiver and feed tank from early 1977 through April 1980 (RHO-CD-80-1045 5 page 8). Tank A-103 received double-shell slurry feed (DSSF) and concentrated complexed (CC) waste during this period. **Deactivation (1980)**: The tank was removed from active service August 14, 1980. Pumpable supernate was removed to meet the deactivation criterion of < 33 kgal free supernatant (SD-WM-TI-356). **Interim Stabilization (May, 1987)**: Pumping of interstitial liquid and supernate from tank A-103 was started on May 16, 1987 and completed on May 24, 1987. A total of 111 kgal gallons of liquid waste were removed from tank A-103 to stabilize this tank (HNF-SD-RE-TI-178 page 15 -18).			[redacted]
Occurrence reports **Occurrence Report 77-141, August 1977**: The allowable rate of surface level decrease exceeded the 0.5-in/week criterion; between August 9, 1977 and August 16, 1977, the surface level decreased from 194.5-in to 193.6-in. The apparent cause of the decrease was dissolution of surface foam that had been observed after the last slurry transfer into the tank on August 6, 1977. A sample of the tank's surface taken on August 10, 1977 was comprised solely of foam (IDMS Accession # D194052856 and SD-WM-TI-356). Occurrence Report 78-15, 1978 (D194035034): Following receipt of 242-A Evaporator/Crystallizer slurry on November 29, 1977, the FIC surface level measurement had become erratic, with readings varying from 232.80-in to 236.10-in. Between January 18, 1978 and January 22, 1978, the surface level decreased from 234.7-in to 233.95-in exceeding the allowable decrease rate of 0.050-in/week. Photographs on January 27, 1978 showed the FIC suspended over a uneven crust varying several inches in height within a 1-ft radius. Drywells and laterals showed no significant changes. **Occurrence Report 79-118, December 1979**: A surface level baseline of 235.20-in was established for tank A-103 on October 5, 1979. On November 29, 1979, the FIC measurement decreased 4-in to 231.40-in in ~5 hours. The manual taped dropped 3.5-in. The drop exceeded the allowable -0.5-in decrease criterion. The apparent cause of the decrease was crust slumping. The tank had been filled with concentrated complexant waste from the 242-A Evaporator/Crystallize during March, and April, 1979. Almost immediately the surface level began to rise. An investigation revealed that the waste exhibited a slurry growth phenomenon similar to growth patterns that had been observed in the 241-SX tanks and tank SY-103. Three surface level baseline changes had been authorized between July, and October, 1979 to compensate for the slurry growth (IDMS Accession # D196216216 and SD-WM-TI-356).	Leak	Alt. Hypoth.	[redacted]

Operating Limit Deviation Report 81-02, April 1981: A surface level decrease of -2.30-in occurring during the period September 9, 1980 and May 8, 1981 was attributed to slurry growth followed by collapse of the surface crust. Drywells and laterals remained stable during the review period and were the primary means of leak detection because of surface solids. Surface level measurement fluctuations ranged from 185.10-in to 190.35-in, and remained within the allowable decrease criterion (SD-WM-TI-356). **Environmental Protection Deviation Report 87-02**: Over a span of approximately 5.5 years (October 8, 1981 to March 5, 1987), the surface level in tank A 103 was observed to have decreased from 187.5 inches (517,520 gallons) to 184 inches (507,860 gallons). As of March 5, 1987, tank A-103 contained an estimated 8,800 gallons of supernate, 208 kgal drainable interstitial liquid, and 499 kgal of solids. In-tank photographs showed the FIC plummet contacting liquid, and this raised questions about the tank's leak integrity. **Event Fact Sheet TF-EFS-88-0151 Rev. 1, December 30, 1988**: Following recalibration of the FIC on December 22, 1988, a surface level reading of 135.10-in was obtained, -2.3-in from the 137.40-in baseline for the tank, and which exceeded the -2.00-in decrease criterion. A slow decrease of -0.7-in in 6 months had been observed since the baseline was established. Both December 28, 1988 and May 24, 1988 photos showed the FIC plummet to be contacting solids in a depression, and the later photos showed the depression to have multiple elevations. The conclusion was that plummet contacts at different elevations were the cause of the erratic readings. The FIC was converted to the intrusion mode, and the installed LOW became the primary interstitial liquid level surveillance device. Drywell, and LOW data were stable. Tank A-103 had been declared interim stabilized in June, 1988.			
Construction history	Leak	Alt. Hypoth.	NA
Gas Release Events Following conversion of tank A-103 to 242-A Evaporator/Crystallizer bottoms receiver, the tank received both DSSF and CC waste. Both of these wastes generated gas that was retained, and episodically released, volumes of gas. The episodic releases were accompanied by drops in the waste surface level. This rise and fall cyclical behavior was experienced in single-shell tank bottoms receivers in both 200-E and 200-W areas, and was not unique to tank A-103. At the time the phenomenon was explained by a variety of mechanisms, including waste settling, and waste mixing. Gas retention was alluded to, but retained gas and retained gas release events were not yet understood. Tank A-103 did not experience significant changes in surface level until the conversion to an evaporator bottoms tank. It is likely that the waste characteristics, rather than a loss of leak integrity, are responsible for most of the reported occurrences from 1977 forward.	Leak	Alt. Hypoth.	NA
Equipment maintenance calibration	Leak	Alt. Hypoth.	NA
Waste characteristics	Leak	Alt. Hypoth.	NA
In-tank operations	Leak	Alt. Hypoth.	NA
Interim Stabilization Estimates of DIL and DLR (1988 - 2005) Tank A-103 was declared interim stabilized in June, 1988 with a 4,600 gal of supernatant and 12 kgal drainable interstitial liquid (DIL) for a total drainable liquid volume of 16.4 kgal (HNF-SD-RE-TI-178, Tank Stabilization Record). The total liquid inventory remaining in the tank at the time of stabilization was 19.4 kgal which included the 4,600 gal of supernatant and 14.8 kgal of interstitial liquid. The 114.8 kgal of interstitial liquid was estimated from the volume of drained liquid recovered from core sample segments taken in 1986. The average volume of liquid recovered for eight segments was 3.5%. HNF-SD-TI-178 assumed the waste to be sludge but does not explain why 2,800 difference between the total interstitial liquid volume and the reported DIL volume. However based on review of the core sample drained liquid data included in the report, it appears that liquid in the bottom 18 inches of sludge was assumed to be capillary held.	Leak	Alt. Hypoth.	NA

In 2000, RPP-5556, Updated Drainable Liquid Volume Estimates for 119 Single-Shell Tanks Declared Stabilized reiterated the assumption that the waste was sludge. Then using a sludge volume of 366 kgal and a tank average sludge porosity of 0.15, the tank was estimated to contain 5,000 gal of supernatant and 54.9 kgal of total interstitial liquid. A capillary height of 24 in. was assumed for the sludge waste which resulted in a drainable interstitial liquid volume of 45 kgal. The total drainable liquid remaining (DLR) volume of 50 kgal was the sum of the supernatant (5,000 gal) and the DIL (45 kgal). In 2001, the Best Basis Inventory determined that much of the waste in tank 241-A-103 was saltcake based on the composition of the 1986 core samples. In 2002, the drainable liquid volumes were re-evaluated (Internal letter 7G300-02-JGF-001 R1, "Addition of Best-Basis Inventory Baseline Volumes to Waste Tank Summary Report," Revision 1). This calculation used the following values to calculate the DIL volume: 364 kgal saltcake, 2 kgal sludge, 0.15 tank average sludge porosity, 0.25 tank average saltcake porosity, and a capillary height of 6 inches. The tank was estimated to contain 4,000 gal of supernatant and 87 kgal of DIL for a total of 91 kgal. In 2005, the DIL and DLR calculations for this tank were updated with a new tank average saltcake porosity of 0.24 and a new tank average sludge porosity of 0.17 (HNF-2978, Updated Pumpable Liquid Volume Estimates and Jet Pumping Durations for Interim Stabilization of Remaining SSTs). Using a capillary height of 6 inches for saltcake, the DIL volume was 86 kgal and the DLR was 90 kgal. The April 1, 2005 BBI estimated 4,000 gal of supernatant, 89 kgal of interstitial liquid in the saltcake and 0.4 kgal interstitial liquid in the sludge. The 4,000 gal of supernatant is from the HNF-SD-RE-TI-178. The 89 kgal of interstitial liquid is based on 372 kgal saltcake with 24% porosity. The waste was determined to be mostly saltcake based on the composition of the 1986 core samples. The total liquid volume is 93 kgal. The key change, subsequent to interim stabilization, is the determination that most of the waste in the tank was saltcake.			
Previous Leak Assessments **RPP-ENV-37956 Rev. 1 and Internal Letter 65950-87-326, May 1987 (D199126708):** A integrity assessment of the previous six year's surface level behavior was conducted in May 1987 following the procedures and rules for other tank integrity assessments documented in RHO-CD-1193 (Internal Letter 65000-WWS-87-033). The integrity assessment panel reviewed information supporting the notion that the observed surface level decrease was attributable to slurry growth (i.e., retained gas accumulation and release). The surface level would slowly rise over a period of 9 to 12 months, then drop rapidly over one to two day period (Internal Letter 65950-87-291). Core samples obtained from tank A-103 in April 1986 showed no interstitial liquid and were laced with air pockets or void spaces large enough to be clearly visible in photographs (IDMS Accession # D196165963). Drywell and lateral radiation readings were unchanged during the six year period.	Leak	Alt. Hypoth.	NA
Three out of the five members of the tank integrity assessment panel stated at 95% confidence level that tank A-103 was sound; that the surface level fluctuations (both increases and decreases) were attributable to waste properties, and additional study of this phenomenon should be conducted. The other two panel members stated there was inconclusive evidence to relate the liquid level fluctuations to some waste phenomena. The assessment panel concluded tank A-103 should be classified as an assumed leaker, although there was no increase in activity detected in the laterals or drywells associated with this tank. The volume of waste leaked from tank A-103 was estimated as between 0 to 5,500 gallons, with the variability in the leak volume due to uncertainty whether the tank actually leaked, and the upper bound on the surface level decrease of 2-in from the last established 186.0-in baseline to 184.0-in, the most commonly reported CASS reading (IDMS Accession # D199126708).			
The phenomenon of retained gas release has also been observed in other tanks (e.g. SY-101, SY-103, AW-101, AN-103, AN-104, and AN-105) and is now referred to as gas release events (GREs). During the 1990's, significant technical work was performed to understand the GRE behavior. However, the GRE process and mechanisms were not understood in 1987 when the tank integrity assessment for tank A-103 was conducted. A mechanism had not yet been identified that could explain the liquid level fluctuations observed in the tank. If the GRE phenomenon had been understood it is likely that the panel would not changed the tank's status to an assumed leaker. The acceptance of the recommendation, R87-2161, is referenced in GJ-HAN-108, but is not recoverable from IDMS.			

TABLE A-2. EX-TANK DATA

Tank 241-A-103 Leak Assessment Ex-Tank Data Form 2009-05-27
(from HNF-3747, Rev. 0)

SPECTRAL GAMMA LOGS (SGL)	Observation		

Radionuclides

Man-made? Cs-137 present in several of the SGL scans reported in GJ-HAN-108 *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-103*, July 1998. No Co-60 or other commonly occurring radionuclides present at tank foundation depth.	Yes	No	NA
Multiple?	Yes	No	NA

Distribution

Peak at bottom of tank? **RPP-ENV-37956 Rev. 1:** Spectral gamma data for several drywells (10-03-01, 10-03-05, 10-03-07, 10-02-03, and 10-03-11) around tank A-103 show surface contamination, and have detected small amounts of Cs-137 (about 0.1 pCi/g) at 80 ft bgs and below, which is thought to be associated with drag down of contamination when the drywells were extended (RPP-35484 page 2-11). Spectral gamma logging of the tank laterals was conducted in March, 2005 and also shows only small amounts of Cs137 (less than 10 pCi/g) beneath the tank (RPP-RPT-27605 pages B-4 thru B-9). The spectral gamma loggings do not shown any evidence of waste loss from tank A-103. The interstitial liquid in tank A-103 was sampled in April, 1986. The results for Cs-137 were an average of 3.97E+05 uCi/ml (SD-WM-TI-198). If tank A-103 had leaked 5,500 gallons, then about 8,260 Ci of Cs-137 (as of April 1986) would have leaked to the soil. The spectral gamma loggings do not show any evidence of waste loss from the tank. Radiation from such a high level of Cs-137 should have been detectable in the laterals or drywells. **GJ-HAN-108 *Vadose Zone Characterization Project at the Hanford Tank Farms Tank Summary Data Report for Tank A-103*, July 1998:** The characterization of the gamma-ray-emitting contamination in the vadose zone surrounding tank A-103 was completed using the SGLS. Data were obtained using the SGLS and the geologic and historical information available from other sources. The data indicate that a plume of Cs-137 contamination is present from about 75 to 80 ft beneath tank A-103. The source of this contamination is not certain. The source of the contamination could be a number of tanks in the vicinity of tank A-103, including tank A-103 itself. Surface spills have also occurred near the tank, and leaks from a shallow subsurface pipeline near the tank are a possibility.	actual data	No or NA
Peak near surface? Spectral gamma data for drywells show surface contamination believed to result from spills and nearby transfer line leaks.	actual data	No or NA
Increased activity in between?	actual data	No or NA
Increased activity below tank? Spectral gamma data show increased soil contamination in some drywells at ~ 80 ft bgs and deeper.	actual data	No or NA

Activity across boreholes

Multiple boreholes? No consistent pattern indicative of a tank leak.	Yes	No	NA

Activity over time

Increased activity? No consistent trend indicative of an active leak from the tank.	Yes	No	NA

HISTORICAL GROSS GAMMA LOGS (GGL)	Observations	

Distribution

Sign. peak at bottom of tank? No peaks present at base of tank.	actual data	No or NA
Sign. peak near surface? Soil contamination extending from the surface to ~ 20 ft bgs indicative of surface spills and underground transfer line leaks.	actual data	No or NA
Sign. increased activity in between? No.	actual data	No or NA
Sign. increased activity below tank? Activity detected at ~ 80 ft. bgs; tank base is ~ 55 ft. bgs.	actual data	No or NA

Activity across boreholes

Multiple boreholes? Low or not soil contamination detected at depths where leaks typically present, including tank base.	Yes	No	NA
Consistent across boreholes? Soil contamination across boreholes is consistently low to non-existent.	Yes	No	NA

Activity over time

Abrupt increase (bottom)? No detectable trend in soil contamination levels during the 1975 - 1992 timeframe.	Yes	No	NA
Abrupt increase (elsewhere)?	Yes	No	NA
Gradual increase (bottom)?	Yes	No	NA
Gradual increase (elsewhere)?	Yes	No	NA

CORROBORATING EVIDENCE	Corroborates SGL or GGL Data Given		
Moisture Probe	Leak	Alt Hypoth.	NA

Psychrometrics			
Evaporation may have been a contributing cause to the 3.5 in surface level drop betweeen October, 1981 and March, 1987 reported in Environmental Protection Deviation Report 87-02. The tank was originally connected to the 702-A ventilation system, and was reported to have been disconnected in the early 1980's according to RPP-ENV-37956 Rev. 1. Even after active ventilation was stopped, the tank could have breathed passively. Several 1990's studies measured passive breathing in SSTs. RPP-5660 Rev. 0 *Collection and Analysis of Selected Tank Head Space Parameter Data indicates a passive breathing rate of 10cfm* Table 4-1).	Leak	Alt. Hypoth.	NA

Bore hole core sample	Leak	Alt. Hypoth.	NA

Laterals			
Tank A-103 was monitored for leaks with three horizontal laterals that run beneath the base of the tank. The laterals radiate outward from a 12-ft-diameter vertical caisson that is about 69 ft deep. The laterals were installed after waste leakage from tank 241-SX-113 was suspected in 1958 and confirmed in 1962. They were backfit to the 241-A Tank Farm tanks by augering horizontally from a location about 3 ft above the bottom of the caisson. Each augered hole was lined with a 4-in.-diameter, schedule-40 steel pipe. Nine laterals were augered outward from each of the two 241-A Tank Farm caissons in fan-like patterns, resulting in three laterals grouped beneath each tank. The laterals are located about 66 ft below the ground surface, which is about 11 ft below the bases of the tanks. The laterals extend outward from the caissons and beneath the tank to a location outside the outer edge of the tanks. Monitoring access to the laterals was provided through 3-in.-diameter tubing. The tubing extends from the ground surface, down the caisson, through a 90-degree Long-radius bend, and to the end of the horizontal 4-in.-diameter steel pipe. A cross section view of the lateral construction would show the lateral is essentially an L-shaped monitoring well. The horizontal portion of the L is the lateral section beneath the tank while the vertical portion of the L is within the caisson. In the horizontal section, the lateral is double encased where the 3-in.-diameter tubing is contained within the 4-in. diameter steel pipe. Probes can be inserted into each lateral to monitor for gamma radiation that could indicate waste leakage from a tank or pipeline. **RPP-RPT-27605 Rev. 0**: Lateral gamma scans completed during CY2005 and those completed in July, 1977 are compared in the document. The comparison shows that the lateral readings have remained stable. The gamma peaks at ~ 65-ft from the face of the lateral are readings through the laterals' caisson wall at about the distance where the lateral changes from vertical to horizontal. It is possible that the probe is reading the leak plume from nearby tank A-105 at this point, because the readings then decrease as the probe moves closer to tank A-103 and further away from tank A-106. Directly beneath tank A-103 there is almost no evidence of gamma radiation. The tank A-104 laterals shown a similar pattern to tank A-103.	Leak	Alt. Hypoth.	NA

Weather conditions

Barometric pressure	Leak	Alt. Hypoth.	NA
Precipitation	Leak	Alt. Hypoth.	NA
Temperature	Leak	Alt. Hypoth.	NA

Surface flooding Occurrence Report 78-24 reports a 60,000 gal water leak that occurred between tanks A-102 and A-105. The OR also references an early leak reported in OR 77-91; OR 77-91 was not electronically retrievable. Raw data from the gross gamma scans are available at \\hanford\data\Sitedata\HLANPlan\Geophysical_Logs\index.html for the nearest Tank A-103 drywells to the leak site - 10-03-10 and 10-03-11. However charts do not exist. The SGL scans show no evidence that the water line leak(s) had an impact on the soil contamination profiles.	Leak	Alt. Hypoth.	NA
Process history	Leak	Alt. Hypoth.	NA
Drywell drilling logs Drywell drilling logs were reviewed in RPP-ENV-37956 Rev. 1 *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Waste Releases.*	Leak	Alt. Hypoth.	NA
Occurrence Reports	Leak	Alt. Hypoth.	NA
Surface spills RPP-ENV-37956 Rev. 1 *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Waste Releases* discusses surface spills and transfer line leaks that may have affected the soild contamination profiles of the Tank A-103 drywells.	Leak	Alt. Hypoth.	NA
Transfer line leaks RPP-ENV-37956 Rev. 1 *Hanford A and AX-Farm Leak Assessments Report: 241-A-103, 241-A-104, 241-A-105, 241-AX-102, 241-AX-104 and Unplanned Waste Releases* discusses surface spills and transfer line leaks that may have affected the soild contamination profiles of the Tank A-103 drywells.	Leak	Alt. Hypoth.	NA
Construction history	Leak	Alt. Hypoth.	NA
Tank Features **RPP-ENV-37956 Rev. 1:** Tank A-103 was vented to an underground vessel ventilation header that connected to 241-AX tank farm and later to the 241-AY tank farm. The purpose of this ventilation header was to remove offgas and water vapor from these tanks, which were often operated with the wastes at boiling conditions. The 241-A and 241 AX tanks were isolated from this ventilation header in the early 1980's. The design of this ventilation header included a baffled, 20-inch diameter pipe inside each 241-A tank. The design of this ventilation header included a baffled, 20-inch diameter pipe inside each 241-A tank. The 20-inch diameter pipe connected to a 24-inch diameter, stainless steel pipe header that is buried a minimum of 4-ft below grade. The 24-inch header ran between the tanks to the 241-A-431 ventilation building. Dresser couplings provide a compression seal on the outer surface of vapor header piping segments that are ~25-ft in length. Dresser couplings were also used to seal the 20-inch diameter pipe from each tank to the 24-inch main vapor header. The couplings provided for expansion and contraction of the vapor header pipe segments.	Leak	Alt. Hypoth.	NA
Equipment maintenance calibration	Leak	Alt. Hypoth.	NA

Waste characteristics	Leak	Alt. Hypoth.	NA
In-tank operations	Leak	Alt. Hypoth.	NA
Other (specify)	Leak	Alt. Hypoth.	NA
Other (specify)	Leak	Alt. Hypoth.	NA

TABLE A-3. ELICITATION FORMS

Expert Opinion: Expert Opinion: D. A. Barnes

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: 5/28/2009

Elicitation from: DA Barnes

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State L	NL	Liklihood Ratio L:NL
p(L)	p(NL)	Ω_0
0.50	0.50	1.00

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.10	0.90	0.11

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (If no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.50	0.50	1.00

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	$p(SLM \mid LOW,L)$ (if no LOW, enter NA)	$p(SLM \mid LOW,NL)$	$L(SLM \mid LOW)$
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	$p(LOW \mid SLM,L)$ (if no SLM, enter NA)	$p(LOW \mid SLM,NL)$	$L(LOW \mid SLM)$
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

Gross Gamma Drywell Logs	$p(GGL \mid L)$ (if no GGL, enter NA here and in Parts 8 and 9)	$p(GGL \mid NL)$	$L(GGL)$
	0.20	0.80	0.25

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

Spectral Gamma Drywell Logs	$p(SGL \mid L)$ (if no SGL, enter NA here and in Parts 8 and 9)	$p(SGL \mid NL)$	$L(SGL)$
	0.20	0.80	0.25

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	$p(GGL \mid SGL,L)$	$p(GGL \mid SGL,NL)$	$L(GGL \mid SGL)$
	0.50	0.50	1.00

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	0.50	0.50	1.00

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM)	L(LOW)	L(SLM|LOW)	L(LOW|SLM)
0.11	1.00	1.00	1.00

L(GGL)	L(SGL)	L(GGL|SGL)	L(SGL|GGL)
0.25	0.25	1.00	1.00

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio		L(SLM,LOW)
		0.11

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	
GGL & SGL; SGL most important? (Mark Part 9 NA)	X

Ex-Tank Liklihood Ratio		L(SGL,GGL)
		0.25

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(LSGL)

Combined Likelihood Ratio for Leak Hypothesis		L(in,ex)
		0.03

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	p(NL|in,ex)	Ω_1
0.03	0.97	0.03

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. Ω_1= L(in,ex) x Ω_0
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)

Expert Opinion: J. W. Ficklin

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: 5/28/2009

Elicitation from: JW Ficklin

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State L	True State NL	Liklihood Ratio L:NL
p(L)	p(NL)	Ω_0
0.50	0.50	1.00

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.20	0.80	0.25

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.50	0.50	1.00

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

<table>
<tr><th>Surface Level Measurement - Liquid Observation Well Interdependence</th><th>p(SLM|LOW,L)
(if no LOW, enter NA)</th><th>p(SLM|LOW,NL)</th><th>L(SLM|LOW)</th></tr>
<tr><td></td><td>0.50</td><td>0.50</td><td>1.00</td></tr>
</table>

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

<table>
<tr><th>Liquid Observation Well - Surface Level Measurement Interdependence</th><th>p(LOW|SLM,L)
(if no SLM, enter NA)</th><th>p(LOW|SLM,NL)</th><th>L(LOW|SLM)</th></tr>
<tr><td></td><td>NA</td><td>NA</td><td>1.00</td></tr>
</table>

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

<table>
<tr><th>Gross Gamma Drywell Logs</th><th>p(GGL|L)
(if no GGL, enter NA here and in Parts 8 and 9)</th><th>p(GGL|NL)</th><th>L(GGL)</th></tr>
<tr><td></td><td>0.20</td><td>0.80</td><td>0.25</td></tr>
</table>

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

<table>
<tr><th>Spectral Gamma Drywell Logs</th><th>p(SGL|L)
(if no SGL, enter NA here and in Parts 8 and 9)</th><th>p(SGL|NL)</th><th>L(SGL)</th></tr>
<tr><td></td><td>0.20</td><td>0.80</td><td>0.25</td></tr>
</table>

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

<table>
<tr><th>Gross Gamma Log - Spectral Gamma Log Interdependence</th><th>p(GGL|SGL,L)</th><th>p(GGL|SGL,NL)</th><th>L(GGL|SGL)</th></tr>
<tr><td></td><td>0.20</td><td>0.80</td><td>0.25</td></tr>
</table>

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	0.20	0.80	0.25

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM)	L(LOW)	L(SLM|LOW)	L(LOW|SLM)
0.25	1.00	1.00	1.00

L(GGL)	L(SGL)	L(GGL|SGL)	L(SGL|GGL)
0.25	0.25	0.25	0.25

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio		L(SLM,LOW)
		0.25

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	X
GGL & SGL; SGL most important? (Mark Part 9 NA)	

Ex-Tank Liklihood Ratio		L(SGL,GGL)
		0.06

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(LSGL)

Combined Likelihood Ratio for Leak Hypothesis		L(in,ex)
		0.02

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	p(NL|in,ex)	Ω_1
0.02	0.98	0.02

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. Ω_1= L(in,ex) x Ω_0
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)

Expert Opinion: J. G. Field

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: 5/28/2009

Elicitation from: JG Field

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State L	True State NL	Liklihood Ratio L:NL
p(L)	p(NL)	Ω_0
0.55	0.45	1.22

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.25	0.75	0.33

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.45	0.55	0.82

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	p(SLM|LOW,L) (if no LOW, enter NA)	p(SLM|LOW,NL)	L(SLM|LOW)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	p(LOW|SLM,L) (if no SLM, enter NA)	p(LOW|SLM,NL)	L(LOW|SLM)
	NA	NA	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

Gross Gamma Drywell Logs	p(GGL|L) (if no GGL, enter NA here and in Parts 8 and 9)	p(GGL|NL)	L(GGL)
	0.10	0.90	0.11

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

Spectral Gamma Drywell Logs	p(SGL|L) (if no SGL, enter NA here and in Parts 8 and 9)	p(SGL|NL)	L(SGL)
	0.10	0.90	0.11

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	p(GGL|SGL,L)	p(GGL|SGL,NL)	L(GGL|SGL)
	0.10	0.90	0.11

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	NA	NA	1.00

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM)	L(LOW)	L(SLM|LOW)	L(LOW|SLM)
0.33	0.82	1.00	1.00

L(GGL)	L(SGL)	L(GGL|SGL)	L(SGL|GGL)
0.11	0.11	0.11	1.00

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio	L(SLM,LOW)
	0.33

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	X
GGL & SGL; SGL most important? (Mark Part 9 NA)	

Ex-Tank Liklihood Ratio	L(SGL,GGL)
	0.11

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(LSGL)

Combined Likelihood Ratio for Leak Hypothesis	L(in,ex)
	0.04

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	p(NL|in,ex)	Ω_1
0.04	0.96	0.05

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. $\Omega_1 = L(in,ex) \times \Omega_0$
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)

Expert Opinion: J. W. Ficklin

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: May 28, 2009

Elicitation from: JW Ficklin

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State L	True State NL	Liklihood Ratio L:NL
p(L)	p(NL)	Ω_0
0.50	0.50	1.00

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.20	0.80	0.25

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.50	0.50	1.00

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	p(SLM|LOW,L) (if no LOW, enter NA)	p(SLM|LOW,NL)	L(SLM|LOW)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	p(LOW|SLM,L) (if no SLM, enter NA)	p(LOW|SLM,NL)	L(LOW|SLM)
	NA	NA	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

Gross Gamma Drywell Logs	p(GGL|L) (if no GGL, enter NA here and in Parts 8 and 9)	p(GGL|NL)	L(GGL)
	0.20	0.80	0.25

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

Spectral Gamma Drywell Logs	p(SGL|L) (if no SGL, enter NA here and in Parts 8 and 9)	p(SGL|NL)	L(SGL)
	0.20	0.80	0.25

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	p(GGL|SGL,L)	p(GGL|SGL,NL)	L(GGL|SGL)
	0.20	0.80	0.25

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	$p(SGL \mid GGL,L)$	$p(SGL \mid GGL,NL)$	$L(SGL \mid GGL)$
	0.20	0.80	0.25

Considering that ex-tank data sources may be interdependent:

$p(SGL|GGL,L)$ = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

$p(SGL|GGL,NL)$ = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. $p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)$

$L(SGL|GGL) = p(SGL|GGL,L) / p(SGL|GGL,NL)$. If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then $L(SGL|GGL) = 1$.

Combined Liklihood Ratios

$L(SLM)$	$L(LOW)$	$L(SLM \mid LOW)$	$L(LOW \mid SLM)$
0.25	1.00	1.00	1.00

$L(GGL)$	$L(SGL)$	$L(GGL \mid SGL)$	$L(SGL \mid GGL)$
0.25	0.25	0.25	0.25

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio		$L(SLM,LOW)$
		0.25

If SLM and no LOW: $L(SLM,LOW) = L(SLM)$
if LOW and no SLM: $L(SLM,LOW) = L(LOW)$
If SLM and LOW and SLM most important: $L(SLM,LOW) = L(LOW|SLM) \times L(SLM)$
If SLM and LOW and LOW most important: $L(SLM,LOW) = L(SLM|LOW) \times L(LOW)$

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	X
GGL & SGL; SGL most important? (Mark Part 9 NA)	

Ex-Tank Liklihood Ratio		$L(SGL,GGL)$
		0.06

If GGL and no SGL: $L(SGL,GGL) = L(GGL)$
if SGL and no GGL: $L(SGL,GGL) = L(SGL)$
If GGL and SGL and GGL most important: $L(SGL, GGL) = L(SGL|GGL) \times L(GGL)$
If GGL and SGL and SGL most important: $L(SGL, GGL) = L(GGL|SGL) \times L(LSGL)$

Combined Likelihood Ratio for Leak Hypothesis		$L(in,ex)$
		0.02

$L(in,ex) = L(SLM,LOW) \times L(SGL,GGL)$

Posterior Probability for Leak Hypothesis

$p(L \mid in,ex)$	$p(NL \mid in,ex)$	Ω_1
0.02	0.98	0.02

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. $\Omega_1 = L(in,ex) \times \Omega_0$
$p(L|in,ex)$ = posterior probability (post-leak assessment) that the tank is a leaker. $(L|in,ex) = \Omega_1/(\Omega_1+1)$
$p(NL|in,ex)$ = posterior probability (post-leak assessment) that the tank is a leaker. $p(NL|in,ex) = 1 - p(L|in,ex)$

Expert Opinion: M. A. Fish

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: May 28, 2009

Elicitation from: MA Fish

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State: L	True State: NL	Liklihood Ratio: L:NL
p(L)	p(NL)	Ω_0
0.50	0.50	1.00

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.10	0.90	0.11

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.50	0.50	1.00

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	p(SLM|LOW,L) (if no LOW, enter NA)	p(SLM|LOW,NL)	L(SLM|LOW)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	p(LOW|SLM,L) (if no SLM, enter NA)	p(LOW|SLM,NL)	L(LOW|SLM)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

Gross Gamma Drywell Logs	p(GGL|L) (if no GGL, enter NA here and in Parts 8 and 9)	p(GGL|NL)	L(GGL)
	0.10	0.90	0.11

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

Spectral Gamma Drywell Logs	p(SGL|L) (if no SGL, enter NA here and in Parts 8 and 9)	p(SGL|NL)	L(SGL)
	0.10	0.90	0.11

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	p(GGL|SGL,L)	p(GGL|SGL,NL)	L(GGL|SGL)
	NA	NA	1.00

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	0.50	0.50	1.00

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM)	L(LOW)	L(SLM|LOW)	L(LOW|SLM)
0.11	1.00	1.00	1.00

L(GGL)	L(SGL)	L(GGL|SGL)	L(SGL|GGL)
0.11	0.11	1.00	1.00

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio	L(SLM,LOW)
	0.11

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	X
GGL & SGL; SGL most important? (Mark Part 9 NA)	

Ex-Tank Liklihood Ratio	L(SGL,GGL)
	0.11

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(SGL)

Combined Likelihood Ratio for Leak Hypothesis	L(in,ex)
	0.01

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	p(NL|in,ex)	Ω_1
0.01	0.99	0.01

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. Ω_1= L(in,ex) x Ω_0
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)

Expert Opinion: B. N. Hedel

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: May 28, 2009

Elicitation from: BN Hedel

Eliciation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State: L	True State: NL	Likelihood Ratio L:NL
p(L)	p(NL)	Ω_0
0.50	0.50	1.00

p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored.

p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L)

Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

Surface Level Measurement	p(SLM|L) (if no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)
	0.20	0.80	0.25

Considering the surface level measurement data reviewed for the leak assessment:

p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker.

p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L)

L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1

If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.

In-Tank Data Liquid Observation Well - Part 3

Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)
	0.50	0.50	1.00

Considering the interstitial liquid level data reviewed for the leak assessment:

p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker.

p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L)

L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	p(SLM|LOW,L) (if no LOW, enter NA)	p(SLM|LOW,NL)	L(SLM|LOW)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	p(LOW|SLM,L) (if no SLM, enter NA)	p(LOW|SLM,NL)	L(LOW|SLM)
	NA	NA	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell Logs - Part 6

Gross Gamma Drywell Logs	p(GGL|L) (if no GGL, enter NA here and in Parts 8 and 9)	p(GGL|NL)	L(GGL)
	0.10	0.90	0.11

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell Logs - Part 7

Spectral Gamma Drywell Logs	p(SGL|L) (if no SGL, enter NA here and in Parts 8 and 9)	p(SGL|NL)	L(SGL)
	0.10	0.90	0.11

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma Log - Spectral Gamma Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	p(GGL|SGL,L)	p(GGL|SGL,NL)	L(GGL|SGL)
	NA	NA	1.00

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	0.40	0.60	0.67

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM)	L(LOW)	L(SLM|LOW)	L(LOW|SLM)
0.25	1.00	1.00	1.00

L(GGL)	L(SGL)	L(GGL|SGL)	L(SGL|GGL)
0.11	0.11	1.00	0.67

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	X
SLM & LOW; LOW most important? (Mark Part 5 NA)	

In-Tank Liklihood Ratio	L(SLM,LOW)
	0.25

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	
GGL & SGL; SGL most important? (Mark Part 9 NA)	X

Ex-Tank Liklihood Ratio	L(SGL,GGL)
	0.11

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(LSGL)

Combined Likelihood Ratio for Leak Hypothesis	L(in,ex)
	0.03

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	p(NL|in,ex)	Ω_1
0.03	0.97	0.03

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. Ω_1= L(in,ex) x Ω_0
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)

Expert Opinion: D. J. Washenfelder

Tank A-103 Leak Assessment Expert Elicitation Form 2009-03-12
(From HNF-3747, Rev. 0)

Elicitation Date: May 28, 2009

Elicitation from: DJ Washenfelder

Elicitation by: Leak Assessment Team

Hypotheses:

Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by a leak.

Non-Leaker: The decreases in tank 241-A-103 surface level observed during the 1977 - 1988 time period were caused by waste properties, most likely a combination of evaporation, gas release events, and a highly irregular waste surface.

Prior Probability - Part 1

True State L	True State NL	Likelihood Ratio L:NL	Comments	Definitions
p(L)	p(NL)	Ω_0	Tank A-103 has a high-heat process history for the period between 1955 and the late 1970's when it was converted to a bottoms receiver tank for the 242-A Evaporator/Crystallizer. SSTs with a high temperature history are more likely to leak than other SSTs.	p(L) = "prior" probability that an assumed sound tank has leaked given only two pieces of information: it is a single-shell tank, and it is either a high-heat tank or not. Any specific data on past surface level drops or ex-tank radioactivity measurements are ignored. p(NL) = "prior" probability that an assumed sound tank has not leaked given the same data. p(NL) = 1- p(L) Ω_0 = "prior" odds in favor of the leak hypothesis. Ω_0 = p(L)/p(NL)
0.60	0.40	1.50		

Conditional Probabilities

In-Tank Data Surface Level Measurement - Part 2

				Comments	Definitions
Surface Level Measurement	p(SLM|L) (If no SLM, enter NA here and in Parts 4 and 5)	p(SLM|NL)	L(SLM)	Several evaluations extending from the late 1970's to April, 1987 concluded that the changes in surface level resulted from the properties of the tank waste, including floating crust; rough, irregular crust beneath the surface level monitor; retained gas and gas release events; salt encrustations on the FIC; and slow evaporation. Wrok in the 1990's estimated the tank A-103 passive breathing rate at 10 cfm. All of these phenomena probably contributed to the observed surface level measurement change. There is a small possibility that a leak was camoflaged by these dynamics as well.	Considering the surface level measurement data reviewed for the leak assessment: p(SLM|L) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a leaker. p(SLM|NL) = ["posterior"] probability that the surface level measurement data would be observed, if the tank is a non - leaker. p(SLM|NL) = 1 - p(SLM|L) L(SLM) = p(SLM|L)/p(SLM|NL). If surface level data are not available for the leak assessment, then L(SLM) = 1 If there are several essentially redundant surface level measurements (e.g., ENRAF, FIC, MT), the probabilities should be assessed only for the more diagnostic and reliable one.
	0.20	0.80	0.25		

In-Tank Data Liquid Observation Well - Part 3

				Comments	Definitions
Liquid Observation Well	p(LOW|L) (if no LOW, enter NA here and in Parts 4 and 5)	p(LOW|NL)	L(LOW)	LOW data are available from 1985 to present tend to track the surface level. The early LOW data are suspect because the first LOW van's scans were frequently elevation shifted.	Considering the interstitial liquid level data reviewed for the leak assessment: p(LOW|L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is a leaker. p(LOW|NL)) = ["posterior"] probability that the LOW interstitial liquid level data would be observed, if the tank is not a leaker. p(LOW|NL) = 1 - p(LOW|L) L(LOW) = p(LOW|L)/p(LOW|NL). If LOW intersititial liquid level data are not available for the leak assessment, then L(LOW) = 1
	0.50	0.50	1.00		

Surface Level Measurement - Liquid Observation Well Interdependence - Part 4

Surface Level Measurement - Liquid Observation Well Interdependence	p(SLM|LOW,L) (if no LOW, enter NA)	p(SLM|LOW,NL)	L(SLM|LOW)
	NA	NA	1.00

Considering that in-tank data sources may be interdependent:

p(SLM|LOW,L) = ["posterior"] probability that the surface level measurement data would be observed if the LOW interstitial liquid level data are observed, and if the tank is a leaker.

p(SLM|LOW,NL) = ["posterior"] probability that a surface level measurement data would be observed if the LOW interstitial liquid level measurement data are observed, and if the tank is a non-leaker. p(SLM|LOW,NL) = 1 - p(SLM|LOW,L)

L(SLM|LOW) = p(SLM|LOW,L)/p(SLM|LOW,NL) . If either surface level measurement data or LOW intersititial liquid level data are not available for the leak assessment, then L(SLM|LOW) = 1.

If there is no LOW, skip to the next part.

Liquid Observation Well - Surface Level Measurement Interdependence - Part 5

Liquid Observation Well - Surface Level Measurement Interdependence	p(LOW|SLM,L) (if no SLM, enter NA)	p(LOW|SLM,NL)	L(LOW|SLM)
	0.50	0.50	1.00

Considering that in-tank data sources may be interdependent:

p(LOW|SLM,L) = ["posterior"] probability that the LOW interstitial liquid level data would be observed if a surface level measurement decrease is observed, and if the tank is a leaker.

p(LOW|SLM,NL) = ["posterior"] probability that a LOW interstitial liquid level measurement decrease would be observed if a surface level measurement decrease is observed, and if the tank is a non-leaker. p(LOW|SLM,NL) = 1 - pp(LOW|SLM,L)

L(LOW|SLM) = p(LOW|SLM,L)/p(LOW|SLM,NL) . If either surface level data or LOW intersititial liquid level data are not available for the leak assessment, then L(LOW|SLM) = 1.

Ex-Tank Data - Gross Gamma Drywell and Lateral Logs - Part 6

Gross Gamma Drywell Logs	p(GGL|L) (if no GGL, enter NA here and in Parts 8 and 9)	p(GGL|NL)	L(GGL)
	0.20	0.80	0.25

There is no evidence of leakage in the drywells or laterals for the period during the surface level changes. There are a large number of drywells surrounding the tank. The likelihood of at least one of the drywells beside the tank or one of the laterals beneath the tank intercepting a leak is expected to be high.

Considering the historical gross gamma drywell logs reviewed for the leak assessment:

p(GGL|L) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a leaker.

p(GGL|NL) = ["posterior"] probability that the gross gamma logs would be observed, if the tank is a non - leaker. p(GGL|NL) = 1 - p(GGL|L)

L(GGL) = p(GGL|L)/p(GGL|NL). If gross gamma logs are not available for the leak assessment, then L(GGL) = 1

Ex-Tank Data - Spectral Gamma Drywell and Lateral Logs - Part 7

Spectral Gamma Drywell Logs	p(SGL|L) (if no SGL, enter NA here and in Parts 8 and 9)	p(SGL|NL)	L(SGL)
	0.20	0.80	0.25

SGL and spectral gamma logs of the drywells and laterals are consistent, and do not match the patterns found for leaking SSTs such as tank A-104.

Considering the spectral gamma drywell logs reviewed for the leak assessment:

p(SGL|L) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a leaker.

p(SGL|NL) = ["posterior"] probability that the spectral gamma drywell logs would be observed, if the tank is a non - leaker. p(SGL|NL) = 1 - p(SGL|L)

L(GGL) = p(SGL|L)/p(SGL|NL). If spectral gamma drywell logs are not available for the leak assessment, then L(SGL) = 1.

Gross Gamma and Lateral Log - Spectral Gamma and Lateral Log Interdependence - Part 8

Gross Gamma Log - Spectral Gamma Log Interdependence	p(GGL|SGL,L)	p(GGL|SGL,NL)	L(GGL|SGL)
	NA	NA	1.00

Considering that ex-tank data sources may be interdependent:

p(GGL|SGL,L) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are are observed, and if the tank is a leaker.

p(GGL|SGL,NL) = ["posterior"] probability that the gross gamma logs would be observed if the spectral gamma logs are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(GGL|SGL,L)

L(GGL|SGL) = p(GGL|SGL,L)/p(GGL|SGL,NL). If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(GGL|SGL) = 1.

Spectral Gamma Log - Gross Gamma Log Interdependence - Part 9

Spectral Gamma Log - Gross Gamma Log Interdependence	p(SGL|GGL,L)	p(SGL|GGL,NL)	L(SGL|GGL)
	0.20	0.80	0.25

Considering that ex-tank data sources may be interdependent:

p(SGL|GGL,L) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are observed, and if the tank is a leaker.

p(SGL|GGL,NL) = ["posterior"] probability that the spectral gamma logs would be observed if the gross gamma logs are are observed, and if the tank is a non-leaker. p(GGL|SGL,NL) = 1 - p(SGL|GGL,L)

L(SGL|GGL) = p(SGL|GGL,L) /p(SGL|GGL,NL) . If either gross gamma logs or spectral gamma logs are not available for the leak assessment, then L(SGL|GGL) = 1.

Combined Liklihood Ratios

L(SLM) 0.25	**L(LOW)** 1.00	**L(SLM|LOW)** 1.00	**L(LOW|SLM)** 1.00
L(GGL) 0.25	**L(SGL)** 0.25	**L(GGL|SGL)** 1.00	**L(SGL|GGL)** 0.25

Which In-Tank Condition Applies? (Mark X in Box)

SLM & No LOW?	
LOW & No SLM?	
SLM & LOW; SLM most important? (Mark Part 4 NA)	x
SLM & LOW; LOW most important? (Mark Part 6 NA)	

In-Tank Liklihood Ratio		**L(SLM,LOW)**
		0.25

If SLM and no LOW: L(SLM,LOW) = L(SLM)
if LOW and no SLM: L(SLM,LOW) = L(LOW)
If SLM and LOW and SLM most important: L(SLM,LOW) = L(LOW|SLM) x L(SLM)
If SLM and LOW and LOW most important: L(SLM,LOW) = L(SLM|LOW) x L(LOW)

Which Ex-Tank Condition Applies? (Mark X in Box)

GGL & No SGL?	
SGL & No GGL?	
GGL & SGL; GGL most important? (Mark Part 8 NA)	x
GGL & SGL; SGL most important? (Mark Part 9 NA)	

Ex-Tank Liklihood Ratio		**L(SGL,GGL)**
		0.06

If GGL and no SGL: L(SGL,GGL) = L(GGL)
if SGL and no GGL: L(SGL,GGL) = L(SGL)
If GGL and SGL and GGL most important: L(SGL, GGL) = L(SGL|GGL) x L(GGL)
If GGL and SGL and SGL most important: L(SGL, GGL) = L(GGL|SGL) x L(LSGL)

Combined Likelihood Ratio for Leak Hypothesis		**L(in,ex)**
		0.02

L(in,ex) = L(SLM,LOW) x L(SGL,GGL)

Posterior Probability for Leak Hypothesis

p(L|in,ex)	**p(NL|in,ex)**	**Ω_1**
0.02	0.98	0.02

Three members of the five member 1987 leak assessment panel reviewed the tank's surface level behavior history and concluded that the tank was sound. The other two members were not convinced that the tank was not leaking. In accordance with the decision rules in place at the time the leak assessment panel had to have 95% assurance that the tank was sound, or else had to reclassify it as an assumed leaker. It was reclassified. Reviewing the same surface level behavior history, combined with the added understanding of retained gas and gas release events that was developed during the SY-101 mitigation effort, there is about 98% assurance that tank A-103 is sound. That is not very different from the $\geq$ 95% assurance the three 1987 panel members concluded.

Ω_1 = posterior (post-leak assessment) odds in favor of leak hypothesis. Ω_1= L(in,ex) x Ω_0
p(L|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. (L|in,ex) = $\Omega_1/(\Omega_1+1)$
p(NL|in,ex) = posterior probability (post-leak assessment) that the tank is a leaker. p(NL|in,ex) = 1- p(L|in,ex)