RPP-RPT-54913, Rev. 0

Hanford Single-Shell Tank Leak Causes and Locations - 241-B Farm

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Abstract: This document identifies 241-B Tank Farm (B Farm) leak cause and locations for the 100 series leaking tank (241-B-107) identified in RPP-RPT-49089, Hanford B-Farm Leak Inventory Assessments Report. This document satisfies the B Farm portion of the target (T04) in the Hanford Federal Facility Agreement and Consent Order milestone M-045-91F.

EXECUTIVE SUMMARY

This document identifies 241-B Tank Farm (B Farm) leak causes and locations for the 100-series leaking tank(s) in B Farm. The leak causes and locations report for all of the 100-series single-shell leaking tanks is one of the targets, M-045-91-T04 (T04), in the Hanford Federal Facility Agreement and Consent Order milestone M-045-91F. The T04 target requires that the DOE provide to State of Washington, Department of Ecology (Ecology) a report on the 100-series single-shell tanks which have been or will be identified as having leaked in RPP-32681, Rev. 0 (Rev. 1), *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning*, leak assessment reports.

The leak assessment report for B Farm, RPP-RPT-49089, *Hanford B-Farm Leak Inventory Assessments Report*, identified one 100-series leaking tank in B Farm, 241-B-107 (B-107). All of the other eleven 100-series tanks in B Farm are classified as “sound” or are identified in RPP-RPT-49089 as requiring re-assessment of their classification per TFC-ENG-CHEM-D-42, *Tank Leak Assessment Process*. The TFC-ENG-CHEM-D-42 assessments are not part of the M-045-91-T04 target.

This B Farm leak causes and locations document is part of a series of tank farm reports that identify leak causes and locations for 100-series leaking tanks. A summary and conclusions document will be issued, RPP-RPT-54909, *Hanford Single-Shell Tank Leak Causes and Locations – Summary*, that compiles the results from all of the leak causes and locations tank farm reports when they have been issued which will fulfill the T04 target requirements.

The identification of tank B-107 leak location(s) focused on the vertical indication of a sidewall leak from liquid level decreases and the subsequent radial direction indicated by radiation detected in one of the drywells. The sidewall liner leak is estimated to have occurred at or below the 186.4-in liquid level based on liquid level decreases. The drywell indicated the leak was close to the base of the tank as the radiation was detected near this below grade level. The liner leak may have penetrated the waterproof membrane at or below the 186.4-in liquid level and followed concrete cracks or construction joints to exit at a different location including the top of the tank footing.

There were several liner leak cause conditions that were examined but the most likely cause of the tank B-107 leak was chemistry-corrosion as there appears to be very little contribution from other potential leak parameters including: tank design, construction temperatures, and thermal conditions.

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Abbreviations and Acronyms

221-U	TBP Plant
221-B	B Plant
241-B Farm	B Farm
241-T Farm	T Farm
ARHCO	Atlantic Richfield Hanford Company
ASTM	American Society for Testing and Materials
BGS	below grade surface
$BiPO_4$	bismuth phosphate
BPF	Blueprint File
B & PVC	Boiler & Pressure Vessel Code
c/m, cpm	counts per minute
c/s, cps	counts per second
Ecology	State of Washington, Department of Ecology
GM	Geiger-Mueller probe
GMP	gamma probe
ITS	in tank solidification
LL	liquid level
MT	manual tape
NaI	sodium-iodide
NO_2^-	nitrite
NO_3^-	nitrate
OH^-	hydroxide
ORP	Office of River Protection
PCSACS	PC Surveillance Analysis Computer System
QI	Questionable Integrity
PUREX	Plutonium Uranium Extraction Plant
REDOX	Reduction Oxidation Plant
SCC	stress corrosion cracking
SGLS	Spectral Gamma Logging System
SP	scintillation probe
SSP	shielded scintillation probe
SST(s)	single-shell tank(s)
TWINS	Tank Waste Information Network System
UNH	uranyl nitrate hexahydrate
WRPS	Washington River Protection Solutions, LLC

Units

Ci	curie
°F	degrees Fahrenheit
ft	feet
gal	gallon
K	1000
kgal	kilogallon (10^3 gallons)

in	inches
L	liter
lb	pound
M	moles per liter
pCi	picocurie (10^{-12} curies)
pCi/g	picocurie per gram
yr	year

Waste Type Abbreviations

1C	first cycle decontamination waste
2C	second cycle decontamination waste
224	Lanthanum fluoride decontamination waste
5-6	high-level B Plant waste
BL	B Plant Low Level Waste
BNW	Laboratory waste from Pacific Northwest Laboratory
CPLX	complexed waste
CW	coating waste
CWP	PUREX Coating Waste
DW	decontamination waste
EB	Evaporator Bottoms
Evap	Evaporator Feed (post-1976)
FP	fission products waste
HLO	Laboratory waste from 300 Area
HLW	high-level waste
IX	Ion Exchange waste
LW	222-S Laboratory waste
MW	Metal waste
NCPLX	noncomplexed waste
OWW	PUREX organic wash waste
P	PUREX HLW
R	REDOX HLW
R-EB	REDOX evaporator bottoms
RIX	REDOX ion exchange loading waste
TBP	Tri-butyl phosphate waste

1.0 INTRODUCTION

The Hanford Federal Facility Agreement and Consent Order target M-045-91F-T04 indicated that part of the RPP- 32681, *Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning,* reporting would include leak causes and locations reports for all of the 100-series single-shell leaking tanks. This document is part of a series of documents that identifies leak causes and locations of 100-series single-shell leaking tanks that have been identified in the individual RPP-32681 tank farm leak assessments. An overall leak causes and locations summary and conclusions document will be prepared along with background and common tank farm information when all of the 100-series single-shell leaking tanks have been addressed (RPP-RPT-54909, *Hanford Single-Shell Tank Leak Causes and Locations ‑ Summary and Conclusion*, To be issued). The information from RPP-RPT-54909 will be incorporated into the summary conclusions report on leak integrity for the Hanford Federal Facility Agreement and Consent Order milestone M-045-91F.

The 241-B Tank Farm (B Farm) tank with a leak loss is addressed in this document. The B Farm assessment in RPP-RPT-49089 (*Hanford B-Farm Leak Inventory Assessments Report*) reported a leak loss for the 241-B-107 (B-107) tank and recommended that tanks B-101, B-103, B-105, B-110, B-111, and B-112 be further assessed using TFC-ENG-CHEM-D-42 (*Tank Leak Assessment Process*). The sound tank B-106 was also recommended to be assessed using TFC-ENG-CHEM-D-42 to investigate sources of activity near the tank.

The identification of B Farm tank leak location focused on the vertical indication of a sidewall leak from liquid level decreases and the subsequent radial direction indicated by radiation detected in one of the drywells. The drywell indicated the leak was closer to the base of the tank as the radiation was detected near the base. Leak detection laterals were not installed underneath the B Farm tanks.

The B Farm tank B-107 leak was most likely due to chemistry-corrosion (see Section 4.4.1). There appears to be very little contribution from tank design, construction temperatures, and thermal conditions.

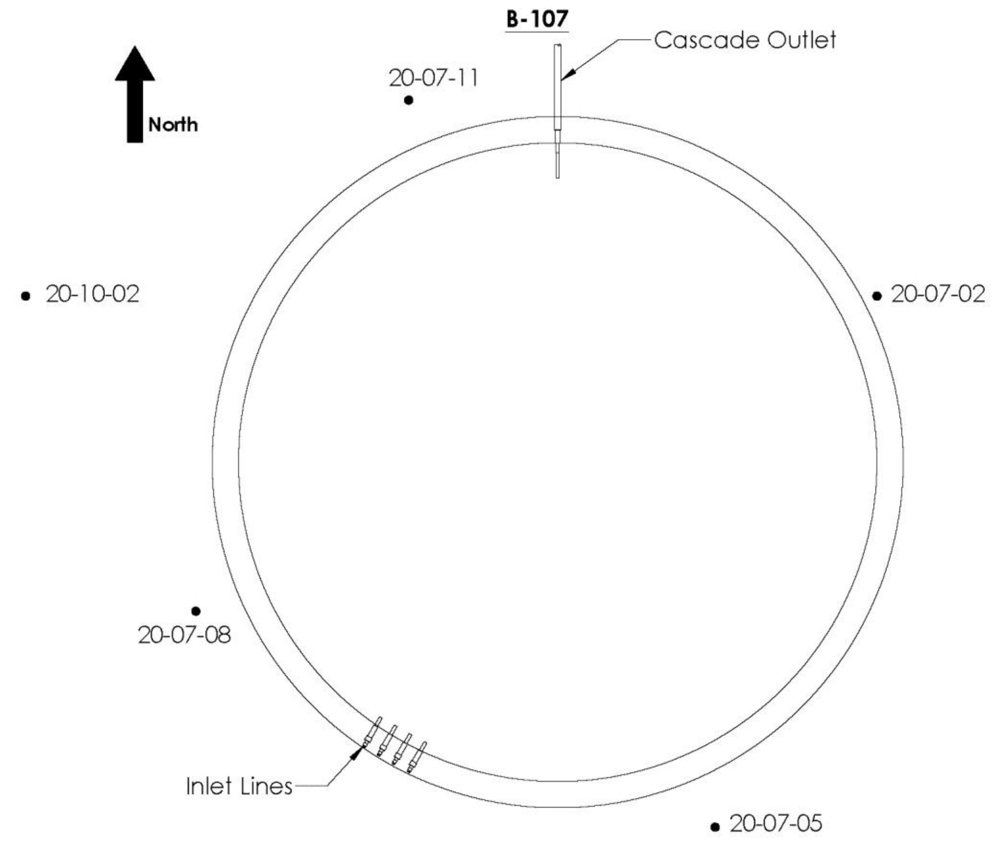
Two meetings were held to review status of tank B-107 with the Office of River Protection (ORP) and the State of Washington, Department of Ecology (Ecology) personnel. A review on February 5, 2013, covered the preliminary information that had been generated on the location of the tank B-107 leak and supporting data. Comments were received and responses incorporated into the draft (see Appendix A). A second meeting on February 19, 2013, provided a review of the full draft B Farm leak locations and causes document along with a comparison of the available information on the other B Farm tanks. Comments were received, responses developed, and additions/revisions were made to the document (see Appendix A).

2.0 B FARM BACKGROUND

The B Farm is located in the northwest portion of the 200 East Area and includes twelve, type II, 530,000 gal 100-series single-shell underground waste storage tanks. The B Farm tanks were constructed during 1943 and 1944 and were designed for non-boiling waste with a maximum fluid temperature of 220°F (WHC-MR-0132, *A History of the 200 Area Tank Farms*). A typical 100-series B Farm tank contains 10 to 12 risers ranging in size from 4-in to 42-in in diameter that provide grade-level access to the underground tank. Normally, there is one riser in the center of the tank dome and four or five each on opposite sides of the dome. The tanks are arranged in four rows of three tanks forming a cascade. The cascade overflow height is ~15.9-ft from the tank knuckle bottom and 2.0-ft below the top of the steel liner.

Figure 2-1 shows a simplified schematic of the B Farm tank B-107 with location of the drywells, cascade line, and spare inlet nozzles.

Figure 2-1. B Farm Tank B-107 and Associated Drywells
Tank inner ring is steel liner, outer ring is outer edge of tank footing



Drywell	Distance to Footing (ft)*	Date Installed
20-07-02	~1.7	Aug-1973
20-07-05	~6.1	Apr-1970
20-07-08	~5.4	Apr-1970
20-10-02	~24.9	Aug-1973
20-07-11	~5.4	Apr-1970

*Assumes perfect vertical alignment

Reference:
H-2-73278 Rev. 7
GJ-HAN-128

T.J. Barnes
1/23/2013

Note: Tank B-107 is located in the south side of the farm (see Figure 3-2)

Tank B-107 contained a mixture of 221-B Plant first cycle (1C) and coating waste (CW), Tri-butyl phosphate waste (TBP) waste from the 221-U Plant, and Plutonium Uranium Extraction Plant (PUREX) coating waste CWP in that order (see Table 2-1).

Table 2-1. Leaking B Farm Tanks with Waste Type

Tank	Waste Type
B-107	1C/CW, TBP, CWP

Waste types are listed in the List of Terms

The following sections describe some of the important common tank features and conditions that could affect tank leak causes and locations. This is followed by the tank B-107 analysis of the possible leak location(s) and causes and a comparison of leaking and non-leaking tanks in the conclusion section. The B Farm tank segment contains excerpts from RPP-RPT-49089.

3.0 B FARM COMMONALITIES

3.1 TANK DESIGN/CONSTRUCTION

3.1.1 Tank Design

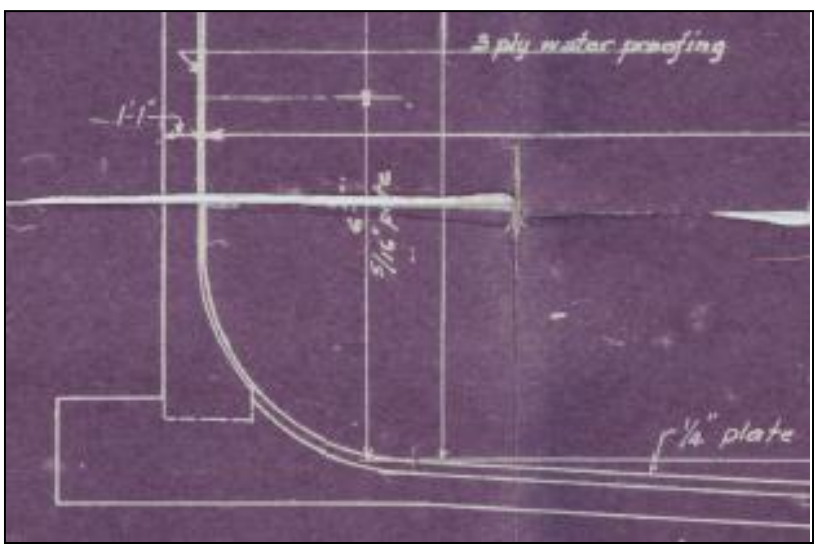
The B Farm single-shell tanks (SSTs) are constructed of 1-ft thick reinforced concrete with a 0.25-in mild carbon steel liner (ASTM A7-39) on the bottom and sides with knuckle plates at 0.3125-in and a 1.25-ft thick domed concrete top. The tanks have a dished bottom with a 4-ft radius knuckle (WHC-SD-WM-ER-310, *Supporting Document for the Historical Tank Content Estimate for B-Tank Farm*).

The tanks are set on a reinforced concrete foundation. A three-ply cotton fabric waterproofing was applied over the foundation and up the sidewalls. Four coats of primer paint were sprayed on all exposed interior tank surfaces. Tank ceiling domes were covered with three applications of magnesium zincfluorosilicate wash. Lead flashing was used to protect the joint where the steel liner meets the concrete dome. Asbestos gaskets were used to seal the access holes in the tank dome. Each tank was covered with ~7-ft of overburden.

The tanks have four process spare inlet nozzles located ~16.5-ft from the tank knuckle bottom, ~0.6-ft above the cascade overflow line and 1.4-ft below the top of the steel liner. The steel bottom of the B Farm tanks intersects the sidewall on a 4-ft radius (BPF-73550, Drawings D-2 and D-3, *Specification for Construction of Composite Storage Tanks (B, C, T, and U Tank Farms)*).

Figure 3-1 shows the detail of the knuckle liner to the grout and three-ply asphaltic waterproof membranes between the bottom, sidewall intersection, and sidewalls (BPF-73550, Sheet B5).

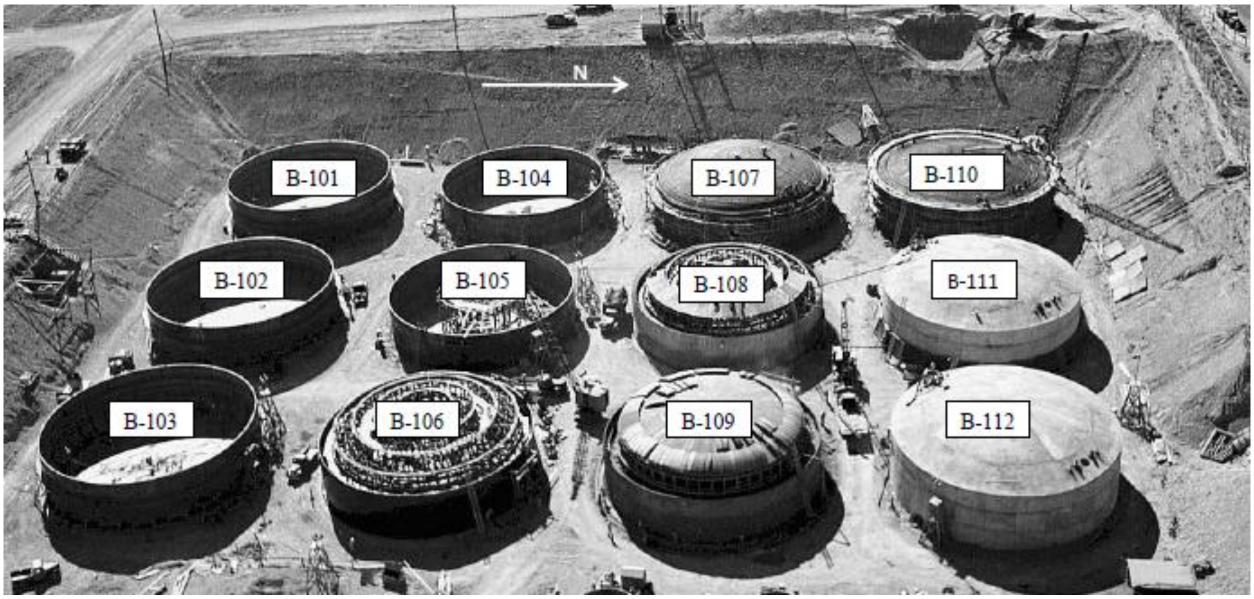
Figure 3-1. B C T U Tank Farm Knuckle Configuration with Three-Ply Waterproofing (BPF-73550, Sheet B5)



3.1.2 Tank Construction Conditions

The B Farm construction temperatures were examined to determine if the tank liner fabrication occurred at or below the ductile-to-brittle temperature transition (see Section 4.3.2). The photograph in Figure 3-2 shows the B Farm under construction on September 25, 1944.

Figure 3-2. B Farm Construction Photograph, September 25, 1944 (P6145 N1600681)



The metallurgical factors that limited carbon steel's ability to resist impact at low temperature were perhaps not well understood when B Farm was constructed and were not specified for the 0.25-in thick ASTM A7-39, *American Society for Testing and Materials, Standard Specifications for Steel for Bridges and Buildings*, mild carbon steel liner at the time. Current standards for construction of pressure vessels, ASME Boiler & Pressure Vessel Code (B&PVC), Section VIII, *Rules for Construction of Pressure Vessels*, provide requirements for vessels constructed of carbon and low alloy steels with respect to minimum design metal temperatures. That standard does not identify ASTM A7-39, as a material type but it does identify ASTM A283, *Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates*. Early versions of ASTM A283 were similar to ASTM A7-39 because they identified the same chemical composition requirements as ASTM A7-39, and ASTM A283 steel plate and ASTM A7-39 steel plate had the same required tensile strength range, minimum yield point, and bending properties. Current B&PVC Section VIII requirements specify, for ASTM A283 material of nominal thickness ≤10-mm (0.394-in), a minimum design metal temperature of 18°F. For the purposes of this report, it will be assumed that the 18°F design temperature is applicable to the fabrication of ASTM A7-39 carbon steel.

Boxes from the list of Vendor Information Reports for the B Farm were searched for any Chemical and Physical Test Reports for the tank steel plates used in the farm but none were found. No other construction information for B Farm was found during the search.

A review of toughness and the ductile-to-brittle transition temperature for carbon steels (designated as "impact transition temperature") in Mark's Standard Handbook for Mechanical Engineers, Tenth Edition, indicates that carbon content can have a significant effect. Decreased carbon content not only raises the propagation energy needed for crack growth but also lowers the temperature for transition from ductile-to-brittle behavior (reference Fig 6.2.11 in Marks), suggesting that the ASME B31T-2010 Code low temperature service limit may be lower than what could be expected for steel of the vintage used in B Farm construction. The concentrations of carbon and trace impurities and their effect on this property are not specifically known, and low temperature impact resistance could only be determined reliably by impact testing of actual tank specimens.

Below the transition temperature, the metal loses its ability to absorb forces such as induced loads, or the impact of falling objects without fracturing. In this circumstance it is possible for micro-fissures or hairline cracks to be created. Later, when the metal is subjected to high stress, it might be possible for the cracks to propagate through the metal, or possibly subject the weakened areas to increased corrosion.

Any low temperatures experienced during construction at or less than the 18°F allowable temperature where impact loading (e.g. a dropped tool or piece of equipment from scaffolding) had the potential for creating micro-fissures may have triggered fissures in the steel liner (see Section 4.3.2).

Design, fabrication, and erection of the tank steel lining were required to be in accordance with current "Standards Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs" as promulgated by the "American Water Works Association" (BPF 73550). Welding and inspection requirements were to conform to the American Welding Society's "Code for Arc and Gas Welding in Building Construction", Section 4.

The possible variability of liner steel from either different runs from the same supplier, or because of multiple suppliers could affect the resistance to low temperatures.

3.2 IN-TANK DATA FOR LEAKING B FARM TANKS

The general information in this section is further developed and applied to the leaking tank in Sections 4.4 for tank B-107 to understand implications of the conditions that could affect liner leaks and identify possible liner leak locations.

3.2.1 Liquid Level

The following is an excerpt from RPP-ENV-39658 (*Hanford SX-Farm Leak Assessments Report*):

> "Originally liquid levels were measured using pneumatic dip tubes (HW-10475-C, *Hanford Technical Manual Section C*, page 908). This practice was later replaced and a manual tape with a conductivity electrode was used to detect the liquid surface (H-2-2257, *Conductor Reel for Liquid Level Measurement*). The biggest limitations of the manual tape measurements were failures of the electrodes, solids forming on the

> electrode and measurement precision. The statistical accuracy of the manual tape and electrode measurement technique was 0.75 in. (~2,060 gal), as determined in July 1955 (HW-51026, *Leak Detection – Underground Storage Tanks*, page 4). Later, liquid-level determinations were automated in many of the SSTs to provide more accurate and reliable measurements".

It was stated in RPP-RPT-43704 (*Hanford BY-Farm Leak Assessments Report*) that the accuracy for the manual tape can vary from 0.25-in to 2-in for different tanks depending on surface conditions (liquid/solids), boiling conditions, air lift circulator (ALC) operation, and conductivity.

The in-tank repeatability limits for Food Industry Corporation (FIC) liquid level gauges are ± 0.25-in (Letter 72730-80-097, "Review of Classification of Six Hanford Single-Shell "Questionable Integrity (QI)" Tanks").

Transfer discrepancies of greater than 1.5-in (4,125 gal) measured at the first hour and every two hours thereafter with an FIC, manual tape, or flowmeter required an orderly and immediate shutdown, investigation, and notification. The 1.5-in. discrepancy requirement is a specification limit in ARH-1601, Section D, *Specifications and Standards for the Operation of Radioactive Waste Tank Farms and Associated Facilities.*

Liquid level measured by manual tape (MT) is calculated for B, C, T, and U Farm tanks with the formula: volume = (MT Reading X 2750 gal/in) + 12,500 gal (LET-082172, H.N. Raymond to C.J. Francis, August 21, 1972, *Maximum Operating Levels and Cascade Levels in 200-West area Tank Farms*). Even though the letter title indicates only west area, the above formula for the B, C, T, and U Farm tanks is found on the last page of the letter. The formula was confirmed to have been used as late as 1980 in RHO-CD-896, page 76, for the then current tank T-111 volume (488,000 gallons) and MT reading (173 inches) which verified use of the formula. All half yearly and quarterly report ending volumes in this document were calculated with this formula. Original MT readings and the MT readings in PCSACS are all measured from the lower knuckle of the above tanks which is 12-in above the bottom inside center of the tanks. The ENRAF liquid level readings in PCSACS have been converted to read from the bottom inside center of the tank. Therefore, for the same reported liquid level the ENRAF reading is 12-in greater than the MT reading.

3.2.2 Temperature

The B Farm tank specifications, 1943, indicated the temperature of the liquid contents would be (up to) 220°F (HW-1946, *Specifications for Composite Storage Tanks – Buildings #241 at Hanford Engineering Works*). However, B Farm tanks did not store self-boiling waste.

The 1969 operating limitations found for B Farm are addressed in ARH-951, *Limitations for Use of Underground Waste Tanks*. The ARH-951 document indicated that tank temperatures for B Farm should be held below 230°F with a 5°F per day rise for liquid temperatures below 180°F and a 3°F per day rise for liquid temperatures above 180°F during waste addition to the tank.

The condensers on the B, C, T, and U Farm tanks were reported to be adequate for the waste temperatures and vapor loads for the original operations at approximately 180°F for supernatant and sludge (WHC-MR-0132, *A History of the 200 Area Tank Farms*). However, tanks B-107 through B-112 were not equipped with condensers as the waste to be stored in these tanks was not projected to have enough heat to need a condenser.

3.2.3 Liner Observations

A bulge in a tank liner may result in the direct failure of the liner or cause enough stress or thinning on the steel liner plates and welds that they become more susceptible to the effects of corrosion. Experience indicates that bulging tends to be a dynamic phenomenon, and it is possible that a tank with no measured bulge at one point in time may actually have had a displaced liner that was not detected at another time.

The low waste temperatures projected in B Farm and the favorable tank design were parameters that should not have caused tank liner bulging. No reports indicating liner bulging were found for any of the B Farm tanks.

3.2.4 Chemistry

The types of corrosion that may occur in the Hanford Site SSTs include uniform corrosion, stress corrosion cracking (SCC), pitting, crevice, and liquid-air interface corrosion which were identified in HNF-3018, *Single-Shell Tank Sluicing History and Failure Frequency*.

Uniform corrosion rates for SSTs are reported to be generally less than 1 mil/year (HNF-3018) for the SSTs. Carbon steel exposed to alkaline solutions has a low general corrosion rate (PNL-5488, *Prediction Equations for Corrosion Rates of A-537 and A-516 Steels in Double Shell Flurry*). However, the presence of the nitrate ion may induce various forms of localized attack (i.e., SCC, pitting, etc.).

Nitrate Ion-Induced Stress Corrosion Cracking

Stress corrosion cracking is the growth of cracks in a corrosive environment. It can lead to unexpected sudden failure of normally ductile metals subjected to a tensile stress, especially at elevated temperatures. Stress corrosion cracking is highly chemically specific in that certain alloys are likely to undergo SCC only when exposed to a small number of chemical environments. The chemical environment that causes SCC for a given alloy is often one which is only mildly corrosive to the metal otherwise.

Nitrate ion-induced SCC is the predominant threat to the integrity of the steel liners in the SSTs and DSTs at the Hanford Site and many investigations have been performed to establish the parameters under which the tanks can be protected from this threat. This work, together with the efforts of many others, led to the adoption of the waste chemistry control limits for SCC prevention in 1983 (OSD-T-151-00017, *Operating Specifications for the Aging Waste Operations in Tank Farms 241-AY and 241-AZ*).

The factors governing the rates of nitrate ion-induced SCC cracking by Hanford Site DST wastes were recently reviewed (RPP-RPT-47337, *Specifications for the Minimization of the Stress Corrosion Cracking Threat in Double-Shell Tank Wastes*). In brief, the test results led to the conclusion that the rates of nitrate ion-induced SCC depended on the properties of the steel, the applied potential versus the open circuit potential (OCP), the temperature and the concentrations of aggressive substances such as nitrate ion, and the potential inhibitors such as hydroxide and nitrite ion.

The technical work has shown that SCC is promoted by high temperatures, high nitrate ion concentrations, low hydroxide ion concentrations, low nitrite ion concentrations, and low nitrite ion/nitrate ion concentration ratios. Tanks with maximum temperatures less than 122°F would not be expected to experience significant SCC damage regardless of waste types (HNF-3018, Rev. 0). Tanks with the maximum temperatures above 122°F and a ratio of nitrate concentration to the sum of nitrite and hydroxide concentrations greater than 2.5 would be expected to suffer SCC-related damage (HNF-3018, Rev. 0). The concentration of nitrate and temperature are parameters that have the most effect on SCC. However, the pH (hydroxide) and nitrite can inhibit SCC. The current double-shell tank operating specifications for chemistry are reported in OSD-T-151-00007, Rev. 10, *Operating Specifications for the Double-Shell Storage Tanks*. While the chemistry specifications stated in this document were prepared for the DSTs, corrosion mechanisms and corrosion protection mechanisms applicable to DST primary tank metal liners they are equally applicable to the older SST metal liners.

Localized Corrosion: Crevice, Pitting, and Liquid-Air Interface Corrosion

Crevice corrosion can occur in regions where a small volume of solution cannot readily mix with the bulk solution such as under deposits, between metal flanges, and other confined areas. Once initiated, crevice corrosion proceeds by the same mechanism as pitting corrosion (RPP-RPT-33306, *IQRPE Integrity Assessment Report for the 242-A Evaporator Tank System*).

Pitting corrosion is the localized corrosion of a metal surface confined to a point or small area that takes the form of cavities. Pitting corrosion in dilute solutions ($NO_3^- < 1M$) of waste has been studied at the Savannah River Site (SRS). Pitting has been determined to not be a problem at hydroxide concentrations greater than 1M for any of the diluted waste solutions tested (WSRC-TR-90-512, *Effect of Temperature on the Nitrite Requirement to Inhibit Washed Sludge*, Oblath and Congdon 1987, *Inhibiting Localized Corrosion during Storage of Dilute Waste*). Nitrate ion was determined to be the usual controlling aggressive species when its concentrations ranged between 0.01M and 1M (WSRC-TR-90-512). The presence of hydroxide ion and nitrite ion has shown to inhibit pitting corrosion due to the aggressive nitrate ion. This work led to the conservative recommendation that the concentration of nitrite ion be greater than 0.033M for the avoidance of pitting in dilute solutions of nitrate ion at pH 10 and 40°C (104°F) (RPP-ASMT-53793, Rev. 0).

The chemical compositions required for prevention of pitting corrosion can also be applied as limits for prevention of liquid-air interface corrosion at the surface of the supernatant.

Crevice, pitting, and liquid-air interface corrosion are types of localized corrosion possible in the SSTs; however, historically SCC is the more predominant type of corrosion of concern.

Historical Corrosion Control

The earliest chemical specifications for SSTs addressing pH, nitrite, nitrate, and hydroxide are listed in Table 3-1 (ARH-1601, Section D, *Specifications and Standards for the Operation of Radioactive Waste Tank Farms and Associated Facilities, 1973*).

Table 3-1. ARH-1601 Specifications 1973

Waste Tank Farms and Associated Facilities Specifications	
Variable	**Specification**
pH	Minimum 8.0
NO_2^-	500 ppm
NO_3^-	< 6M
OH^-	< 7M

There was no similar specification found that addressed all of these parameters during the operation of B Farm prior to 1973. However, if the ARH-601 specifications were in effect during B Farm waste storage, the storage of undesirable concentrations of NO_2^-, NO_3^-, and OH^- would result in vulnerability to SCC and/or localized corrosion.

Historical waste sample data as well as temperatures are typically not available for the SSTs and none were recovered for tank B-107. Thus, the concentrations of NO_2^-, NO_3^-, and OH^- listed in Sections 4.4.4 are typical concentrations that were reported for the waste types listed that could be based on limited data and/or were values obtained from process flowsheets. Therefore, waste chemistry conditions are speculative when sample and temperature data is unavailable especially when multiple waste types are present in the tank.

3.2.5 Photographs

Available photographs of the B Farm tank B-107 were reviewed. Photographs were reviewed to identify beachlines possibly indicating previous operations of overfilling the tank, damaged equipment, possible liner bulges, and any other anomalies that could be indicative of a tank liner leak, and/or possible leak location. See Section 0 for details for tank B-107. The photographs do not indicate a liner bulge for tank B-107.

3.3 EX-TANK DATA FOR LEAKING B FARM TANKS

The general information in this section is further developed and applied to the leaking tank in Section 4.5 for tank B-107 to understand implications of the conditions that could affect liner leaks and identify possible liner leak locations.

3.3.1 Laterals

Leak detection laterals were installed approximately 10-ft underneath some of the tanks containing self-boiling waste in 241-A and 241-SX Farms. Lateral leak detection systems were not installed under the B Farm tanks. Each lateral is a 3-in pneumatic stainless steel tubing enclosed in 4-in carbon steel pipe. Probes were driven to the end of the lateral with compressed air then slowly withdrawn to gather a radiation profile below the bottom of the tank.

3.3.2 Drywells

Six original B Farm drywells were drilled around the tanks in 1944 (H-2-36933, *Well Information As-Built 200 E Area* and MACTEC-ERS *Spectral Gamma-Ray Borehole Log Data Reports*). The remainder of the B Farm drywells was drilled between 1970 and 1974 (H-2-36933). Drywells were drilled vertically from the surface and drywell coordinates and detailed drywell information (e.g., pipe dimensions and configuration) for tank B-107 are addressed in references sited in the individual tank segment. Drywells will not be useful to detect releases that enter the soil from the tank unless the volume released is sufficiently large to facilitate lateral transport to a drywell typically to within ~1-ft of the drywell. The vertical height of a tank liner leak may not be directly related to the point of detection in the drywell. This is especially true for small leaks that may flow downward some distance before encountering a drywell.

The "00" series drywells (drywell 20-00-01, B Farm) were installed shortly after tank construction, usually around the periphery of the farm and most extend to 150-ft below grade surface (BGS). Others with tank numbers embedded in the drywell number (20-<u>07</u>-02, tank B-107) were constructed later, sometimes after tank operations had ceased and generally to 100-ft BGS, with a few deeper than 100-ft BGS. The usual number of drywells surrounding a tank is one to four. If there are more, then there likely was some concern regarding a release which was being investigated. The second number corresponds to the clocked position of the drywell with respect to due north.

Four gamma ray probe types were used to monitor gamma in drywells to detect leaks (HNF-5433, *Analysis and Summary Report of Historical Dry Well Gamma Logs for the 241-B Tank Farm- 200 East*). The most widely used probe was the unshielded gross gamma sodium iodide (NaI) probe (or probe 04; the shielded NaI probe was referred to as probe 14). The NaI probe (04) is very sensitive and able to record gamma ray activity from 30 counts per second (cps) up to about 40,000 cps (15mR/hr) before the data becomes unreliable (RHO-RE-EV-4, *Supporting Information for the Scientific Basis for Establishing Dry Well Monitoring Frequencies*). The next most commonly used probe was the Red-GM (or probe 02) which is less sensitive but can reliably record gross gamma at much higher levels of activity (up to ~500R/hr). Operation of these and other probes are discussed in HNF-3136, *Analysis Techniques and Monitoring Results, 241-SX Drywell Surveillance Logs*. A scintillation probe (SP) was also used to measure low levels of radiation in the drywells. Leak location identification is primarily focused on the first indication of a leak and is therefore typically concerned with the lower levels of gross gamma detection and initial migration.

Drywell sections (see Section 4.5.1) contain gross gamma figures taken from HNF-5433 showing continuing or new contamination in the drywells based on BGS depth from 1975 to 1994. Some of these gross gamma figures show anomalous data that appear to be unexplained detections that do not reflect radioactivity in the soil. In 1999, a baseline characterization of the gamma-ray-emitting radionuclides distributed in the vadose zone sediments beneath and around B Farm was performed using spectral gamma logging (SGLS) and documented in GJO-HAN-28, *Vadose Zone Characterization Project at the Hanford Tank Farms B Tank Farm Report*. The gross gamma figure detection sensitivity is higher than SGLS (~10 pCi/g verus ~0.1 pCi/g equivalent Cs-137). Therefore, radioactivity $\leq$ 10 pCi/g does not appear on the gross gamma figures (GJO-HAN-28). The Co-60 isotope has a higher detection threshold with the gross gamma logging system; therefore, SGLS will detect Co-60 at much lower levels than what is detected by gross gamma logging. The SGLS logging can confirm Cs-137 and/or Co-60 radioactivity which can assist in the leak location analysis. The criteria for drywell monitoring are defined in RHO-ST-34 (*A Scientific Basis for Establishing Drywell-Monitoring Frequencies*) with the monitoring frequency found in SD-WM-TI-356 (*Waste Storage Tank Status and Leak Detection Criteria*).

All of the radiation readings in drywells are assumed to be maximum or peak readings unless otherwise noted and are from the Red-GM probe unless otherwise indicated. The individual tank B-107 segment provides detail on the available drywell data and the drywell summary section provides the analyses of the associated drywells with the tank.

3.4 LINER LEAK LOCATIONS

Drywell radioactivity when first detected can indicate a radial or depth location of a tank leak, migration of the tank leak, or the possible migration of an adjacent tank leak. The radial drywell radioactivity is also dependent on any possible flow paths from the actual tank liner leak location to the drywell itself as well as the waste viscosity and distance to the drywell. Drywells can also indicate the tank liner sidewall leak vertical location but the indication needs to be analyzed relative to non-tank liner leaks associated with pipe lines or other sources.

Liquid level decreases can be used for sidewall as well as bottom liner leaks but need to be analyzed in relationship with the vertical level of the tank drywell radioactivity, evaporation, and drywell contamination from pipe line leaks and other non-tank sources.

A liner leak may have penetrated the waterproof membrane at any location and followed concrete cracks or construction joints to a different location including the top of the tank footing. Therefore, the point of waste egress from the tank liner may not be the point of entry of the leaking waste to the soil. Later indications of radioactivity in the drywells with improved detector capabilities could indicate additional leakage but the location of the leak could not be pinpointed without some additional information.

The lack of radioactivity above background in a drywell indicates that if there was a liner leak it either occurred at another location, the leak flow was insufficient to reach the effective radius of the probes used in the drywell, or was not able to adequately detect the specific radioisotope with the gamma probe. When there is no radioactivity detected in a drywell or no recoverable data for a drywell it is not included as part of the leak location analysis.

3.5 POSSIBLE LINER LEAK CAUSE(S)

Analysis of the B Farm commonalities which centered on tank design/construction, in-tank data, and ex-tank data indicates chemistry-corrosion, is the most plausible cause of the failed liner. Waste chemistry was not controlled to the degree necessary to minimize corrosion when tank B-107 was suspected to have leaked. There appears to be very little contribution from tank design (no inherent flaws have been documented in the literature reviewed), construction temperatures, and waste thermal conditions. However, some or all of the factors can act serially or together to contribute to tank liner failure. The following sections provide a tank B-107 review of these conditions as they relate to liner leak causes.

Other general tank construction factors such as the quality of materials and fabrication could also contribute to tank liner failure. Because no evidence has been found to substantiate quality defects, these are not included as a leak cause.

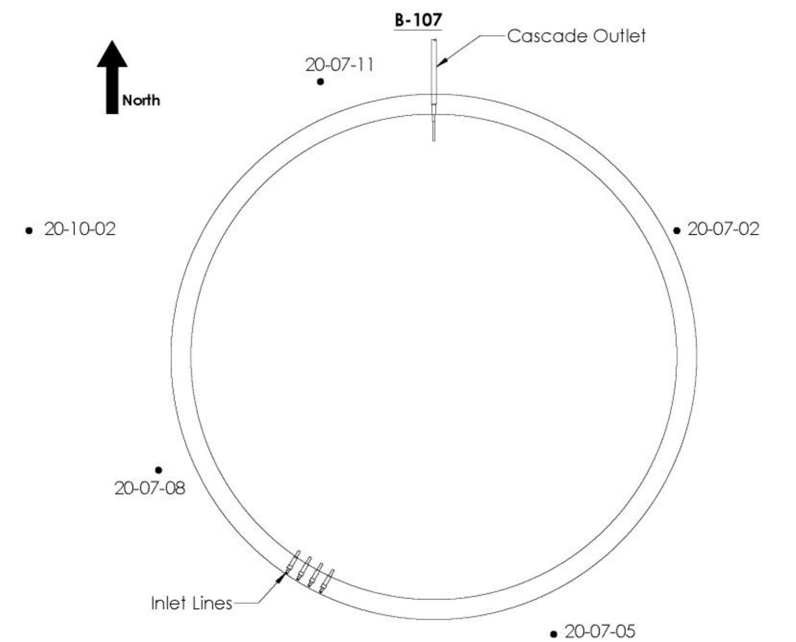
4.0 TANK B-107 SEGMENT

4.1 TANK B-107 BACKGROUND HISTORY

This section provides information on the historical waste loss event associated with single-shell tank (SST) 241-B-107 (B-107). There are five drywells located around tank B-107 with specified distances from the drywell to the tank footing shown in Figure 4-1: 20-07-05, 20-07-08, and 20-07-11 installed in April 1970 and 20-07-02 and 20-10-02 installed in August 1973.

The bottom of the tank footing is ~38-ft 3-in Below Grade Surface (BGS) with ~6.3-ft soil cover over the dome (WHC-SD-WM-TI-665, *Soil Load above Hanford Waste Storage Tanks*; BPF-73550).

Figure 4-1. Tank B-107 Associated Drywells
Tank inner ring is steel liner; outer ring is outer edge of tank footing



Drywell	Distance to Footing (ft)*	Date Installed
20-07-02	~1.7	Aug-1973
20-07-05	~6.1	Apr-1970
20-07-08	~5.4	Apr-1970
20-10-02	~24.9	Aug-1973
20-07-11	~5.4	Apr-1970

*Assumes perfect vertical alignment

Reference:
H-2-73278 Rev. 7
GJ-HAN-128

T.J. Barnes
1/23/2013

4.2 TANK B-107 OPERATIONS SUMMARY

Tank B-107 was constructed between February and November 1944 and irradiated nuclear fuel was first processed in 221-B Plant beginning on April 13, 1945 (HW-7-1649-DEL, page 18, *Hanford Engineer Works Monthly Report April 1945*). Tank B-107 started receiving first decontamination cycle (1C) waste combined with coating waste (CW) in May 1945 from 221-B Plant (HW-7-1793-DEL, page 22, *Hanford Engineer Works Monthly Report May 1945*). Tank B-107 was the first tank in the cascade series with tanks B-108 and B-109. By October 1945, tank B-107 was reported as being filled with 1C/CW waste overflowing to tank B-108 (HW-7-2706-DEL, page 21, *Hanford Engineer Works Monthly Report October 1945*). Tanks B-107, B-108, and B-109 continued to receive 1C/CW waste until April 24, 1946, when these tanks were reported as being filled (HW-7-4004-DEL, page 20, *Hanford Engineer Works Monthly Report April 1946*). Cascade lines remained open during this period. Prior to October 1945, the 1C/CW waste was adjusted to a pH of approximately 10 before transferring to the SSTs (HW-3-3220, page 13, *A Study of Decontamination Cycle Waste Solutions and Methods of Preparing Them for Disposal*). Beginning in November 1945, the 1C/CW waste at 221-T Plant was adjusted to approximately pH 7 prior to transferring to the SSTs to allow for precipitation of bismuth and plutonium so the supernatant would contain a lower concentration of plutonium (HW-7-2706-DEL, page 21). The 221-B Plant is assumed to have adopted the plan to adjust 1C/CW to pH 7 at the same time. As a result, tank B-107 contained low pH settled 1C/CW solids and 1C/CW supernatant (RPP-17702, *Origin of Waste in Single-Shell Tank 241-B-107*).

From April 1946 through December 13, 1951, no transfers were made into or out of tank B-107. Floating head suction pumps were installed in the SSTs that contained 1C/CW waste to allow supernatant to be transferred from these tanks (H-2-2076, *First Cycle Evaporation 241 B, C, BX, & BY Tank Pump Arrangement and Details*). Beginning on December 14, 1951, the 1C/CW supernatant was transferred out of tank B-107 to tank B-106 for processing in the 242-B Evaporator, leaving a heel of approximately 220 kgal of 1C/CW sludge in tank B-107.

The concentrated 1C/CW supernatant generated during this time was then stored in tanks B-105, B-107, and B-109. Tank B-107 started receiving this concentrated 1C/CW waste beginning in August 1952 (HW-27839, page 20 and page 32, *Waste Status Summary July 1952 Thru September 1952*). The cascade of tanks B-107, B-108, and B-109 were reported as being filled with concentrated 1C/CW supernatant and sludge as of December 4, 1952 (HW-27840, page 31, *Waste Status Summary Separations Section October, November, and December 1952*). From February 18, 1953 through June 1953, the concentrated 1C/CW waste in tank B-107 was processed through the 242-B Evaporator to gain further reduction of waste volume (HW-27842, page 9, *Waste Status Summary, Separations Section February 1953*, and HW-28712, page 4, *Waste Status Summary, Separations Section- Operations June 30, 1953*). The re-concentrated 1C/CW supernatant was then transferred to tanks B-107, B-108, and B-109, which were filled from February 1953 through August 1953 (HW-27842, page 9, and HW-29242, page 4, *Waste Status Summary Separations Section August 31, 1953*).

From January through June 1953, tank B-107 was reported to contain 220 kgal of 1C/CW sludge. However, after receiving re-concentrated 1C/CW supernatant, tank B-107 was reported to contain 172 kgal of 1C/CW sludge. From August 1953 through August 1954, the sludge volume was reported as 172 kgal (with 358 kgal of concentrated 1C/CW supernatant) in tank B-107. There is no reason provided in the waste transfer records for the apparent 48 kgal decrease in 1C/CW sludge volume. No waste transfers into or out of tank B-107 occurred from September 1953 through July 1954.

From January through November 1954, concentrated 1C/CW supernatant contained in tanks B-107, B-108, and B-109 were discharged to trenches (HW-33591, pages 11 and 12, *Summary of Liquid Radioactive Wastes Discharged to the Ground- 200 Areas July 1952 through June 1954*, and HW-38562, pages 10, 28, and 29, *Radioactive Contamination in Liquid Wastes Discharged to Ground at Separation Facilities through June 1955*). On August 31, 1954, approximately 320 kgal of concentrated 1C/CW supernatant was transferred from tank B-107 to the 241-BXR-3 (later renumbered to 216-B-37) trench. Disposal of 1C/CW supernatant to these trenches was based on the concept of retaining fission products, plutonium, and uranium in the soil column and was thought to be an economical method for providing additional capacity in the SSTs for storage of wastes with higher radioactivity (HW-34281, *1st Cycle Supernatant Ground Disposal*). After this transfer, tank B-107 was reported to contain approximately 225 kgal of 1C/CW sludge and no supernatant. The sludge volume in tank B-107 (225 kgal) was consistent with the sludge volume reported for the period preceding the addition of the concentrated 1C/CW supernatant to this tank. Therefore, it is surmised that the sludge volume reported in tank B-107 from August 1953 through August 1954 (172 kgal) was inaccurate.

Beginning on September 20, 1953, the tri-butyl phosphate (TBP) waste stored in SSTs was transferred into tank B-106 and processed through the 242-B Evaporator (HW-29624, page 2, *Waste Status Summary Separations September 30, 1953*) which continued to concentrate TBP waste until November 1954, after which the evaporator was shut down (HW-33962-DEL, page Ed-6, *Monthly Report Hanford Atomic Products Operation for November 1954*). The concentrated TBP supernatant generated in the 242-B Evaporator was stored in various tanks including tank B-107. Tank B-107 received 263 kgal of concentrated TBP supernatant from tank B-105 in October 1954 (HW-33544, page 4, *Waste Status Summary Separations Section October 31, 1954*). An additional 182 kgal of concentrated TBP supernatant was transferred in March 1955 from tank B-105 to tank B-107, with approximately 140 kgal of concentrated TBP supernatant cascading into tank B-108 (HW-36001, page 4, *Waste Status Summary Separations Section March 31, 1955*). As a result of these two transfers, tank B-107 was reported to contain 305 kgal of TBP supernatant and 225 kgal of 1C/CW sludge in March 1955 (HW-36001, page 4, *Waste Status Summary Separations Section March 31, 1955*). No transfers into or out of the tank were reported until September 1957.

In September 1957, approximately 264 kgal of TBP supernatant was transferred out of tank B-107 to tank C-101 (HW-52932, page 4, *Waste Status Summary Chemical Processing Department September 30, 1957*). By October 1957, tank B-107 was reported to contain 261 kgal of 1C/CW sludge and no supernatant (HW-53573, page 4, *Waste Status Summary Chemical Processing Department October 1957*). No additional waste transfers into or out of tank B-107 occurred until the third quarter of calendar year (CY) 1963.

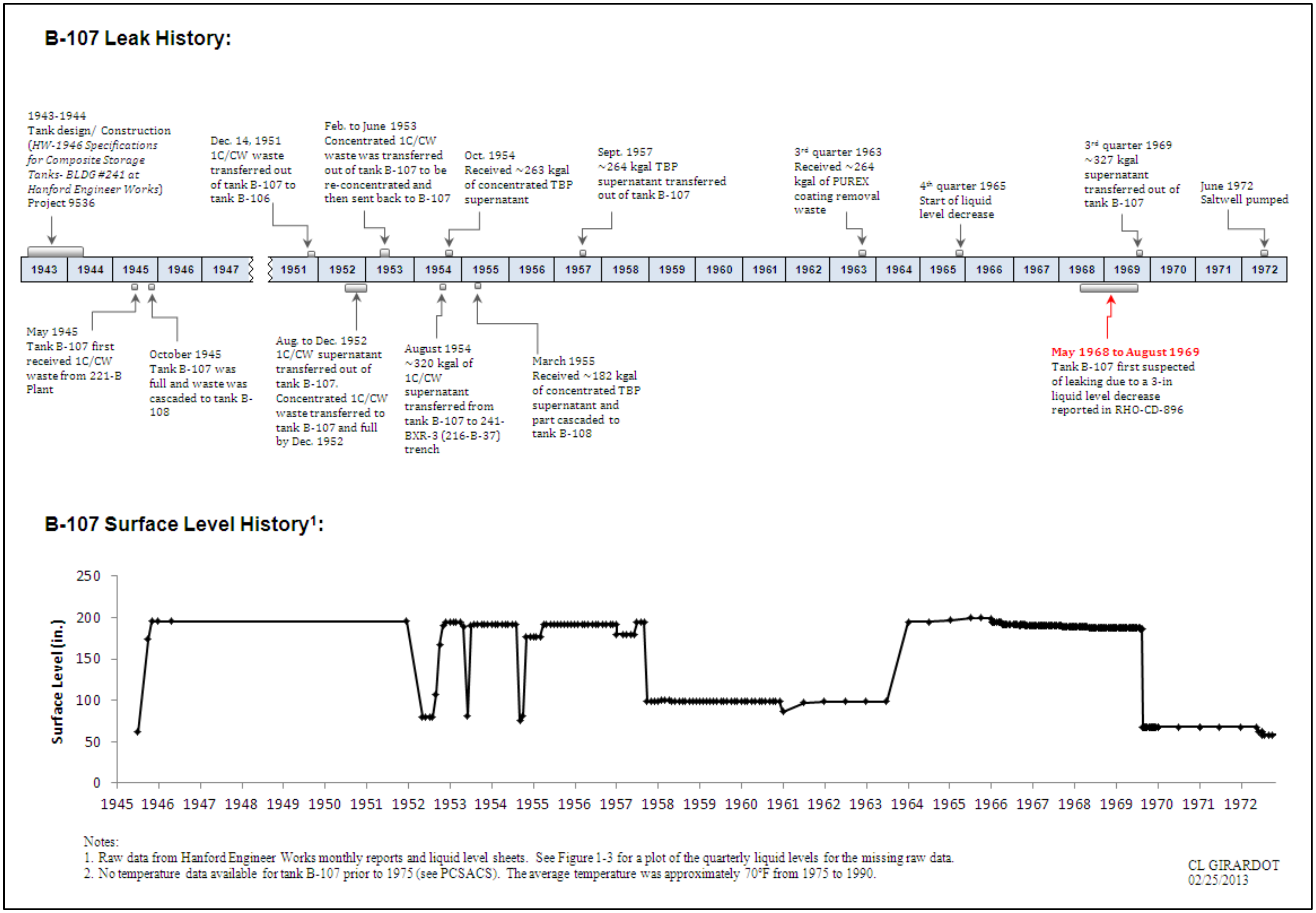
Beginning in the third quarter of CY 1963, approximately 264 kgal of PUREX coating removal waste (CW) were transferred into tank B-107 from tank C-102 (HW-80379, page 4, *Chemical Processing Department- Waste Status Summary, Planning and Scheduling Production Operation, July- December 1963*). No additional waste transfers into or out of tank B-107 occurred until the third quarter of CY 1969. However, the volume of supernatant and sludge present in tank B-107 were measured in the first quarter of 1965 and determined to be 347 kgal and 202 kgal, respectively, which was 14 kgal over the cascade outlet lines (RL-SEP-659, *Chemical Processing Department- Waste Status Summary, January 1, 1965 through June 30, 1965*). The decrease in sludge volume may have been due to dissolution of aluminum in the 1C/CW sludge, sludge settling, or correction of prior erroneous measurements.

In the third quarter of CY 1969, approximately 327 kgal of supernatant were transferred from tank B-107 to tank B-103. No additional waste transfers occurred until June 1972, when saltwell pumping of this tank was initiated. Tank B-107 was first suspected of leaking in August 1969 after a 3-in liquid level decrease was observed between May 1968 and August 1969. The tank was classified as questionable integrity and was pumped to a minimum liquid level of 68-in and removed from service in August 1969. Tank B-107 was declared an assumed leaker in 1980 with a leak volume estimate of 8 kgal.

Tank B-107 was administratively declared interim stabilized on March 20, 1985 (HNF-SD-RE-TI-178, pages 33 and 34, *Single-Shell Tank Leak Stabilization Record*).

The operational history of tank B-107 leak related details including liquid level is charted in Figure 4-2.

Figure 4-2. Operational Leak History of Tank B-107

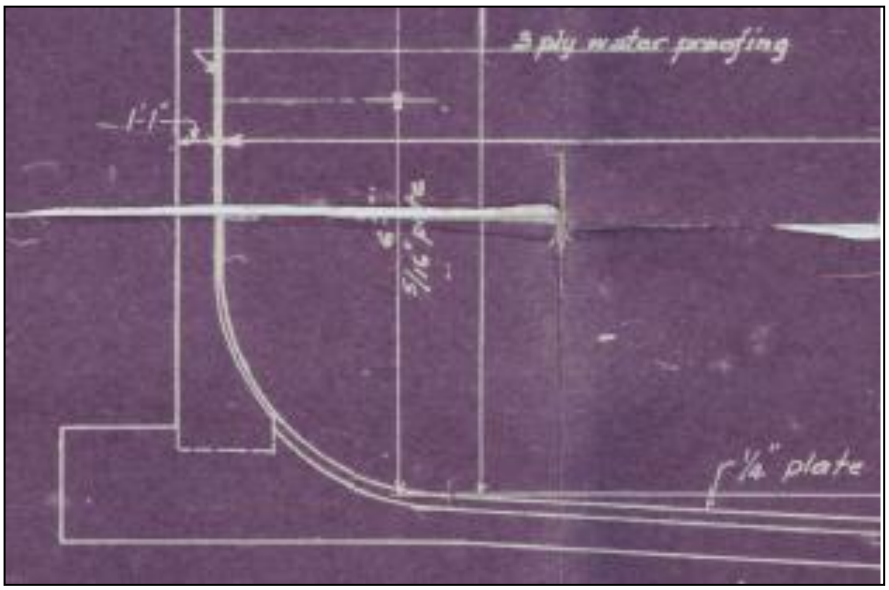


4.3 TANK DESIGN/CONSTRUCTION

4.3.1 Tank Design

The steel bottoms of the B Farm tanks intersect the sidewall on a 4-ft radius knuckle transition (BPF-73550, Drawings D-2 and D-3). Figure 4-3 shows the detail of the rounded knuckle transition, the three ply asphaltic membrane waterproofing between the liner and the concrete, a notched footing construction joint, and the concrete shell. These features are common to all B Farm tanks (see Section 3.1.1).

Figure 4-3. B C T U Tank Farm Knuckle Configuration with Three-Ply Waterproofing BPF-73550, Sheet B5



4.3.2 Tank Construction Conditions

Tank B-107 was constructed between February 1944 and November 1944. Section 3.1.2 indicates that from February 1944 through May 18, 1944 there were two minimum temperatures of 12°F with day time temperatures of 44°F and 57°F, one at 18°F, and four at 20°F with day time temperatures between 41°F and 56°F. Temperatures are not available for 1944 between the dates of May 18 and December 1. It is reasonable to assume based on historical data for these months that there may have been some minimum temperatures below 18°F.

As described in Section 3.1.2, cold weather affects the ductile-to-brittle steel transition temperature with 18°F being the assumed design temperature for the carbon steel liner, which could result in a fracture upon impact.

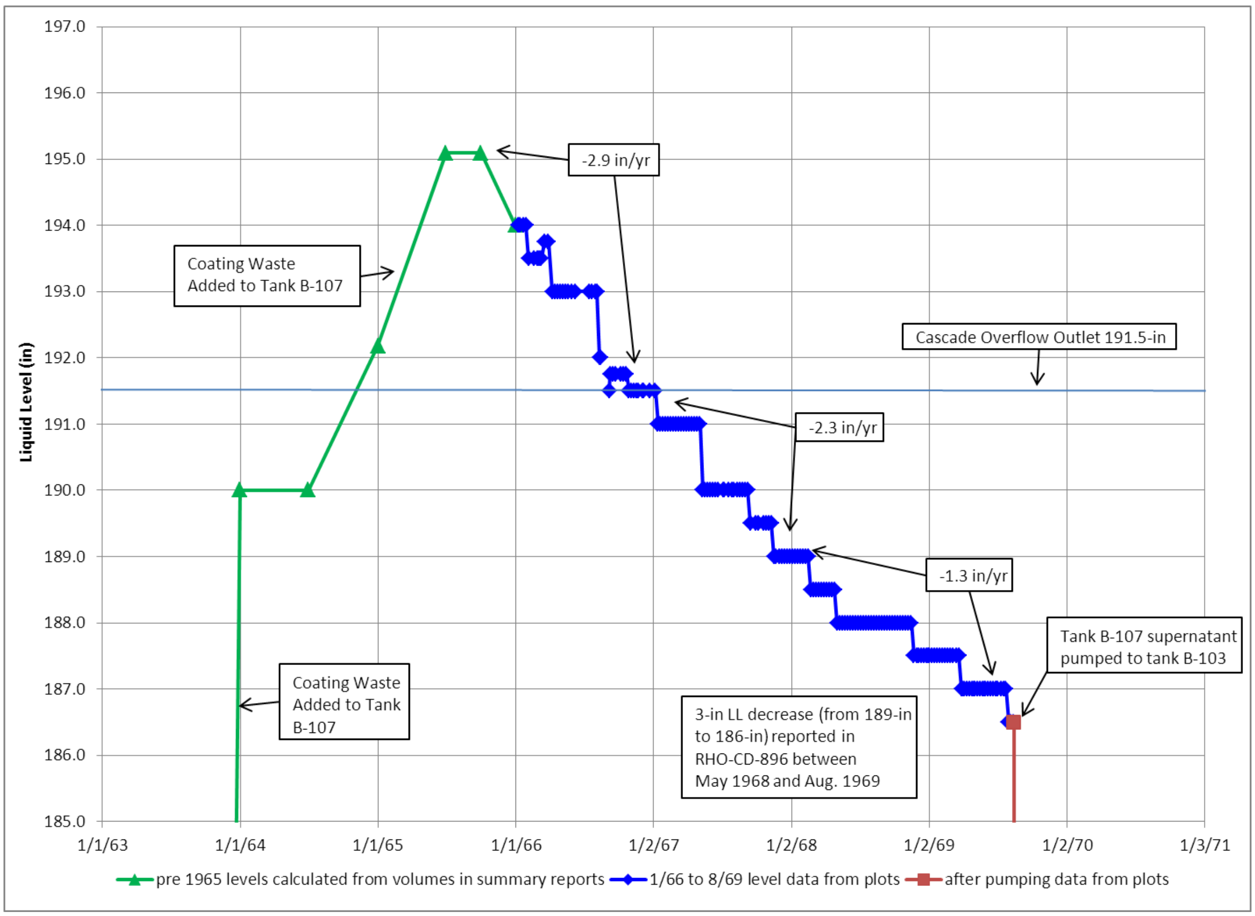
Design, fabrication, and erection of the tank steel lining were required to be in accordance with current “Standards Specifications for Elevated Steel Water Tanks, Standpipes and Reservoirs” as promulgated by the “American Water Works Association” (BPF 73550). Welding requirements were required to conform to the American Welding Society’s “Code for Arc and Gas Welding in Building Construction”, Section 4.

4.4 TANK B-107 IN-TANK DATA

4.4.1 Liquid Level

Tank B-107 was first suspected of leaking due to a 3-in liquid level drop between May 1968 and August 1969 with a reported leak loss of 8 kgal (RHO-CD-896, *Review of Classification of Nine Hanford Single-Shell "Questionable Integrity" Tanks*). However, after reviewing historic liquid level charts for tank B-107, it appears there was only a 2 ½-in decrease during this time. It also appears that the liquid level began decreasing before May 1968, as early as the fourth quarter of 1965, which is shown in Figure 4-4. It is not clear why RHO-CD-896 selected May 1968 through August 1969 for the leak determination when a plot indicates the liquid level was decreasing much earlier.

Figure 4-4. Tank B-107 Liquid Level 1963-1969 with Leak Rates



In 1964 to the end of the June 1965, tank B-107 received PUREX CW (CWP) and the tank was filled about 3.5-in above the cascade overflow outlet (located at the 191.5-in level, as measured at the tank wall to the bottom of the cascade outlet pipe). From the end of June through the end of September 1965, the liquid level was reported to be holding steady at ~195-in; however, these are quarterly readings and may hide intervening liquid levels. During this time, the liquid levels for tanks B-108 and B-109 were also holding steady and these tanks were also above the cascade inlet line liquid levels. This indicated that there was no leakage coming from either the cascade line or wall connection seals and/or from tank B-107 through the cascade line itself. The tank B-107 liquid level started to decrease sometime between October and the end of December 1965 at a rate of approximately 2.9 in/yr. Towards the end of 1966, the liquid level approached the cascade overflow outlet at 191.5-in. The liquid level continued to decrease through August 1969 and the tank B-107 supernatant was pumped out of the tank. The leak rates are shown in Figure 4-4 and the largest rate was observed when the liquid level was above the cascade overflow outlet. The difference between this rate and the next could be due to a leak through the cascade line wall connections or inlet line wall connections and from differences in the hydrostatic pressure. In any case the liquid level continued to decrease after reaching the cascade line outlet which could be due to a tank leak or evaporation.

Tanks B-108 and B-109 liquid levels did not increase or decrease during the time tank B-107 liquid level was decreasing. The equivalent heat load in tanks B-107, B-108, and B-109 as measured by total Cs-137 and Sr-90 decayed to 2008 is listed in Table 4-1 along with information on the respective liquid levels during the tank B-107 liquid level decrease.

Table 4-1. Comparison of Tank B-107 Cascade Tanks

Parameter	Tank B-107	Tank B-108	Tank B-109
Total Cs-137	9940 Ci	6870 Ci	1180 Ci
Total Sr-90	2910 Ci	844 Ci	341 Ci
Decreasing LL	~2.6 in/yr	No	No

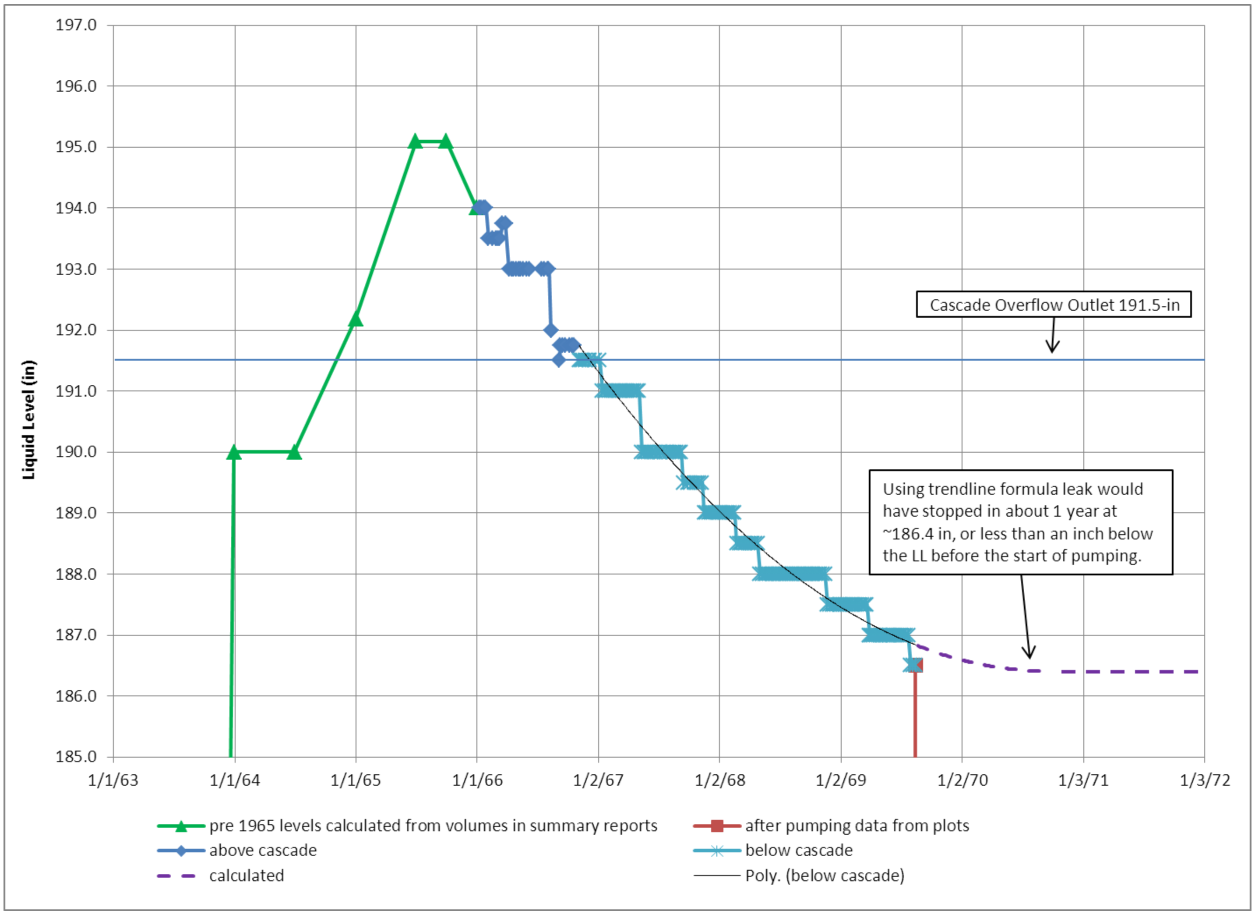
TWINS Best Bases Inventory: RPP-RPT-42989, RPP-RPT-42950, and RPP-RPT-42951

Tank B-108 heat load did not result in a decrease in liquid level which could be used as a proportional heat load baseline resulting in no evaporation when compared with tank B-107. This would indicate that at least about 60% of the tank B-107 liquid level decrease could have come from a tank leak with the possibility of up to 40% being evaporation, all other things being equal.

A 2nd degree polynomial was fit to the liquid level data from October 1966 (liquid level at the cascade overflow line) to just prior to pumping the tank in August 1969 (see Figure 4-5). This polynomial projection indicated that the tank B-107 leak may be a sidewall leak located near the 186.4-in level although the level of uncertainty is relatively high.

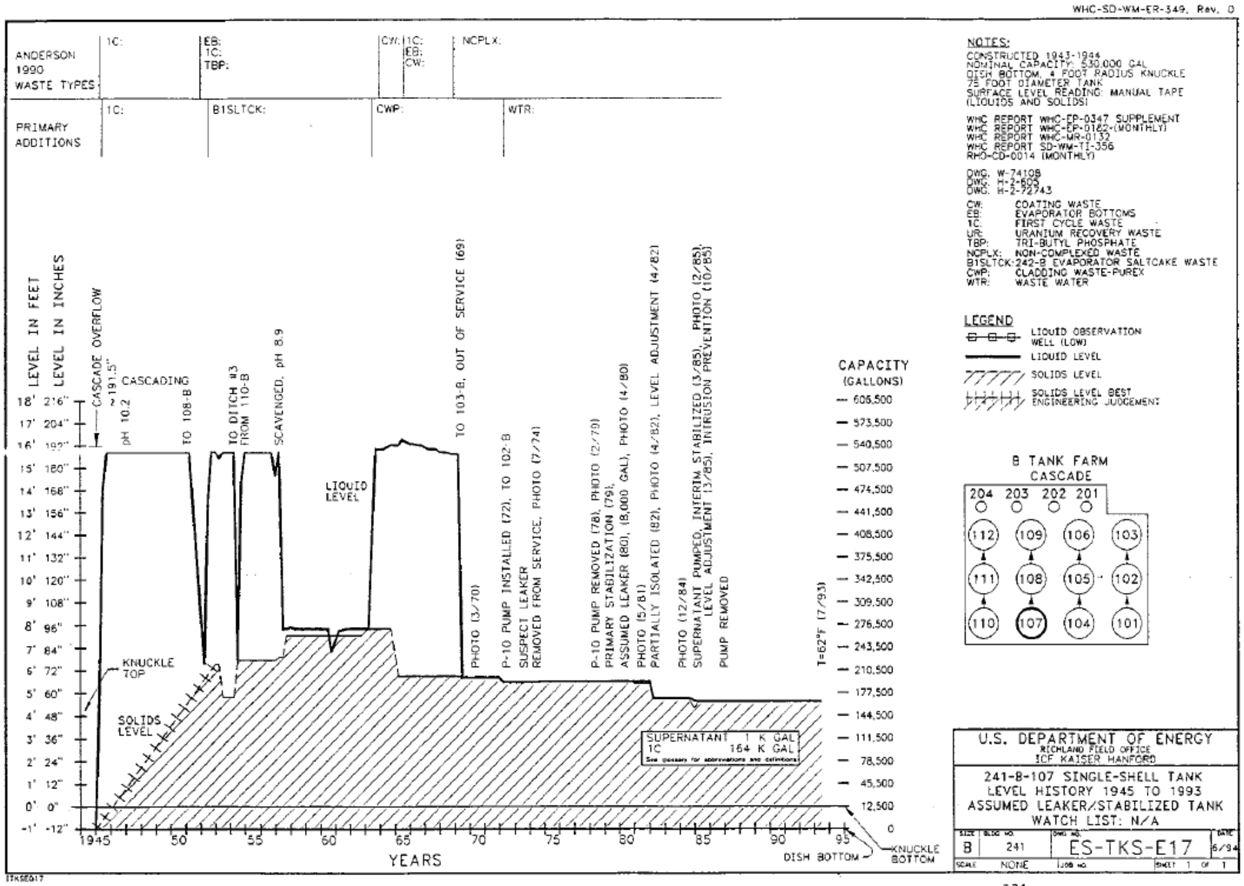
The tank B-107 leak may have started as early as the fourth quarter of 1965, or over three years earlier than what was reported in RHO-CD-896. It appears there was minimal leakage through the cascade line or any connections as the liquid levels in tanks B-108 and B-109 were holding steady during the time the tank B-107 levels were decreasing. Thus, it appears the leak is greater than the 8 kgal reported in RHO-CD-896 and could be as large as 22 kgal disregarding evaporation, hydrostatic pressure, and possible leakage through the cascade line or inlet wall connection seals.

Figure 4-5. Tank B-107 Liquid Level 1963-1969 with Projected Level if Tank Not Pumped



The liquid level plot in Figure 4-6 indicates the transfers into and out of the tank. The liquid levels are end of quarter levels so this figure may not reflect all significant transfers into and out of tank B-107 that occurred during the operational history of the tank. See Figure 4-2 for historical monthly liquid level readings.

Figure 4-6. Tank B-107 End of Quarter Surface Level



WHC-SD-WM-ER-349, Rev 0, June 1994, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*

4.4.2 Temperature

No temperature data were recovered for tank B-107 from May 1945 when the tank was first put into service until 1975. The following information on the three waste types stored in tank B-107 coupled with the temperature requirements in Section 3.2.2 indicate the tank B-107 temperatures were less than 180°F.

<u>1C/CW</u>

Seven tanks in the B, C, T, and U Farms that contained metal waste (MW) ranged in temperature from 84°F to 174°F between 1945 and 1947 (HW-14946, *A Survey of Corrosion Data and Construction Details, 200 Area Waste Storage Tanks*). The only B Farm tanks (tank B-101 and B-102) contained MW waste which was found to range from 99°F to 165°F between 1945 and 1947 (HW-14946). Document HW-20742, *Loss of Depleted Metal Waste Supernatant to Soil*, reports MW was cascaded into a 241-BX Farm series of tanks with temperatures recorded in the first tank of ~180°F, which contains the bulk of the uranium and fission products, and ~70°F in the last tank of the cascade. The MW contains approximately 90% of the fission products from the Bismuth Phosphate ($BiPO_4$) process at 221-B Plant.

Tank B-107, the first tank in the tank B-107 through tank B-109 cascade, which contained a mixture of 1C/CW waste, would have experienced much lower temperatures as the fission product content was much lower than MW. The 1C/CW waste contained approximately 10% of the $BiPO_4$ process fission products with approximately 90% in the MW.

TBP

Tri-Butyl Phosphate (TBP) wastes were concentrated and cooled to ~180°F within the 221-U Plant and were estimated to be 110-180°F after pumping to the storage tanks (HW-19140, *Uranium Recovery Technical Manual*, p. 1209). The temperature ranged depending on the distance to the receiving tank and the tanks position in the cascade. The shorter the distance and the first tank in the cascade were typically the highest in the temperature range.

CWP

PUREX CWP which was the last liquid waste in tank B-107 would have a significantly lower fission product content and resulting heat load than the 1C/CW mixture resulting in a still lower temperature, probably less than 100°F.

4.4.3 Liner Observations

No liner observations relating to a tank B-107 leak have been found.

4.4.4 Chemistry-Corrosion

Tank B-107 began receiving waste in May 1945 and received various waste types throughout operation as shown in Table 4-2. The first batches of 1C/CW waste were adjusted to pH 10. Six months later 1C/CW waste was thought to be adjusted to pH 7 to precipitate bismuth and plutonium starting in November 1945 based on 221-T Plant information.

A study dated October 29, 1945 (HW-3-3220, *SE-PC-#82 A Study of Decontamination Cycle Waste Solutions and Methods of Preparing Them for Disposal*) indicated that a solution pH of 7 was needed in waste storage tank to perform the required precipitation. Several methods to lower the existing pH 10 tank waste to pH 7 were proposed. The most promising method was to transfer 1C waste to the tank at pH 5-6. Mixing, of course, was a concern and it was thought that current batches of waste should not be below pH 5-6. It was stated that, "Enough mixing would occur so that solution added at low pH's would not remain that acid for very long." One of the recommendations of the report, namely neutralizing 2C waste to pH 7 had already been adopted at 221-T Plant, beginning in October 1945. Samples of 2C waste at 221-T Plant indicated that the desired precipitation of bismuth and plutonium had been effective at pH 7. This would also be the case for 1C waste at both 221-B and 221-T Plants as indicated by laboratory tests.

No information has been found to indicate that any transfers from either 221-B or 221-T Plants had been made at <pH 7 or if and for how long 1C waste was adjusted to pH 7 at 221-B Plant. However, it is assumed that 221-B Plant followed 221-T Plant approach and added the lower 1C pH waste until the last tank in the cascade measured a pH 7. Presumably, after tank B-107 was initially filled in October 1945, the subsequent 1C waste was adjusted to pH 7 at 221-B Plant, transferred to tank B-107, cascaded to B-108 and tank B-109 until these tanks were full and then

stored until 1951. The reduction in the quantity of CW to adjust 1C to pH 7 instead of pH 10 would have resulted in the combined waste having not only a lower pH but a somewhat higher nitrate to nitrite-hydroxide ion ratio which would contribute to corrosion, pitting and SCC.

The typical concentrations for nitrite, nitrate, and hydroxide for these waste types are shown in Table 4-3. Nitrite and hydroxide are known as nitrate induced SCC inhibitors. One key characteristic for inhibiting SCC is to maintain a high nitrite concentration to nitrate concentration ratio (see Section 3.2.4).

Table 4-2. Tank B-107 Waste Storage Chronology

Date	Waste Type[1]	Length of Storage
May 1945 to Dec. 1951	1C/CW	~ 7 years
Aug. 1952 to Aug. 1954	Concentrated 1C/CW	~ 2 years
Oct. 1954 to Oct. 1957	Concentrated TBP	~ 3 years[2]
Sept. 1963 to Sept. 1969	CWP	~ 6 years

1. The 1C/CW waste in tank B-107 could have a pH close to 7
2. Additional ~6 years with some TBP waste associated with top layer of the sludge (~1957-1963) prior to CW

Table 4-3. Waste Chemistries for Waste Types Stored in Tank B-107

Waste Type	$[NO_3^-]$[1]	$[NO_2^-]$[1]	$[OH^-]$[1]	$[NO_3^-]/([OH^-] + [NO_2^-])$	
1C[2]	1.54	0.28	0.28	2.75[3]	< 2.5[5]
CW, CWP	0.6	0.9	1.0	0.3	< 2.5[5]
TBP	7.35	NA	0.073	NA[4]	< 2.5[5]

1. Reference WHC-EP-0449, 1991, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups.*
2. The 1C waste type is un-concentrated. The concentrated 1C waste chemical ratios would have been similar.
3. The ratio of 1C to CW is unknown however the combination would have lowered the $[NO_3^-]/[OH^-] + [NO_2^-]$ ratio unless the plan to transfer 1C at pH 7 was in effect.
4. The NO_2^- would probably have been low resulting in a relative high ratio.
5. OSD-T-151-0007 (2012) specification for waste chemistry

Tank B-107 stored concentrated TBP waste for approximately three years. Samples of TBP waste indicate hydroxide concentrations below 0.1M and nitrate concentrations above 6M. These conditions of the TBP waste would likely create an environment conducive to SCC. The sludge stored on tank B-107 between September 1957 and third quarter 1963 would have contained TBP waste associated with the top layer of sludge possible setting up a pitting situation along with SCC.

Tank B-107 stored CWP for approximately six years and was present in the tank in 1965, when the tank could have started leaking based on liquid level decreases. CWP alone should not be a concern for either pitting or SCC under the tank B-107 conditions.

Corrosion testing of simulants indicative of aggressive chemical species currently stored tank B-107 waste is included in RPP-PLAN-50077, *Test Plan to Evaluate the Propensity for Corrosion in Single Shell Tank.* The tanks selected for testing contained "non-compliant" wastes identified using the DST chemistry specifications. A separate report will address the test plan results.

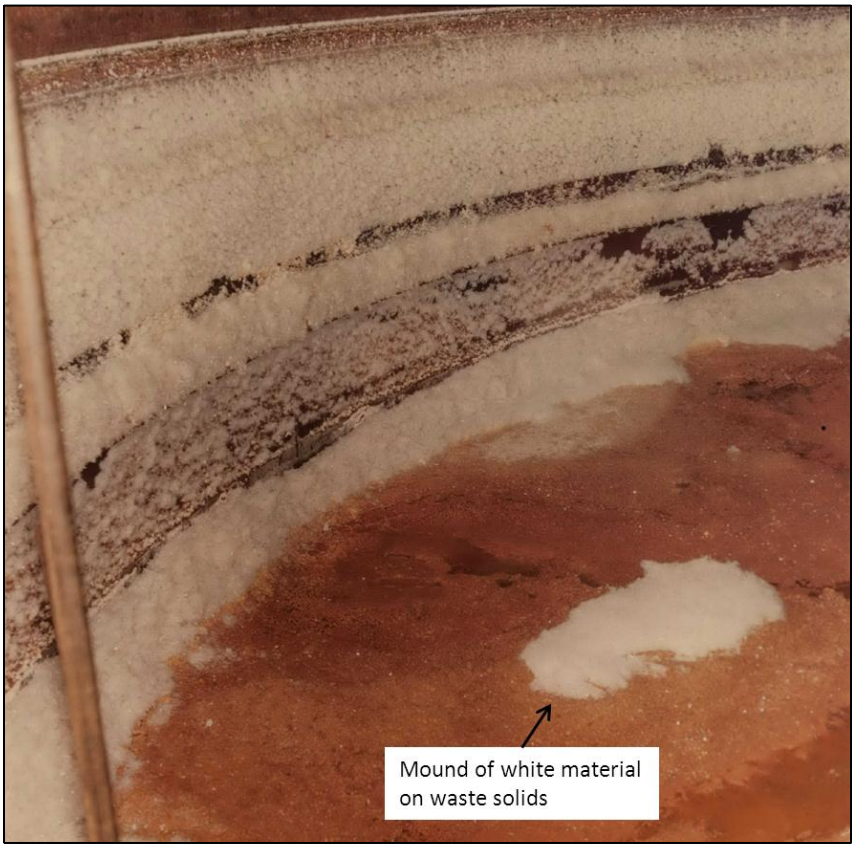
4.4.5 Photographs

Tank B-107 photographs taken in March of 1970 show a beachline covering the inlet line penetrations which is above the cascade line (see Figure 4-7). The March 1970 photographs were taken about 7 months after pumping the CWP supernatant to tank B-103. The white solids appearing on the tank liner were probably deposited during the 5½ years of CWP storage as a result of cooler surrounding tank liner-concrete temperature. The only white solids appearing above the liquid level show up on the upper surface of the lead flashing which could have been a result of seasonal changes in relative humidity and temperature, oxidation, or some other mechanism. The July 1980 set of photographs show very little further deposits or growth of solids (see Figure 4-8). In-tank photographs of tank B-108 and B-109 do not show white solids on the tank liner.

Tank B-107 photographs do not show any evidence pointing to a tank leak.

Figure 4-7. Tank B-107 Photograph March 19, 1970 (701322-6 CN)

Figure 4-8. Tank B-107 Photograph April 3, 1980 (90637-2CN)



4.5 TANK B-107 EX-TANK DATA

4.5.1 Drywells

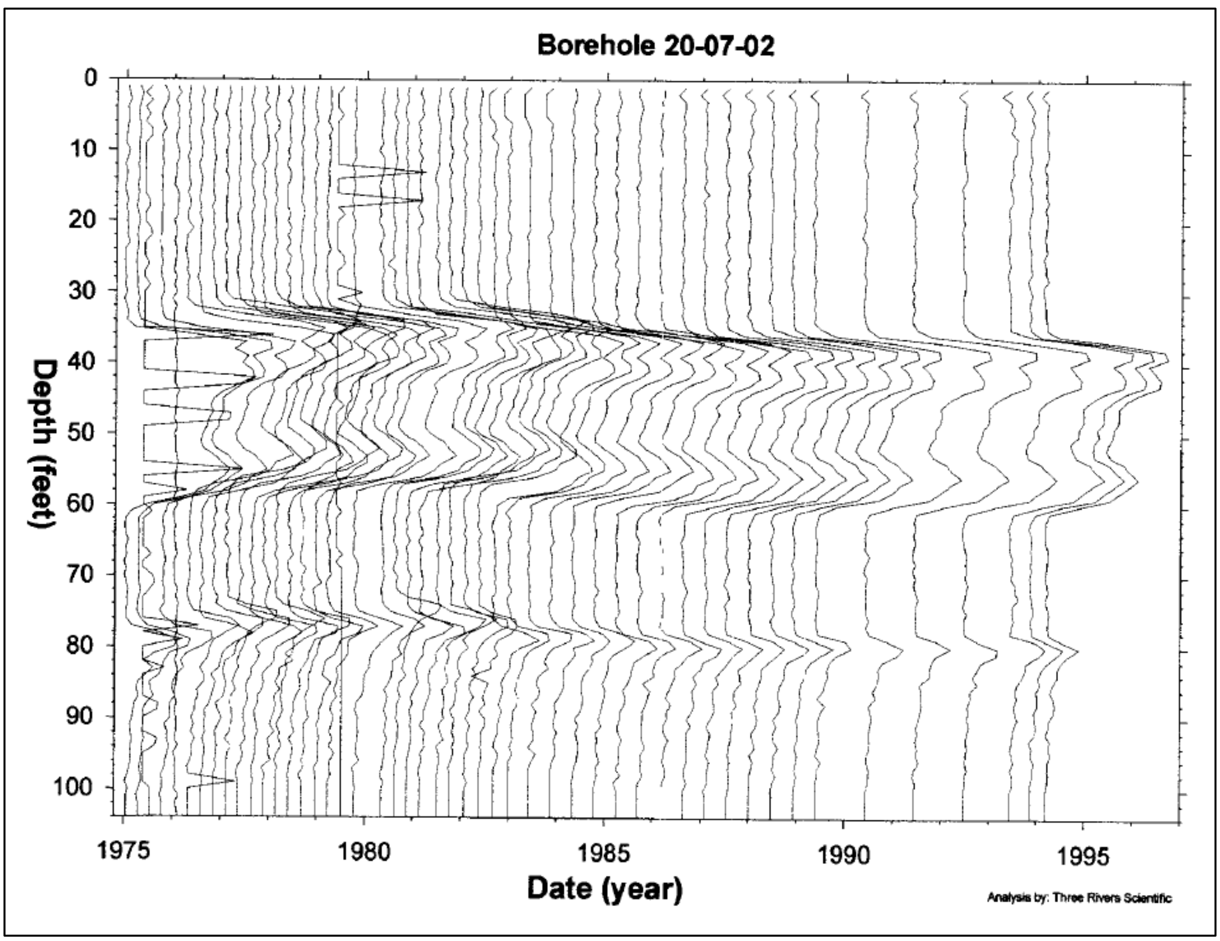
There are five drywells located around tank B-107: 20-07-05, 20-07-08, and 20-07-11 installed in April 1970 and 20-07-02 and 20-10-02 installed in August 1973. All of the radiation readings in drywells are assumed to be maximum or peak readings unless otherwise noted (see Section 3.3.2). The following subsections report the available drywell information and the drywell summary section provides the analyses of the associated drywells with tank B-107.

4.5.1.1 Drywell 20-07-02

Drywell 20-07-02 was drilled in August 1973 with the first recoverable reading on October 11, 1973 with a peak of 360K cpm at 38-ft BGS (see Appendix A). Radioactivity continued to increase at this below grade level and was reported at 848K cpm by the end of October 1973. Readings gradually decreased and were reported between 500 and 700K cpm through 1986.

In August 1999, Cs-137, Co-60, Eu-154, and Eu-152 were detected in this drywell with the highest concentrations forming a plume that occupies the region directly below the base of the tank farm excavation (GJ-HAN-128). Thick zones of continuous Cs-137 contamination were measured from 35.5 to 59.5-ft BGS and from 77 to 99-ft BGS with the maximum concentration of 1147 pCi/g at 42-ft BGS. Document GJ-HAN-128 reports, "The Cs-137, Co-60, Eu-154, and Eu-152 plume detected by the SGLS between 35 and 60 ft probably originated from a leak from tank B-107 that occurred prior to 1973." Figure 4-9 shows the depths of radioactivity from 1975 to 1995 (HNF-5433).

Figure 4-9. Tank B-107 Drywell 20-07-02 (HNF-5433)



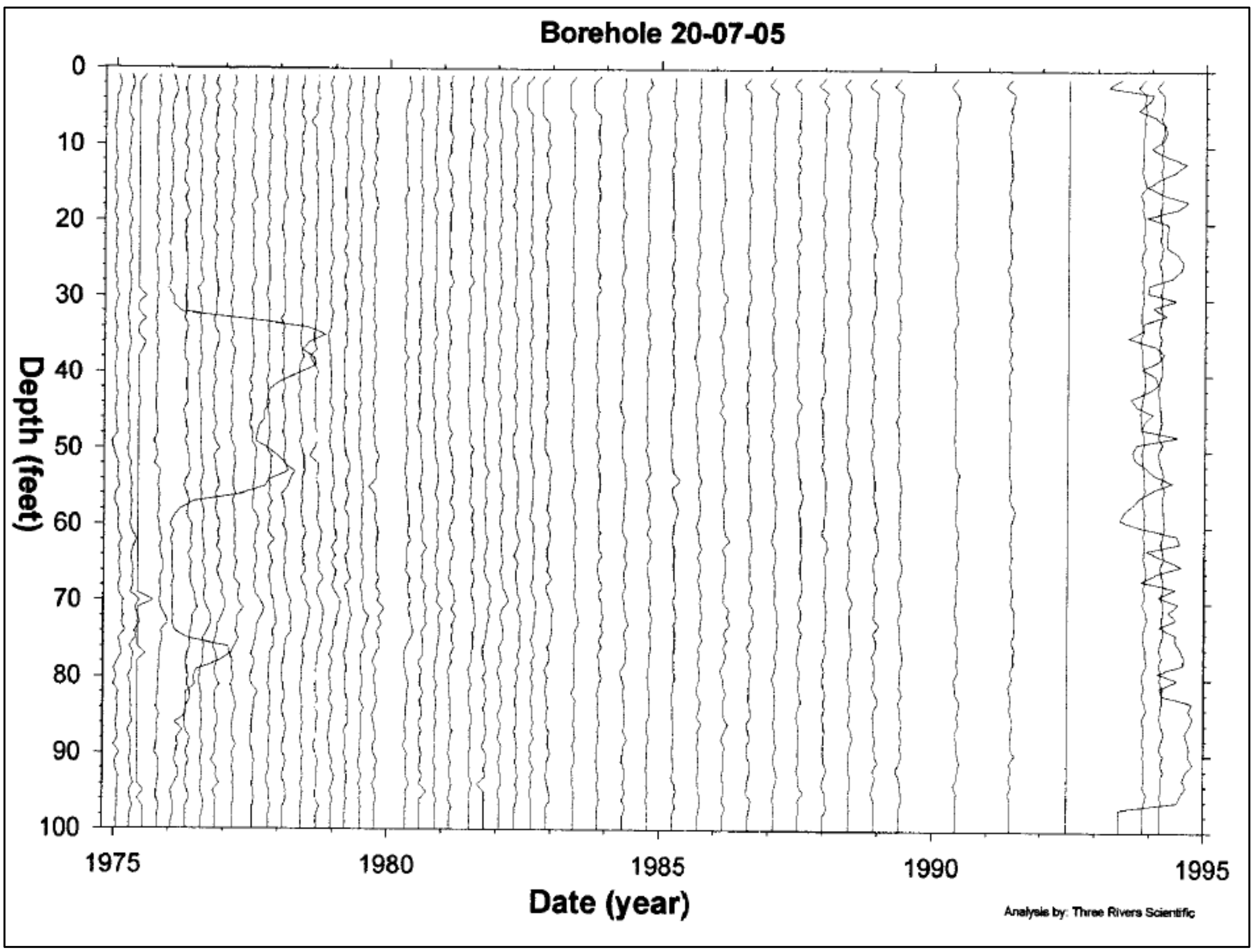
Note: Bottom of the tank footing is ~38-ft 3-in BGS

4.5.1.2 Drywell 20-07-05

Drywell 20-07-05 was drilled in April 1970 with the first recoverable readings on August 24, 1972 and February 7, 1973 which reported no radioactivity in this drywell (see Appendix A). The first indication of radioactivity in this drywell occurred on March 21, 1973 with a peak of 5.6K cpm was reported at 63-ft BGS. Readings remained relatively low from 1973 through 1986, and were reported as less than values beginning in 1981.

In August 1999, Cs-137 was the only man-made radionuclide detected in drywell 20-07-05 (GJ-HAN-128). From the ground surface to 7-ft BGS, from 62 to 65.5-ft BGS, and at 85.5-ft BGS, Cs-137 concentrations were below 2 pCi/g. Document GJ-HAN-128 states, "The Cs-137 contamination detected between the ground surface and 7 ft may have originated from a surface spill that invaded the backfill material or has been dragged down during drilling. The minor occurrences of Cs-137 contamination deeper in the borehole may also be the result of drag down by drilling." Therefore, drywell 20-07-05 is not included as part of the leak location for tank B-107. Figure 4-10 shows the depths of radioactivity from 1975 to 1995 (HNF-5433).

Figure 4-10. Tank B-107 Drywell 20-07-05 (HNF-5433)



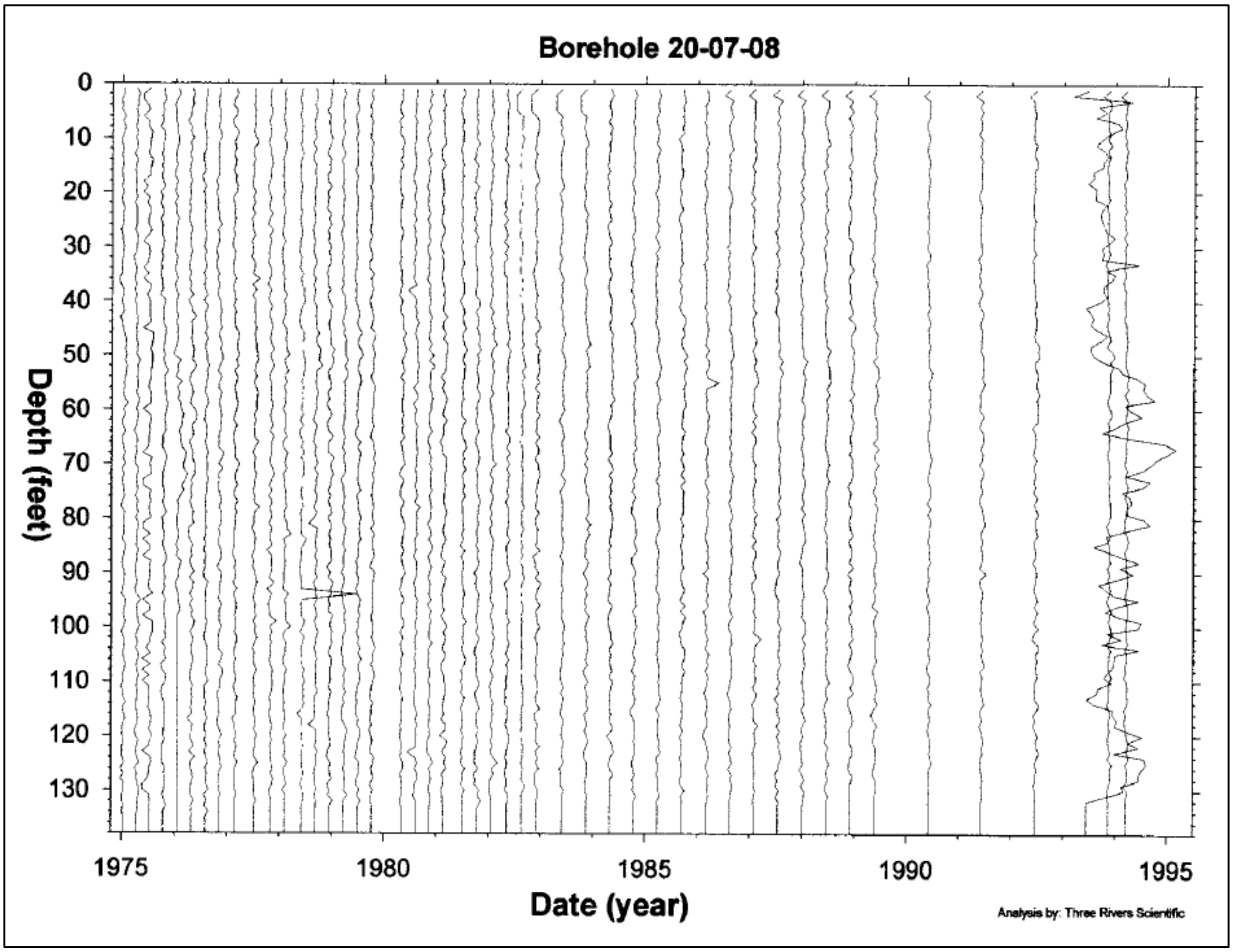
Note: Bottom of the tank footing is ~38-ft 3-in BGS

4.5.1.3 Drywell 20-07-08

Drywell 20-07-08 was drilled in April 1970 with the first recoverable reading on August 24, 1972, which reported no radioactivity present (see Appendix A). The next recoverable reading on February 7, 1973, reported a peak of 5.6K cpm at 63-ft BGS. Readings remained relatively low from 1973 to 1987 and were reported as less than values beginning in 1981.

In August 1999, Cs-137 was the only man-made radionuclide detected in drywell 20-07-08 from the ground surface to 8-ft BGS at concentrations ranging from 0.3 to 2.2 pCi/g (GJ-HAN-128). Document GJ-HAN-128 reports "The zone of Cs-137 contamination detected between the ground surface and 2-ft may be the result of a surface spill that migrated downward into the shallow backfill around this borehole….The lower concentrations of Cs-137 contamination detected below this zone were probably carried down during drilling." Therefore, drywell 20-07-08 is not included as part of the leak location for tank B-107. Figure 4-11 shows the depths of radioactivity from 1975 to 1995 (HNF-5433).

Figure 4-11. Tank B-107 Drywell 20-07-08 (HNF-5433)



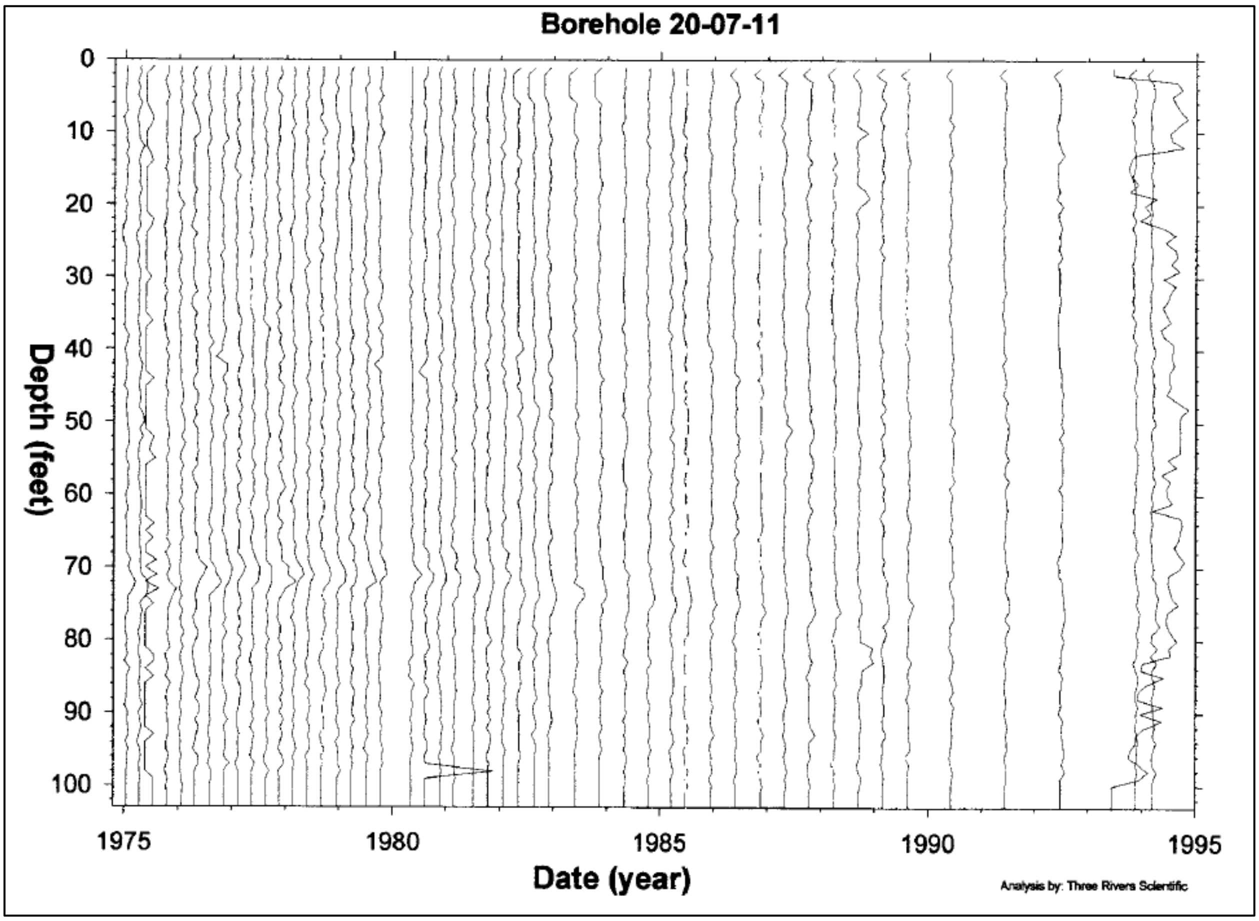
Note: Bottom of the tank footing is ~38-ft 3-in BGS

4.5.1.4 Drywell 20-07-11

Drywell 20-07-11 was drilled in April 1970 with the first recoverable reading on August 24, 1972, which reported no radioactivity present (see Appendix A). The next recoverable reading on February 8, 1973, reported a peak of 4.1K cpm at 74-ft BGS. Readings remained relatively low at approximately 3K cpm from 1973 to 1986.

In August 1999, Cs-137 was the only man-made radionuclide detected in drywell 20-07-11 and was detected from the ground surface to 13.5-ft BGS at concentrations less than 1 pCi/g (GJ-HAN-128). Document GJ-HAN-128 reports, "Some of the low Cs-137 concentrations detected by the SGLS from the ground surface to about 13.5 ft may be the result of a surface spill that has dispersed downward into the backfill and/or the result of contaminated near-surface material being dragged down during drilling to lower depths." Therefore, drywell 20-07-11 is not included as part of the leak location for tank B-107. Figure 4-12 shows the depths of radioactivity from 1975 to 1995 (HNF-5433).

Figure 4-12. Tank B-107 Drywell 20-07-11 (HNF-5433)



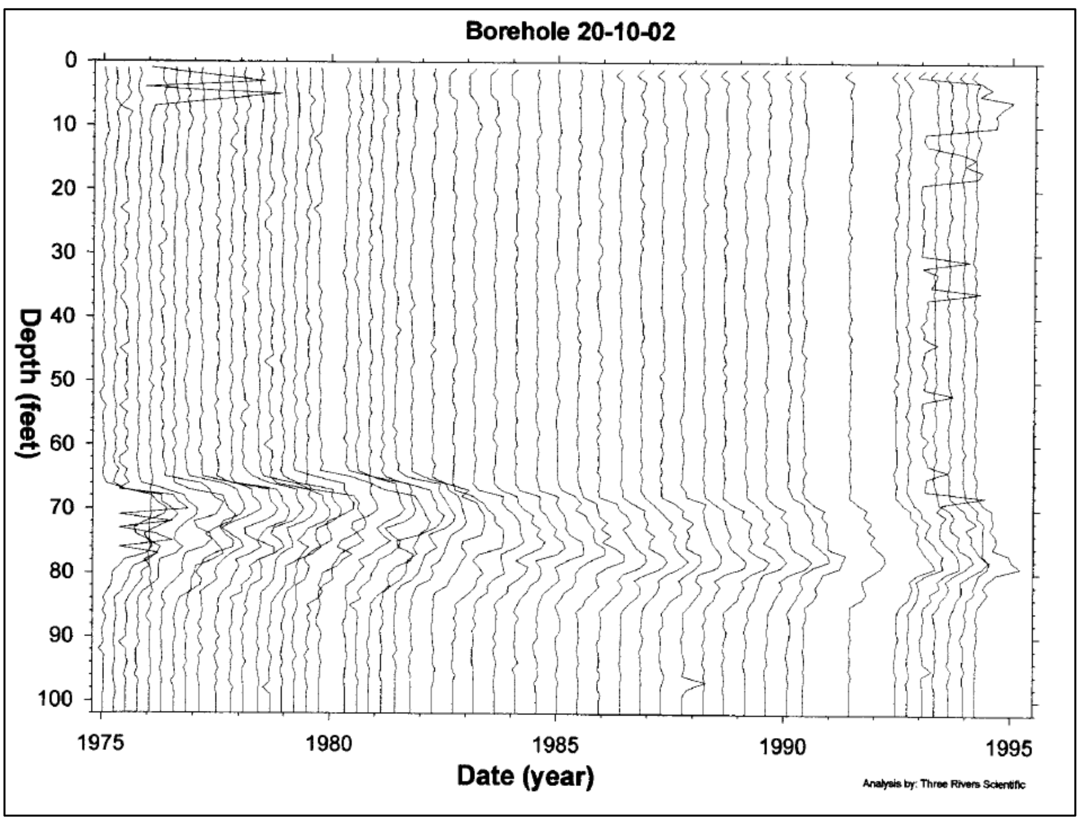
Note: Bottom of the tank footing is ~38-ft 3-in BGS

4.5.1.5 Drywell 20-10-02

Drywell 20-10-02 was drilled in August 1973 with the first recoverable reading on October 12, 1973 with a peak of 12.2K cpm at 70-ft BGS (see Appendix A). Radiation levels increased to 36.9K cpm a month later at 72-ft BGS. Radioactivity then gradually decreased from November 1973 to 1987.

In August 1999, Cs-137 and Co-60 were the only man-made radionuclides detected in drywell 20-10-02 (GJ-HAN-128). From the ground surface to 18-ft BGS and from 20.5 to 43-ft BGS, Cs-137 concentrations were recorded at concentrations ranging between 1 to 3 pCi/g. From 67 to 73.5-ft, Co-60 contamination was detected at concentrations ranging from 0.2 to 1.6 pCi/g. An anomalous SGLS detected zone occurred between 70-ft and 85-ft which had been recorded in the historical gross gamma data. It was determined that a decay curve of Ru-106 and Sr-90 closely matched the decrease in gross gamma activity between 1981 and 1994. The most likely source of the contamination was from the northern side of tank B-110 (GJ-HAN-128). Drywell 20-10-02 is 3-ft from tank B-110 where highly concentrated contamination intersects drywell 20-10-12. Drywell 20-10-02 is ~27-ft from tank B-107. Document GJ-HAN-128 indicated that the radioactivity detected above the anomalous zone in this drywell is likely associated from surface spills that migrated down into the backfill around this drywell and/or dragdown. Therefore, drywell 20-10-02 is not included as part of the leak location for tank B-107. Figure 4-13 shows the depths of radioactivity from 1975 to 1995 (HNF-5433).

Figure 4-13. Tank B-107 Drywell 20-10-02 (HNF-5433)



Note: Bottom of the tank footing is ~38-ft 3-in BGS

4.5.1.6 Drywell Summary

Tank B-107 was first suspected of leaking due to a 3-in liquid level decrease between May 1968 and August 1969; however, it appears the tank started leaking as early as the fourth quarter in 1965 (see Section 4.4.1). No drywells were installed near tank B-107 until April 1970 and August 1973.

Tank B-107 drywells 20-07-05, 20-07-08, 20-07-11, and 20-10-02 do not indicate any radioactivity associated with a tank B-107 leak. Therefore, these drywells are not included in the leak location for tank B-107.

Drywell 20-07-02 detected radioactivity that could be associated with a tank B-107 leak. The first recoverable reading for drywell 20-07-02 reported high levels of radioactivity in October 1973 at ~38-ft BGS. Radioactivity in this drywell increased a couple of weeks later and has remained relatively stable through 1986. No direct pushes or laterals were installed near tank B-107.

4.6 POSSIBLE TANK B-107 LINER LEAK LOCATION(S)

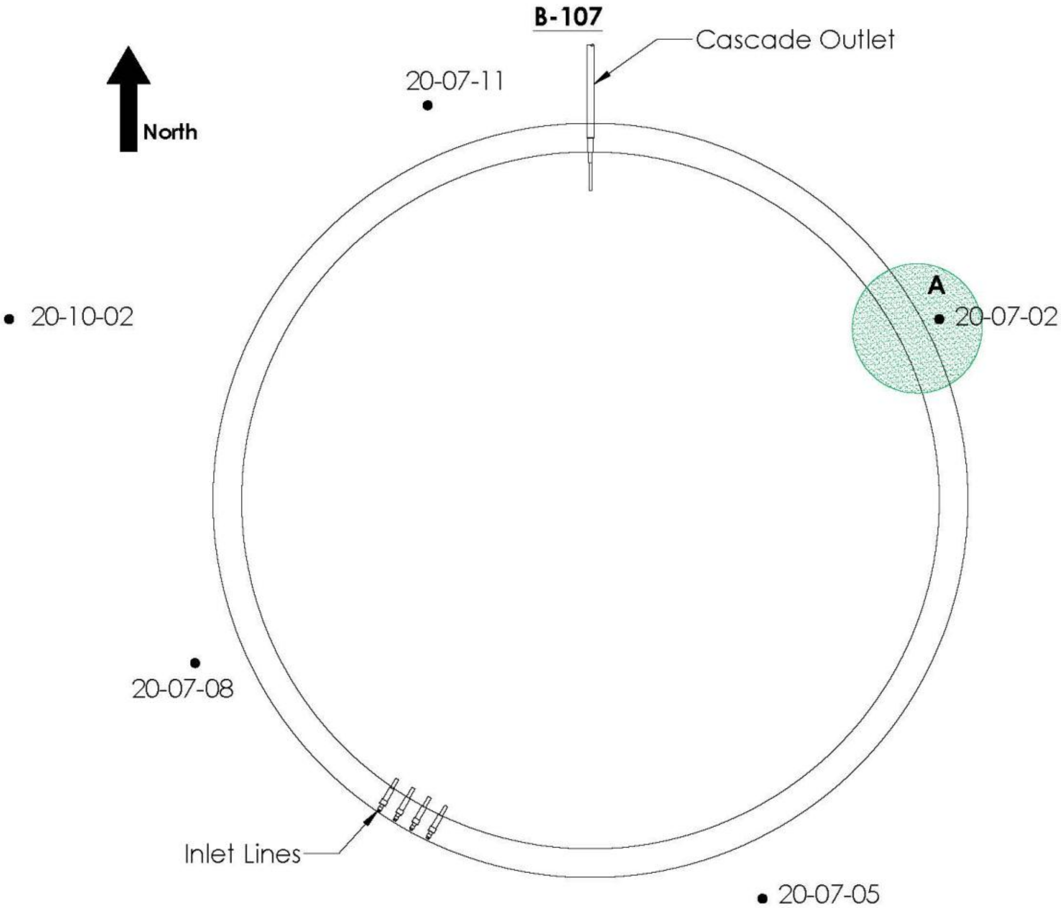
A liner leak may have penetrated the waterproof membrane at any location or pooled on the waterproof membrane and followed concrete cracks or construction joints to a different location for egress to the soil, including the top of the tank footing.

Tank B-107 had at least one leak site which is likely a sidewall leak at or below the 186.4-in liquid level based on liquid level decreases. There is also a possibility of a small leak from the cascade outlet line or sidewall connections but only until the liquid level reached the level of the cascade line outlet which would probably not have been detected in the distant drywell 20-07-02 (see Section 4.5.1.5).

4.6.1 Leak Detected in 1965-1973

Tank B-107 was first reported as leaking due to a 3-in liquid level drop between May 1968 and August 1969 (RHO-CD-896). However, it appears the tank B-107 leak could have started as early as the fourth quarter in 1965 due to the liquid level decreasing from October 1965 until August 1969, when the supernatant was pumped out of the tank (see Section 4.4.1). The liquid level was above the cascade outlet line level in October 1965 when the liquid level initially started to drop. A review of liquid levels for tanks B-108 and B-109 indicated no increases or decreases during the time the tank B-107 was above the cascade line and decreasing. Based on a polynomial projection of the liquid level data, there appears to be a sidewall leak located at or below 186.4-in. The leak was detected in drywell 20-07-02 in the northeast portion of the tank when the drywell was drilled in 1973. No other drywells indicated a tank B-107 leak.

Figure 4-14. Tank B-107 Possible Leak Location (1965-1973)
Tank inner ring is steel liner; outer ring is outer edge of tank footing



Drywell	Distance to Footing (ft)*	Date Installed
20-07-02	~1.7	Aug-1973
20-07-05	~6.1	Apr-1970
20-07-08	~5.4	Apr-1970
20-10-02	~24.9	Aug-1973
20-07-11	~5.4	Apr-1970

*Assumes perfect vertical alignment

Reference:
H-2-73278 Rev. 7
GJ-HAN-128

T.J. Barnes
1/23/2013

4.7 POSSIBLE TANK B-107 LINER LEAK CAUSE(S)

Tank B-107 was examined against five conditions that could contribute to a failed liner.

4.7.1 Tank Design

The B Farm tank design does not appear to be a factor contributing to a failed liner (see Section 3.1.1).

4.7.2 Thermal Conditions

No temperature data are available for tank B-107 prior to 1975 although tank B-107 held non-boiling waste. Since no records are available, it is uncertain what the maximum temperature was in tank B-107 during operation as well as the rate of temperature rise when waste was initially added. However, the thermal attributes of the waste and other information (see Section 4.4.2) would indicate that thermal stresses were likely minimal and should not have challenged the tank limits.

Thermal shock creates stress both from rapid temperature rise as well as waste-induced high temperatures which were thought to be minimal.

Temperature requirements in ARH-951 (*Limitations for Use of Underground Waste Tanks*) issued December 18, 1969, indicated that tank temperatures should be held below 230°F.

4.7.3 Chemistry-Corrosion

Tank B-107 stored 1C/CW, TBP, and CWP during operation. Tank B-107 stored waste types 1C/CW for approximately nine years total which may have approached pH 7 with a high nitrate to nitrite-hydroxide ratio for most of the period.

Tank B-107 stored TBP waste for approximately three years from 1954 to 1957. The TBP waste was pumped and the resulting sludge consisting mostly of 1C/CW precipitate with some TBP waste associated with the top layer of the sludge was stored for ~6 years. The mixture would consist of low hydroxide, high nitrate, and low nitrite concentrations creating an environment conducive to pitting and SCC. A tank with only the TBP waste type present would likely increase SCC in the tank liner (see Section 3.2.4 and 4.4.4).

Although temperatures were relatively low by radioactive waste storage standards, the presence of 1C/CW and TBP waste likely created an environment where pitting and SCC corrosion could occur.

4.7.4 Liner Observations

A review of the available photographs for tank B-107 does not contain any evidence pointing to a tank leak. There is no documentation available indicating a liner bulge was present in tank B-107.

4.7.5 Tank Construction Temperature

The B Farm tank liners were constructed from February 1944 to November 1944. Only isolated minimum temperature were experienced during tank construction at or below 18°F with day time temperatures between 41°F and 57°F (see Section 4.3.2). Impact occurrences could have occurred during cold temperatures that may have triggering fissures in the steel liner; however, the possibility seems much less that might have occurred during construction in other tank farms.

4.8 TANK B-107 CONCLUSIONS

Liquid level evidence indicates that the tank B-107 liner leaked near the northeast portion of the tank in the sidewall at or below a liquid level of 186.4-in. Drywell data indicates the leak was near the tank base. Thus, the liner leak may have penetrated the waterproof membrane at or below the 186.4-in liquid level and followed concrete cracks or construction joints to a different location including the top of the tank footing.

There are several liner leak cause conditions that were examined but the most likely cause of the tank B-107 leak was chemistry-corrosion as it relates to the storage of 1C/CW and TBP process wastes. The 1C/CW and TBP process waste is conducive to pitting and SCC. There appears to be very little contribution from tank design, construction temperatures, and thermal conditions. However, some or all of the factors can act serially or together to contribute to tank liner failure.

5.0 CONCLUSIONS

The primary contributor to the B Farm Type II tank B-107 liner failure at or below the 186.4-in liquid level appears to have been chemistry-corrosion. There does not appear to be much contribution from construction temperature and thermal conditions. In addition, tank design does not appear to be a factor in liner failure as it basically contained features that were thought to be favorable to waste storage under tank B-107 conditions; however, there could be many unknown variables present in the quality of materials and quality of construction. No liner observations were found such as bulging that could contribute to or indicate a liner failure.

Some of the tank construction occurred in winter under relatively mild temperature conditions which probably did not affect the ductile-to-brittle transition temperature. There were some isolated temperatures below 20°F but no sustained low temperature periods.

Detailed thermal conditions were not found; however, secondary information from technical manuals, flowsheets, and other sources indicate storage temperatures were far less than the specification of 230°F and probably less than 130°F. Temperature rate of rise was not able to be calculated without the detailed temperature data sheets or graphs.

The 1C/CW waste probably was stored at pH 7 with a low nitrite to nitrate ratio which could have caused pitting and SCC even at low temperature. Waste from the TBP process was cooled to ~180°F and pumped to the B Farm tanks in one batch and probably cooled fairly quickly. The TBP waste was high in the SCC nitrate ion and probably low in the corrosion inhibiting hydroxide ions which even at moderate temperatures could have caused SCC. Two other B Farm tanks contained TBP waste; however, these have been recommended to be assessed with the TFC-ENG-CHEM-D-42 procedure (see Tables 5-1 and 5-2).

The storage of 1C/CW and TBP waste seems to be the overriding factor that could have led to tank B-107 liner failure. Waste chemistry was not controlled to the degree necessary to minimize corrosion when tank B-107 was suspected of leaking. The other conditions that could influence liner failure do not seem to be factor. It should be noted that six of the B Farm tanks have been recommended to be assessed with the TFC-ENG-CHEM-D-42 procedure. An overall final conclusion for the B Farm tanks would need to consider the information generated in the assessments for these six tanks.

Table 5-1. B Farm Leaking Tanks

Leaking Tank	Initial Waste Details		Leak Status		TBP Waste Storage		Thermal Conditions
	First Filled	Waste Type	Leak Detected	Indication of leak	Stored TBP Waste	TBP Only Storage Length	Estimated Max Temp[2]
B-107	May 1945[1]	1C/CW, TBP, CWP	4th quarter 1965	LL decrease, drywell	Yes	~ 9 years	124°F

Note: 1 Reference HW-7-1793-DEL, *Hanford Engineer Works Monthly Report May 1945*
2 Reference WHC-SD-WM-TI-591, *Maximum Surface Level and Temperature Histories for Hanford Waste Tanks*
Waste Type: 1C: first-cycle decontamination waste; CW: coating waste; TBP: Tributyl phosphate waste; CWP PUREX: coating waste

Table 5-2. B Farm Sound Tanks

Sound Tank	Initial Waste Details		Leak Status		TBP Waste Storage		Thermal Conditions
	First Filled	Waste Type	Leak Integrity Classification[1]	Basis for Formal Leak Assessment[1]	Stored TBP Waste	TBP Only Storage Length	Estimated Max Temp[2]
B-101	May 1945	EB, MW, CW, BL	"Questionable Integrity" but TFC-ENG-CHEM-D-42	Drywell	No	–	137°F
B-102	October 1945	EB, MW, BL, CW, IX, NCPLX, Evap.	Sound	–	No	–	108°F
B-103	December 1945	EB, CW, MW, IX, BNW, N, LW, DW, TBP, NCPLX	"Questionable Integrity" but TFC-ENG-CHEM-D-42	Drywell	Yes	~ 2 years	83°F
B-104	August 1946	EB, 2C, NCPLX	Sound	–	No	–	122°F
B-105	January 1947	EB, 2C, 1C	"Questionable Integrity" but TFC-ENG-CHEM-D-42	Drywell	No	–	107°F
B-106	September 1947	TBP, HLO, 224, BNW, 2C, NCPLX, 1C, EB	"Sound" but TFC-ENG-CHEM-D-42	Drywell	Yes	~15 years	86°F
B-108	October 1945	EB, 1C, CW, NCPLX, IX	Sound	–	No	–	105°F
B-109	January 1946	EB, CW, IX, 1C, NCPLX, 224	Sound	–	No	–	105°F
B-110	May 1945	2C, 1C, 5-6, FP, BL, EB, IX	"Confirmed leaker" but TFC-ENG-CHEM-D-42	LL Decrease	No	–	121°F
B-111	November 1945	2C, 1C, 5-6, FP, IX, EB	"Questionable Integrity" but TFC-ENG-CHEM-D-42	Drywell	No	–	98°F
B-112	April 1946	5-6, 1C, EB, IX, 2C, FP	"Assumed leaker" but TFC-ENG-CHEM-D-42	Drywell	No	–	101°F

Note: 1 Reference RPP-RPT-49089, Rev. 0, *Hanford B-Farm Leak Inventory Assessments Report*
2 Reference WHC-SD-WM-TI-591, *Maximum Surface Level and Temperature Histories for Hanford Waste Tanks*
Waste Types: EB: Evaporator bottoms; TBP: Tributyl phosphate waste; 1C: First-cycle decontamination waste; 2C: second-cycle decontamination waste; 224: Lanthanum fluoride decontamination waste; CW: cladding waste; 5-6: High-level B Plant waste; IX: ion exchange waste; NCPLX: noncomplexed waste; BNW: Laboratory waste from Pacific Northwest Laboratory; BL: Low-level waste from the waste fractionization plant; MW: metal waste; Evap: post-1976 evaporator feed; FP: fission products waste; HLO: Laboratory waste from 300 Area; DW: decontamination waste; LW: Laboratory waste from 222-S Building

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APPENDIX A

TANK B-107 GROSS GAMMA DRYWELL DATA

Table A-1. Tank 241-B-107 Drywell Radioactivity (K counts per minute) (August 1972 through November 1986) (Drywell Data Sheets Retrieved on January 24, 2013 and SD-WM-TI-356)

20-07-02			20-07-05			20-07-08			20-07-11			20-10-02		
Date	Peak (K cpm)	Depth (ft)	Date	Peak (K cpm)	Depth (ft)	Date	Peak (K cpm)	Depth (ft)	Date	Peak (K cpm)	Depth (ft)	Date	Peak (K cpm)	Depth (ft)
	N/A[1]		8/24/1972	None	N/A[1]	8/24/1972	None	N/A[1]	8/24/1972	None	N/A[1]		N/A[1]	
	N/A[1]		2/7/1973	None	N/A[1]	2/7/1973	2.8	60	2/8/1973	4.1	74		N/A[1]	
	N/A[1]		3/21/1973	5.6	63	3/21/1973	4.9	72	3/21/1973	4.6	61		N/A[1]	
	N/A[1]		6/19/1973	4	65	6/19/1973	3.4	72	6/19/1973	3.2	74		N/A[1]	
	N/A[1]		7/20/1973	1.3	63	7/20/1973	1	112	7/20/1973	0.9	72		N/A[1]	
	N/A[1]		8/17/1973	1	53	8/17/1973	0.7	132	8/17/1973	1.1	111		N/A[1]	
	N/A[1]		9/13/1973	4.3	64	9/13/1973	4.2	81	9/13/1973	3.8	98		N/A[1]	
10/11/1973	360.2	38	10/11/1973	5.8	65	10/12/1973	10	84	10/11/1973	6.1	81	10/12/1973	12.2	70
10/15/1973	365.6	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
10/22/1973	886.4	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
10/30/1973	848.3	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
11/15/1973	735	38	11/14/1973	14.8	59	11/14/1973	15	87	11/15/1973	14.3	97	11/14/1973	36.9	72
12/6/1973	739.7	37	12/12/1973	4.6	66		N/A[1]			N/A[1]			N/A[1]	
12/20/1973	853.9	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
1/11/1974	647.4	37		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
1/15/1974	609.2	40	1/15/1974	3.6	68		N/A[1]		1/15/1974	3.5	74	1/17/1974	25.3	76
2/4/1974	662.8	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
2/25/1974	600	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
3/4/1974	686.9	39		N/A[1]			N/A[1]			N/A[1]		3/13/1974	29.9	71
4/16/1974	803.3	39		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
5/7/1974	660.3	38		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
5/30/1974	733	38	5/9/1974	3.1	72	5/9/1974	2.6	56	5/9/1974	4	73	5/9/1974	29.3	70
6/11/1974	726.2	37	6/25/1974	3.4	68	6/25/1974	2.6	112	6/26/1974	3.1	73	6/26/1974	27.2	72
6/25/1974	757.7	40	7/16/1974	3.2	73	7/9/1974	2.1	86	7/16/1974	3.4	72	7/22/1974	27.1	71
7/9/1974	669.8	39	8/13/1974	4.3	66	8/6/1974	2.2	96	8/19/1974	2.8	73	8/13/1974	36.1	71
7/22/1974	673.6	37	9/17/1974	3.4	70	9/2/1972	3.7	51	9/17/1974	3.5	74	9/10/1974	26	71
8/12/1974	736.3	38	10/1/1974	3.2	72	10/1/1974	2.5	76	10/14/1974	3.5	73	10/29/1974	29.2	73
9/2/1974	645.8	37	11/4/1974	4.7	23	11/5/1974	4.3	56	11/12/1974	4.1	74	11/18/1974	26.9	70
10/1/1974	576.5	37	11/12/1974	3.5	74	12/2/1974	2.3	77	12/9/1974	3.3	72	12/16/1974	26.3	73
11/5/1974	730.3	37	12/3/1974	4	73	1/9/1975	2.5	60	1/21/1975	3.8	74	1/21/1975	30.4	70
12/2/1974	715.4	39		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
1/21/1975	675.6	38	1/21/1975	3.4	72	1/21/1975	< 3	N/A[1]	7/8/1975	3.1	71	7/8/1975	26.2	69
7/8/1975	665.5	37	7/8/1975	3.1	73	7/8/1975	< 3	N/A[1]	1/6/1976	3.8	71	1/6/1976	27.9	69
1/6/1976	616.2	36	1/6/1976	4.2	71	1/6/1976	< 3	N/A[1]	7/13/1976	3.2	71	6/1/1976	22.8	69
6/1/1976	690.2	35	7/15/1976	3.5	76	7/13/1976	< 3	N/A[1]	11/29/1976	4	72	11/29/1976	23.6	69
12/6/1976	649.1	36	11/29/1976	3.6	71	11/29/1976	< 3	N/A[1]	7/6/1977	3.4	72	6/7/1977	24.4	69
4/12/1977	696.6	35	6/7/1977	3.3	71	7/13/1977	< 3	N/A[1]	1/4/1978	3.1	71	1/10/1978	25.6	70
9/20/1977	646.1	36		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
1/10/1978	580	36	1/10/1978	3	72	1/10/1978	< 3	N/A[1]	7/18/1978	3.42	71	7/4/1978	26.5	70
7/11/1978	624.1	36		N/A[1]			N/A[1]			N/A[1]			N/A[1]	
1/17/1979	659.1	36	1/17/1979	3.4	71	1/17/1979	< 3	N/A[1]	1/17/1979	3.1	73	1/17/1979	24.4	73
1/28/1980	678	34	1/28/1980	3.1	70	1/28/1980	< 3	N/A[1]	1/28/1980	2.7	71	1/30/1980	21.5	71
1/12/1981	625.3	35	1/13/1981	< 3	N/A[1]	1/13/1981	< 3	N/A[1]	1/12/1981	2.5	71	1/12/1981	26.2	70
1/26/1982	577.7	35	1/28/1982	< 3	N/A[1]	1/26/1982	< 3	N/A[1]	1/26/1982	2.9	71	1/11/1982	18.4	73
12/29/1982	627	37	12/29/1982	< 3	N/A[1]	12/29/1982	< 3	N/A[1]	12/29/1982	3.1	74	12/14/1982	15.9	75
11/16/1983	606.5	37	11/16/1983	< 3	N/A[1]	11/16/1983	< 3	N/A[1]	11/16/1983	2.8	74	11/16/1983	15.2	76
10/15/1984	575.6	37	10/15/1984	< 3	N/A[1]	10/15/1984	< 3	N/A[1]	10/15/1984	2.6	74	10/15/1984	12.2	76
12/11/1985	727.5	38	12/11/1985	< 3	N/A[1]	12/9/1985	< 3	N/A[1]	12/9/1985	2.8	75	12/9/1985	13.2	78
11/12/1986	508.9	39	11/12/1986	< 3	N/A[1]	2/3/1987	< 3	N/A[1]	11/12/1986	2.6	76	2/3/1987	11.8	78

Note: [1]N/A: Data not available

APPENDIX B

MEETING MINUTES

February 5, 2013
February 19, 2013

MEETING SUMMARY

washington river protection solutions

From: D. G. Harlow
Phone: 373-5514
Location: Ecology Office
Date: February 5, 2013
Subject: Tank Farm Leak Integrity Assessments
To: Distribution/Attendees

Attendees:

Jim Alzheimer, ECOLOGY
Mike Barnes, ECOLOGY
Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, WRPS
Don Harlow, WRPS
Jeremy Johnson, ORP

PURPOSE:

The purpose of this meeting was to discuss the status of the Tank B-107 Leak Location and Cause summary effort and associated report.

Tank B-107 Leak Location and Cause Status

The results to date from the tank B-107 analysis were discussed. From the information reviewed a preliminary determination indicated that a leak could have occurred from tank B-107 sidewall detected in drywell 20-07-02, north east of the tank. The radioactivity measured in drywell 20-07-02 was first detected when the drywell was installed in 1973. No other drywells have detected a tank B-107 leak. Records show that tank B-107 waste level was above the cascade line in 1965 and the surface level was slowly decreasing. There was no change in the tank B-108 or tank B-109 waste surface levels during the time the tank B-107 liquid level was above the cascade line and decreasing. Using this hypothesis a tank leak could have occurred before and after the waste level reached the cascade outlet. An initial plot of the waste level indicated that a reduction in the tank B-107 waste surface level may have started as early as 1965 and may be greater than the 3-in. drop reported in RHO-CD-896 in 1980. The liquid level plot is being further evaluated and refined to identify rates of decrease before reaching the cascade outlet and after including further analysis of the tanks B-108 and B-109 liquid levels.

Possible leak causes are being examined.

The team suggested that the investigation also assess the possibility of evaporation as cause for the decreasing waste level. A number of assumptions may be necessary as detailed waste temperature data is not available. A comment was noted that Leon Stock may have some theories from observations of the white solids on the sides of the tank (at the liner flashing). Suggestion was also made to explore the history of the cascade line plugging in the tank B-107 through tank B-109 cascade system prior to 1965.

The draft Tank B-107 report will be discussed in the next meeting.

ACTIONS:

1. All: Review meeting summary for discussion in the next meeting.
2. D. Harlow: Prepare and distribute January 15, 2013 Meeting Summary.
   Status: Complete.
3. C. Girardot/D. Harlow: Complete Tank A-105 Leak Location and Cause report and distribute (incorporate any comments as appropriate).
   Status: In progress.
4. C. Girardot/D. Harlow: Find information on SX Farm plates including photos and construction and update SX Farm report as required.
   Status: In progress. Additional boxes of construction records have been requested.
5. C. Girardot/D. Harlow: Continue preparation of the tank B-107 Leak Location and Cause report to be discussed at the next meeting. Address the questions and comments above.
   Status: Complete.

NEXT MEETING:

Part 1. TX Farm Leak Assessment. Part 2. Review tank B-107 leak location and causes.
Date: February 19 (Part 1 and Part 2)
Time: 1:00-4:00 (as Part 2: 2:30 – 4:00)
Location: ECOLOGY Office. Conference Room 3B

MEETING SUMMARY

washington river protection solutions

From:	D. G. Harlow
Phone:	373-5514
Location:	Ecology Office
Date:	February 19, 2013
Subject:	Tank Farm Leak Integrity Assessments
To:	Distribution/Attendees

Attendees:

Michelle Hendrickson, ECOLOGY
Mike Barnes, ECOLOGY
Joe Caggiano, ECOLOGY
Jim Field, WRPS
Les Fort, WRPS
Crystal Girardot, WRPS
Don Harlow, WRPS
Jeremy Johnson, ORP

PURPOSE:

The purpose of this meeting was to distribute, review, and discuss the conclusions of the B Farm Leak Location and Cause draft report including designated leaking tank B-107; as well as distribute the draft February 5, 2013 Meeting Summary.

Tank B-107 Leak Location and Cause Status

The results from the tank B-107 analysis were discussed. It was determined that the tank B-107 leak was probably at the sidewall below the 186-in. surface elevation and was detected by radionuclide measurements of drywell 20-07-02, north east of the tank, when the drywell was installed in 1973. No other drywell measurements detected a release from tank B-107. Records show that tank B-107 waste level was above the cascade line in 1965 and the waste surface level slowly decreased. There was no change in tanks B-108 or B-109 waste surface levels during the time period that the tank B-107 waste level was above the cascade line and decreasing. The tank B-107 waste surface level continued decreasing after reaching the cascade outlet for a total of ~8-in before the waste was transferred. Such a decreasing waste surface level could have been caused by a waste release from the tank liner, evaporation, and/or a leak through the cascade line wall penetration packing or inlet line wall penetration packing. Waste discharging through a partially plugged cascade line was ruled out as the waste surface level in tanks B-108 and B-109 were unchanged. Any waste release by the cascade or outlet line wall penetrations would have only occurred when the surface level was above the cascade and inlet line penetrations. Some of the decreasing rate of surface level decline could be an effect of decreasing hydrostatic head above a leak point.

As a means of determining if evaporation was a cause of the waste level decrease a comparison was made of the Cs137 and Sr 90 content of tanks B-107 and B-108. The heat load of these heat emitting radionuclides in tank B-108 which did not show evidence of evaporation was about

60% of the tank B-107 heat load. This indicated that the tank B-108 equivalent of these heat emitting radionuclides in tank B-107 would not have been contributing to evaporation in tank B-107 as a minimum. Also, the mild thermal conditions in tank B-107 at the time of surface level decrease would have only a small part in surface level decrease by evaporation.

Using the above rational it is postulated that a tank liner waste release occurred prior to and continued after the waste surface level in tank B-107 reached the cascade outlet elevation. A plot of the waste level indicated that the tank B-107 waste surface level began to decrease as early as 1965 and may be much greater than the 3-in. decrease reported in 1980 (RHO-CD-896).

The most probable leak cause was chemistry-corrosion with the storage of 1C/CW and TBP wastes creating a pitting and stress corrosion cracking environment.

The B Farm Leak Location and Cause draft report conclusions section was discussed. The conclusion section detailed available information for tank B-107 and all of the remaining 11 designated sound and questionable integrity B Farm tanks described in RPP-RPT-49089. The 11 sound and questionable tanks included 7 tanks that are to be assessed with the TFC-ENG-CHEM-D-42 procedure. The available data was not detailed enough to distinguish the differences between sound and leaking tank locations and causal factors. With the information available it was concluded that tank design, construction temperatures, waste storage thermal conditions, and the lack of any liner anomalies did not appear to contribute to tank liner failure. More definitive comparisons may be made as the B Farm tanks are assessed with the D-42 procedure and further information from assessment of the other leaking tanks in the C, T, and U Farms becomes available.

The team suggested that the Chemistry-Corrosion section 4.7.3 of the Leak Location and Cause draft report should provide more detail on the waste conditions and corrosion mechanisms.

The draft Tank C-101 report will be discussed in a future meeting.

ACTIONS:

6. All: Review the B Farm Leak Location and Cause Report and provide comments by February 28, 2013. Review meeting summary for discussion in the next meeting.
   Status: *Comments received from Jim Field February 22, 2013and Joe Caggiano March 7, 2013. See attached with comments with responses. See Attachment 1.*
7. C. Girardot/D. Harlow: Complete the A Farm Leak Location and Cause report and distribute (incorporate any comments as appropriate).
   Status: Complete.
8. C. Girardot/D. Harlow: Complete the B Farm Leak Location and Cause report and distribute (incorporate any comments as appropriate).
   Status: *Complete.*
9. C. Girardot/D. Harlow: Find information on SX Farm; including photos and construction diagrams and update SX Farm report as necessary.
   Status: Complete, additional boxes were ordered and contents reviewed, however, no additional applicable information was found

10. C. Girardot/D. Harlow: Initiate preparation of the tank C-101 Leak Location and Cause report to be discussed in an upcoming meeting.
    Status: Complete.

<u>Next Meeting:</u>

Part 2. Review Tank C-101 Leak Location and Cause report.
Date: April 16, (Part 1 and Part 2)
Time: 1:00-4:00 (as Part 2: 2:30 – 4:00)
Location: ECOLOGY Office. Conference Room 3B

ATTACHMENT 1

Comments and Resolutions to the 241-B Farm Report

From: Field, Jim G
Sent: Friday, February 22, 2013 9:25 AM
To: Harlow, Donald G; Girardot, Crystal L
Cc: Fort, Leslie A
Subject: Comments on B-107 Leak Location and Cause Report

1. Consider removing redundancy between Sections 3 and 4. It seems like some of the subsections could be eliminated from one and consolidated to the other.

Example: Discussion in sections 4.3 is common to all B farm tanks, suggest moving to 3.1 and eliminating 4.3.

This is the same format we use with all the other reports and want to be consistent. The B Farm review is the only report that just addresses one tank.

2. P. 3-8, 2d par. Reword to clarify that this is referring to tanks in other farms not just B farm. Suggest: "A number of leaking tanks in BY and TY Farm also stored undiluted TBP waste (reference). This indicates that storage of undiluted TBP waste could be a cause for liner failure."

Changed

3. Suggest in par. 3 of 4.7.3 add, (see Sections 3.2.4 and 4.4.4).

Changed

4. Section 4.7.3 should also include a paragraph explaining what is different about the B-107 chemistry compared to other B Farm tanks and why B-107 leaked, but they didn't. Or conversely why we may expect to see similar pitting and potential leaks from other B farm tanks.

Added in a sentence about two other B Farm tanks storing TBP waste. A detailed chemistry history was not performed for all of the other B Farm tanks as it is not included in the scope of the Leak Location and Cause task which focuses on the RPP-RPT-32681 identified leaking tanks. Seven of the B Farm tanks were recommended for a future D-42 leak assessment which would add information that could be used to fill in the missing information for a full B Farm comparison.

5. Suggest in the last sentence of 4.7.3 add "… storage standards, the presence of TBP waste likely created an environment where SSC corrosion could occur." (Without this addition, the sentence seems to imply that corrosion was possible but unlikely).

Changed

6. Move the Table of Contents for 4.0 on p. 4-1 to the TOC in the front of the report.

This is the same format we used with previous reports. The B Farm review is the only report that just addresses one tank.

Jim Field
2704HV rm B222, 376-3753
Washington River Protection Solutions
Contractor to the U. S. Department of Energy

REVIEW COMMENTS with RESPONSES
JOE CAGGIANO, 3-6-2013
DRAFT LEAK CAUSE AND LOCATIONS FOR B TANK FARM

1. Pg. 1-1, para 3. Many of the B Farm tanks were overfilled, resulting in potential releases to soil through spare inlet or other pipes. The release from B-107, according to what is stated, is suspected to be from loss of integrity of the steel liner due to chemically-induced corrosion. The distinction between releases due to loss of liner integrity and releases due to overfills is insignificant for environmental insults, but is potentially important for decisions regarding retrieval and future tank waste management and monitoring. Please address.

   Response: Agree, but we are focusing on the leaking tanks and their location and causes. The RPP-RPT-32681 farm assessments look at the environmental insults wherever they come from in addition to other vadose zone assessment documents.

2. Pg. 3-2, Fig. 3-2. The photo caption should state that the photo is looking south, as there isn't a map showing all tanks in B Farm. Please add.

   Response: A north arrow has been added to the photo to be consistent with previous tank farm segments.

3. Pg. 3-3, last lines, para 1. What does this statement mean and how is it relevant to the point you are trying to make? Please rewrite and explain.

   Response: Revised the paragraph and added a sentence to indicate the potential for brittle fracture if the steel was impacted during construction in cold weather.

4. Pg. 3-4, Liq. Level. It's good that you discuss the uncertainty of various LL measurements because that certainly contributes to an understanding of what may have happened. It's probably also worthwhile mentioning that there was an acceptable level of uncertainty in measurements associated with transfers, in both the sending and receiving tank (likely in the 5 – 10% range) so that could account for some of the challenges one faces—especially in interpreting drywell logging results. Please consider some mention of this.

   Response: Added a paragraph with a reference on transfer limits to section 3.2.1.

5. Pg. 3-5, Sect. 3.2.3. The "elastic" bulging of the liner, especially the tank bottom, could affect LL measurements if the amplitude of the bulge would change the LL beyond the range of measurement error. As this may have happened repeatedly, it could affect interpretation of changes in LLs. Could any of this be involved in the change in LLs between the indicated dates? Please address.

Response: Added a sentence indicating that the low temperatures in B Farm and the favorable design should not have caused tank liner bulging. No reports were found indicating B Farm tank liner bulging. The significant decrease in liquid level doesn't indicate a fluctuating tank liner. We have included the comment on fluctuating liners in the SX and A Farm leak location and cause segments which seems to be associated with boiling waste and would be addressed in the summary of the overall effort.

6. Pg. 3-6, TBP waste, para 3. Here, and elsewhere in the report, you use the term "neutralized" to a pH around 9.5. I think a better term is "adjusted" the pH. To me, and others, neutralizing would be to adjust the pH to ~7. Considering that pH is a log scale, this is a significant difference. Please change wording.

   Response: Changed the word "neutralize" to "adjust".

7. Pg. 3-8, Sect. 3.3.2, para 1. Neither drywells nor laterals will detect a release unless the waste impinges on the drywell/lateral. Logging is generally effective to a radius of ~1 ft., so if there is sufficient volume to induce lateral flow and the flow passes close to a drywell/lateral, it will be detected. That could happen at any depth in a drywell. Many drywells will show detections at or near the base of the tank, but the point of egress of waste from the tank doesn't necessarily correspond to this elevation. A slow leak somewhere along the tank wall might proceed down the tank wall until it reaches the footing at which point it moves laterally. Please clarify.

   Response: Added the effective radius and a sentence on the vertical height perspective.

8. Pg. 3-9, para 3. Please explain what you mean by "pseudo" detections. Are these operator error, instrument error, other? An example might be helpful.

   Response: Not sure what the word "pseudo" meant either and it seemed to be somewhat redundant with the word "unexplained" so deleted pseudo.

9. Pg. 3-9, para 4. The Red GM probe was for detecting higher levels of radiation that would swamp the Green GM probe (NaI). You state that all readings used were from the Red GM probe. Do you know what the limit of detection was for this probe? As it was shielded so it could read higher counts, could it have missed some lower level detections? Please address.

   Response: Added limit of detection and a reference for further information.

10. Pg. 3-10, last para Sect. 3.4. Here's where waste type can affect detections, as the gamma probes detect only gamma emitters—principally Cs-137 and Co-60. If a waste stream is deficient in Cs-137, this could affect whether a release is detected or the magnitude of the release. Please address.

Response: Added further clarification to the last paragraph on the ability to detect radioisotopes.

11. Pg. 4-21, 20-10-02. The GJO report shows probably Sr-90 at ~70 – 85 ft. What would be the potential source of this isotope? As Sr-90 decay is a significant heat generator, the source of this isotope might be significant. Any thoughts on this?

    Response: Added Ru-106 and Sr-90 information to the second paragraph and the GJ-HAN-128 indicated most likely source being tank B-110.

12. Pg. 4-23, Fig 4-14. This diagram shows the location of inlet lines and the cascade line, neither of which are real close to 20-07-02. The SGLS log clearly shows tank waste in this drywell at or close to the tank bottom. Even though the tank was overfilled, a release point somewhere in this vicinity with egress close to the tank bottom is suggested. Are there other possible sources for this signature? If not, then B-107 must have released waste. Please correct.

    Response: Agree, see Section 4.5.1.6 fourth paragraph also Section 4.6.1 and conclusions Section 4.8.

13. Pg. 4-24, Sect. 4.7.2. If there really is Sr-90 in the vicinity of B-107, then there is a source of heat for some tank/facility in that area. Please check and include.

    Response: With the 20-10-02 drywell showing some possibility of Sr-90 using shape factor results 27-ft. from tank B-107 and 3-ft. from tank B-110 would point in the direction of tank B-110 being the source of Sr-90, see Section 4.5.1.5. Tank B-110 has been recommended for a D-42 assessment.

14. Pg. 4-25, Conclusions. As drywell 20-07-02 is a principal line of evidence and it is on the NE side of the tank, how did you arrive at a leak from somewhere in the NW quadrant? Please clarify.

    Response: Corrected to NE side of tank.

15. Pg. 5-1. Was the fill history of tank B-107 that unique and different from other tanks in B Farm such that this is the most likely cause of a liner failure? Please check other tank histories in B Farm and explain your conclusion.

    Response: Comparison of the available information on B Farm tanks was included in section 5.0 and the associated tables. A detailed fill history was not performed for all of the other B Farm tanks as it is not included in the scope of the leak location and cause task which focuses on the RPP-RPT-32681 identified leaking tanks. Seven of the b farm tanks were recommended for a future D-42 leak assessment which would add information that could be used to fill in the missing information for a full b farm comparison.

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(1) Document Number: RPP-RPT-54913		(2) Revision Number: 0	(3) Effective Date:
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(b) Reviewer (Optional, Print/Sign):

T.J. Venetz *S J Venetz*	Date: 6/25/2013		Date:
	Date:		Date:
	Date:		Date:

(c) Responsible Manager (Print/Sign): D.J. Washenfelder *D J Washenfelder* Date: 06-25-2013

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INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part I: Background Information

Title: Hanford Single-Shell Tank Leak Causes and Locations- 241-B Farm	Information Category: ☐ Abstract ☐ Journal Article ☐ Summary ☐ Internet ☐ Visual Aid ☐ Software ☐ Full Paper ☒ Report ☐ Other
Publish to OSTI? ☒ Yes ☐ No	
Document Number: RPP-RPT-54913, Rev. 0	Date: 06/19/2013
Author: C.L. Girardot, D.G. Harlow	
Purpose of Document: Identifies leak causes and locations for B Farm tanks	

Part II: External/Public Presentation Information

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Date of Conference: N/A	Conference Location: N/A
Will Material be Handed Out? ☐ Yes ☒ No	Will Information be Published? ☐ Yes ☒ No *(If Yes, attach copy of Conference format instructions/guidance.)*

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Part IV: WRPS Internal Review

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Subject Matter Expert	Tank Integrity	6/24/2013	Crystal Girardot / Crystal Girardot
Responsible Manager	Tank Integrity	06/25/2013	DJWashenfelder / D J Washenfelder
Other:			

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From:	Lawrence, Hugh K
To:	Girardot, Crystal L
Cc:	Wolfley, Clinton T
Subject:	RE: RPP-RPT-54913 Rev. 0 for safety review
Date:	Wednesday, June 26, 2013 8:56:10 AM

Crystal,

I have reviewed the document photos you provided (RPP-RPT-54913 Rev.0). From an Industrial Safety point of view, the photos in this document are **approved** for external use.
Any question or comment please ask.

Hugh Lawrence
WRPS Safety Programs
cell (208) 547-7334

From: Girardot, Crystal L
Sent: Wednesday, June 26, 2013 7:48 AM
To: Lawrence, Hugh K
Cc: Harlow, Donald G
Subject: RPP-RPT-54913 Rev. 0 for safety review

Hugh,

Could you please provide a safety review of the pictures in the attached document for external release? If acceptable, please email your approval to me.

Thanks!

Crystal