241-AZ Tank Farm Construction Extent of Condition Review for Tank Integrity

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Abstract: This report provides the results of an extent of condition construction history review for tanks 241-AZ-101 and 241-AZ-102. The construction history of the 241-AZ tank farm has been reviewed to identify issues similar to those experienced during tank AY-102 construction. Those issues and others impacting integrity are discussed based on information found in available construction records, using tank AY-102 as the comparison benchmark. In the 241-AZ tank farm, the second DST farm constructed, both refractory quality and tank and liner fabrication were improved.

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EXECUTIVE SUMMARY

The construction history of the 241-AZ tank farm has been reviewed to identify any concerns for the long-term integrity of the tanks. This initial review was prompted by construction issues identified during the formal leak assessment for tank 241-AY-102 (AY-102), RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report.* In AY-102, bulges in the secondary liner, deterioration of refractory during post-weld stress relieving (post-weld heat treatment), and primary tank floor plate welding rework during construction left residual stresses in the tank that may have accelerated corrosion and contributed to the primary tank failure. The main purpose of this review was to determine whether the construction methods adopted after completion of the 241-AY tank farm either improved the quality and integrity of the second double-shell tank farm built (241-AZ tank farm) or produced similar reduced margins.

During construction of the 241-AZ tank farm, fewer welding problems of the secondary liner and primary tank bottoms were noted compared to the 241-AY tank farm. The secondary liner bottom thickness in the 241-AZ tank farm was increased to 3/8 in. (from 1/4 in. in 241-AY tank farm) and only a minor mention of secondary liner irregularities was noted, requiring the refractory thickness to be increased to ensure a thickness of at least 8 inches in all locations. The thickness of the primary tank bottom was also increased from 3/8 in. in the 241-AY tank farm to 1/2" in the 241-AZ tank farm. The overall primary liner weld rejection rates were much lower in the 241-AZ tank farm. Refractory installation and weather protection were improved and although issues with this protection were noted, no significant refractory repairs were required. The post-weld stress relieving process required modifications, but the changes allowed for more efficient and effective heat treatment in tanks 241-AZ-101 (AZ-101) and 241-AZ-102 (AZ-102) compared to the tanks in the 241-AY tank farm.

The most significant deficiency found was the presence of plate laminations. Some surface grinding on the bottom plate of the primary tank occurred. In tank AZ-102, six plates in the upper shell ring were found to have laminations, with four of them severe enough to require replacement prior to heat treatment. Other minor issues, unique to the 241-AZ tank farm were noted. Both primary tanks had leaks found during the hydrostatic test. They were above the normal waste level and repaired without additional stress relieving. A square groove was discovered to have been ground into one weld in the lower knuckle in the tank AZ-101 primary side wall after heat treatment, but this condition was evaluated and accepted as-is. Fires occurred during construction in the annulus of tank AZ-102 and in the bottom of the primary tank in tank AZ-102 but the job logs did not indicate that any significant damage was caused by these two fires. These issues are not expected to significantly affect the tank integrity.

Following completion of the 241-AY tank farm, design evaluations and lesson learned meetings occurred to remedy issues encountered during construction and resulting changes were incorporated into the 241-AZ tank farm. Although there were improvements in the construction of 241-AZ tank farm, issues were still noted, some unique to tanks AZ-101 and AZ-102. Tanks AZ-101 and AZ-102 should remain in a category subject to enhanced inspection.

TABLE OF CONTENTS

TABLE OF APPENDICES

LIST OF FIGURES

LIST OF APPENDIX FIGURES

LIST OF TABLES

LIST OF TERMS

Abbreviations and Acronyms

AEC	Atomic Energy Commission
ARHCO	Atlantic Richfield Hanford Company
ASME™	American Society of Mechanical Engineers
ASTM™	American Society of Testing Materials
DST	Double-Shell Tank
IDMS	Integrated Data Management System
LDP	Leak Detection Pit
NCR	Non-Conformance Report
NDE	Non-Destructive Examination
PDM	Pittsburgh-Des Moines Steel Company
PWHT	Post-Weld Heat Treatment[1] (also referred to as post-weld stress relieving and annealing)
PUREX	Plutonium Uranium Extraction Process
RHA	Records Holding Area
SRP	Shell Ring Plate
SST	Single Shell Tank
WADCO	Westinghouse Advanced Development Company
WRPS	Washington River Protections Solutions LLC
WST	Waste Storage Tank
WTP	Waste Treatment and Immobilization Plant

Units

ft	Feet
in	Inch
h	Hour
lb	Pound
gal	Gallon

TRADEMARK DISCLOSURE

ASME is a registered trademark of American Society of Mechanical Engineers
ASTM is a registered trademark of American Society for Testing and Materials
Kaolite is a registered trademark of Babcock & Wilcox Company

[1] This is the process used to relieve stresses in the material caused by welding.

1.0 INTRODUCTION

This document provides an overview of the construction history noting any difficulties encountered for 241-AZ tank farm, the second double-shell tank (DST) farm constructed. In October 2012, it was determined that the primary tank of DST 241-AY-102 (AY-102) was leaking (RPP-ASMT-53793, Rev. 0, *Tank 241-AY-102 Leak Assessment Report*). Bulges in the secondary liner, deterioration of refractory during post-weld stress relieving, and primary tank floor plate welding rework during construction compromised the intended robustness and corrosion resistance of the tank AY-102 design and probably contributed to the primary tank's failure in tank AY-102.

Following identification of the tank AY-102 probable leak cause, an Extent of Condition (EOC) evaluation was prepared using U.S. Department of Energy's Energy Facilities Contractors Group (EFCOG) *Guidance for Extent of Conditions Evaluations*. The EFCOG process was used to identify other DSTs with construction, waste storage, or thermal histories similar to that of tank AY-102 (WRPS-1204931, *Double-Shell Tank 241-AY-102 Primary Tank Leak Extent of Condition Evaluation and Recommended Annulus Visual Inspection Intervals*). The EOC evaluation identified six tanks with similar construction and operating histories for additional evaluation which include: 241-AY-101, 241-AZ-101, 241-AZ-102, 241-SY-101, 241-SY-102, and 241-SY-103. One of the identified evaluations was to identify any similarities in construction that could be a precursor for accelerated corrosion and premature failure.

1.1 PURPOSE

The construction history of the 241-AZ tank farm has been reviewed to identify issues similar to those experienced during tank AY-102 construction. In this document, those issues and others impacting integrity are discussed based on information found in available construction records, using tank AY-102 as the comparison benchmark.

1.2 OVERVIEW

Six double-shell tank (DST) farms were constructed over a period of roughly 18 years (from 1968 to 1986), with a presumed design life of 20 to 50 years. 241-AZ tank farm was the second DST farm to be constructed and is the focus of this report. Table 1-1 provides the construction dates, year of initial service, and the expected service life for the DSTs. Following completion of the first DST farm, 241-AY tank farm, design evaluations and lesson learned meetings occurred to remedy issues encountered during construction and were incorporated into the design and fabrication of the 241-AZ tank farm. Discussion of the resulting quality of construction and any issues noted are captured herein.

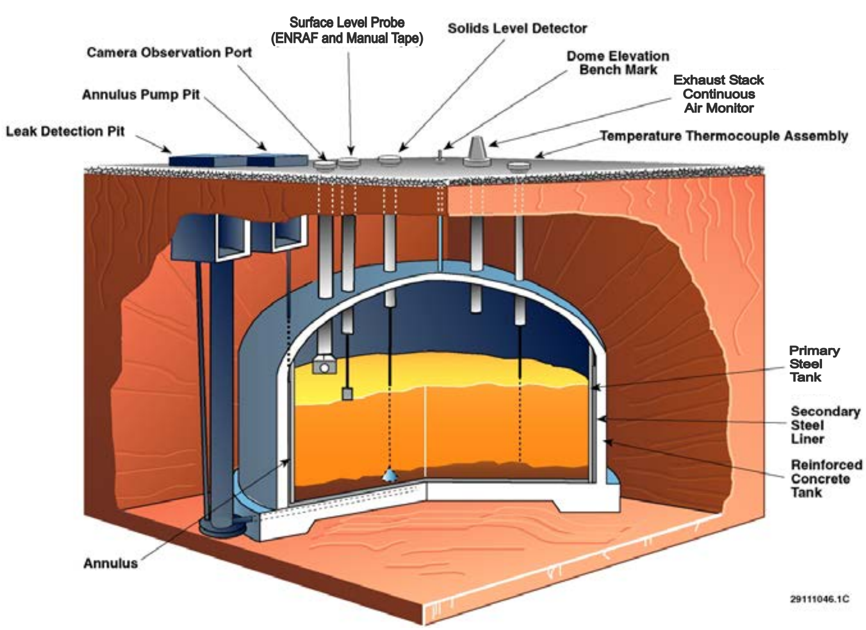
Table 1-1. Double-Shell Tank Construction and Age as of 2013

Tank Farm	Number of Tanks	Construction Period	Construction Project	Initial Operation	Service Life	Current Age
241-AY	2	1968 – 1970	IAP-614	1971	40	42
241-AZ	2	1970 – 1974	HAP-647	1976	20	37
241-SY	3	1974 – 1976	B-101	1977	50	36
241-AW	6	1976 – 1979	B-120	1980	50	33
241-AN	7	1977 – 1980	B-130, B-170	1981	50	32
241-AP	8	1982 – 1986	B-340	1986	50	27
Total	28					

1.3 DOUBLE-SHELL TANK DESCRIPTION

Each DST consists of a primary carbon steel tank, 75 ft. in diameter, inside of a secondary carbon steel liner, which is surrounded by a reinforced-concrete shell. Both the primary tank and secondary liner are constructed in four courses. The primary steel tank rests atop an eight inch insulating concrete slab, separating it from the secondary steel liner, and providing for air circulation/leak detection channels under the primary tank bottom plate. An annular space of 2.5 ft. exists in between the secondary liner and primary tank, allowing for visual examination of the tank wall and secondary liner annular surfaces and ultrasonic volumetric inspections of the primary tank walls and secondary liners, as well as other activities.

Figure 1-1. Double-Shell Tank Design



Each of the DSTs in the 241-AZ tank farm has 105 risers penetrating the dome, providing access for video cameras, ultrasonic inspection devices, waste sampling devices, mixer pumps, and other equipment which requires access to either the primary tank interior or annular space. Drawing H-14-010507, Sheet 1, *Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-101*, and Sheet 2, *Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-102*, provides a complete depiction of these tank penetrations. Above each 241-AZ DST are four pits, extending from grade to varying depths, which house valves and pumps, shown on drawing H-14-010507, Sheet 1 and 2.

2.0 241-AZ TANK FARM CONSTRUCTION INFORMATION

The 241-AZ tank farm was constructed between 1970 and 1974. It was designated as Project HAP-647, *Tank Farm Expansion 241-AZ Tank Farm*. The Atlantic Richfield Hanford Company (ARHCO) built the tank farm for the Atomic Energy Commission (AEC). The 241-AZ tank farm contained two tanks and ancillary equipment. The tanks were designed and designated as aging waste tanks for receipt of PUREX waste. Pittsburgh-Des Moines Steel Company (PDM), the contractor selected to build the tank farm, was also the contractor selected for the 241-AY tank farm, which was the first double-shell tank (DST) farm. Construction management was provided by Vitro Engineering.

The 241-AZ tank farm was built according to ARH-1437, *Design Criteria Purex AZ Tank Farm*, and the following construction specifications:

- HWS-8981, *Specifications for Excavation and Tank Foundations*
- HWS-8982, *Specifications for Primary and Secondary Steel Tanks*
- HWS-8867, *Specification for Completion of Tank 102*

To obtain information about the construction of 241-AZ tank farm, the Record Holding Area (RHA) and Integrated Data Management System (IDMS) were queried for boxes containing files from Project HAP-647, *Tank Farm Expansion*, *241-AZ*.

This information includes:

1. Weld Radiography
2. Materials Certifications
3. Non-conformance reports
4. Quality Assurance construction log books
5. Project reports, correspondence, and meeting minutes

The following sections provide an aggregation of the information collected, highlighting important events and information relevant to leak integrity. From the information collected, the resulting quality of construction and any issues or difficulties noted are discussed in this document.

3.0 MATERIALS OF CONSTRUCTION

The materials of construction evolved from the construction of the 241-AY tank farm to the construction of the 241-AZ tank farm. The primary change in material selection was to increase the thickness of the secondary liner and primary tank bottom plates. The refractory material and pour pattern were also modified.

Table 3-1. Material Comparison Between 241-AY and 241-AZ Tank Farms.

Material	Tank Farm	
	241-AY	**241-AZ**
Concrete	3000 psi Type V for the walls; Type III for the upper haunch and dome	3000 psi Type V for the walls; Type III for the upper haunch and dome
Reinforcing Bar	A432	A615-60
Steel Plate	ASTM A515-65	ASTM A515-69
Refractory	Kaolite[2] 2200LI	Kaolite 2000

3.1 CONCRETE

All concrete used in the concrete shell vertical wall and dome required a 3,000 psi, 28-day compressive strength. The concrete samples were taken and tested at 7 days and 28 days to confirm the compressive strength. The cement for structural concrete conformed to Federal Specification SS-C-192 Type V, except what was used for the haunch and dome sections of the DSTs conformed to Type III, as described in HWS-8867. Type III cement is high early strength cement and Type V cement is high sulfate resistant cement.

3.2 REINFORCING BAR

The reinforcing bar was manufactured to American Society of Testing and Materials (ASTM[3]) ™ A615, Grade 60 specifications with minimum yield strength of 60,000 psi. The tank foundation was reinforced with #5, #6, and #7 rebar (see H-2-67243, *Structural Concrete Tank Foundation Plan and Details*, for details) while the concrete walls and dome sections were reinforced with #4, #6, #8, and #9 rebar (see H-2-67245, *Concrete Tank Section and Haunch Reinforcement*, for details).

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[2] **Kaolite** is a registered trademark of Babcock & Wilcox Company
[3] **ASTM** is a registered trademark of American Society for Testing and Materials

3.3 STEEL PLATE

All sheet steel used in the 241-AZ tank farm primary tank and secondary liner construction was shipped from the United States Steel Corporation and was manufactured to ASTM A515, Carbon Steel, for Intermediate and High Temperature Service, Grade 60, standards. The tanks were erected using the 1968 Edition of the ASME[4] Boiler and Pressure Vessel Code.

3.3.1 Secondary Plate

The secondary liner consists of 3/8 in. thick bottom plates and a 1/2 in. thick knuckle sections. The walls of the secondary liner are 3/8 in. thick. Drawing H-2-67317, *Tanks 101 and 102 Section and Details 241-AZ Tank Farm*, shows these details.

3.3.2 Primary Plate

The primary tank bottom primarily consists of 1/2 in. carbon steel plates, except for the 4 foot diameter center which is composed of a 1 in. thick carbon steel plate, and a 7/8 in. carbon steel plate is used for the primary tank bottom knuckle.

The primary tank wall varies from 7/8 in. thick carbon steel at the bottom knuckle to 3/8 in. thick at the top transition plate. The first course is 3/4 in. thick, and the next two courses are 1/2 in. thick.

The top transition plate is welded to a 3/8 in. thick top knuckle. The top knuckle is then welded to the primary tank dome, which is constructed of mostly 3/8 in. thick plates with the center portion of the dome having a thickness of 1/2 in. Drawing H-2-67317 shows these details.

3.3.3 Material Certification

Material certifications and chemical and physical test reports were required for each steel plate which was identified by a heat and slab number.

Material certifications contained yield and tensile strength information along with percent elongation for each specific heat and slab number.

The chemical and physical test reports identified the percent of each element (i.e., carbon, manganese, phosphorus, etc.) contained within a sample of the material as well as properties such as, yield point, tensile strength, percent elongation, and information gathered from bend test results.

[4] **ASME** is a registered trademark of American Society of Mechanical Engineers

3.4 REFRACTORY

The castable refractory was required to limit the structural concrete base slab to a maximum temperature of 500°F. The material had to have a minimum compressive strength of 130 psi after heating either wet or dry. In addition, the material had to be compatible with the tank waste chemistry. Kaolite 2000 (Kaolite) was used as the insulating refractory in the 241-AZ tank farm.

3.5 PIPING

All pipe used for permanent risers was manufactured to ASTM A53, Grade B, Type E or S, or ASTM A106, Grade A or B specifications. Flanges conformed to ASTM A181, Grade I specifications. Coal tar enamel with bonded asbestos felt wrap and an outer wrapping of kraft paper was used for corrosion protection for un-insulated black steel pipelines (HWS-8867).

4.0 CONSTRUCTION SEQUENCE

Construction of the two 241-AZ farm tanks was awarded to PDM. Excavation began in 1970 and the project was completed in 1974. The construction manager was Vitro Engineering. Following completion of the excavation work, the construction sequence of the 241-AZ tank farm tanks proceeded as follows:

1. Install concrete foundation on which the secondary liner bottom rests. The foundation has a tertiary leak detection system, which includes a waffle grid in the structural concrete, collection pipes, and a leak detection pit.
2. Fabricate and inspect the secondary liner bottom up to the top of the bottom knuckle plate, elevating it onto cribbing to facilitate access to the underside.
3. Inspect secondary liner bottom.
4. Lower the secondary liner bottom onto the concrete foundation using a truss assembly.
5. Fabricate and inspect the secondary liner wall up to the placement of the secondary top knuckle.
6. Install the air supply piping, and thermocouple conduits, to be embedded in the refractory as well as the retainer ring used as a form for the perimeter of the refractory.
7. Install refractory (during secondary liner wall erection).
8. Fabricate and inspect the primary tank bottom up to the top of the bottom knuckle plates, elevating it onto cribbing to facilitate access to the underside.
9. Inspect primary tank bottom.
10. Lower the primary tank bottom onto the refractory.
11. Place the concrete shell.
12. Start backfilling the tank farm area.
13. Fabricate and inspect the primary tank walls and wall penetrations.
14. Install temporary center support post to support dome sections.
15. Fabricate and inspect the primary tank dome and dome penetrations.
16. Install tank dome support superstructure (truss) to support the dome during concrete pour.
17. Insulate and provide stress relief of the primary tank.
18. Conduct hydrostatic test of the primary tank.
19. Complete fabrication of the secondary liner and penetrations.
20. Place concrete over the upper haunch area and tank dome.
21. Remove the tank superstructure after dome concrete cured.
22. Install appurtenances (thermocouple trees, airlift circulators, etc.).
23. Backfill to top of the dome.
24. Install the waste transfer system of piping, pump pits, and valve pits.
25. Complete backfill.

4.1 CONCRETE FOUNDATION

The structural reinforced concrete foundation is 89 ft. 6 in. in diameter and is designed to distribute all weight loads uniformly. The circular center portion of the foundation is 6 ft. in diameter and 2 ft. thick. From the circular center portion, the foundation thickness decreases linearly out to about 1 ft. thickness at the 12 ft. 8 in. diameter and maintains that thickness out to the 47 ft. 9 in. diameter. The thickness then increases linear to a thickness of 2 ft. over the next 8 ft., radially. The 2 ft. thickness is maintained to the perimeter of the tank at the 89 ft. 6 in. diameter. The structural foundation contains slots to direct any leakage to drain lines which empty to a leak detection pit (LDP). The foundation is composed of reinforced steel and concrete, requiring a 3000 psi, 28-day compressive strength (see drawing H-2-67243, *Structural Concrete Tank Foundation Plan and Details*, for details). Figure 4-1 shows the foundation prior to the placement of the concrete and the rebar and wood used to form the slots. Figure 4-2 shows the completed tank foundations, including the slots that direct any accumulation of liquid to the drain lines. Tank AZ-101 is in the foreground and tank AZ-102 can be seen in the background.

Figure 4-1. Progress on Tank Bases – Looking West (54511-15 Photo) (Taken 3/22/71)

Figure 4-2. Overall View of Foundation Construction – Looking West (53930-1 Photo) (Taken 1/22/71)

4.2 SECONDARY LINER BOTTOM

The secondary liner bottom was constructed onsite on top of the concrete foundation, with a protective cover installed to minimize damage to the concrete. The secondary liner bottom knuckles were fabricated offsite at a PDM fabrication facility in Provo, Utah, prior to being shipped to the worksite for welding to join the knuckles with the adjacent plates. The secondary liner bottom plates are 3/8 in. thick carbon steel, increased from the 1/4 in. thick plates in the 241-AY tank farm, and the bottom knuckles are made of 1/2 in. thick carbon steel. The secondary liner is 80 ft. in diameter and is shown in Figure 4-3.

Figure 4-3. Viewing Erection of the Two Tanks' Secondary Liners (55748-6 Photo) (Taken 8/25/71)

Individual plates would be placed on the concrete foundation, and fabricators would use fit-up tools to secure the plates within the allowable tolerance to allow for proper welding. After completion of fabrication on the top side of the secondary plates, the fabricator raised the secondary liner bottom to gain access to the bottom side of the plates. The secondary liner bottom was raised with hydraulic jacks, and cribbing was installed under the secondary liner to allow workers to gain access to the underside.

Figure 4-4. Constructing Secondary Liner – Looking North (55808-3 Photo) (Taken 8/30/71)

After completion and inspection of the welds, as described in Table 5-3, in Section 5.1 the secondary liner bottom was lowered, using a superstructure that supported it from the top to limit deformation. Figure 4-4 and Figure 4-5 show the super structure and cribbing that was used to elevate the secondary liner, facilitating welding activities. Prior to lowering the secondary liner bottom down onto the concrete foundation, the slots and center sump region of the foundation were cleaned with the knowledge that further access into these locations would not be provided again.

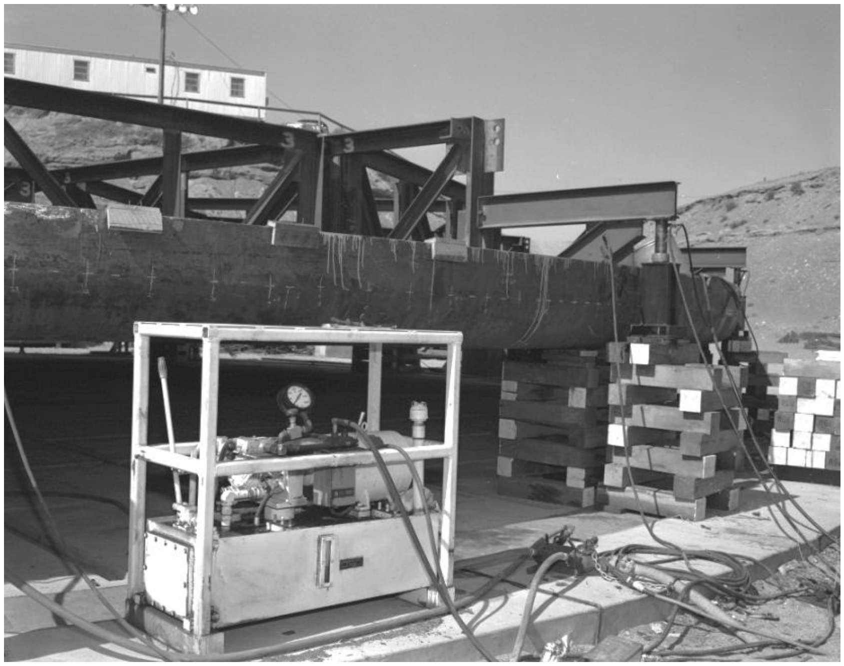


Figure 4-5. Secondary Liner Raised with Cribbing and Superstructure (55808-4 Photo) (Taken 8/30/71)

4.3 REFRACTORY

The primary purpose of the refractory was to act as an insulating barrier between the primary tank and the concrete foundation during the stress relieving process where temperatures could damage the concrete if not protected. The refractory design used for the two 241-AZ tank farm tanks specified a nominal 8 in. layer of Kaolite to be located between the primary tank and secondary liner bottom. The refractory pad also housed air ventilation piping, thermocouple conduit, and air distribution slots. The air distribution slots, patterned differently than those in the 241-AY tank farm, allowed airflow to cool the primary tank bottom and to direct potential leaks to the tank annulus where leak detection instrumentation is installed (see H-2-67317, *Tanks 101 & 102 Section & Details 241-AZ Tank Farm*). Figure 4-6 shows a completed section of refractory before the forms for the air circulation grooves were removed.

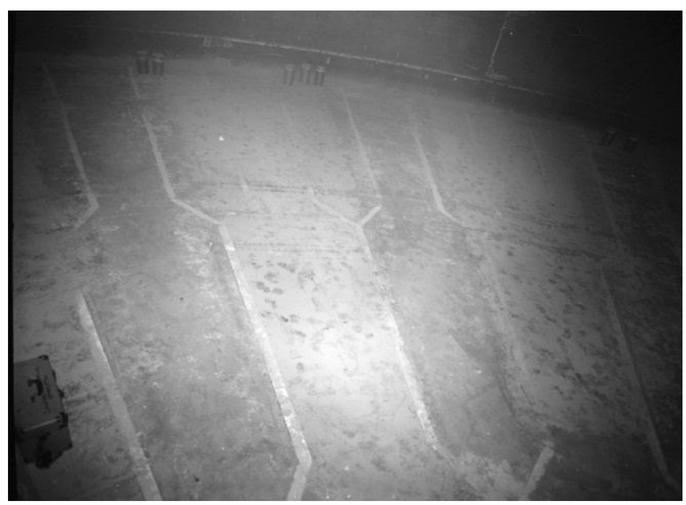


Figure 4-6. Tank AZ-101 Completed Castable Refractory Section Pour (55952-5 Photo) (Taken 9/17/71)

Prior to installing the refractory, thermocouple conduit was installed and located as necessary to allow temperature monitoring of the primary tank bottom once placed into service. Four ventilation pipes were installed in the refractory, terminating at the center of the foundation with an air distribution ring. Figure 4-7 shows the interface between the four, 4 in. ventilation pipes and the air distribution ring. Air is drawn through this ventilation piping to the air distribution ring and out along the air distribution slots in the refractory. The structure above the air distribution ring is a screed used to smooth the refractory surface.

Figure 4-7. Tank AZ-101 Air Distribution Ring, 4 in. Air Supply Line, and Air Distribution Channels (55952-3 Photo) (Taken 9/17/71)

Following the installation of the ventilation piping, center air distribution ring, and thermocouple conduit, a 7 in. x 3/4 in. retainer ring was installed along the perimeter of the yet to be installed refractory. The retainer ring was to act as a form and to contain any spalling material during installation of the refractory. The ventilation piping and the thermocouple conduit penetrate through the retainer ring. Figure 4-8 shows the ventilation piping penetration. Figure 4-9 shows the work practices utilized for refractory pouring and shows a hole that was cut into the side of the secondary liner to allow entry of workers and materials. These holes were cut into both tanks AZ-101 and AZ-102. They were later sealed in January 1972 as is discussed in the daily logbooks. The logbook entries are summarized in Appendix A and provide additional details of the sealing which occurred between January 13th and 19th of 1972.

Figure 4-8. Refractory Retainer Ring and Ventilation Piping Interface (57482-17 Photo) (Taken 3/24/72)

Figure 4-9. Tank AZ-101 Forms Placed and Refractory Being Poured (55952-6 Photo) (Taken 9/17/71)

4.4 SECONDARY LINER WALL AND CONCRETE SHELL

Figure 4-10. Overall View of Tank Construction – Looking West (56502-1 Photo) (Taken 11/22/71)

Following the secondary liner bottom fabrication, work began on the secondary liner wall. The secondary liner wall, shown in Figure 4-10 and Figure 4-11, is made up of a four plate course, including a bottom and top knuckle. The 3/8 in. thick secondary liner wall was welded up to the elevation just below the secondary top knuckle. Due to the curvature of the top knuckle and the requirement for access into the annulus during the primary tank construction, the top knuckle was installed after completion of all welding, inspection, stress relieving, and hydrostatic testing of the primary tank.

The concrete shell is 83 ft. outside diameter, is 1 1/2 ft. thick, and rests on steel bearing plates supported by the tank foundation. The concrete shell was poured directly against the secondary liner (i.e., the secondary liner was used as a casting form for the concrete shell). The vertical portion of the reinforced concrete shell was poured in three courses. Each course was composed of concrete requiring a 28-day compressive strength of 3,000 psi. All three courses were completed prior to allowing backfill to begin. Figure 4-12 shows the site before backfilling occurred and Figure 4-13 shows it after partial backfilling.

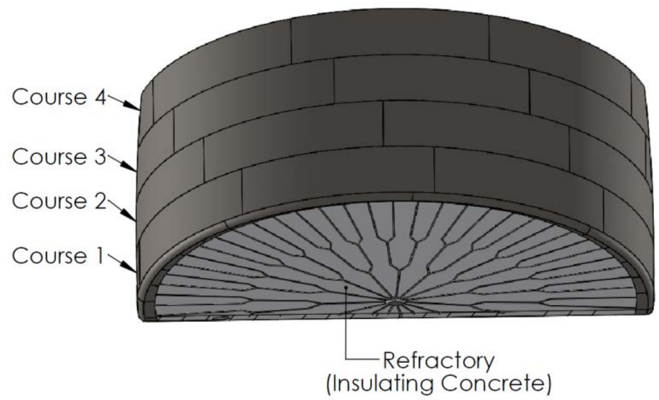


Figure 4-11. Cross-Section of Primary Tank and Refractory

Figure 4-12. Vertical Concrete Shell Pouring (56710-9 Photo) (12/21/71)

Figure 4-13. Backfilling Operations (56929-11 Photo) (Taken 1/21/72)

4.5 PRIMARY TANK BOTTOM

Following the pouring and curing of the refractory, work began on the primary tank bottom. The work to construct the primary tank bottoms of tanks AZ-101 and AZ-102 occurred between October 1971 and December 1971. In the case of tank AZ-102, some welds were inspected and repaired on the primary tank bottom through mid-January 1972 before they were considered acceptable.

The tank primary bottom is composed of primarily 1/2 in. thick steel plates, increased from 3/8 in. used in the 241-AY tank farm, with the exceptions of the center 4 ft. diameter which is composed of

Figure 4-14. Welders Repairing Welds on the Primary Tank Bottom Sections Looking South, Tank AZ-101 (56272-6 Photo) (Taken 10/26/71)

1 in. thick steel plate, and a 7/8 in. thick plate used for the bottom knuckle. A small vertical section of 7/8 in. thick steel plate, referred to as the bottom transition plate, is also joined to the bottom knuckle. Similar to the secondary liner bottom, the welds on the top of the primary tank bottom were completed and the assembly was lifted up and placed on cribbing to allow workers to access the bottom of the plates. Figure 4-14 and Figure 4-15 show workers repairing welds on the primary tank bottom of tanks AZ-101 and AZ-102, respectively. For methods of inspection and acceptance of tank welds, see Table 5-3, in Section 5.1.

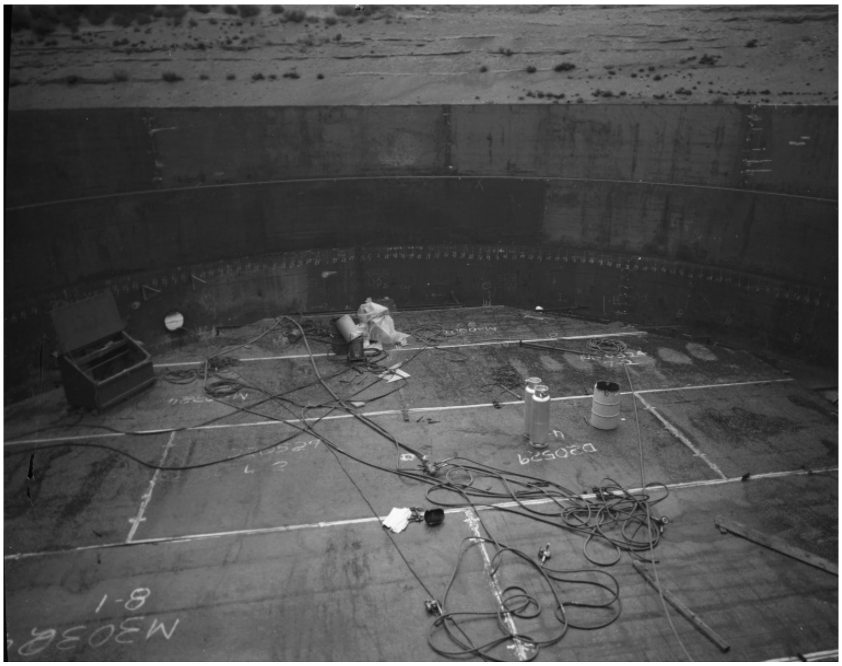


Figure 4-15 Weld Repairs in Progress on Tank AZ-102 – Looking South (56272-4 Photo) (Taken 10/26/71)

4.6 PRIMARY TANK WALL AND TANK DOME

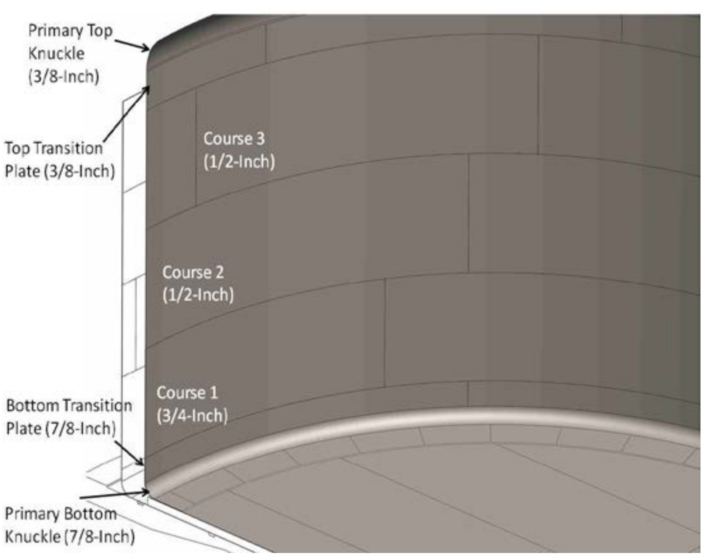


Figure 4-16. Cross-Section of Primary Tank

The primary tank measures 75 ft. in diameter (measured from the centerline of the steel plates composing the cylindrical section). While the vertical wall of the secondary liner is all 3/8 in. thick steel, the primary tank vertical wall plate thickness begins at a thickness of 7/8 in. and decreases as the elevation increases. Above the bottom knuckle and bottom transition plate, there are three main courses of plates as shown in Figure 4-16. Course 1 is 3/4 in. thick, the next two courses are 1/2 in. thick, and above the third course plate is a 3/8 in. thick plate referred to as the top transition plate. This

Figure 4-17. Construction Progress on Tank AZ-101 (57174-14 Photo) (Taken 2/22/72)

top transition plate is butt welded to a 3/8 in. thick primary top knuckle, which begins the elliptical shape of the steel tank dome.

To facilitate the installation of the tank dome plates, a temporary center support pole was installed. This pole provided a resting place for the tank dome plates for proper fit-up and welding. Several smaller dome sections were welded together on supports at grade level, before being lifted by a crane and welded in place. Figure 4-17 shows detail of the dome installation. After fabrication was complete, the center support pole was removed.

4.7 PRIMARY TANK STRESS RELIEVING

After installation of the risers, the tanks were prepped for post-weld stress relieving. Insulation was installed over the primary tank and in the annulus to protect the concrete foundation from high temperatures and to help regulate the heating of the primary tank. The refractory also protected the concrete foundation. The insulation used to retain heat and protect the concrete can be seen wrapped around the primary tank in 241-AZ tank farm on May 25, 1972 (Figure 4-18, Figure 4-19, and Figure 4-20).

Figure 4-18. Insulation Installed and Held in Place with Wire Mesh on Tank AZ-102. (58073-4 Photo) (Taken 5/25/72)

The requirements for stress relieving were in accordance with ASME Code, Section VIII (1971) which specified a holding temperature of 1100°F for 1 hour. In addition, the difference between maximum and minimum temperatures in the tank at any given time was required to be less than 200°F. Thermocouples were installed throughout the tank to measure the temperature inside the tank. The thermocouples installed during the insulating refractory pour were used to monitor the progress of the tank post-weld stress relieving temperatures in the primary tank bottom.

Section 16, "Stress Relieving," of HWS-8982, *Specification for Primary and Secondary Steel Tanks Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm*, provided the following direction for stress relieving:

b. "Stress relieving shall be in accordance with Paragraph UCS-56, Section VIII, of the ASME Boiler and Pressure Vessel Code, except that:

1) With reference to Note 1, Table UCS-56 tabulation, the minimum allowable holding temperature shall be 1000°F.

2) The rate of temperature rise and reduction between 600°F and 1000°F shall be no more than 100°F, per hour.

3) The period of heating from 600°F to 1100°F shall consume no more than 12 hours.

4) During the heating-up period, above 600°F, the temperature of all parts of the tank being heated shall be uniform with a maximum temperature differential at any time, between the highest and lowest temperature, of 200°F."

Table 4-1. Post-Weld Stress Relieving in 241-AZ Tank Farm

Event	AZ-101	AZ-102
Burners Turned On	3:30 p.m. April 19, 1972	5:08 p.m. May 24, 1972
Completed Initial Hold Time to Cure Refractory	Unknown	Unknown
Completed Final Hold Time for Post-Weld Stress Relief	1:40 p.m. April 20,1972 Two Hour Hold at 1050°F	12:10 a.m. May 26, 1972 Three Hour Hold at 1000°F
All Thermocouples Reading Below 600°F Recorders Turned Off.	Unknown	Unknown

The heating occurred in several stages and key events were captured in a stress relieving log. Important entries from this log have been included in Appendix A.

4.7.1 Tank AZ-101

Following a previously unsuccessful attempt, official startup of the successful stress relieving on tank AZ-101 was at 3:30 p.m. on 4/19/1972 (see Section 5.7). The contractor (PDM) had 12 hours to raise the temperature of the tank to 600°F. When the first thermocouple reached 600°F, the lowest thermocouple was required to be at least 400°F to maintain the differential below the maximum 200°F. Another 12 hour stage would follow when the lowest thermocouple reached 600°F to then elevate the temperature to 1100°F. At 7:30 p.m., the highest reading was 500°F and the lowest was 300°F. PDM began trying to reduce the differential. At 11:00 a.m. on

4/20/1972, PDM started the 3 hour hold with the lowest thermocouple at 1000°F; however, the tank continued to heat and, at 11:40 a.m., the lowest thermocouple temperature reached 1050°F. With the increased temperature of 1050°F, a reduced hold time of 2 hours was allowed per Table UCS-56, Note 1, ASME Section VIII ASME Boiler and Pressure Vessel Code. A 2 hour hold time was initiated at 11:40 a.m. and then terminated at 1:40 p.m., which began the cooling phase. Cooling rate for the first two hours was 40-70°F per hour.

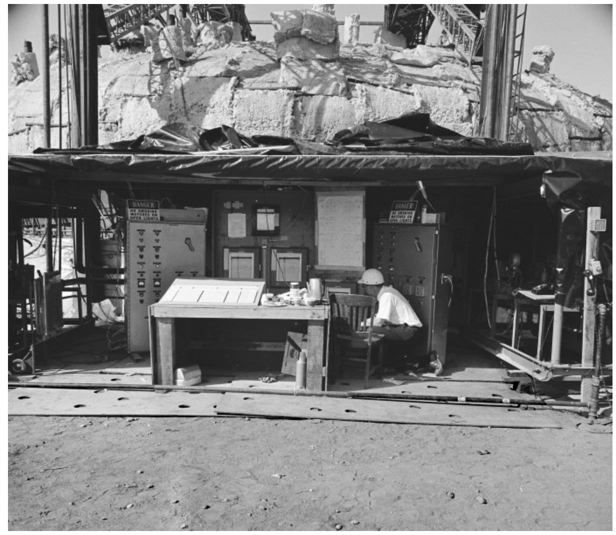


Figure 4-19. Worker Monitoring Chart Recorders for PWHT of Tank AZ-102 (58073-1 Photo) (Taken 5/25/72)

4.7.2 Tank AZ-102

Official startup of stress relieving on tank AZ-102 was at 5:08 p.m. on 5/24/1972. At 8:00 p.m., all thermocouple temperatures were reading below 600°F and the average temperature reading in the Kaolite was over 250°F. On 5/25/1972 at 3:45 p.m., the maximum temperature was 600°F and the minimum temperature was 400°F. By 10:10 p.m. on that same day, the maximum temperature reached 715°F with the minimum temperature at 520°F. At midnight that night, the minimum temperature reached 600°F and the temperature was increased by 50-60°F per hour. The last thermocouple reached 1000°F at 9:10 a.m. on 5/26/1972 when the maximum temperature recorded was 1160°F. The 3 hour hold time initiated at this time. At 12:10 p.m., cooling began, concluding the post-weld stress relieving operation on tank AZ-102.

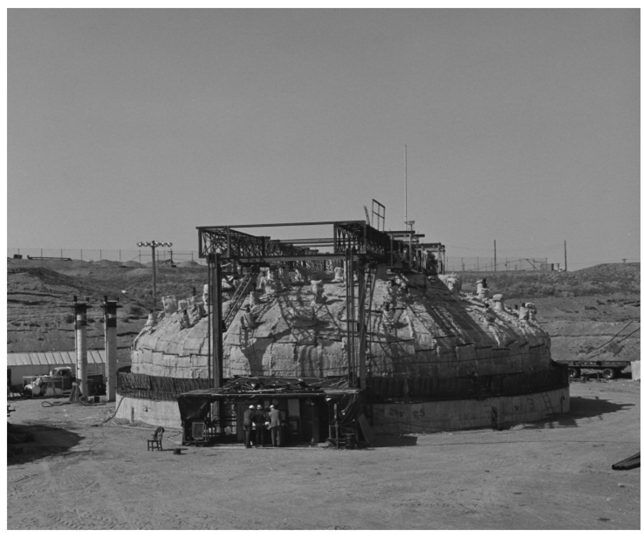


Figure 4-20. Overview of Tank AZ-102 PWHT Activities (58073-5 Photo) (Taken 5/25/72)

4.8 PRIMARY TANK HYDROSTATIC TEST

After completion of stress relieving, the heating equipment and temporary insulation were removed in preparation for hydrostatic testing to begin.

Section 18, "Hydrostatic Test," of HWS-8982, *Specification for Primary and Secondary Steel Tanks Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm*, provided the following direction for hydrostatic testing:

a. "After the tank has been stress relieved, a full hydrostatic test shall be applied to the primary tanks by filling with water to a depth of 39 feet from the bottom of the tank (±1 inch). One of the vertical risers near the center of the tank dome shall be used for introduction of water. Air bleed ports shall be provided during the test. All accessible weld joints below the water level shall be coated with blue chalk. A preliminary hydrostatic test may be made, before stress relieving, at the Contractor's option.

b. The hydrostatic pressure shall be maintained for 24 hours.

c. *Leak detection shall be by visual inspection of each welded joint previously coated with blue chalk."*

Official startup of hydrostatic testing on tank AZ-101 was on 4/24/1972 with the start of tank filling. Prior to reaching the desired level for the hydrostatic test, the primary tank wall penetrations for product side fill lines were blanked. On 4/28/1972, the water level in the tank had reached 467 1/2 inches. The weld joints were chalked and then inspected on 5/1/1972 with leakage noted in five areas on a dome section. The water level was lowered and the areas were repaired.

Official startup of hydrostatic testing on tank AZ-102 was on 5/31/1972 with water being transferred from tank AZ-101 to tank AZ-102. No official fill height was noted in available documentation. Given that the water was transferred from tank AZ-101, the best assumption is that the fill height was also 467 1/2 inches. On 6/7/1972, chalking of the weld seams was started and they were inspected on 6/8/1972 and 6/9/1972. One minor repair was required on a penetration above the top knuckle.

4.9 COMPLETE SECONDARY LINER AND TANK PENETRATIONS

After completion of the hydrostatic test, the secondary liner top knuckle was installed and welded to the secondary liner vertical wall. The secondary liner is not welded to the primary tank. By design, a 1 in. maximum gap exists between the end of the secondary liner and the primary tank dome. To cover the existing gap, metal flashing was tack welded over it as shown in Figure 4-21 (H-2-67317, *Tanks 101 & 102 Section & Details 241-AZ Tank Farm,* Sheet 2, Detail 9). No photographs could be located for the period between May 25th, 1972 and June 20th, 1972, which is when the work referenced in this section occurred. The best available image of the completion of the secondary liner for tank AZ-101 is shown in Figure 4-22.

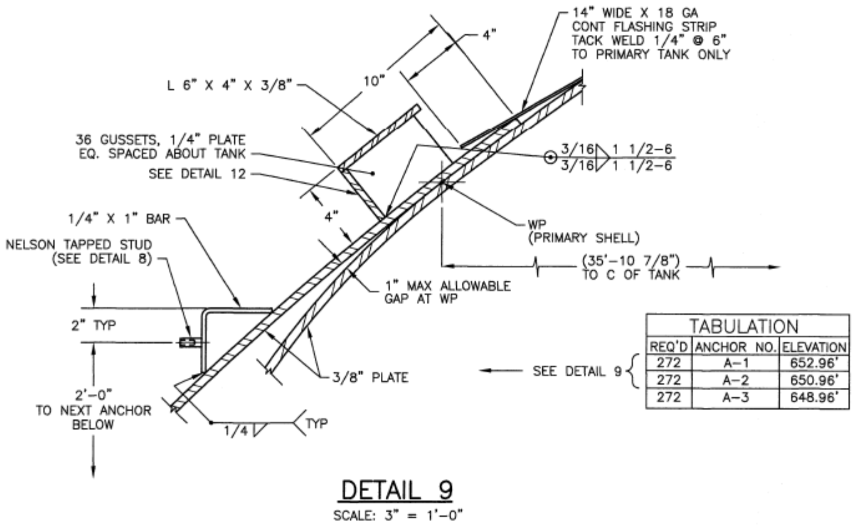


Figure 4-21. Detail 9 from Sheet 2 of Drawing H-2-67317 Showing the Intersection Between the Secondary Liner and Primary Tank Dome.

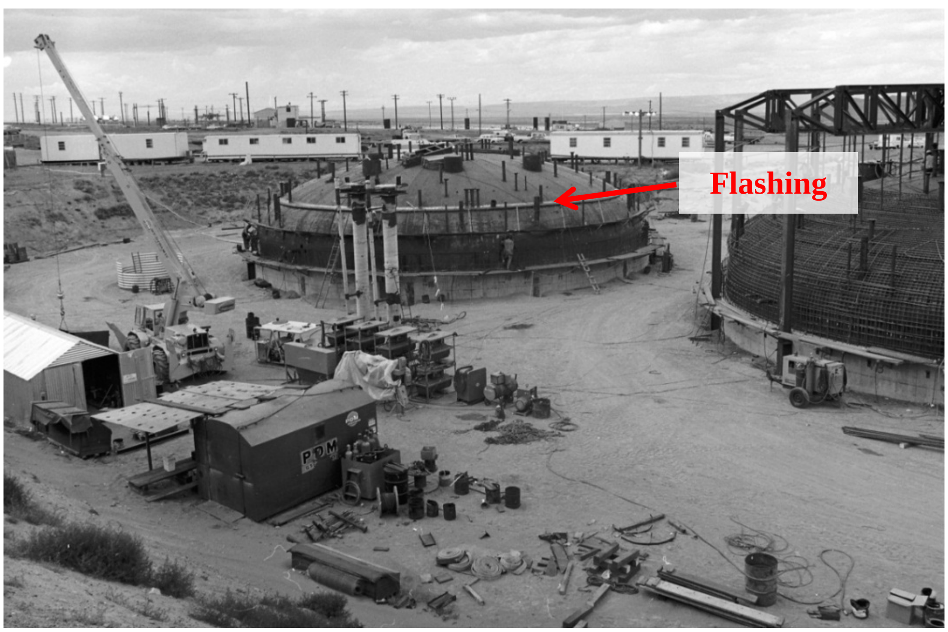


Figure 4-22. Overall View Looking Northwest at Tank AZ-102 in the Background (58288-34 Photo) (Taken 6/20/72)

During this time, penetrations into the secondary were made for the 4 inch diameter product side lines. Eight inch diameter pipe sleeves were installed in the secondary liner and an encasement bellows assembly was installed and bolted on to an 8 inch flanged sleeve penetration that previously installed on the primary tank sidewall during liner fabrication. Sealing between the primary product piping and encasement sleeves was provided by graphite impregnated asbestos packing.

4.10 CONCRETE DOME POUR

Section 19, "Support of Tanks During Construction," of HWS-8982, provided the following direction to support concrete pours:

a. *"Tank supports shall be installed to maintain the tanks in the geometric shape shown on the drawings during the period while the wall and dome concrete is being placed. The secondary tanks will be used as the inside form for the concrete walls.*

b. *Concrete and concrete reinforcing steel will be furnished and placed by another contractor. Placement of concrete will be limited to a rate of not more than 2 feet in elevation per hour from the bottom or the wall to a point 2 feet above the tangent line of the done. Concrete in the haunch area, to the construction joint approximately 9 feet in from the outer wall form, will be placed at a rate not greater than one foot in elevation per hour. After concrete in the haunch area has cured a minimum of 3 days, concrete in the remainder of the dome will be placed in one continuous pour. The following are the wet concrete and live loads to be imposed on the tank:*

Within Radius of Tank Center (ft)	*Load (lb. per sq. ft)*
0' - 25'	*375*
25' - 37'	*450*
37' - 40'	*450 at 37' radius to 1,100 at 40' radius*
Tank Wall	*600*

c. *High-early-strength cement will be used in concrete above the tangent line of the tank domes to permit earlier access to tank interiors and completion of tank appurtenances. Concrete will have a slump of not more than 4 inches at the time of placement and a minimum compressive strength of 3000 psi in 28 days.*

d. *Shoring shall be of such design and construction that when the dome concrete is placed that no additional load will be placed on the shell of the primary tank.*

e. *Tank dome supports shall remain in place a minimum of 7 days after completion of the final placement of concrete in the tank dome, except that the center support shall remain in place 14 days.*

f. *The floor of the primary tank shall be covered with 5/8 inch plywood or one inch thick lumber to prevent the accidental re-concentration of stresses removed during stress relief. Dome support columns shall be designed to rest on blocks or heavy timbers which will aid in distributing the load."*

After review of the logs and photographs, it was concluded that instead of using internal dome supports and shoring to support the dome, a large overhead truss system was utilized to support the tank dome from above during concrete pouring. This truss system was installed on tank AZ-101 as hydrostatic testing was completed in early June 1972. A significant amount of structural rebar was installed around the tank prior to pouring the concrete. The rebar was used to reinforce the concrete and was being installed on both tanks AZ-101 and AZ-102 in late June 1972. In Figure 4-23, the crew is installing rebar in the dome region while concrete forms are in place on tank AZ-101 and the overhead truss system is visible. In addition to the truss support, during the concrete pour, air pressure was applied to the primary tank to provide additional support.

On 7/6/1972 at 8:20AM, dome pouring on tank AZ-101 began. The logbook entry of 7/17/1972 stated:

Confirmed with a telecon with D. Lien that the truss assembly could be removed if:

a. The Air Pressure was maintained.
b. A cylinder test would show 2000 psi minimum after 3 days.

Two test cylinders broke at 2100+ and 2300+ psi on 7/17/1972, meeting the 2000 psi requirement. With air pressure in the tank maintained, they then removed the truss system and it was then moved and installed on tank AZ-102.

On 7/31/1972, the haunch was poured for tank AZ-102. The dome is shown being prepared with reinforcing steel on 8/3/72 in Figure 4-24. The dome pour took place on 8/4/72. Two test cylinders broke at 2100+ psi on 8/8/1972, meeting the 2000 psi requirement. With air pressure in the tank maintained, the truss system was removed, concluding dome pouring in the 241-AZ tank farm. The completed concrete dome is shown in Figure 4-25, taken on 8/22/1972.

Figure 4-23. Tank AZ-101 Reinforcing Steel and Concrete Forms Being Placed on Tank AZ-101 (58324-2cn Photo) (Taken 6/23/72)

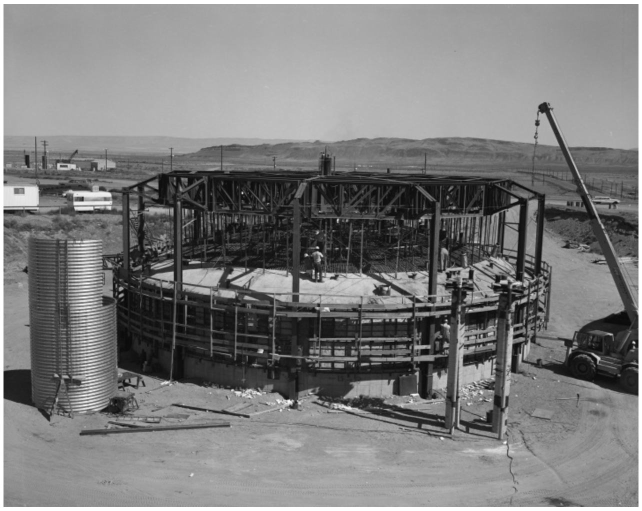


Figure 4-24. Tank AZ-102 Haunch and Dome Concrete Pour Progress, Showing Forms and Truss System (58580-2 Photo) (Taken 8/3/72)

Figure 4-25. Overall View of 241-AZ Tank Farm Following Concrete Dome Completion (58744-40 Photo) (Taken 8/22/72)

4.11 TANK APPURTENANCES

After completing the concrete pours, the tank dome support truss system was removed. The equipment to be placed on the interior of the secondary liner and primary tank was then installed, including the tank air lift circulators, thermocouples, steam coil, and drop legs for the drain lines from the annulus pump pit and leak detection pump pit. These pieces of equipment were welded to the existing penetrations that had previously been installed on the tank dome prior to the tank stress relief. Figure 4-26 shows the in-tank equipment installed in tank AZ-102.

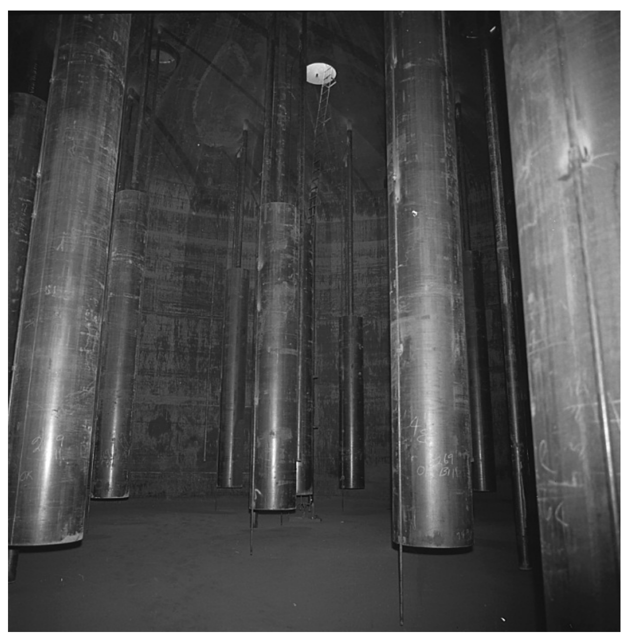


Figure 4-26. Looking at Completed Internals of Tank AZ-102 (58994-2 Photo) (Taken 9/20/72)

5.0 CONSTRUCTION ISSUES

This section provides a detailed view of the construction issues identified during the fabrication of tanks AZ-101 and AZ-102. This information has been compiled from a review of the Quality Assurance (QA) daily logbooks, inspection sheets, memos, drawings, photos, construction records, and post-construction reports. The focus of this review was the secondary liner and primary tank bottom fabrication/testing, and the refractory.

5.1 WELD REJECTION AND NON-DESTRUCTIVE EXAMINATION

A quantitative comparison of weld acceptance on tanks AZ-101 and AZ-102 is shown in Table 5-1, “241-AZ Tank Farm Primary Tank Bottom Weld Comparison.” A similar comparison was completed and included within RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report,* for the 241-AY tank farm. Analysis of the tank AY-101 and AY-102 primary tank bottom radiography test diagrams (weld maps) was completed for a second time as a part of this extent of condition effort to ensure accuracy and consistency and is shown in Table 5-2. They are nearly identical to those previously tabulated except for the addition of the primary tank bottom center dollar plate in this report.

The overall weld rejection rates for the primary tank in tanks AZ-101 and AZ-102 were 14.5% and 6.3%, respectively. The tank AY-102 overall weld rejection rate was 33.8%. The maximum number of times a weld section was repaired in the 241-AY tank farm was four, with one weld section repaired four times in both tanks AY-101 and AY-102. In comparison, one weld section within tank AZ-101 was repaired five times and one weld section in tank AZ-102 was repaired three times before acceptance.

All welding was performed in accordance with approved procedures and by individuals qualified in accordance with Section IX, ASME Boiler and Pressure Vessel Code. All welds were examined and accepted using the methods described hereafter, and all welds were stress relieved during the post-weld stress relieving process.

See Appendix B for the weld maps for the complete primary tank and secondary liner of tanks AZ-101 and AZ-102.

Table 5-1. 241-AZ Tank Farm Primary Tank Bottom Weld Comparison

	Tank AZ-101			Tank AZ-102		
	Feet of Weld (ft)	Reject Rate (%) per Repair Cycle	Total Reject Rate (%)	Feet of Weld (ft)	Reject Rate (%) per Repair Cycle	Total Reject Rate (%)
Weld prior inspection	582	N/A	N/A	582	N/A	N/A
Weld rejected after original weld	68	11.7%	11.7%	31	5.3%	5.3%
Weld rejected after first repair	20	29.4%	13.5%	7	22.6%	6.2%
Weld rejected after second repair	8	40.0%	14.3%	1	14.3%	6.3%
Weld rejected after third repair	2	25.0%	14.5%	0	N/A	N/A
Weld rejected after fourth repair	1	50.0%	14.5%	0	N/A	N/A
Weld rejected after fifth repair	0	N/A	N/A	0	N/A	N/A
Total weld rejections	**99**			**39**		
Total weld	**681**			**621**		
Overall weld rejection rate	**14.5%**			**6.3%**		

Table 5-2. 241-AY Tank Farm Primary Tank Bottom Weld Comparison

	Tank AY-101			Tank AY-102		
	Feet of Weld (ft)	Reject Rate (%) per Repair Cycle	Total Reject Rate (%)	Feet of Weld (ft)	Reject Rate (%) per Repair Cycle	Total Reject Rate (%)
Weld prior inspection	672	N/A	N/A	673	N/A	N/A
Weld rejected after original weld	67	10.0%	10.0%	229	34.0%	34.0%
Weld rejected after first repair	7	10.4%	10.0%	86	37.6%	34.9%
Weld rejected after second repair	1	14.3%	10.1%	27	31.4%	34.6%
Weld rejected after third repair	1	100.0%	10.2%	1	3.7%	33.8%
Weld rejected after fourth repair	0	N/A	N/A	0	N/A	N/A
Total weld rejections	**76**			**343**		
Total weld	**748**			**1016**		
Overall weld rejection rate	**10.2%**			**33.8%**		

Throughout construction of the primary tank and the secondary liner, nondestructive examination (NDE) was required. The level of NDE varied between the primary tank and secondary liner and the elevation of the tank. The change in NDE relative to elevation was based on the planned use of the tank to contain waste up to a specific elevation. Table 5-3 provides a summary of the NDE used to ensure the pedigree of the primary tank and secondary liner. Further information on the NDE used can be found in the construction specification for the tank, HWS-8982, *Specification for Primary and Secondary Steel Tanks Tank Farm Expansion 241-AZ Tank Farm*.

Table 5-3. 241-AZ Tank Farm Nondestructive Examinations Used During Construction[5]

	Primary Tank Inspections	Secondary Liner Inspections
Tank Bottom	• 100% radiography • Magnetic particle • Vacuum leak test • 100% visual • Hydrostatic leak test	• 100% radiography • Vacuum leak test • 100% visual
Bottom Knuckle	• 100% radiography • Magnetic particle • Vacuum leak test • 100% visual • Hydrostatic leak test	• 100% radiography • Vacuum leak test • 100% visual
Vertical Wall	• 100% radiography up to 422 in. • Magnetic particle • 100% visual • Hydrostatic leak test to 468 in. ± 1 in.	• 100% radiography up to 381.5 in. • 100% visual
Upper Knuckle and Tank Dome	• 100% Visual Inspection • Hydrostatic leak test of upper knuckle and the horizontal weld connecting the dome and upper knuckle	• 100% Visual Inspection

5.2 PLATE LAMINATIONS

5.2.1 Tank AZ-101

Minor plate laminations found in the tank AZ-101 primary tank bottom by magnetic particle inspection were allowed to be removed by surface grinding provided that the depth did not exceed 1/16 in. A daily logbook recording from Tuesday, March 14, 1972 described the beginning of the issue and reads as follows:

[5] Tank NDE inspection reference documents: HWS-8982, H-2-67317, and Weld Maps (see Appendix B)

"Weather: Sunny, +60°F, Wind at 3mph

Indications revealed by Magnetic Particle Testing were being ground today, and some were determined to be relevant. Surface grinding resulted in discoloration of areas of the plate. These areas of varying widths could be literally "peeled off" the surface. Further grinding of those areas was discontinued at this time per my instructions to PDM, pending notification of other responsible personnel.

Subsequent evaluation of these areas revealed that the lamination type discontinuities could be removed by surface grinding to a depth not to exceed 1/16". The ground area was then re-tested and no indications noted. This information was revealed to E.F. Smith, who later informed me that if the discontinuities were of no more serious nature than those already detected, we would not be concerned with testing the shell rings. A. Short was also present during evaluation of these indications.

Preparations are now in progress to install the center plate of the 101 Tank Dome.

Welding continued on the pipe penetrations, and repair work on both primarys (sic)*."*

5.2.2 Tank AZ-102

Plate laminations were also seen in the primary tank AZ-102 upper shell ring plates in course four (SRP-4) during arc-gouging of welds and later detected by additional ultrasonic inspection. A total of six plates initially identified from two different heat and slab numbers (See WADCO Nondestructive test report 72-41, dated 3/17/1972, found in Appendix C, as App Figure C-1). The affected plates were four from heat 92B163, Slab 5-1 and two from heat 90B208, Slab 1-2. Plates from the same heats were used elsewhere in the tank, but not from the same slab.

Additional inspection of the six plates by WADCO was done again on 3/27/72 to more specific parameters, based on guidelines from ASME Boiler and Pressure Vessel Code Section V, SA435, (reference WADCO Nondestructive test report 72-41-1, dated 3/27/1972, copy in Appendix C as App Figure C-2). Based on these new criteria, laminations were now only reported in three of the plates from heat 92B163, Slab 5-1 and none in the two from heat 90B208, Slab 1-2.

The next day, on 3/28/1972, it was noted in the log:

"PDM was notified by John Slaughter that plate laminations should be repaired as indicated in PDM procedure RP-3. PDM responded by Arc-gouging a small section (3 inches long) adjacent the weld, which subsequently completely separated from the other half of the 3/8'plate. The lamination was still visible in the parent material (approx. 3/4 inch from the original weld edge...Additional areas were gouged, revealing similar conditions in the plate."

Pittsburgh-Des Moines was advised to not weld on laminated edges so work on the laminated plates was halted with recommendations made for replacement of four plates from heat 92B163, Slab 5-1. The plates from heat 90B208, slab 1-2 were not replaced and, although no documented basis was found, it is assumed that this decision was based on the fact that no laminations were found during the re-inspection. As the laminations were caused by spreading non-metallic contaminants in the slab rolling process or rolling the slab when too cold and allowing phase transformations during rolling, only the affected slab number would be suspect.

The four new plates for SRP-4 were delivered on 4/25/1972, and welded into place starting on 4/26/1972. A copy of the deficiency report is located in Appendix C as App Figure C-3.

5.3 DEFECTS

In the primary tank sidewall of tank AZ-101, a square groove from grinding was discovered after heat treatment and allowed to remain without repair. The groove is approximately 5-1/2 in. long by 3/16 in. wide by 3/32 in. deep (see Figure 5-1 and App Figure C-4). The groove is in the weld where the lower knuckle is joined to course one (seam E-1 between weld footage 127’-0 to 127’-6” with north assigned as zero). The following is a chronology of the events leading to the recommended disposition to leave as is.

On July 13, 1972, a letter was written by J. H. Slaughter, Field Engineer for the Construction Management Division of the United States Atomic Energy Commission to J.M. Frame, President of Vitro Engineering. The letter addressed several findings of a recent audit that had occurred. This letter is located within Appendix C as App Figure C-5. Item 2 of the findings stated the following:

> “*An area about six inches long was found on the E 1 weld seam of tank #101 that appeared to be ground out, and not replaced with weld metal. The deepest indentation thereon was 3/32 inches.”*

Fifteen days later on July 28, 1972, Edgar F. Smith, Project Engineer for Vitro Engineering, responded to the above statement in a letter included in Appendix C as App Figure C-6. The response was the following:

> *“With respect to the apparent grinding of the E-1 seam without replacement by weld metal, we find that this condition exists in a 5-1/4” length of the E-1 weld seam which joins the ¾” shell plate to the 7/8” plate forming the vertical extension of the bottom knuckle. In this length there is an aggregate of approximately 2-1/2” inches of gouging adjacent to the 7/8” plate this deeper than the extended surface of the ¾” plate. The deepest penetration is .020”. Inasmuch as the tank has been stress relieved, it would be inappropriate to fill this gouge with weld metal at this time. However, the following corrective action will maintain the integrity of the tank and be within the parameters of allowable sharp gouge defects permitted under the specification:*
>
> *The weld crown existing vertically above the gouge area should be ground flush with the surface of the ¾” plate that constitutes the inner surface of the tank. Removal of any part of the ¾” plate should be specifically prohibited. The edge of the 7/8” plate adjacent to the gouge should be tapered by grinding on a 1 to 4 ratio in a vertically downward direction. Removal of metal beyond the plane surface of the ¾” plate that constitutes the*

inner surface of the tank should be prohibited. The same method and parameters for metal removal horizontally at the ends of the gouge should be employed. Recognizing that the tank has been stress relieved, extreme caution should be taken in implementing these procedures to avoid impact forces on the tank and creating any local high heat zones."

A letter written on August 24, 1972 by W.C. Armstrong, addresses the structural effects of the groove at seam E-1 of the AZ-101 primary tank (see App Figure C-7). This letter overrides the recommendation in the July 28th letter to grind and taper down the 7/8 in. plate to meet the groove and instead recommends that no corrective action be taken.

"The structural effect of the unrepaired weld grindout in the E-1 seam inside the 101-AZ primary tank has been investigated by our structural engineer F.R. Vollert, using the data of the geometry survey by Mr. A. Short, Vitro Engineering. As a result, it is considered that the grindout as it exists does not present a structural threat to the tank. The geometry of the grindout presents no stress riser condition, and a liquid penetrant test revealed no crack emanates from the grindout base. It is, therefore, recommended that no corrective action be attempted lest overgrinding result or the benefits of stress relieving be impaired by filler welding."

A day later on August 25th, a report was written to summarize the issue and provide a recommended disposition. This document is included in Appendix C as App Figure C-4 and stated the following to describe the deficiency:

"Weld seam E-1 on the inside of the Primary Tank 101 between weld footage 127'-0 to 127'-6" has a grind out approximately 5 ½" long by 3/16" wide by 3/32"deep (at deepest point). Which was overlooked and not noticed until after Stress Relieving had been completed (sic)*."*

The disposition to the report was consistent with the August 25th letter, discussed above, and simply recommended the following which was approved:

"Leave as is the groove caused by the grind out."

The final decision to leave the unrepaired weld grind out was based upon review by the ARCHO structural expert with conclusion that no structural threat to the tank existed. Liquid penetrant testing revealed that there was no crack emanating from the base of the groove and, as a matter of practicality, any repair attempted could impart additional stresses that would not have been relieved since post-weld stress relieving had already occurred. No similar condition was recorded for tank AZ-102.

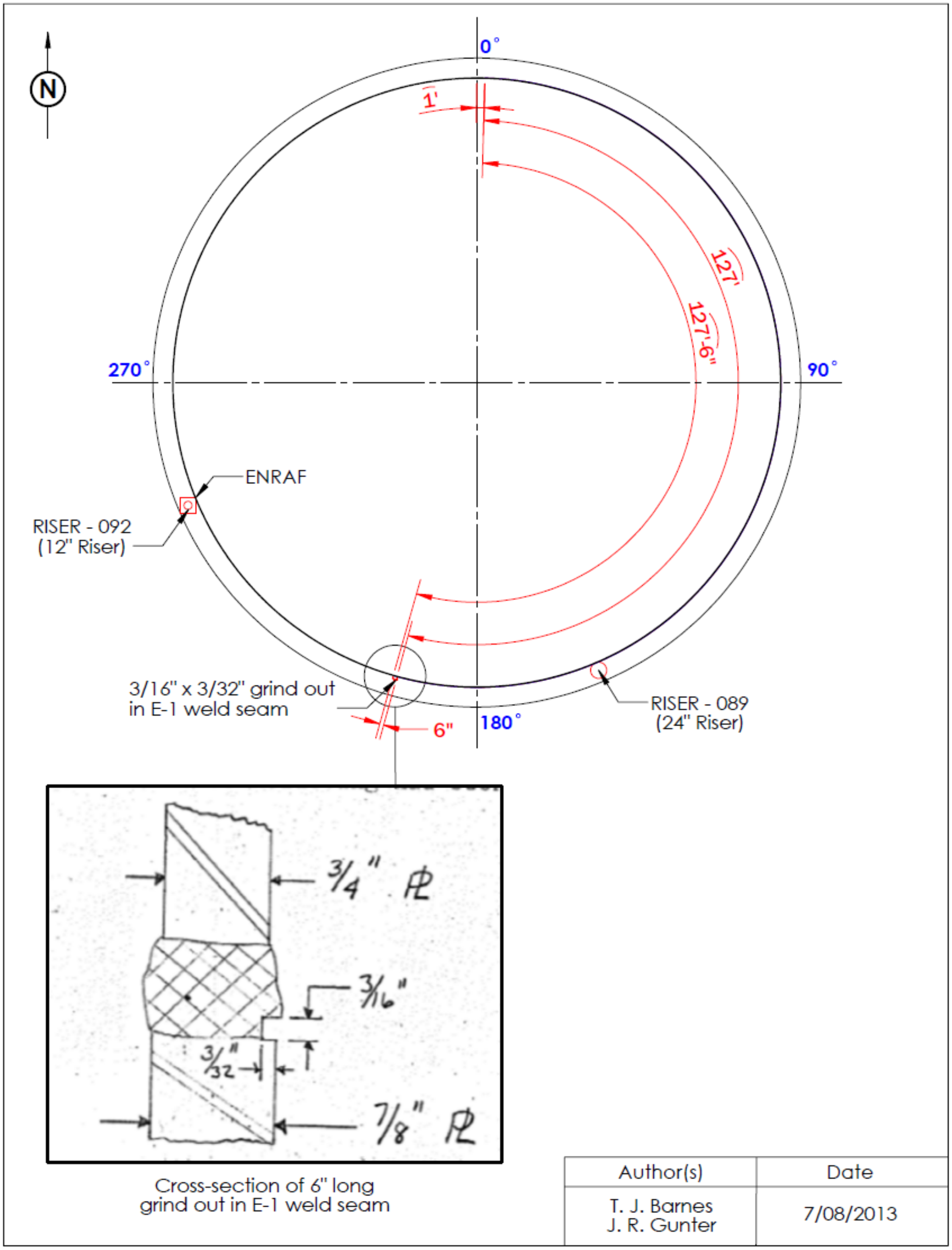


Figure 5-1. Tank AZ-101 Weld Grind Out in E-1 Seam

5.4 WELD REPAIRS FOLLOWING HEAT TREATMENT

As stated within Section 4.8, there were five areas within tank AZ-101 and one area within tank AZ-102 where additional weld repair was required following hydrostatic testing. These repairs took place after hydrostatic testing and no additional stress relieving was done at these locations. It should be noted that these areas were all located above the maximum waste fill height of the tank.

5.5 MINOR PITTING FROM HYDROSTATIC TEST WATER

On July 13, 1972, a letter was written by J. H. Slaughter, Field Engineer for the Construction Management Division of the United States Atomic Energy Commission to J.M. Frame, President of Vitro Engineering. The letter addressed several findings of a recent audit that had occurred. This letter is located within Appendix C as App Figure C-5. Item 3 of the findings stated the following:

> *"The inside surfaces of the tanks have experienced pit corrosion."*

Direction was provided in the letter to recommend a course of action to be taken to assure that the tanks maintain the desired degree of integrity.

Edgar F. Smith, Project Engineer for Vitro Engineering, responded to the above stated finding on July 28, 1972 in a letter included in Appendix C as App Figure C-6. The following was his response:

> *"As to pit corrosion on the inside surfaces of the tank, this, generally, is normal scaling rust action peculiar to the type of construction. In tank 101, however, a five foot depth of water was retained for a somewhat longer period than usual awaiting the time when it could be transferred to tank 102. In checking this area, it has been found that pitted areas generally have depths of .007" to .008"; the deepest pit being .010." Other rusted areas appear to have lesser pitting. It is opinioned that this scaling has not violated the desired degree of tank integrity and no further action is recommended."*

On August 7, 1972, another letter was written from E.L. Moore to W.C. Armstrong, discussing the primary tank pitting (see App Figure C-8). The letter stated in part:

> *"Conditions in the tanks when filled with raw water during hydrostatic testing were ideal for promotion of pitting in carbon steel. This was quiescent water, undoubtedly containing chlorides, and breaks in the mill scale where rusting could occur. Pits can develop under this rust first as a result of differential aeration cells which then develop into passive-active cells. Hence, any crevice, such as under a rust deposit, is a place where the pit is likely to initiate. It is here that oxygen with respect to the immediate surrounding area creates an anodic area, and a differential aeration cell is formed. The loss of passivity in this region follows, creating a potential difference with respect to the large surrounding cathodic areas richer in oxygen. This is the passive-active cell. This condition promotes corrosion of the anodic areas. Through current flow, chloride ions in the water transfer into the pit, keeping the pit surface active. Pitting corrosion can be*

reduced and even eliminated by the addition of alkali to chloride containing water. This stifles pit growth because hydroxyl ions move into the pit more rapidly than chloride ions precipitating basis metal chlorides. Oxygen can again diffuse into the pit and restore passivity.

The removal of the mill scale from the inside surface of the primary tanks has been suggested as a means of reducing pitting corrosion. I feel that the benefit received would not be worth the expense of the sand blasting.

It is my understanding that the 102-AZ tank will be put in an emergency standby condition at some future date. This will mean filling with approximately five feet of water and maintaining a temperature of 180°F. Rather than go to the expense of sand blasting, I would recommend that the water be adjusted to a pH of 10 or above by addition of NaOH.

As a final note, some time ago I became interested in the extent of the passive-active cell set up between a carbon steel coupon covered with mill scale and one with the scale removed. Battelle ran a short test to measure the current generated when the two coupons were coupled in a $NaNO_3$ *solution adjusted to a pH of 9. It was found that within a few hours the current fell to zero, and the pitting corrosion ceased. This demonstrates the value of the hydroxyl ion in reducing pitting type corrosion."*

Mr. Armstrong wrote a letter to Mr. J.H. Slaughter on August 24, 1972. It has been included in Appendix C as App Figure C-7. His comments on this subject matter were as follows:

"The very slight pits noted on the inside surfaces of the 101-AZ and 102-AZ primary tanks are considered by Mr. E.L. Moore, the Atlantic Richfield Hanford Company metallurgist, to have been caused by water during hydrostatic testing. The 101-AZ tank will be held in the empty condition which will not propagate pits. The 102-AZ tank will be held in a standby condition containing approximately five feet of water at a temperature of 180°F. It is recommended that the water be maintained at a pH 10 or above by the addition of NaOH which experience has shown to inhibit pitting."

The minor pitting that resulted from the extended storage of a raw water heel from hydrostatic testing was judged to present no threat to the tank integrity. Recommendations were made to prevent additional pitting by adding NaOH to a pH of 10 or greater if water was to be held in the tank before the addition of caustic tank waste. No detail of extended raw water contact during hydrostatic testing was discovered in tank AY-102 that would indicate the presence of pitting during construction.

5.6 REFRACTORY

5.6.1 Refractory Material Choice Concerns and Mitigation

The refractory was specified to be either Kaolite 2000 or Kaolite 2200 LI, although the contractor was allowed to provide another material provided that it met all of the specification requirements found in HWS-8982, *Specifications for Primary and Secondary Steel Tanks, Project HAP-647, Tank Farm Expansion, 241-AZ Farm.* The specification also stipulated that the refractory meet a minimum compressive strength of 200 psi (relaxed to 130 psi during construction) and be certified compatible with the primary tank bottom and the simulated waste chemicals which was the same as specified for the 241-AY tank farm.

Kaolite 2000 was selected as the refractory material for 241-AZ tank farm. The best information available supporting the decision to use Kaolite 2000 is stated in a memo *(Purex Tank Farm Expansion, 241-AZ Tanks Insulating Concrete-It's Purpose and Function,* Smith (1971)):

> *"Samples of two castable refractories, Kaolite 2000 and Kaolite 2200 LI, furnished by Babcock and Wilcox were evaluated by Battelle Northwest Laboratories. The results of these tests (covered in separate reports) indicated that these materials met the functional, requirements and were compatible with the postulated chemical composition of waste liquids that might be conducted to the annulus in the grooves of the refractory. Accordingly, these two materials were listed in the specifications as being acceptable materials to meet the requirements."*

A comprehensive review all DST refractories was performed in 2003 and documented in RPP-19097, *Evaluation of Insulating Concrete in Hanford Double-Shell Tanks.* This reference included, as attachment 7, the test results for Kaolite 2000 (BNWL-B-56, *Evaluation of Kaolite-2000 Insulating Castable*). The procedure for testing Kaolite 2000 was very similar to that used for testing Kaolite 2200-LI and Kaolite 20. For Kaolite 2000, however, the test results indicate that unfired samples immersed in simulated tank waste "decomposed" and were not subjected to compressive strength testing. No record has been found in the project records as to why the Kaolite 2000 was used in the 241-AZ tank farm despite this issue, but the rationale for the decision to use Kaolite 2000 seemed to rely on the top surface of the refractory being heated to 1100°F during primary tank heat treatment. BNWL-B-56 indicated that fired refractory would not decompose when exposed to waste.

5.6.2 Installation Abnormalities

During pouring of the refractory it was found that the irregular surface of the secondary liner bottom required the thickness to be increased above the design of 8 in. A report was written to address the deviation from design and is included in Appendix C as App Figure C-9. The deviation was described as follows:

> *"The depth of Kaolite 2000 will be increased due to the irregular surface of the secondary bottom. The depth will vary between 8" and 10". The center elevation of the secondary bottom requires the depth of Kaolite to be approximately 9 ½." The increased depth will cause the primary tank to be higher in elevation than design calls for."*

The recommended disposition for this deviation was the following:

> *"The center sump will be welded to the secondary bottom with a temporary flat bar attached to the inside of the sump at the top to restrain the Kaolite during pouring (shown on sketch). The temporary flat bar will be removed after the Kaolite has been cured. Elevation readings on the surface of the Kaolite will be taken after pouring and the upper primary shell ring will be shortened accordingly (the difference between design thickness and actual)."*

This increased thickness is apparent in Figure 4-9, which shows a worker pouring a section of refractory. On March 24, 1972, inspection photographs, such as Figure 5-2, were taken of the refractory and the over-thickness can be seen where several inches of material extend below the retainer ring. The primary tank bottom was installed at a higher elevation than originally planned as a result of this design variation, but does not create conditions for any potential failure mechanism.

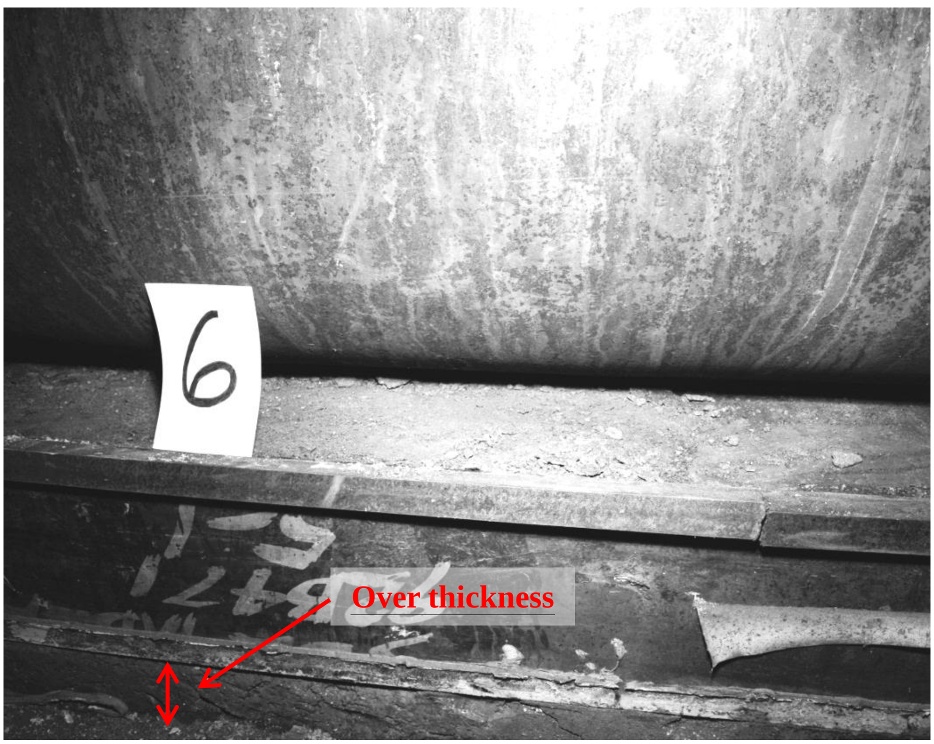


Figure 5-2. Refractory Over-Thickness (57482-20 Photo) (Taken 3/24/72)

During installation of the Kaolite retainer ring, shown in Figure 5-2 above, it was inadvertently installed upside down. A report was written and has been included in Appendix C as App Figure C-10. This variation in design received a recommended disposition as follows:

> *"The holes in TK 101 for the air distributor piping were slotted out towards the secondary bottom plates to facilitate the maintaining of the proper relative elevation. A 2" bar, per VITRO Engineering, will be welded to the back of the retainer band at the top*

to compensate for the removed steel below the band. (see below) The relative location of the pipe at the retaining band is as follows:"

Location (TK 101)	*Distance to Centerline of Pipe*	
	From Secondary Floor	*From Top of Kaolite*
SE	*4"*	*5"*
NE	*4 ¾"*	*4 ¼"*
NW	*4 ¾"*	*4 ¼"*
SW	*4 ½"*	*4"*

One of the four 2 in. bars that were installed to stabilize the air distribution piping through the retaining band in the modified configuration is shown in Figure 5-3.

Figure 5-3. 2 in. Bar Welded to the Retainer Ring to Support Air Distribution Piping (57482-17 Photo) (Taken 3/24/72)

These modifications to the retainer ring and air distribution piping interface were deemed acceptable during construction and are not expected to have any impact on tank integrity.

Continuing with another abnormality of installation, the retaining ring was supposed to have slots cut into it where the thermocouple leads could run around the perimeter of the refractory and have adequate paths to allow for the air slots to drain into the annulus, given a leak event. The thermocouple slots were not cut as detailed during original installation and there were no unobstructed drainage pathways for the air slots. A report was written and has been included in Appendix C as App Figure C-11. This variation in design is described as follows:

"Per VITRO Drawing H-2-67295, Revision 0, a ¼" wide by 2 ½" deep slot was to be cut where every thermocouple lead penetrates the Kaolite Retaining Band. These slots were not cut as detailed."

As disposition to the variation, the following was recommended and later performed:

> *"A slot approximately ¼" deep by 2" wide will be cut in the Kaolite Retaining Band to facilitate the thermocouple penetration. In order to provide drainage, a 1" diameter hole was cut in the Kaolite Retaining Band at the bottom of the air slots as shown on the attached sketch. The air slots selected for cutting of the holes will be at a different location than where the thermocouple leads penetrate the Kaolite Band, thus reducing the possibility of damaging the thermocouple lead."*

These modifications to the retaining band served to provide adequate pathways to protect thermocouple wiring and for waste to drain to the annulus to reach leak detection equipment in a leak scenario. In Figure 5-4, shown below, one of the 1 in. diameter drainage holes is shown. Refer to Appendix C, App Figure C-11, for a diagram of the air slots where these holes were drilled. Regarding the thermocouple wiring penetrations, Figure 5-5 was the best available photo representing this variation, showing the thermocouple wiring coming out of the air slot in the refractory and entering into a protective metal channel along the top of the Kaolite retaining ring.

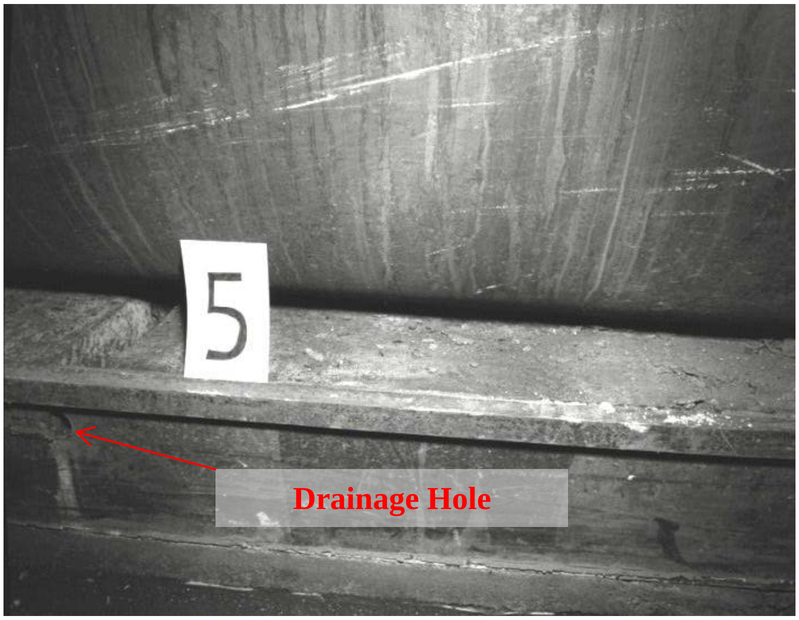


Figure 5-4. Kaolite Retaining Ring with 1 in. Drainage Hole Drilled at Air Channel

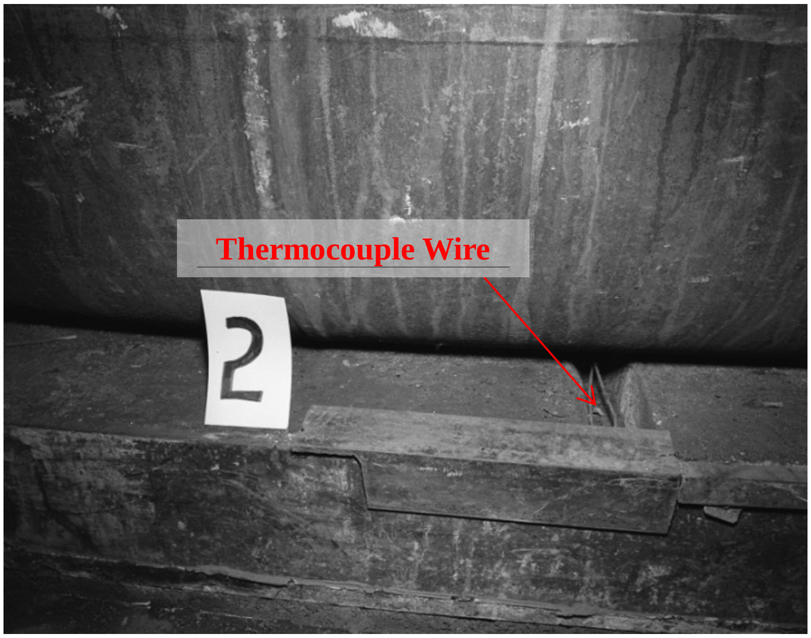


Figure 5-5. Thermocouple Wiring Protection. (57482-16 Photo) (Taken 3/24/72)

5.6.3 Weather Protection

On June 4, 1971, a letter was sent from Babcock & Wilcox, the refractory supplier, to Willard Smith, containing written responses to several questions about refractory protection and quality. This document is included as App Figure C-12 in Appendix C. On the topic of freeze protection, the following detail is offered:

> *"There are two aspects to the question as to whether or not freezing and thawing conditions have any affect upon castable refractories. Generally speaking freezing and thawing of cured castables which contain only the water used in their placement will not be adversely affected. We will concede however that these same cured castables completely saturated by additional quantities of water are subject to deterioration as a result of freezing and thawing."*

Appendix A contains daily accounts of construction activities. Those relevant to refractory weather protection have been repeated here in Table 5-4.

Table 5-4. Significant Refractory Weather Events from Appendix A (2 Pages)

Reference	Date	Tank	Comments
64	9/1/1971	101	0.54 inches of rain, a number of kaolite bags not protected and were wet.
77	9/15/1971	101	Temperature last night in tent was 50°F, discussion of using heaters. Air pipe being placed.
80	9/16/1971	101	Wind gust tore canvas tent, pouring section 14, chipping kaolite from center pan.
81	9/17/1971	101	TK 101 kaolite completed. Battelle photographer onsite. Some cracks 1" deep being repaired. Heaters and temp recorder being setup.
84	9/20/1971	101	Recorded low Temp was 62°F, curing to be complete at 4 pm. Core drilling of kaolite on TK 101 completed.
94	9/27/1971	101	Curing protection removed from pourbacks and construction loads being supported.
95	9/28/1971	102	Temp in 102 tent low of 53F, limit is 50F per procedure, more heaters to be used.
97	9/28/1971	102	Rain squall, leak into tent on section 17.
98	9/29/1971	102	Low temp in 102 tent was 52°F, not enough kaolite is left to finish TK 102.
100	9/30/1971	102	Low temp of 53°F, will add heaters and additional kaolite located.
101	9/30/1971	102	Swing shift to be laid off due to lack of kaolite. Sections 24 and 26 completed. Heating problems continue.
102	10/1/1971	102	Low temp was 79°F, all heaters working.
103	10/4/1971	102	Semi with Kaolite 2000 arrived, requested it be protected.
104	10/5/1971	102	Section 28 badly cracked, to be chipped out and repaired, new kaolite not protected, contractor problems noted.
107	10/8/1971	102	Curing of TK 102 kaolite completed, canvas tent removed.
120	11/1/1971		Water has collected in the annulus and soaked into the kaolite, responsibility for kaolite protection not defined.
123	11/4/1971	102	Increasing width of air slots and cutting out areas for re-pouring.
125	11/5/1971	102	Kaolite cutouts keyed and repoured. Heat during cure is requested.
126	11/6/1971	102	All Kaolite repairs completed.
129	11/9/1971	101	Kaolite inspected and no problems noted in lowering of primary tank.
148	12/16/1971		Some damage may have occurred to kaolite due to freezing, ice formation in 101 primary bottom.
149	12/17/1971	102	Heaters placed under 102 bottom to avoid future freezing.
150	12/21/1971	102	Damaged kaolite being removed from TK 102 where necessary.
152	12/24/1971		Kaolite temperature will be checked over holiday.

Table 5-4. Significant Refractory Weather Events from Appendix A (2 Pages)

Reference	Date	Tank	Comments
154	12/29/1971	102	Trusses being removed, requiring opening of tent, concern about maintaining kaolite.
161	1/11/1972		Winds to 60 mph. Many portions of canvas torn or missing.
165	1/14/1972		Heat being maintained on both tanks and the caisson.
171	1/23/1972	101	TK 101 was properly covered to prevent rain from entering the annulus, TK 102 was previously covered.
181	2/10/1972	102	Fire discovered in TK 102. Damage limited to canvas material used for heating kaolite and wood scaffolding. Fire department thoroughly wetted material.
183	2/13/1972	101	Most of the tarps have blown off the 101 tank, but rain not expected.
184	2/14/1972	101	No longer required to cover TK 101 on routine basis.
186	2/18/1972		Heat being supplied to annulus to keep it dry as snow is falling.
196	3/1/1972		Rain and snow. Notified G. Adolf to remove water from the annulus should it become excessive. Heat should be turned on during rainy periods.
206	3/13/1972		Heaters and plywood removed from the annulus, in view of the warm temperatures and to facilitate removal of water from the annulus.

Referring to log entry reference number 148, dated 12/16/1971, it was believed that some of the discovered damage to the refractory in tank AZ-101 was due to freezing and ice formation. As a result of this discovery, and with the advice provided by Babcock and Wilcox to prevent saturation to avoid deterioration in mind, immediate efforts were undertaken to maintain the environment under the tent above 50°F, prevent water intrusion, and dry it out should intrusion occur.

A memorandum was written on December 16, 1971 by E.F. Smith, confirming direction to protect the refractory with additional measures. This correspondence has been included in Appendix C as App Figure C-13 and states the following with reference to protection measures:

> *"Our telephone conversation at 3:30 pm, this date, is confirmed; you were directed to take immediate action (and implemented today) to protect Kaolite in Tank 102, as follows:*
>
> > *Kaolite is to be covered with "Visqueen", propped up by horses or by other suitable methods with space heaters placed above the Kaolite. The warm air should be circulated by fans or other means."*
>
> *These steps are taken in the interest of removing excess moisture so that frost action will not damage the Kaolite. Upon removal of the excess moisture, protective measures should be taken to prevent additional moisture entering the Kaolite."*

Two additional pieces of correspondence discuss the discovered frost damage and resulting protection measures, both dated 12/20/1971. The first of the two was sent from E.S. Davis and is included as App Figure C-14 in Appendix C. It provides the following explanation of events:

> *"On 12/16/1971 while inspecting work being performed on kaolite in Tank 102, I noted that the outer edges of the kaolite contained frost crystals. Further investigation indicated that for a distance of approximately 10' from the outer edge toward the middle the surface of the kaolite was frozen. I picked up samples of the frosted material and placed them in a 72° environment. After thawing, the samples appeared damp. Later I placed the samples in an oven and dried them out. There appeared to be no damage to the material.*
>
> *I called John Slaughter, AEC, and advised him of these conditions. Mr. Slaughter came to the job site and arranged for sample cores to be made. I also advised Edgar Smith of the conditions and he arranged to get heat applied to the kaolite overnight.*
>
> *At 8a.m., 12/17/1971, I inspected the kaolite again in Tank 102. There was no frost indication remaining along the outer edges of the kaolite. There were numerous areas where the kaolite, for depths varying from 1/16" to 1/4", was either mushy or brittle and flaky. This variation seemed to depend upon the amount of moisture in the material. In addition, there were areas along the outer edge that sounded hollow when tapped with a steel tool. The contractor was advised that these areas would have to be repaired."*

E.S. Davis made note in the previous memorandum that he advised Edgar F. Smith (E.F. Smith) of the conditions and that he arranged overnight Kaolite heating. As evidence to this action, the second letter on 12/20/1971 was from E.F. Smith, confirmed the Kaolite protection measures. This letter has been added as App Figure C-15 in Appendix C. It states in part:

> *"Auxiliary heat has been provided in both tanks 101 and 102 to maintain temperatures above freezing and to drive out excess moisture from the Kaolite. Heat was applied in tank 102 on the evening of 12-16-71 (see reference memorandum); additional heaters were obtained off-site and were available for both tanks on 12-18-71. Satisfactory temperatures have been maintained since that time.*
>
> *Preliminary information regarding freeze-thaw cycles of Kaolite containing excess moisture (see referenced memorandum) is confirmed. Several telephone conferences with Edward Dixon, who heads up Technical Research for Babcock & Wilcox of Atlanta, Georgia, have pointed out that ice formation in fully saturated, light weight castables will break down the granular structure resulting in a loss of strength."*

As the various log comments in Table 5-4 indicate, water retention within the tank and potential oversaturation of the Kaolite material presented several problems during construction. In general, the response to the deficiency was swift and effective. The application of heat and covering served to protect the refractory through the winter until post-weld stress relieving could take place in the spring of 1972.

Some lessons learned from the 241-AY tank farm construction were incorporated into the design of the 241-AZ tank farm refractory slab and better efforts were made to keep the refractory dry after curing to protect from freeze damage. The 241-AZ tank farm refractory did not require major repair after stress relieving as occurred for tank AY-102.

5.7 STRESS RELIEVING OF THE PRIMARY TANK

The initial stress relief attempt of the tank AZ-101 primary tank began on April 7, 1972. On April 8, 1972, 4-12 shift workers experienced several difficulties, including large temperature differentials, inability to control heat spreading, and large overshoot of desired temperatures. Following those difficulties, the 12-8 shift of that same day attempted to increase the tank temperature above 600°F, but could not do so in a controlled and even manner, violating specification requirement 16.0 b (4) of HWS-8982, "*Specification for Primary and Secondary Steel Tanks Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm*," which states:

> *"During the heating-up period, above 600°F, the temperature of all parts of the tank being heated shall be uniform with a maximum temperature differential at any time between the highest and lowest temperature of 200°F."*

The process was stopped at this time and the temperature charts were taken for review. On April 12, 1972, a PDM Engineer provided modifications to the stress relieving procedure, which served as a recommended disposition to the related deficiency or variation report, shown in Appendix C as App Figure C-16. The description of the contract deviation/change/repair and recommended disposition are repeated here for clarity:

"Description of Contract Deviation/Change/Repair:

> *Stress Relieving attempt on April 7 thru 9 was not able to conform to specification requirements HWS-8982 para 16.0 b (4).*

Recommended Disposition:

> *Voluntarily stop Stress Relieving Operation and make the following modification or addition to Stress Relieving Equipment:*
>
> 1. *Stuff insulation in Kaolite slots and up tight against Lower Primary Knuckle.*
> 2. *Extend vent tubes down to within a foot of the bottom.*
> 3. *Extend burner tunnels down 15 feet approximately to the spring line of secondary tank.*
> 4. *Install a 10" OD (top) and 2'-0 OD (bottom) 60° angle truncated cone, 12 inches below burner tunnels to deflect heat over to lower primary shell and knuckle.*
> 5. *Make Burner B operational."*

After these modifications were made, stress relieving was successfully performed as described in Section 4.7.

5.8 EVALUATION OF REFRACTORY AFTER HYDROSTATIC TEST

No post-hydrostatic test refractory deficiencies were recorded. However, several photos of the refractory before heat treatment were found with captions indicating it being damp, soft, soggy, or mushy to a depth of 1/8 in., or having a crust that was 1/8 in. deep. Several of these photographs have been included within this section as Figure 5-6, Figure 5-7, and Figure 5-8. No records following heat treatment indicated that these conditions resulted in repair or replacement.

Figure 5-6. Kaolite Condition (Damp, Soft for 1/8 in. Depth) (57482-18 Photo) (Taken 3/24/72)

Figure 5-7. Kaolite Condition (Soggy and Mushy for 1/8 in. Depth) (57482-21 Photo) (Taken 3/24/72)

Figure 5-8. Kaolite Condition (1/8 in. Crust) (57482-19 Photo) (Taken 3/24/72)

5.9 TANK BOTTOM FLATNESS

On August 9, 1971, it was noted in the log that a survey crew checked the tank AZ-101 secondary liner bottom to determine the amount of distortion and it was noted that the results "*are on file.*" While, no specific survey report was located and no NCRs were found on out-of-flatness relating to either tank bottom for either the primary tank or secondary liner, it was later noted in a deficiency report for tank AZ-101, regarding the increased kaolite thickness from 8 in. to 10 in., that the cause was "*the irregular surface of the secondary bottom.*" A logbook entry on September 17, 1971 notes "*some cracks 1" deep being repaired*," which could have been the result of secondary liner bulging. Based on the lack of documented deficiencies, it is assumed that all measurements of bottom flatness met specification.

Some minor rippling was noted in the logbook for tank AZ-102 during pouring of the kaolite. It was stated on September 24, 1971 that "*the floor plate has dropped down under the weight of the kaolite in section 3 in TK 102. Their seams* (sic) *to be a blister in the tank floor plate sections 1 and 2 also.*" Later on the same day, it is noted that the "*steel plate buckled down on section 2 about 3/8 inch, but occurred near center. No visible change from 15 feet toward outer ring.*" On October 5, 1971, chipping and repair of badly cracked Kaolite in section 28 is noted. These resulting cracks are seemingly similar to those discovered after the refractory pour in tank AY-102, possibly caused by secondary liner bulging.

On November 22, 1971, it was noted that "*the AZ-101 primary bottom was checked for deformation and found to be acceptable without flattening*." No specific notation was found in the logs for a tank AZ-102 primary tank bottom survey and, as mentioned above, no deficiency reports on the subject were found for either tank. Based on the lack of specific negative reports, it is assumed both primary tank bottoms met specification.

5.10 ISSUES UNIQUE TO 241-AZ TANK FARM

5.10.1 Radiograph Misrepresentation Discovery

On August 6, 1971, a memorandum, located in Appendix C as App Figure C-17, was sent from D.S. Mager to A. Short regarding 241-AZ tank farm radiography. In this document, Mr. Mager discusses his review of available radiographs to update the status of weld acceptability and prevent possible delay of lowering the tank bottom as scheduled on 8/4/1971. Through review of several radiographs, it was apparent that four of the radiographs were not a match to the actual area they were referenced to, but were simply copies of radiographs from more easily accessible areas of the tank. The following comment was made within the document:

> *"It is significant to note that all four areas not radiographed correctly are under the temporary truss supports. This makes it necessary for the radiographer to move the equipment from the top side of the tank bottom to the underside of the tank bottom.*
>
> *It is my conclusion, based on the evidence available, that the misrepresentation of weld areas was intentional, solely on the part of the radiographer and/or his assistant, and that his purpose for doing so was to save time and physical labor."*

Following this discovery, a letter written by J.H. Slaughter on July 13, 1972 discussed an audit finding related to this issue. See Appendix C, App Figure C-5, for the full document. The finding related to the misrepresented radiographs was as follows:

> *"The substitute radiographs from the radiographer's misrepresentation were not filed along with those accepted."*

A response to the audit finding was produced by Edgar F. Smith on July 28th in a letter, included as App Figure C-6 in Appendix C. His response was the following:

> *"Regarding falsified radiographs that were detected by our inspection personnel, we do not believe such radiographs should be inserted in the same filing system used for official project radiographs. However, they will be suitably identified so that they will not be misconstrued and filed so they are readily available."*

It is important to note that the welds were properly radiographed and official accepted records were obtained to replace those that were misrepresented.

5.10.2 Fires During Construction

Two fires occurred in tank AZ-102 during construction. The first occurred on 2/10/1972 in the primary tank. The fire was discovered at noon and extinguished by the fire department after their arrival. The log states "*damage was limited to the canvas material used for heating the kaolite and some of the wood used for scaffolding.*" Welding of the second course of shell ring plates was occurring on the primary tanks at that time.

The second fire occurred on 2/19/1972 in the tank AZ-102 annulus. The fire was extinguished before the fire department could arrive. It was reported to have been started by welding sparks igniting gas under the plywood scaffolding in the annulus. The job log did not describe the extent of the damage, which is assumed to be minimal given the short duration of the fire.

No similar fires were noted for tank AZ-101.

5.10.3 Knuckles Swapped Between Tanks AZ-101 and AZ-102

When installing the bottom knuckles on tanks AZ-101 and AZ-102, the plates used were reversed. The plates intended for tank AZ-102 were installed on tank AZ-101 and vice versa. Two reports were written to make note of this and they are included within Appendix C as App Figure C-18 and App Figure C-19 .

For the tank AZ-102 plates used on tank AZ-101 the following detail is provided:

> *"The primary knuckles, Piece Marks BKP-A, BKP-B, BKP-C, BKP-D, BKP-E, BKP-F, BKP-G, BKP-H, plus the corresponding X-rays made in Provo reflect Tank Number 102 on both the knuckles and the X-rays. These knuckles were used on Tank Number 101."*

The recommended disposition for this reversal was the following:

> *"The knuckles will be documented on the as-built drawings with the piece mark number and orientation as shown on the attached drawing. The X-rays will be filed in the Tank Number 101 X-ray Report File."*

For the tank AZ-101 plates used on tank AZ-102 the following detail is provided:

> *"The primary knuckles, Piece Marks BKP-1A, BKP-1B, BKP-1C, BKP-1D, BKP-1E, BKP-1F, BKP-1G, BKP-1H, plus the corresponding X-rays made in Provo reflect Tank Number 101 on both the knuckles and the X-rays. These knuckles were used on Tank Number 102."*

The recommended disposition for this reversal was the following:

> *"The knuckles will be documented on the as-built drawings with the piece mark number and orientation as shown on the attached drawing. The X-rays will be filed in the Tank Number 102 X-ray Report File."*

6.0 CONCLUSIONS

The leak assessment report for AY-102, RPP-ASMT-53793, identified first-of-a-kind construction difficulties and trial-and-error repairs as major contributing factors in the failure of that tank. To determine if improvements in DST construction continued, a review and evaluation of the construction records for the 241-AZ tank farm was completed to determine if similar or other difficulties were present.

After a review of the construction history of the 241-AZ tank farm, it is concluded that, during construction of the 241-AZ tank farm, there were fewer construction difficulties. Table 6-1 includes a summary of the issues seen in tank AY-102 and the 241-AZ tank farm, focusing on the critical difficulties that were identified in RPP-ASMT-53793.

There were fewer problems noted with welding of the secondary liner bottom and primary tank bottom than were seen in 241-AY tank farm. The thickness of the secondary liner bottom in 241-AZ tank farm was increased to 3/8 in. (from 1/4 in 241-AY tank farm) and only a minor mention of bulges in the secondary liner was noted. The thickness of the primary bottom was increased to 1/2 inch (from 3/8 in. in 241-AY tank farm). The primary liner weld rejection rate for tank AZ-101 (14.5 percent) and tank AZ-102 (6.3 percent) was much less than that for tank AY-102 (33.8 percent).

Refractory installation for the project used a different pour pattern, but similar techniques to those used for the 241-AY tank farm. Greater effort was placed on preventing exposure of the unfired refractory to freezing weather and water saturation. Although some issues with this protection were noted, no significant refractory repairs were required after post-weld stress relieving. Refractory thickness in this farm remained difficult to control, with sections noted up to 10 in. This was primarily attributed to an irregular surface of the secondary liner bottom. The refractory selected for 241-AZ tank farm, Kaolite 2000, was tested and stated to meet specifications, although testing of unfired materials showed poor resistance to simulated caustic waste. The original specification for the refractory compressive strength of 200 psi was relaxed to 130 psi and remained at the lower value for future tank farms.

Initial attempts at stress relieving were unsuccessful because of large temperature differentials, inability to control heat spreading, and large overshoot of desired temperatures. Physical modifications to the stress relieving were made and the process was restarted. These changes allowed for more efficient and effective stress relief in tanks AZ-101 and AZ-102 than was seen in tank AY-102 due to protection of refractory from freezing and water saturation.

The most significant deficiency found was the presence of plate laminations and near-surface defects. Extensive magnetic particle testing was performed. Grinding of the primary tank bottom plate up to 1/16 in. was allowed to remove near-surface laminations. In tank AZ-102, six plates in the upper shell ring were found to have laminations, with four of them severe enough to require replacement prior to heat treatment and 2 additional ones accepted as-is.

Other issues, unique to 241-AZ tank farm were noted. Both primary tanks had leaks found during the hydrostatic test, but these leaks were in the dome sections above the normal waste level. All leaks were repaired, with this re-weld occurring after stress relieving.

A square groove was discovered ground into one weld in the lower knuckle of primary wall plates in the tank AZ-101 primary sidewall after stress relief. This condition was evaluated and accepted as-is. Fires occurred during construction in the annulus of tank AZ-102 and in the bottom of the primary tank in AZ-102, but the daily logbooks did not indicate any significant damage was caused by these two fires.

Minor pitting, up to 0.010 in., was noted in tank AZ-101 as a result of extended storage of five ft. of untreated water from the hydrostatic test. There were repairs and modification made to the refractory retaining band as a result of installation errors. These minor issues are not expected to significantly affect the tank integrity.

In conclusion, in the 241-AZ tank farm, the second DST farm constructed, the prior contractor was used (PDM) and fewer construction issues were noted than with tank AY-102 construction. Secondary liner thickness was increased and, while fewer issues were noted with bulging, the thickness of the refractory was increased due to bottom irregularities. No evidence that these irregularities did not meet specification was found. Refractory weather protection was more evident and no major refractory repairs were required. The primary liner weld rework rate was low and the effectiveness of the post-weld stress relieving was judged to be greater.

Table 6-1. Summary Comparison 241-AZ Tank Farm Construction to Tank AY-102

Tank	AY-102	AZ-101	AZ-102
Evaluation Document	RPP-ASMT-53793, *Tank 241-AY-102 Leak Assessment Report*	RPP-RPT-54818, *241-AZ Tank Farm Construction Extent of Condition Review for Tank Integrity*	
Construction Order	1st DST constructed	1st DST in 2nd Farm	2nd DST in 2nd Farm
Construction Contractor	Pittsburgh-Des Moines (PDM) Steel Company		
Secondary Liner Bottom Material	0.25-in. plate, ASTM A515, Gr 60	0.375-in. plate, ASTM A515, Gr 60	
Secondary Liner Bottom Bulges	Excessive distortion and bulges noted throughout. Maximum slope noted as much as 1 inch per foot. 22 places exceed 2 inch peak-to-valley tolerance.	Only minor notation, no deficiencies or NCRs found. Noted that Kaolite thickness was increased due to irregular bottom.	Only minor notation, no deficiencies or NCRs found, Log noted that plate dropped 0.375-in. when Kaolite poured.
Primary Tank Bottom Material	0.375-in. plate, ASTM 515, Gr 60	0.5-in. plate, ASTM 515, Gr 60	

Table 6-1. Summary Comparison 241-AZ Tank Farm Construction to Tank AY-102

Tank	AY-102	AZ-101	AZ-102
Primary Tank Bottom Weld Rework	33.8%	14.5%	6.3%
	Ultimately all welds were accepted and stress relieved, although problems with that process were noted.	Ultimately all welds were accepted and stress relieved.	Ultimately all welds were accepted and stress relieved.
Primary Tank Bottom Bulges	Primary bottom flatness described as "generally good." However, during refractory repair, much of the primary tank bottom wasn't in contact with the refractory. Voids were filled with Styrofoam.	Noted as "acceptable without flattening"	No specific notation found.
Stress Relieving Process	Required 2 days to remove all the water in the refractory. Lowest temperature recorder just prior to initiating 3 hold time was 915°F (accepted as being 1000°F).	Initial attempt aborted, modification made and 2nd attempt successful reached 1050°F for 2 hour hold. No refractory steaming noted.	Modified procedure used, minimum temperature was 1000°F for 3 hour hold.
Refractory	Kaolite 2200LI	Kaolite 2000	
Refractory Protection	Allowed to saturate with rain water, not protected from freezing.	Measures taken to heat refractory and keep water out (heaters, tarping). Some failures noted but generally good.	
Refractory Condition	After hydrostatic test, refractory found to be very degraded, extensively cracked, and spalled. Samples showed excessive carbonation.	Logs indicate post-hydrostatic test inspection performed, no reports on deficiencies could be found.	
Refractory Repair	Major- 21 inches of perimeter removed and replaced with structural concrete.	Minor repairs made during initial pour, none after post-weld stress relieving.	

Table 6-1. Summary Comparison 241-AZ Tank Farm Construction to Tank AY-102

<table>
<tr><th>Tank</th><th>AY-102</th><th>AZ-101</th><th>AZ-102</th></tr>
<tr><td>Other Issues</td><td>Unsupported areas of primary bottom filled with Styrofoam as backing for perimeter refractory replacement concrete pours.</td><td>Plate laminations in primary tank bottom ground out as much as 0.0625-in. depth.

Weld grind out in lower knuckle weld seam found after stress relief and accepted based on expert opinion.

Minor leaks above normal waste level found during hydrostatic test, (and after stress relief). Water level lowered, welds repaired.</td><td>Plate laminations, within ASME Boiler and Pressure Vessel Code allowance found in two plates in upper shell ring and accepted. Four other plates replaced.

Minor leaks above normal waste level found during hydro test, (and after stress relief). Water level lowered, welds repaired.</td></tr>
<tr><td>Overall Conclusion on Construction Difficulties</td><td>Difficultly with liner fabrication and the castable refractory left the tank with unsupported areas in the tank bottom and unexpected residual stresses in the tank bottom that probably contributed to failure.</td><td colspan="2">241-AZ tank farm, the second DST farm constructed, used the same contractor as in 241-AY tank farm (PDM) and far fewer issues were noted. Secondary liner bottom thickness was increased and fewer bulges were seen. Refractory weather protection was improved and no major refractory repairs were required. The thickness of the primary tank bottom was increased and the overall primary tank weld rework rate was low. Post-weld stress relief process was improved. Records of unsupported primary bottom sections and other areas of high residual stress were not found. Plate laminations were present in both primary liners, minor areas were ground out, and plates with major areas were replaced. Leaks found after hydrostatic test were above the normal waste level, repaired, and are not expected to negatively impact tank integrity.</td></tr>
</table>

7.0 REFERENCES

ARH-1437, 1970, *Design Criteria Purex AZ Tank Farm*, Atlantic Richfield Hanford Company, Richland, Washington.

BNWL-B-56, 1971, *Evaluation of Kaolite-2000 Insulating Castable*, Battelle Pacific Northwest Laboratory, Richland Washington.

RPP-19097, 2003, *Evaluation of Insulating Concrete in Hanford Double-Shell Tanks*, CH2M Hill Hanford Group, Inc., Richland, Washington.

RPP-ASMT-53793, 2012, *Tank 241-AY-102 Leak Assessment Report*, Washington River Protection Solutions, Richland, Washington.

H-2-63796, 1970, *241-AY Tank Farm Annulus Pump Pit Arrangement*, Vitro Hanford Engineering Services, Richland, Washington.

H-2-67243, 1973, *Structural Concrete Tank Foundation Plan & Details Tank 241-AZ-101 &102*, Vitro Hanford Engineering Services, Richland, Washington.

H-2-67245, 1973, *Concrete Tank Section & Hanch Reinforcement, Rev. 1*, Vitro Hanford Engineering Services, Richland, Washington.

H-2-67295, 1974, *Instrumentation Insulating Concrete Plan & Details*, Vitro Hanford Engineering Services, Richland, Washington.

H-2-67317, 1973, *Tanks 101 & 102 Sections and Details 241-AZ Tank Farm*, Sheet 1, Rev. 1, Vitro Hanford Engineering Services, Richland, Washington.

H-14-010507, 2010, *Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-101*, Sheet 1, Rev. 15, Washington River Protection Solutions LLC, Richland, Washington.

H-14-010507, 2012, *Dome Penetration Schedules (WST/WSTA) Tank 241-AZ-102*, Sheet 2, Rev. 12, Washington River Protection Solutions LLC, Richland, Washington.

HWS-8981, 1970, *Specifications for Excavation and Tank Foundations Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm*, Vitro Hanford Engineering Services, Richland, Washington.

HWS-8982, 1970, *Specifications for Primary and Secondary Steel Tanks Project HAP-647 Tank Farm Expansion 241-AZ Tank Farm*, Vitro Hanford Engineering Services, Richland, Washington.

HWS-8867, 1972, *Specifications for Completion of Tank 102 Project HAP-647 Tank Farm Expansion, 241-AZ Tank Farm*, Automation Industries, Inc. Vitro Engineering Division, Richland, Washington.

HNF-4957, 1999, *241-AZ Double-Shell Tanks Integrity Assessment, Rev. 0,* Lockheed Martin Hanford Corporation, Richland, Washington.

WRPS-1204931, 2012, *Double-Shell Tank 241-AY-102 Primary Tank Leak Extent of Condition Evaluation and Recommended Annulus Visual Inspection Intervals*, Washington River Protection Solutions LLC, Richland, Washington.

APPENDIX A 241-AZ Tank Farm Key Event Table

Reference	Date	Log	Tank	Comments	Event
1	10/9/1970	Construction		Survey crew lays out tank centerlines.	Construction
2	10/16/1970	Construction		JAJ moving existing cathodic anode per H-2-67242.	
3	11/16/1970	Construction		Excavation started	Construction
4	12/3/1970	Construction		Survey crew checking elevation of excavation 615.25 @10 am.	
5	12/4/1970	Construction		Stabilizing material placed and level per spec. Some material larger than spec call for.	
6	12/11/1970	Construction		Forms in place for leak detection system.	
7	12/11/1970	Construction		Concrete placed on leak detection well footings, Well footings are 5/8 inch low, will be corrected by having 1 and 5/8 inch of grout rather than 1 inch as shown on drawing.	Construction
8	12/15/1970	Construction		Setting perimeter from for tank foundation.	
9	12/22/1970	Construction		Mr. Pegram said to have error in plates corrected would require sending them to Portland. Wants to install as is. Slaughter is looking into it.	
10	12/23/1970	Construction		Slaughter said to use plates as is. Fitters welding drain pipe.	
11	12/31/1970	Construction		Soil compaction results, density 94% with 5.5 % water at 4 vibrator passes, 97% with 5.5% water with 6 vibrator passes.	
12	1/4/1971	Construction		More compaction tests, 97% with 9.5% water, 100% compaction with 11.5% water.	

Reference	Date	Log	Tank	Comments	Event
13	1/5/1971	Construction	101	Drain line tied into LDP riser.	
14	1/6/1971	Construction	101	LDP riser and drain line leak tested, 12 ft of water for 30 minutes, coating flaws found and repaired.	Construction / Issue
15	1/8/1971	Instrumentation	101	Conduits for base TCs installed.	
16	1/11/1971	Construction		1st rebar for base delivered.	
17	1/11/1971	Construction	101	Re steel installation started on TK 101, outside forming completed.	Construction
18	1/27/1971	Construction	102	LDP riser and drain line leak tested, 12 ft of water for 30 minutes, coating flaws found and repaired.	Construction / Issue
19	1/28/1971	Instrumentation		TC system for monitoring pour temps installed.	
20	2/11/1971	Construction	101	Removal of drain slot blockouts initiated.	
21	2/16/1971	Construction		Cleanup on base on 101, drain line blockout installed on 102 in prep for base pour.	
22	2/24/1971	Construction	101	1/4 inch thick CS plate installed on TK 101 and leak detection risers backfilled.	
23	3/1/1971	Construction		Cleanup work completed on concrete bases, final inspection bv F. Ardnt and A. Short.	Construction
24	5/5/1971	Construction		Received Mill Certs of material purchased for tank fabrication.	
25	5/11/1971	Construction		Discussion on automatic weld procedure and undercutting.	
26	5/25/1971	Construction		Request to use Ir192 on primary knuckles.	
27	6/14/1971	Construction		Weld test radiograph too dark and to be repeated.	

Reference	Date	Log	Tank	Comments	Event
28	6/18/1971	Construction		1st steel for plates arrived, appears satisfactory.	
29	6/22/1971	Construction	101	Plywood placed on slab, temporary supports erected, 1st secondary plate placed.	Construction
30	6/23/1971	Construction	101	Began tacking bottom sketch plates - 101 secondary.	
31	6/25/1971	Construction		Test plate welded using automatic welder.	
32	6/28/1971	Construction	101	Welding on bottom plates initiated using automatic welder.	Construction
33	6/29/1971	Construction	101	Welding on bottom plates continues.	
34	7/2/1971	Construction	101	Welding on bottom plates continues.	
35	7/9/1971	Construction	101	Knuckle sections placed.	Construction
36	7/12/1971	Construction	101	New weld procedure (71-19) implemented.	
37	7/14/1971	Construction		Welding knuckles on 101 and tacking bottom plates for 102.	
38	7/20/1971	Construction	101	Welding knuckles on 101 and welding knuckles to bottom plate.	
39	7/22/1971	Construction	101	All bottom plate weld radiographed once, 3 seams accepted entire length, identification on 101 knuckles clarified.	
40	7/27/1971	Construction	101	Final closure seam on secondary bottom completed.	Construction
41	7/28/1971	Construction	101	Repair work on welds continues, installing trusses to allow lowering.	
42	8/4/1971	Construction	101	Water found filling drain line and LDP riser, must be removed prior to placing sump insulation.	Issue

Reference	Date	Log	Tank	Comments	Event
43	8/5/1971	Construction	101	Final inspection and cleaning of slab, secondary lowered, minor problem noted with center ring insertion into sump, bottom shifted slightly.	Construction / Issue
44	8/5/1971	Construction	102	Bottom plate welding done and fitting knuckle sections.	Construction
45	8/9/1971	Construction	101	Survey crew shot 101 secondary tank bottom to determine amount of distortion, "results on file."	Issue
46	8/9/1971	Construction	102	WADCO contacted about weld soundness issues on 102 knuckle sections.	
47	8/10/1971	Construction	102	Some radiographs are of sub-standard quality. Long discussion of weld undercut on horizontal welds.	
48	8/10/1971	Construction	102	Radiographs of two knuckle sections on 102 have less dense section, possible un-fused weld layer. WADCO did UT test and determined weld is acceptable, no cause found for bad indication.	Issue
49	8/11/1971	Construction	101	101 secondary bottom vacuum box tested and no defects found. Welding of first shell ring begins.	
50	8/11/1971	Construction	102	Welding of knuckle continues noting the weld reject rate has decreased from TK 101. Reject rate on TK 101 secondary bottom given as 3.5%, based on an average of 3 inches per rejected radiograph.	
51	8/12/1971	Construction	101	Installation of kaolite retainer ring.	Construction
52	8/16/1971	Construction	102	Noted significant improvement on welds on Tk 102.	

Reference	Date	Log	Tank	Comments	Event
53	8/16/1971	Construction	101	Kaolite retainer ring installed upside down and in wrong position. Will be lifted and air supply pipe penetrations modified.	Issue
54	8/17/1971	Construction	101	New weld procedure, 45-3 approved for use.	
55	8/18/1971	Construction	101	Kaolite retainer ring will be raised one inch above highest point, requiring more kaolite to fill lower areas, estimated to be equal to 1 and 5/8 inch for entire surface.	Issue
56	8/18/1971	Construction	101	Welder not using 45-3 procedure as instructed.	
57	8/20/1971	Construction	102	Center air chamber ring will be welded to secondary bottom without raising it. Air supply pipes will slope to center.	Issue
58	8/23/1971	Construction	102	Began installing trusses on 102 bottom.	
59	8/25/1971	Construction		Both LDP risers pumped out by JAJ. 4 inch air supply pipe identified as API 25 not A53 as per spec.	
60	8/27/1971	Construction	101	Began tacking second shell ring.	Construction
61	8/30/1971	Construction	102	Weld repair is ongoing on 6 areas on 102 secondary bottom.	
62	8/30/1971	Construction	101	Unqualified welder attached unistrut to liner and shows areas of undercut.	Issue
63	8/31/1971	Construction	102	Final radiographs on 102 secondary bottom and bottom lowered to slab. Center ring misaligned with sump - fit up of horizontal seams not per procedure.	Construction / Issue

Reference	Date	Log	Tank	Comments	Event
64	9/1/1971	Kaolite	101	0.54 inches of rain, a number of kaolite bags not protected and were wet.	
65	9/7/1971	Kaolite	101	Trial batches mixed, 3 bags with 8.5 gal water, wet density of 16.5 and 16.7 lbs for 1/5 cu ft, coated with horn cure 30 D.	
66	9/8/1971	Kaolite	101	Water meters calibrated.	
67	9/9/1971	Kaolite	101	Pour for section 13 initiated at 1:25 pm completed at 4:10 pm, temp measured and one batch rejected.	Construction
68	9/9/1971	Kaolite	101	Pour for section 11 at 8:50 pm, completed at 12:45.	
69	9/10/1971	Kaolite	101	Air temp high 102F, section 15 poured.	
70	9/10/1971	Kaolite	101	Section 7 poured.	
71	9/11/1971	Kaolite	101	Section 16 and 3 poured.	
72	9/12/1971	Kaolite	101	Section 5 and 6 completed.	
73	9/12/1971	Kaolite	101	Section 1 completed, occasional issues with mixers, water meters, extra bags noted throughout.	
74	9/13/1971	Kaolite	101	Completed section 12 and section 8. Will change to 12 degree 30ft sections.	
75	9/14/1971	Kaolite	101	Pouring 12 ˚ 30 ft sections, minimum cutout section to be 3 inches, section edges to be prepared by spudding or power wire brushing. Method of vibration questioned and changed.	Issue
76	9/14/1971	Kaolite	101	Mixer power broke and pour blocked and suspended pour in section 23.	

Reference	Date	Log	Tank	Comments	Event
77	9/15/1971	Kaolite	101	Temperature last night in tent was 50F, discussion of using heaters. Air pipe being placed.	Issue
78	9/15/1971	Kaolite	101	Poured three sections, test cubes noted as fragile.	Issue
79	9/16/1971	Kaolite	101	4 batches rejected, bad mixer.	
80	9/16/1971	Kaolite	101	Wind gust tore canvas tent, pouring section 14, chipping kaolite from center pan.	
81	9/17/1971	Kaolite	101	TK 101 kaolite completed. Battelle photographer onsite. Some cracks 1" deep being repaired. Heaters and temp recorder being setup.	Construction / Issue
82	9/17/1971	Instrumentation	101	All TC conduit in kaolite in correct position.	
83	9/18/1971	Instrumentation		Instrument logs not reviewed in details, problems noted with TCs and strain gages for several months.	
84	9/20/1971	Kaolite	101	Recorded low Temp was 62F, curing to be complete at 4 pm. Core drilling of kaolite on TK 101 completed.	
85	9/21/1971	Kaolite	101	Took F&G cores and filled core holes.	
86	9/21/1971	Kaolite	101	Test on cores, low 74 psi, high 205, 17 below 130 psi and 148 psi average. Additional cores taken near failed locations.	Issue
87	9/22/1971	Kaolite	101	Surveying surface of kaolite, lowering high spots and filling low spots, taking additional cores.	Construction
88	9/22/1971	Kaolite	102	Pouring of Kaolite to begin on swings.	Construction
89	9/23/1971	Kaolite	101	3 inch pour made on 101, numerous cracks noted.	Issue

Reference	Date	Log	Tank	Comments	Event
90	9/23/1971	Kaolite	102	Completed section 11.	
91	9/23/1971	Kaolite	101	Leveling 101. Moving bottom steel into place. B&W rep onsite and not in favor of vibrating kaolite.	
92	9/24/1971	Kaolite	102	Photographer in TK 102. Floor plate dropped under the weight of Kaolite in section 3. Blister in the floor plate in sections 1 and 2 noted also.	Issue
93	9/24/1971	Kaolite	102	Steel plates buckled down 3/8 inch on section 2 near tank center.	Issue
94	9/27/1971	Kaolite	101	Curing protection removed from pourbacks and construction loads being supported.	
95	9/28/1971	Kaolite	102	Temp in 102 tent low of 53F, limit is 50F per procedure, more heaters to be used.	
96	9/28/1971	Kaolite	101	Taking core from section 28 on TK 101.	
97	9/28/1971	Kaolite	102	Rain squall, leak into tent on section 17.	Issue
98	9/29/1971	Kaolite	102	Low temp in 102 tent was 52F, not enough kaolite is left to finish tk 102.	Issue
99	9/29/1971	Construction	101	Welding on 101 primary bottom, general note that an effort must be made to improve radiography quality.	Construction / Issue
100	9/30/1971	Kaolite	102	Low temp of 53F, will add heaters and additional kaolite located.	
101	9/30/1971	Kaolite	102	Swing shift to be laid off due to lack of kaolite. Sections 24 and 26 completed. Heating problems continue.	
102	10/1/1971	Kaolite	102	Low temp was 79F, all heaters working.	

Reference	Date	Log	Tank	Comments	Event
103	10/4/1971	Kaolite	102	Semi with Kaolite 2000 arrived, requested it be protected.	
104	10/5/1971	Kaolite	102	Section 28 badly cracked, to be chipped out and repaired, new kaolite not protected, contractor problems noted.	Issue
105	10/6/1971	Kaolite	102	Last section completed and 28 sections core drilled.	Construction
106	10/7/1971	Kaolite	102	Repair core drill holes.	
107	10/8/1971	Kaolite	102	Curing of TK 102 kaolite completed, canvas tent removed.	
108	10/8/1971	Construction	101	Welding primary knuckle sections.	Construction
109	10/11/1971	Kaolite	101	Located equipment that can be used to core drill under the raised bottom of TK 101.	Issue
110	10/12/1971	Kaolite	102	Survey crew establishing elevation on 102, TBM is 618.93.	Construction
111	10/12/1971	Construction	102	Placing primary plates into 102, new radiograph machine onsite, 700-800 ft behind schedule.	Construction
112	10/13/1971	Kaolite	102	Filling records.	
113	10/13/1971	Construction		Repair rate (based 3"per reject radiograph) for 101 secondary bottom 3.4 %, 102 secondary bottom 1.9%.	Construction
114	10/18/1971	Construction	101	Welding primary bottom and repairing secondary.	
115	10/18/1971	Construction	102	Welding 3rd ring on secondary.	Construction
116	10/20/1971	Construction	101	1 inch thick plate being welded.	Construction
117	10/26/1971	Construction	101	Primary bottom radiography completed.	

Reference	Date	Log	Tank	Comments	Event
118	10/27/1971	Construction	101	Installation trusses on primary bottom.	
119	11/1/1971	Kaolite	101	Core drilling section in TK101 that were less than 130 psi , 1-B, 3-B, 11-B, 12-A&B, 15-B, 16 -A&B, 18-A&B, 22-B, 24-B, 28-B, 31-A, 32-A, 8-B, Total 16 cores.	Issue
120	11/1/1971	Construction		Water has collected in the annulus and soaked into the kaolite, responsibility for kaolite protection not defined.	Issue
121	11/2/1971	Kaolite	102	33 pours made on TK 102 and 32 pours made on TK 101, additional pour made at center of tank per no. CS-370-1.	
122	11/2/1971	Kaolite	101	Elevation at Tank 101 was 618.96.	Construction
123	11/4/1971	Kaolite	102	Increasing width of air slots and cutting out areas for re-pouring.	Issue
124	11/4/1971	Kaolite	101	Will lower primary on Tk101 on 11/7.	
125	11/5/1971	Kaolite	102	Kaolite cutouts keyed and repoured. Heat during cure is requested.	
126	11/6/1971	Kaolite	102	All Kaolite repairs completed.	Construction
127	11/8/1971	Kaolite	101	Some areas in TK 101 under cribbing may need repair, gouged out areas noted in at the center of the secondary tanks bottom where center post was. Repairs requested.	Issue
128	11/8/1971	Construction	101	Mag particles tests on primary and secondary sump area, all acceptable.	
129	11/9/1971	Kaolite	101	Kaolite inspected and no problems noted in lowering of primary tank.	

Reference	Date	Log	Tank	Comments	Event
130	11/9/1971	Construction	101	Primary bottom lowered, no problems.	Construction
131	11/10/1971	Construction	101	Welding on 4th ring of secondary.	
132	11/10/1971	Construction	102	Welding on primary bottom.	
133	11/12/1971	Construction	101	Work to correct plumbness initiated.	
134	11/15/1971	Construction	101	JAJ began concrete work on 101.	Construction
135	11/18/1971	Construction	102	Area 6-7 (seam C-1) determined to be a cold lap.	Issue
136	11/19/1971	Construction		Extensive mag particle testing is becoming apparent for the AZ tanks.	Issue
137	11/22/1971	Construction	101	Primary bottom checked for deformation and found to be acceptable without flattening.	Issue
138	11/22/1971	Construction	102	Area previously determined to be a cold lap (6-7 (seam C-1))verified by mag particle inspection.	Issue
139	11/23/1971	Construction	101	1st lift of concrete being placed, vitro to inspect.	Construction
140	11/23/1971	Construction	101	101 secondary weld reject rate is 1.9%, as girth weld 1.3%, vertical welds 4.8%.	
141	11/29/1971	Construction	102	Cold lap noted examined by ARCHO, suspect to be mill scale. Area sandblasted and re-examined and determined to be relevant. Area to be repaired and reexamined.	Issue
142	12/5/1971	Construction	101	Second lift of concrete placed.	Construction
143	12/6/1971	Construction	102	Installing trusses on 102 primary to lower bottom.	
144	12/7/1971	Construction	102	Cold lap area ground down and re-inspected.	
145	12/9/1971	Construction	101	Third lift of concrete placed.	Construction

Reference	Date	Log	Tank	Comments	Event
146	12/15/1971	Construction		Noted that water in annulus must be kept pumped out.	Issue
147	12/15/1971	Construction		Weld reject rate is given TK 101 secondary girth 1.3%, vertical 4.8%, TK 102 secondary girth 1.4%, vertical 1.8%.	
148	12/16/1971	Construction		Some damage may have occurred to kaolite due to freezing, ice formation in 101 primary bottom.	Issue
149	12/17/1971	Construction	102	Heaters placed under 102 bottom to avoid future freezing.	
150	12/21/1971	Construction	102	Damaged kaolite being removed from TK 102 where necessary.	Issue
151	12/22/1971	Construction	102	Magnetic particle testing in secondary sump area shows no damage from center post.	Issue
152	12/24/1971	Construction		Kaolite temperature will be checked over holiday.	
153	12/28/1971	Construction	102	Second lift of concrete placed, 102 primary tank bottom lowered.	Construction
154	12/29/1971	Construction	102	Trusses being removed, requiring opening of tent, concern about maintaining kaolite.	
155	1/4/1972	Construction	101	Placing the 3rd shell ring on 101 primary tank, magnetic particle testing on exterior of 101 Primary tank.	
156	1/4/1972	Construction	102	Weld repair in progress on 102 primary bottom.	
157	1/5/1972	Construction	101	Leak detection riser, fabricated to unapproved specification readied for installation. NCR initiated. Sump needs to be cleaned out.	Issue

Reference	Date	Log	Tank	Comments	Event
158	1/5/1972	Construction		PDM to designate footage to be left uncovered daily buy JAJ to permit radiography. PDM will work inside tank during backfill operation by using portable welding machines.	
159	1/7/1972	Construction	102	Pouring 3rd lift on 102 concrete.	Construction
160	1/10/1972	Construction	102	Remainder of 1st ring placed on 102 primary.	Construction
161	1/11/1972	Construction		Winds to 60 mph. Many portions of canvas torn or missing.	
162	1/13/1972	Construction		Insert plates for the access holes on tanks 101 and 102 were welded in place.	
163	1/13/1972	Construction		Concluded that time spent by PDM on magnetic particle testing of primary bottom must be monitored.	
164	1/14/1972	Construction		Radiographs of insert plates show welds are unacceptable, not done per DVR and increased chance of cracking and will require magnetic particle testing as a second test. Repair completed by noon and radiographed and still not acceptable. Jones not able to pour concrete in these openings.	Issue
165	1/14/1972	Construction		Heat being maintained on both tanks and the caisson.	
166	1/14/1972	Construction	102	TK 102 leak detection Riser installed.	Construction
167	1/17/1972	Construction	102	Weld repairs on TK 102 again rejected, weld repairs on TK 101 accepted. Magnetic particle testing also acceptable.	Issue

Reference	Date	Log	Tank	Comments	Event
168	1/18/1972	Construction	102	Final repair of TK 102 secondary insert was acceptable. Also magnetic particle tested.	Issue
169	1/19/1972	Construction		Placed concrete in 101 and 102 access holes, concrete will be protected from backfill by 1/4 inch plate and angle iron re-enforcement.	
170	1/19/1972	Construction		Began backfilling. Cautioned contractor not to approach the tanks (8 ft limit) with rigs over 5 ton.	
171	1/23/1972	Construction	101	TK 101 was properly covered to prevent rain from entering the annulus, TK 102 was previously covered.	Issue
172	1/24/1972	Construction		Numerous amount of cracks were noted in the concrete cylinder walls.	
173	1/25/1972	Construction		Weld repairs on TK 101 and welding 102 verticals. Heat be maintained and monitored.	
174	1/26/1972	Construction		9°F, work stopped at 9 am (-2°F two days later and no stoppage).	Issue
175	2/1/1972	Construction	101	Magnetic particle testing initiated on 101 primary bottom, determined to be not effective and efficient, decided not to continue.	
176	2/2/1972	Construction	102	PDM to begin magnetic particle testing on 102 primary skirt.	
177	2/4/1972	Construction	102	2nd ring placed on TK 102 primary, heat being maintained for protection of kaolite.	Construction
178	2/7/1972	Construction		Stress relieving equipment delivered, magnetic particle testing of 102 primary skirt.	

Reference	Date	Log	Tank	Comments	Event
179	2/8/1972	Construction		Upper knuckle sections placed on 101 primary.	
180	2/8/1972	Construction		Told to cover re-stl with heavy blankets for safety. Suggested it may provide a fire hazard, blankets placed.	
181	2/10/1972	Construction	102	Fire discovered in TK 102. Damage limited to canvas material used for heating kaolite and wood scaffolding. Fire department thoroughly wetted material.	Issue
182	2/11/1972	Construction	101	Center insert plate of 101 primary magnetic particle tested to allow placement of center support column.	
183	2/13/1972	Construction	101	Most of the tarps have blown off the 101 tank, but rain not expected.	Issue
184	2/14/1972	Construction	101	No longer required to cover TK 101 on routine basis.	
185	2/16/1972	Construction		Long account is provided regarding the magnetic particle testing, primary dealing with proper surface preparation prior to testing, decided not to power brush, but remove loose rust and scale.	
186	2/18/1972	Construction		Heat being supplied to annulus to keep it dry as snow is falling.	
187	2/19/1972	Construction	102	Fire in TK 102 annulus, welding sparks ignited gas under plywood scaffolding in annulus bottom. The fire department was summoned immediately; however, the fire was extinguished by the time of their arrival.	Issue

Reference	Date	Log	Tank	Comments	Event
188	2/21/1972	Construction		Received letter on cleaning in preparation for Mag particle testing, where cleaning is only to be done in areas directed by commission.	
189	2/22/1972	Construction		J Slaughter and Bob Wendleant (PDM-Seattle) discussed magnetic particle testing, work to begin as soon as possible.	
190	2/23/1972	Construction	101	First section of dome plate placed on 101 primary.	Construction
191	2/23/1972	Construction		Discussion with PDM on how to clean and prep the steel for magnetic particle testing to resolve concerns.	Issue
192	2/23/1972	Construction		Long QA program change discussion.	
193	2/24/1972	Construction		Cleaning of primary bottom plate (1/2 of center plate completed) as first area for magnetic particle testing.	
194	2/28/1972	Construction		PDM man permanently assigned to magnetic particle testing until completion. Installation of reinforcement for kaolite retainer ring initiated. 3rd horizontal being welded on 102 primary.	
195	2/29/1972	Construction	101	Magnetic particle testing resumed in 101 primary tank. All scaffolding removed from 101 primary.	
196	3/1/1972	Construction		Rain and snow. Notified G. adolf to remove water from the annulus should it become excessive. Heat should be turned on during rainy periods.	Issue
197	3/2/1972	Construction		Discussed modification of the re-enforcement pads for retainer ring.	

Reference	Date	Log	Tank	Comments	Event
198	3/3/1972	Construction		Magnetic particle testing resumed in 101 primary tank. Installed 4th primary ring on 102 tank.	Construction
199	3/6/1972	Construction		2nd man assigned to magnetic particle testing.	
200	3/7/1972	Construction	101	Laying out dome penetrations on 101 tank. Welding on repair and final dome section which was placed today.	
201	3/8/1972	Construction		Survey crew checking coordinates for 101 dome penetrations. Discussed removing sections of the backing strip on the dome sections to allow the flashing to closely joined to the primary tank.	
202	3/9/1972	Construction		Additional welding needed on retainer ring as specified in design change (ES-647-H1). Backing strip to be removed where flashing strip was to be installed.	
203	3/10/1972	Construction	101	Magnetic particle testing continues in 101 primary along with weld repairs.	
204	3/11/1972	Construction	101	PDM now has 3 magnetic particle men present doing inspection in 101 primary.	
205	3/12/1972	Construction	101	Magnetic particle testing in 101 primary continues with 3 men present. Some small areas of bottom are wet.	
206	3/13/1972	Construction		Heaters and plywood removed from the annulus, in view of the warm temperatures and to facilitate removal of water from the annulus.	Issue

Reference	Date	Log	Tank	Comments	Event
207	3/13/1972	Construction		A boilermaker was assigned to grind magnetic particle indications to determine if they are relevant. Indications not removed by grinding are set aside for further evaluation.	
208	3/14/1972	Construction	102	Indications from mag particle testing were ground some and found to be relevant. Areas of varying widths could be peeled off the surface. Later found that these lamination type discontinuities could be removed by surface grinding to a depth not to exceed 1/16 inch. Ground area retested and no indications found. If the discontinuities are no more serious, there should be no concern testing the shell rings.	Issue
209	3/15/1972	Construction		Meeting to resolve time differences for mag particle testing and erection delay. All issues resolved.	
210	3/16/1972	Construction	102	Back-gouging the L-1 seam of the 102 primary, severe plate lamination revealed. Present in two plates in top rings, suggestion made to UT these are using Westinghouse personnel.	Issue
211	3/17/1972	Construction	102	Met with Westinghouse, ARCHO, AEC, and PDM personnel to discuss UT. Magnetic particle testing on TK 102 primary bottom.	
212	3/20/1972	Construction	101	Provided PDM with a list of radiographs required to complete the 101 primary shell.	

Reference	Date	Log	Tank	Comments	Event
213	3/21/1972	Construction	102	Asked to have Westinghouse perform ultrasonic testing on the TK 102 primary plates known to contain laminations. Upper knuckles placed on 102 primary , plates with lamination will not be welded.	Issue
214	3/21/1972	Construction	101	All radiographs have been received on the 101 primary tank and one repair remains. Will start insulating Tk 101 tomorrow.	Construction
215	3/21/1972	Construction		Notified PDM that 1/4 inch space must exist between the kaolite stop and the secondary tank.	
216	3/21/1972	Construction		Obvious confusion and misinterpretation of the ultrasonic test performed last Friday. Intend to clarify when subsequent testing is performed.	
217	3/22/1972	Construction	101	PDM removed kaolite "stop" at bottom of the retainer band. Requested E.S. Davis assign inspector to make evaluation of Kaolite at this time. Accepted primary radiographs on 101 primary today, all work and documentation complete.	
218	3/23/1972	Construction	101	E.S Davis personally examined the condition of the kaolite (report on file). First insulation placed in annulus.	Construction
219	3/23/1972	Construction	102	Bill Armstrong requested that UT on the shell plates (4th Ring) be IAW ASTM A435. This will require additional UT and cost. J. Slaughter notified and accepted additional cost.	Issue

Reference	Date	Log	Tank	Comments	Event
220	3/24/1972	Construction	102	Air-arc gouging on the 4th Shell ring in TK102 primary disclosed a 3rd plate with lamination at the edge. Work halted on this plate. Westinghouse personnel on site to UT plates.	Issue
221	3/27/1972	Construction	102	Now 4 plates of the 102 primary 4th shell ring are found to contain laminations after air-arc gouging.	Issue
222	3/28/1972	Construction	102	PDM attempted repair of plate edge lamination using PDM procedure RP-3. Arc-gouged a small section (3 inches long) adjacent the weld which completely separated from the other half of the 3/8" plate. Lamination still visible in the parent material 3/4 " from weld. Similar conditions found in other areas of plate. PDM advised to not weld on laminated edges.	Issue
223	3/29/1972	Construction	102	Work on laminated plates halted by PDM, subject to expert examination. Recommendations given to replace plates. Ready to place primary plates on 102 dome.	
224	3/30/1972	Construction	102	ARCHO conducted UT on one of the laminated plates. PDM in favor of replacing entire plates. Letter to be forwarded to commission with alternatives.	Issue
225	3/30/1972	Construction	101	Begin final inspection of 101 primary bottom plates.	
226	3/31/1972	Construction	102	John Slaughter said laminated plates must be replaced and informed PDM. Mr. Kligfiled request more information.	Issue

Reference	Date	Log	Tank	Comments	Event
227	3/31/1972	Construction	101	Final inspection of TK 101 primary before stress relief, areas of attention marked for PDM.	Construction
228	4/4/1972	Construction	102	PDM says 4 plates ordered from mill (A-55-60) and should arrive near April 16th.	
229	4/5/1972	Construction	102	Magnetic particle testing still In progress in TK 102 primary.	
230	4/6/1972	Construction	101	Jay Varvel and D Koreis assigned as 2nd and 3rd shift inspectors for stress relief.	
231	4/7/1972	Construction	101	Main Burners started as 7:25 pm. A separate stress relieving log book will be used for coverage.	Construction
232	4/7/1972	Stress Relief	101	Main Burners started as 7:25 pm. Only burner D remained on, burner C restarted at lower gas flow rate.	
233	4/7/1972	Stress Relief		All burners on at 11 pm, Problems with #3 recorder, TC 65 over burner D is 590° @1155pm, 3 burners on.	
234	4/8/1972	Stress Relief		Bill Armstrong indicated 8 hour heat up of kaolite could start at 12:00 am. All thermocouples on the tank read above 250F except for three on the outside tank bottom (230F). Thermocouples near burners B&D read 20F above the 600F required.	
235	4/8/1972	Stress Relief		Two burners Ran most of the night.	
236	4/8/1972	Stress Relief		4-12 shift notes numerous problems, large differentials, inability to control spread, large overshoots above 600°F.	

Reference	Date	Log	Tank	Comments	Event
237	4/8/1972	Stress Relief		12-8 shift tries to increase above 600°F, cannot evenly and stops process.	Construction / Issue
238	4/10/1972	Construction	101	Cover plates removed to allow entry, charts taken to PGH.	
239	4/11/1972	Construction	101	Stress relieving system to be modified by John Adams (PDM engineer).	
240	4/12/1972	Construction	101	Modifications described to stress relieving process, including insulating primary knuckle.	Construction
241	4/13/1972	Construction	101	Insulators placing material against bottom primary knuckle and in the air slots.	
242	4/13/1972	Construction		PDM requested confirmation of modification from 1 and 1/2 "H20 Minimum pressure to a 2" H20 pressure.	
243	4/18/1972	Construction	101	Vent tubes longer than proposed and had to be cut back, asked R. Nederhood to examine thermocouple location and possible damage.	
244	4/19/1972	Construction	101	Nederhood informs that location and conditions of inside 'couples" appears satisfactory.	
245	4/19/1972	Construction	101	2nd Stress relieving started at 3:30 pm, refer to SR logbook.	Construction
246	4/19/1972	Stress Relief	101	Official startup of stress relieving (2nd occurrence) was 3:30 pm. PDM has 12 hrs to reach 600F, 12 hr period starts when lowest couple reaches 600F, when 1st couple reaches 600F lowest must be 400F (200F diff), At 700F , 1.5 inches of H20 required.	

Reference	Date	Log	Tank	Comments	Event
247	4/19/1972	Stress Relief	101	At 7:30 pm highest reading was 500F and lowest 300F. PDM attempting to decrease differential.	
248	4/20/1972	Stress Relief	101	Stress relieving operation going well, at 11 am PDM started the 3 hr hold with lowest thermocouple at 1000F. TE-25, 27 and 28 considered malfunctioning.	
249	4/20/1972	Stress Relief	101	At 11:40 , lowest TC reading 1050F, initiating a 2 hrs hold. Soak period terminated at 140 pm and cooling started. Cooling rate for 1st two hrs 40-70F/hr.	Construction
250	4/24/1972	Construction	101	Vacuum leak testing of 101 primary and no indications noted, Visual examination of interior revealed no abnormalities or damage.	Construction
251	4/24/1972	Construction		Progress on M.P.T. is not satisfactory and the commission will be notified.	
252	4/24/1972	Construction	101	Began filling 101 tank for hydrostatic test.	Construction
253	4/25/1972	Construction	102	Four shell ring plates arrived to replace the laminated plates found in the 102 primary.	
254	4/26/1972	Construction	102	Welding and fit up of the SRP-4 plates. Noted more time should be allowed 102 tank stress relieving for cool down.	Issue
255	4/26/1972	Construction	102	Monitoring of the 102 tank for prevention of kaolite freezing was ended yesterday.	
256	4/28/1972	Construction	101	Water level in 101 is at 38 ft -11.5 inches. Chalking of seams to take place Monday.	Construction

Reference	Date	Log	Tank	Comments	Event
257	5/1/1972	Construction	101	Installation of strain gages on 101 tank started today.	
258	5/1/1972	Construction	101	Examined chalked areas, leakage noted in 5 areas on dome section.	Construction / Issue
259	5/2/1972	Construction	101	Water level lowered to facilitate repair of leaks detected yesterday.	Issue
260	5/2/1972	Construction	102	Examined "new" plates that has been arc-gouged for welding and did not detect any laminations.	
261	5/3/1972	Construction	101	Haunch sections being installed on 101 secondary.	Construction
262	5/5/1972	Construction	102	Magnetic particle testing completed on 102 primary bottom. Welding on TK 102 4th primary shell ring.	
263	5/11/1972	Construction	102	Final section of TK 102 primary dome placed today.	Construction
264	5/12/1972	Construction	102	Final radiography will be completed this weekend as final repairs are in progress.	
265	5/15/1972	Construction	102	Radiography of 102 Primary tank complete and accepted today.	Construction
266	5/15/1972	Construction		Omitted from log of 5/11, Examined stainless steel dome penetration when welding complete and found acceptable.	
267	5/16/1972	Construction	102	Visual examination of 102 primary tank exterior.	
268	5/18/1972	Construction	102	Burner tubes and installation of insulation continue on TK 102. Vacuum box testing of 102 primary tank bottom began.	

Reference	Date	Log	Tank	Comments	Event
269	5/19/1972	Construction	102	Vacuum box testing completed and all areas accepted in 102 primary bottom.	
270	5/23/1972	Construction	102	Final inspection made on 102 primary interior, found acceptable and ready for stress relief, thermocouples checked by R. Nederhood.	Construction
271	5/24/1972	Construction	102	Final preparations for stress relieving completed today, refer to stress relieving log for Wed 5/24/72 to Fri 5/26/72.	
272	5/24/1972	Stress Relief	102	Stress relieving of 102 primary tank started at 5:08 pm.	Construction
273	5/24/1972	Stress Relief	102	As of 8 pm all temperature below 600F, average reading in kaolite was over 250F.	
274	5/25/1972	Stress Relief	102	At 3:45 pm max temp was 600F and min temp was 400F.	
275	5/25/1972	Stress Relief	102	At 10:10 pm max temp was 715F and min temp was 520F.	
276	5/25/1972	Stress Relief	102	Lowest temp reached 600F at midnight. The began increasing temps increased 50-60F per hour.	
277	5/26/1972	Stress Relief	102	Soak time started at 9:10 am when last TC reached 1000F. Max TC was 1160F. Cooling started at 12:10 pm. TC # 12 considered erroneous.	Construction
278	5/30/1972	Construction	102	Examined 102 tank interior and found post stress condition normal and ready for hydrostatic test.	
279	5/31/1972	Construction	101	Work began on bellows and penetrations on north south centerline of 101 tank.	

Reference	Date	Log	Tank	Comments	Event
280	5/31/1972	Construction	102	Water being transfer from TK 101 to TK 102.	Construction
281	6/2/1972	Construction		Pipe delivered for process fill lines was not type 304L and cannot be used.	
282	6/6/1972	Construction	101	Erection of truss system for dome support during concreting still in progress.	Construction
283	6/7/1972	Construction	102	Coating of the weld seams with blue chalk for the hydrostatic test was started.	
284	6/8/1972	Construction	102	Examined welds on the 102 primary for leaks and found none.	
285	6/8/1972	Construction	101	Air supply pipe being welded into position on TK 101 annulus.	
286	6/9/1972	Construction	102	Completed examination of 102 primary tank for leakage, one minor repair was required on penetration above knuckle. Secondary haunch is now being placed on 102 tank.	Construction / Issue
287	6/12/1972	Construction	101	JAJ began placing re-stl on 101 tank for dome concrete.	
288	6/13/1972	Construction	102	Preparing to drain the 102 primary tank.	
289	6/14/1972	Construction		John Slaughter pickup up all the AZ tank radiographs and magnetic particle testing reports, no further auditing pending return of the "books."	

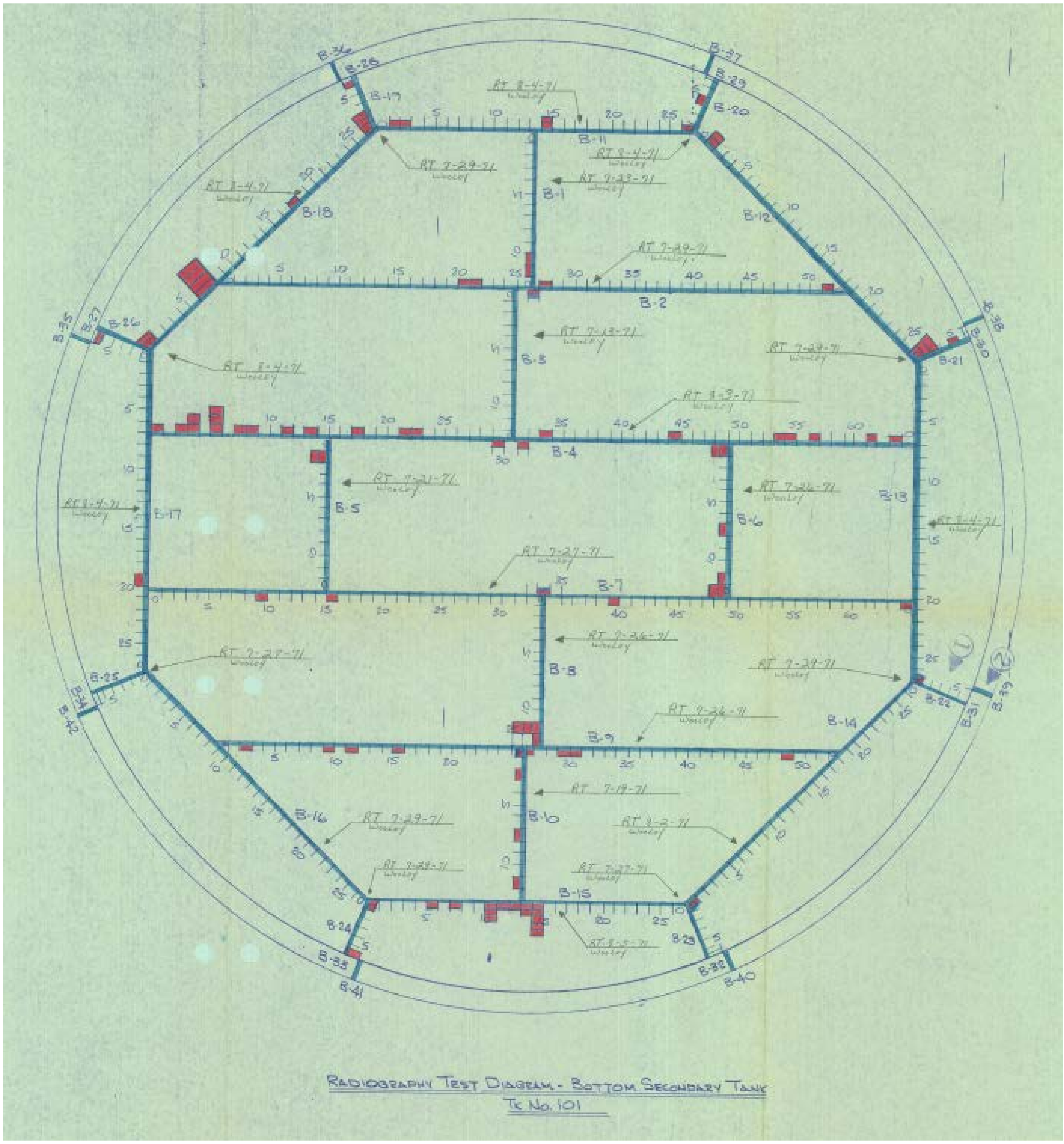
Reference	Date	Log	Tank	Comments	Event
290	6/22/1972	Construction		Discovered that the welder employed by Thompson Mechanical on the fill lines was not qualified on the SMA process. One pass remaining and weld completed. PDM to investigate prior qualification and send weld to test ship for immediate qualification.	Issue
291	6/23/1972	Construction		Site visited by J. Slaughter and J. Hendron and two Westinghouse NDT personnel. Visual inspection and spot magnetic particle testing conducted throughout the day.	
292	6/26/1972	Construction		Determined that welder had prior qualification and inspection showed welds are acceptable, but that situation should not re-occur.	Issue
293	6/27/1972	Construction		Reinforced steel installation taking place on both tanks	
294	7/5/1972	Construction	101	All items for dome pour on TK 101 appear to be in order.	
295	7/6/1972	Construction	101	Dome pour to start at 8:20 am. Details logged by J. Diehl, Vitro inspector on concrete. Air introduced for additional support, Vitro will monitor internal pressure.	Construction
296	7/7/1972	Construction	101	Air pressure being maintained while concrete is curing.	
297	7/12/1972	Construction		Strain gage installation and re-stl work covered in log by Nederhood and Diehl.	
298	7/13/1972	Construction	101	Concrete pour today.	

Reference	Date	Log	Tank	Comments	Event
299	7/17/1972	Construction	101	Truss can be removed if a 1) air pressure maintained, 2) cylinder test shows 2000 psi minimum after 3 days (test on 2 cylinders were 2100+ and 2300+).	Construction
300	7/24/1972	Construction	101	Entry into tank 101 today to check unwelded gouge in E-1 seam and "pitting" detected in recent audit. Many dimensions taken to aid in disposition.	Issue
301	7/25/1972	Construction	101	Visited tank 101 for additional data.	
302	7/28/1972	Construction	101	Preformed dye penetrant examination of the gouge in E-1 seam, tank 101. No rejectable discontinuities found.	Issue
303	7/31/1972	Construction	102	Haunch Pour today.	Construction
304	8/4/1972	Construction	102	Dome pour today, air pressure being maintained.	
305	8/8/1972	Construction	102	Two test cylinders broken today, results were 2100+, truss can be removed.	Construction
306	8/11/1972	Construction		Due other commitments removed from AZ farm, for progress and daily coverage refer to log of J. Parrish.	
307	8/21/1972	Construction		Thru 9/5/71, Backfilling AZ excavation.	Construction
308	9/6/1972	Construction		Official acceptance of construction inspection today by J.Slaughter (AEC), J. Kemp (ARHCO for W.C. Armstrong), and this author. Accepted with two minor exceptions.	Construction

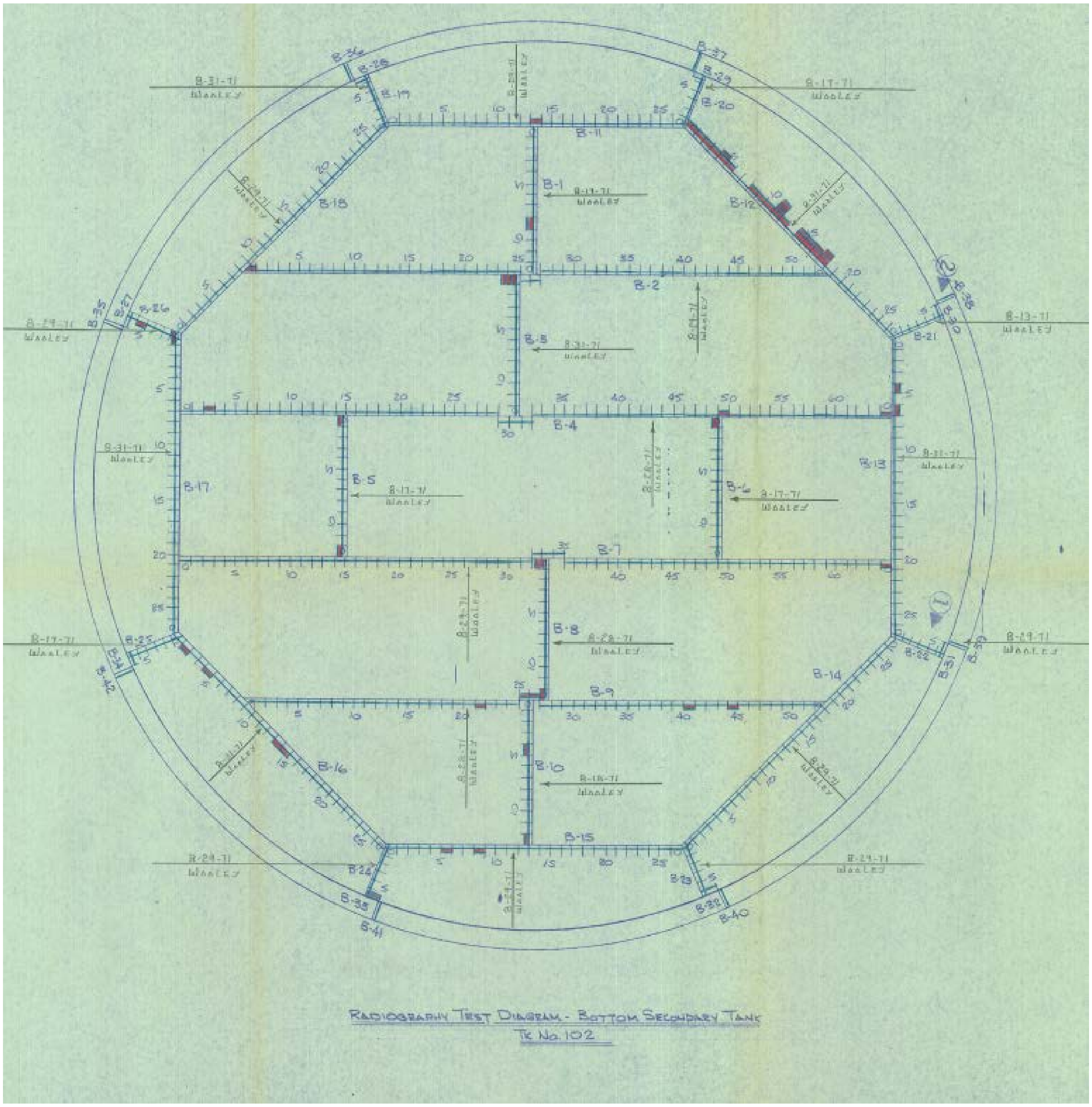
Reference	Date	Log	Tank	Comments	Event
309	9/6/1972	Construction		Repeated request to JAJ that information necessary (material certs, welder qualification, and weld procedures) regard Phase III work was not submitted.	
310	9/7/1972	Construction		Initiated NCR-V-NC-4 for lack of submittals mentioned in 9/6.	
311	10/2/1972	Construction		AZ farm work shutdown by JAJ, lack of approved specifications.	
312	10/6/1972	Construction		Last entry says work still on hold, expected to resume next week.	

APPENDIX B 241-AZ Tank Farm Weld Maps

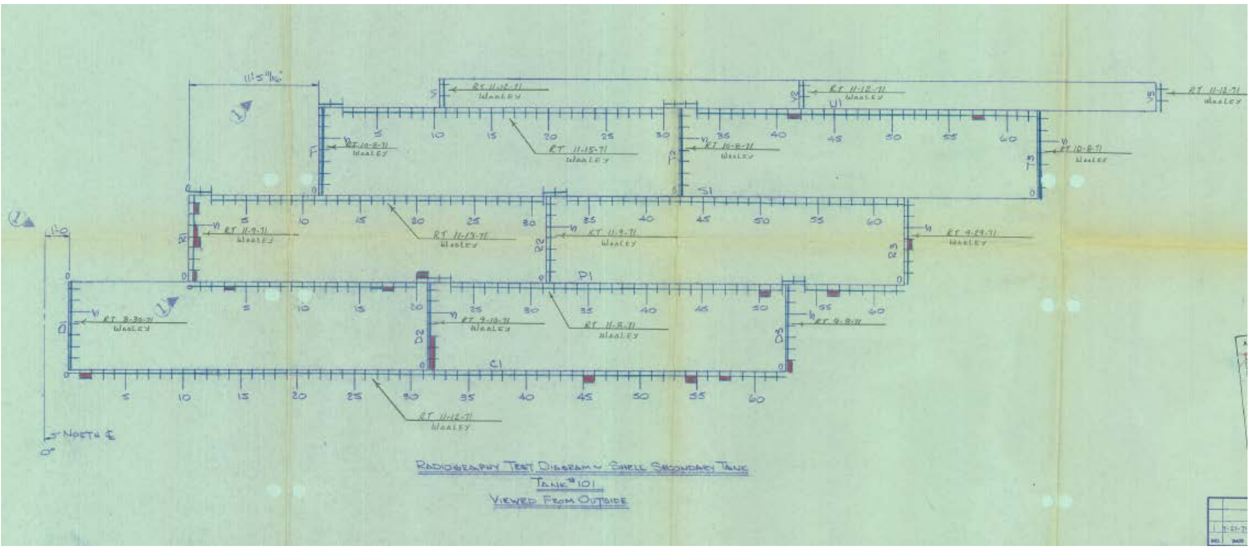
App Figure B-1. Tank AZ-101 Secondary Bottom Weld Map



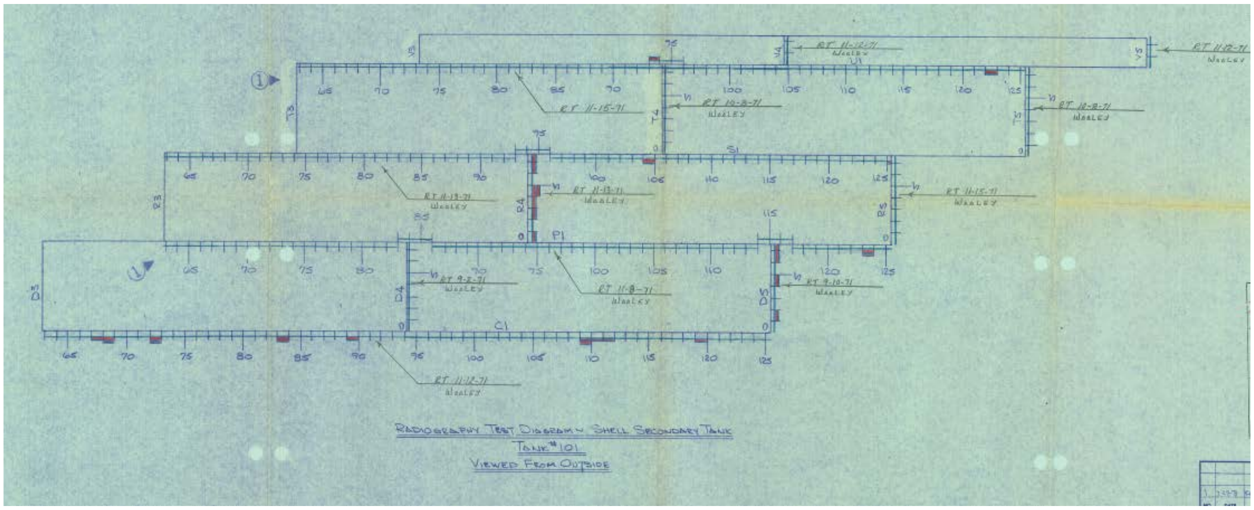
App Figure B-2. Tank AZ-102 Secondary Bottom Weld Map



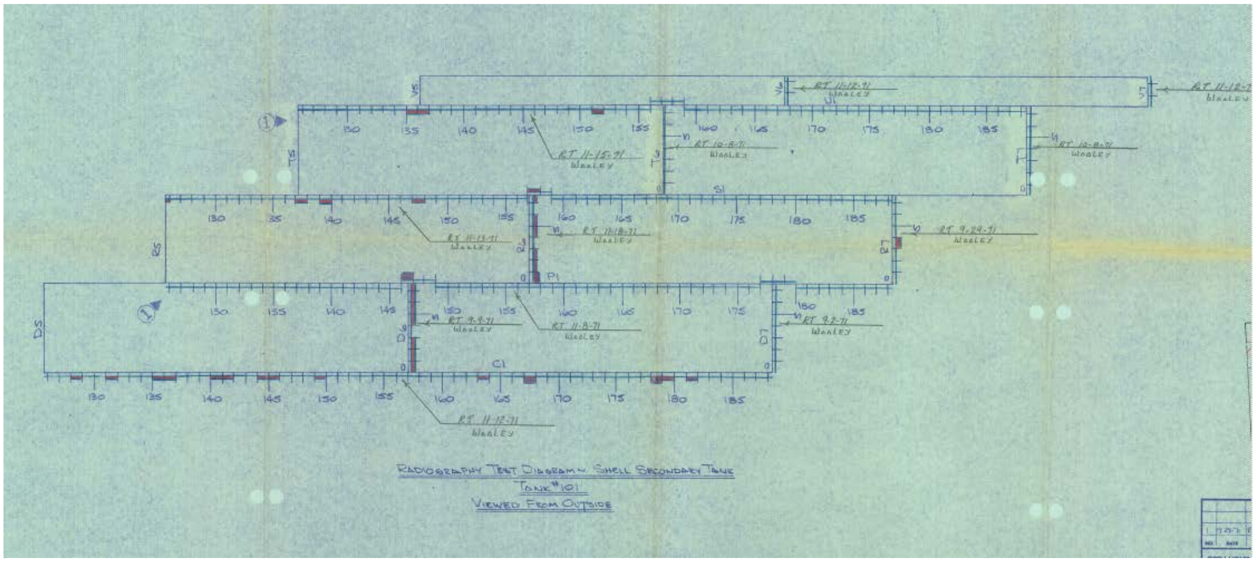
App Figure B-3. Tank AZ-101 Secondary Shell Weld Map (1 of 4)



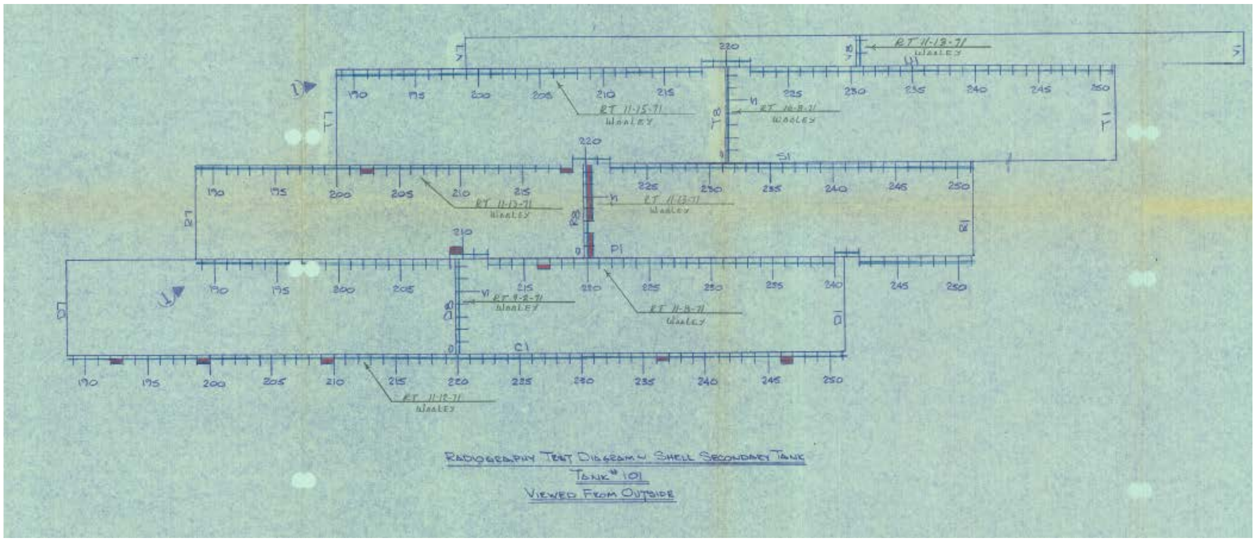
App Figure B-4. Tank AZ-101 Secondary Shell Weld Map (2 of 4)



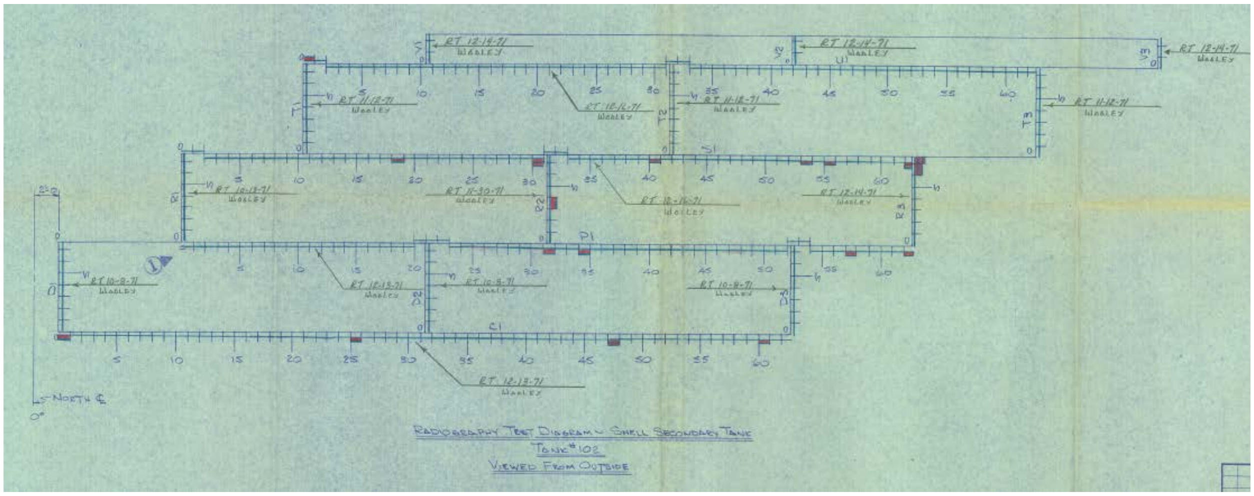
App Figure B-5. Tank AZ-101 Secondary Shell Weld Map (3 of 4)



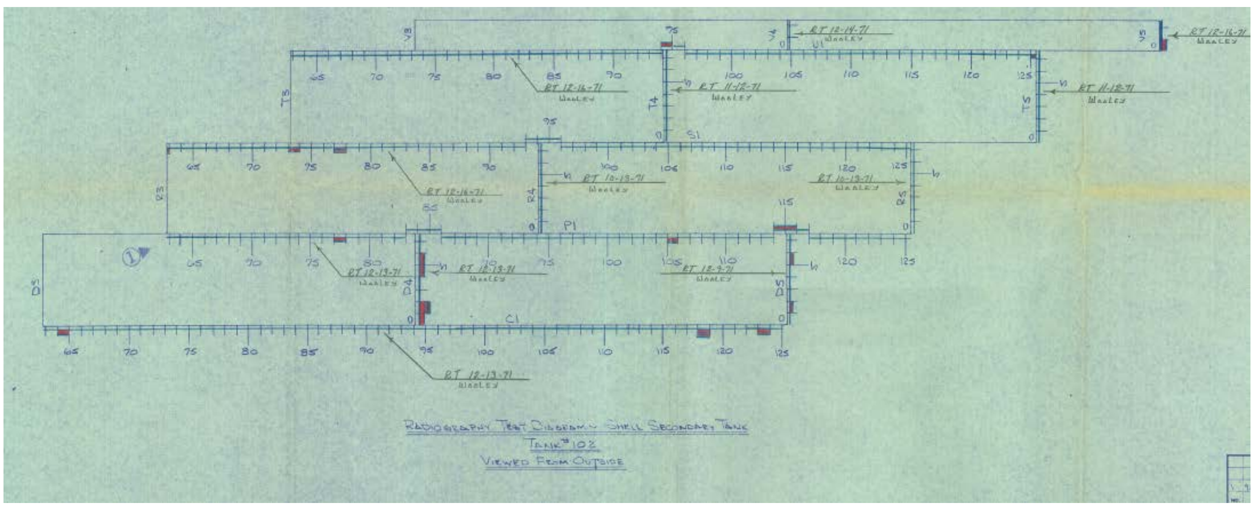
App Figure B-6. Tank AZ-101 Secondary Shell Weld Map (4 of 4)



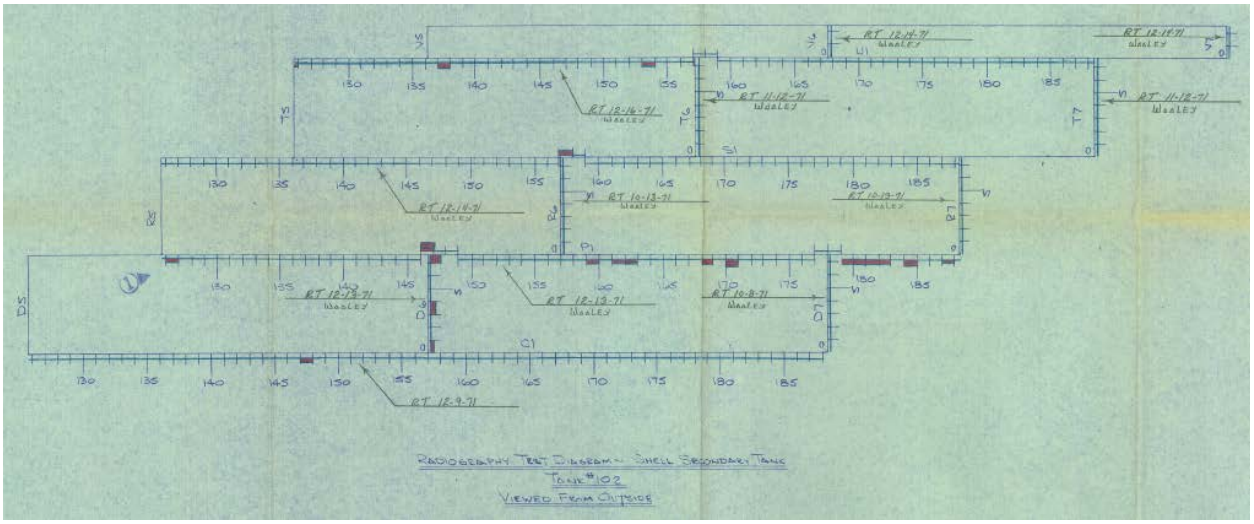
App Figure B-7. Tank AZ-102 Secondary Shell Weld Map (1 of 4)



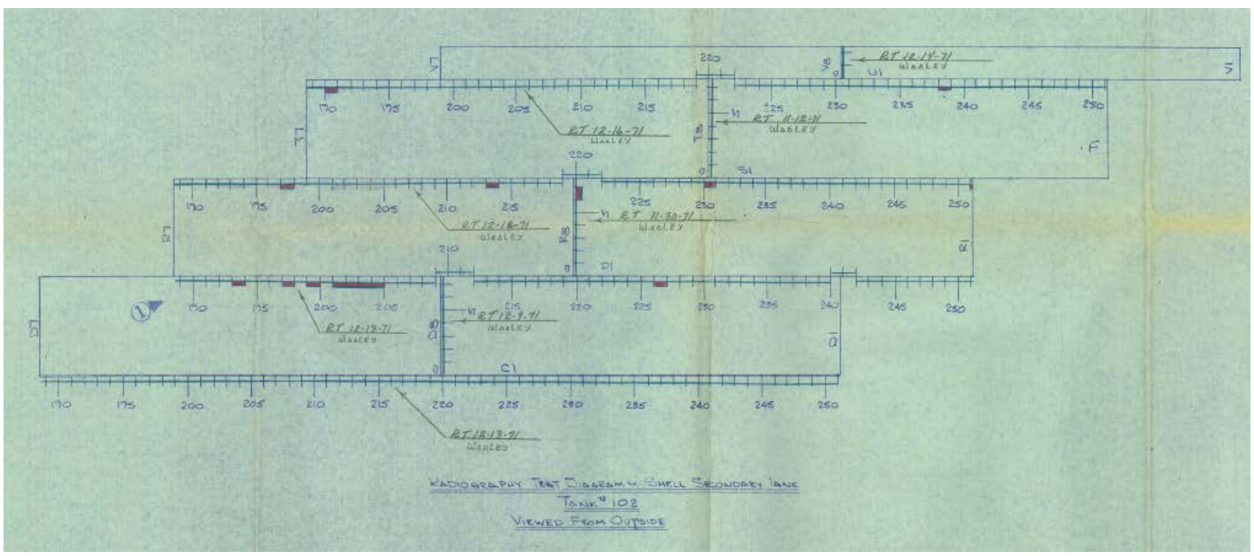
App Figure B-8. Tank AZ-102 Secondary Shell Weld Map (2 of 4)



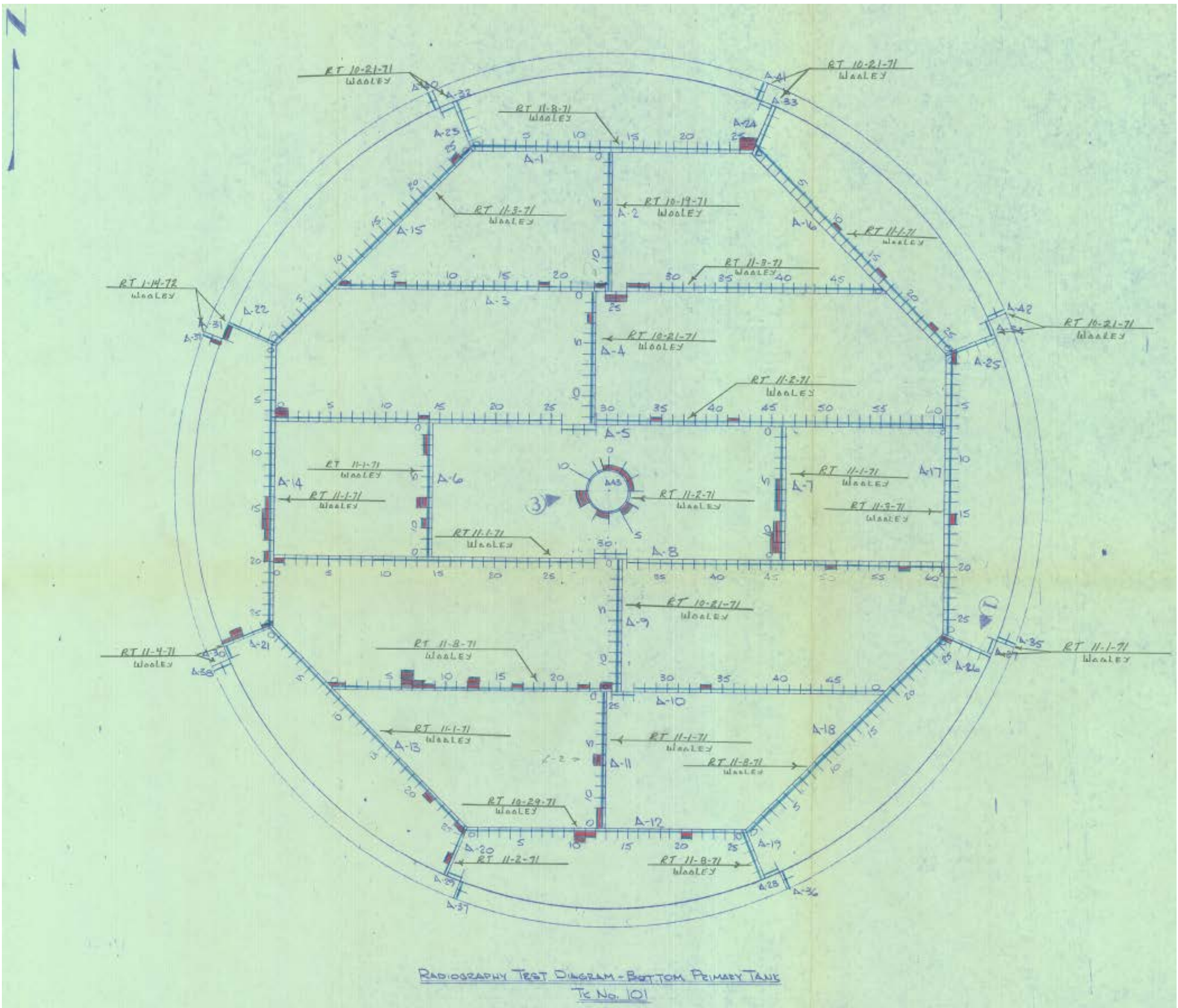
App Figure B-9. Tank AZ-102 Secondary Shell Weld Map (3 of 4)



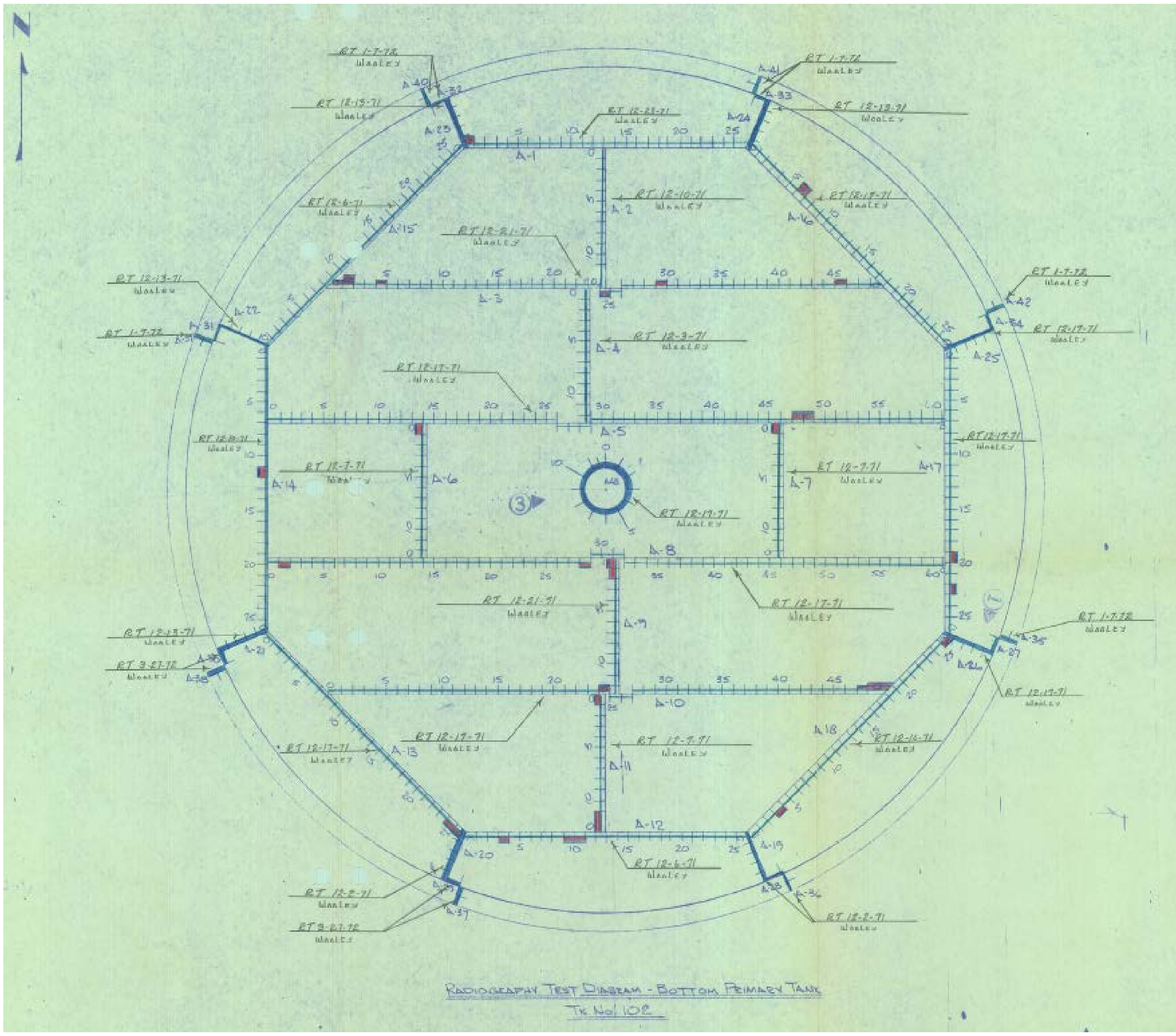
App Figure B-10. Tank AZ-102 Secondary Shell Weld Map (4 of 4)



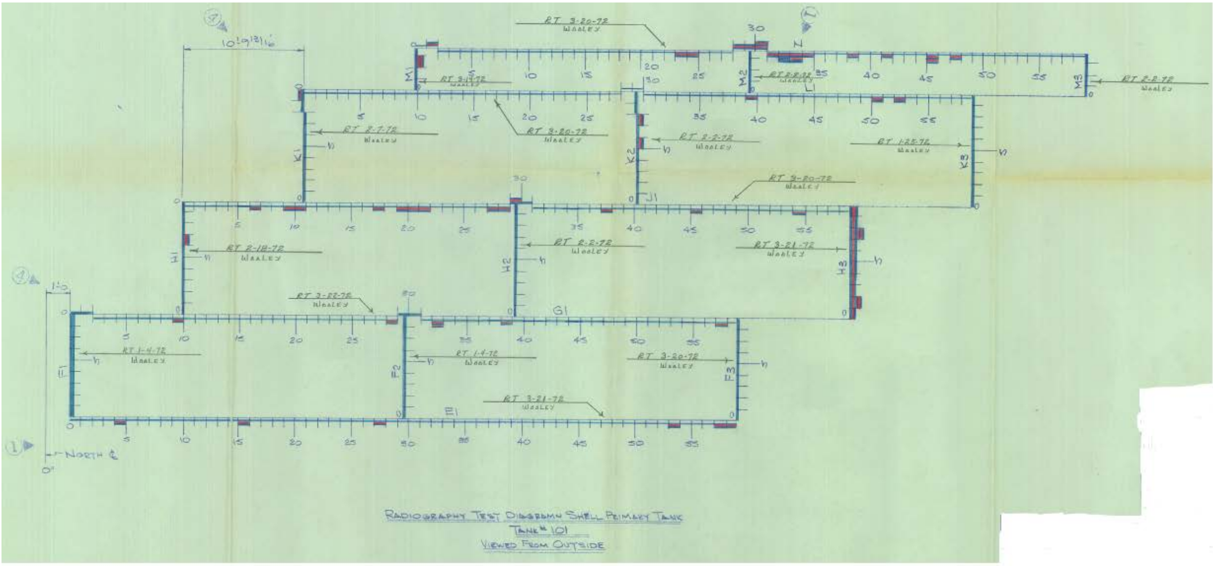
App Figure B-11. Tank AZ-101 Primary Bottom Weld Map



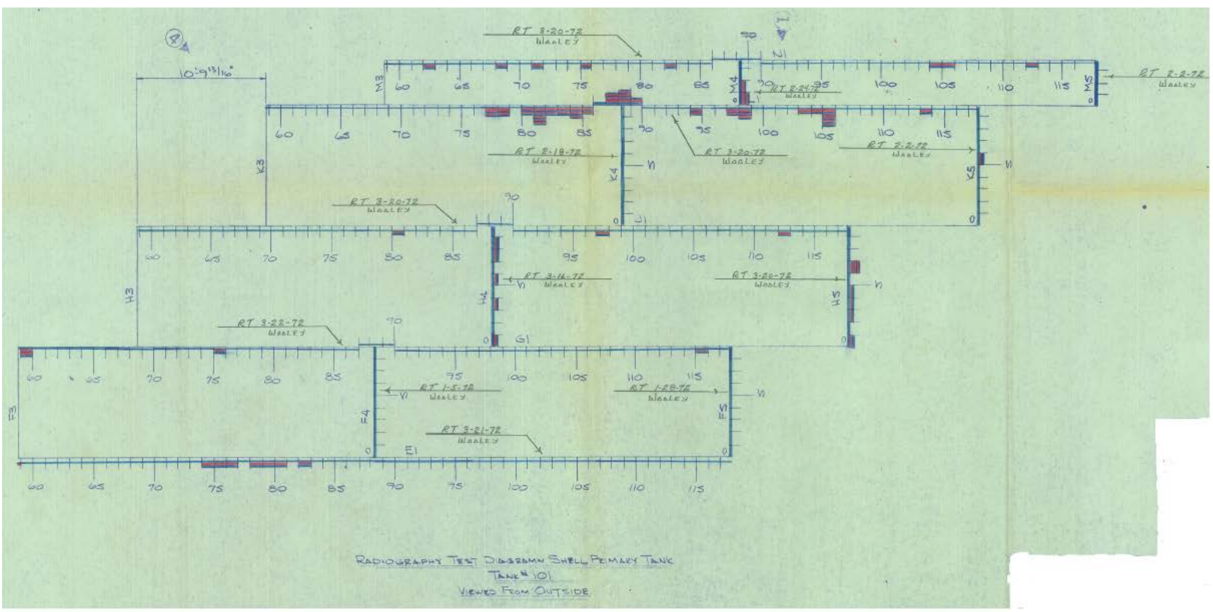
App Figure B-12. Tank AZ-102 Primary Bottom Weld Map



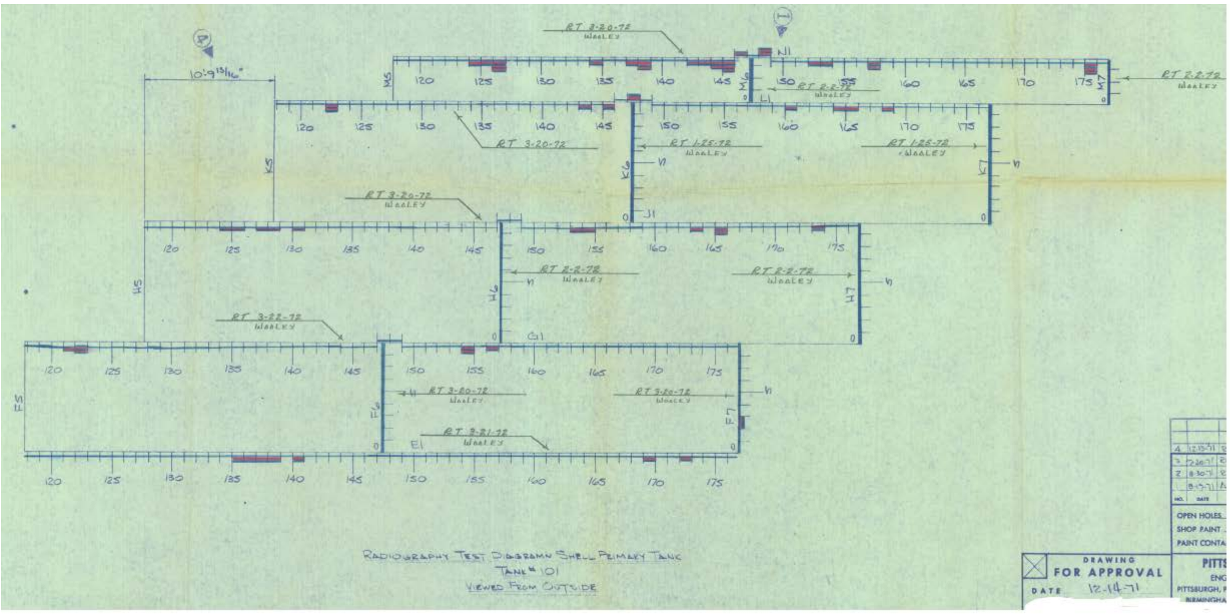
App Figure B-13. Tank AZ-101 Primary Shell Weld Map (1 of 4)



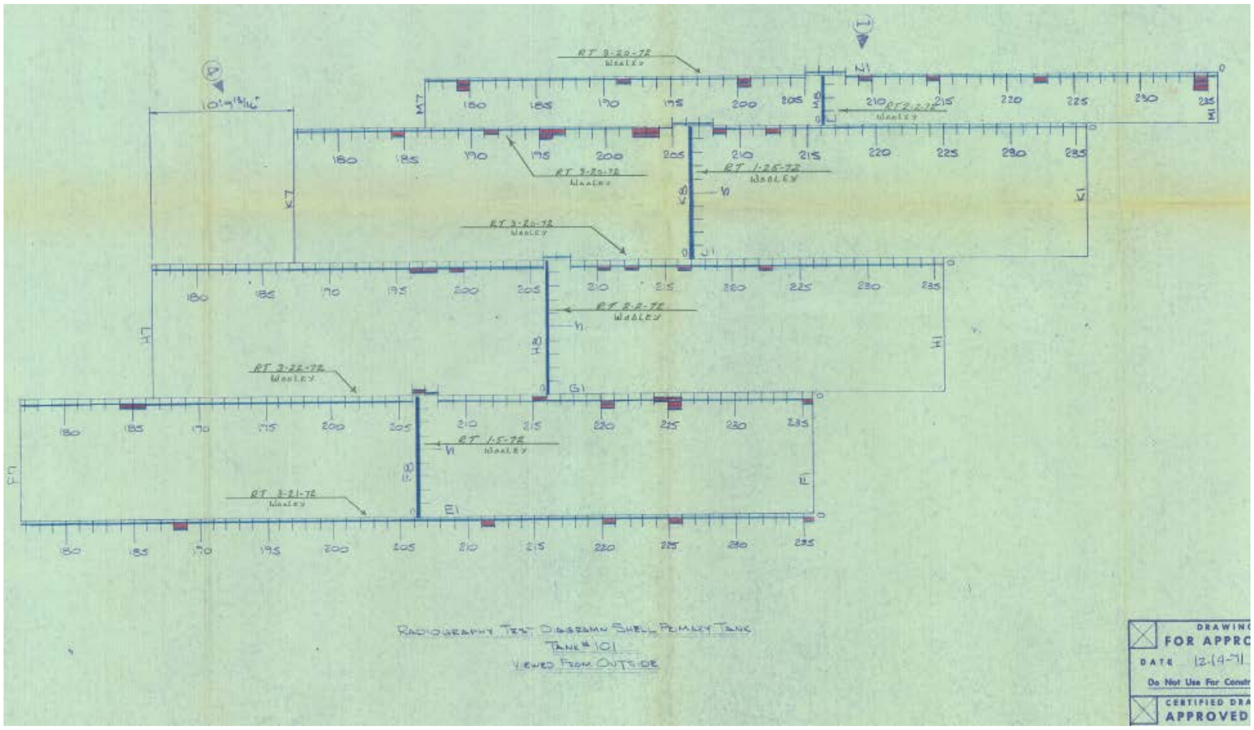
App Figure B-14. Tank AZ-101 Primary Shell Weld Map (2 of 4)



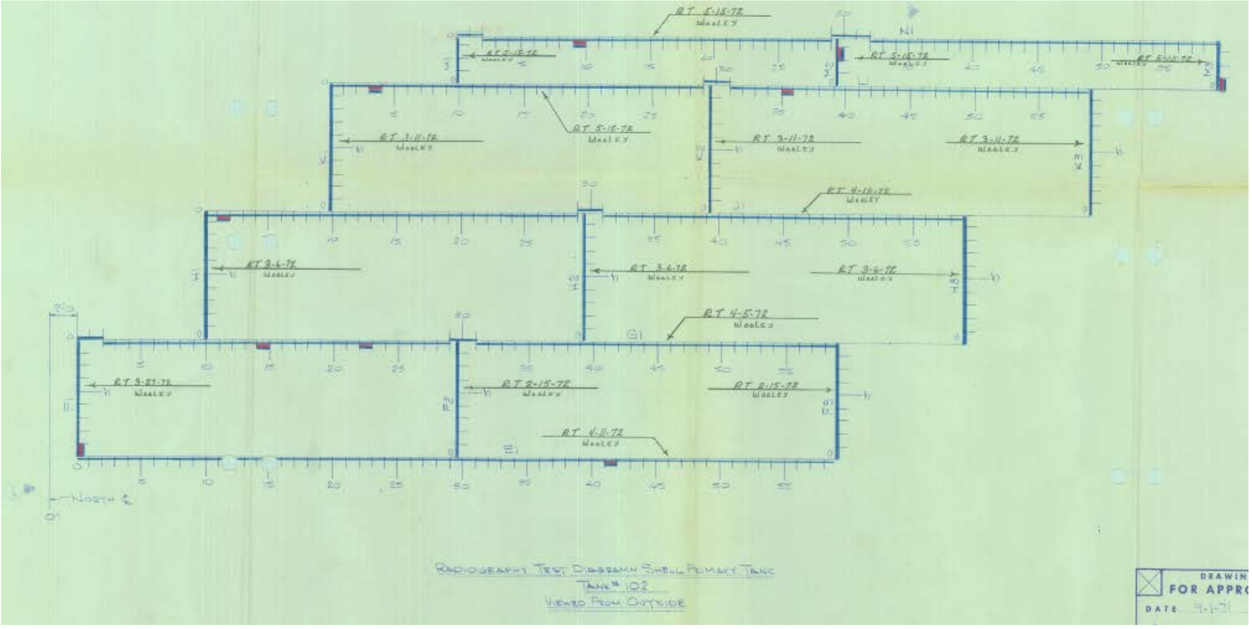
App Figure B-15. Tank AZ-101 Primary Shell Weld Map (3 of 4)



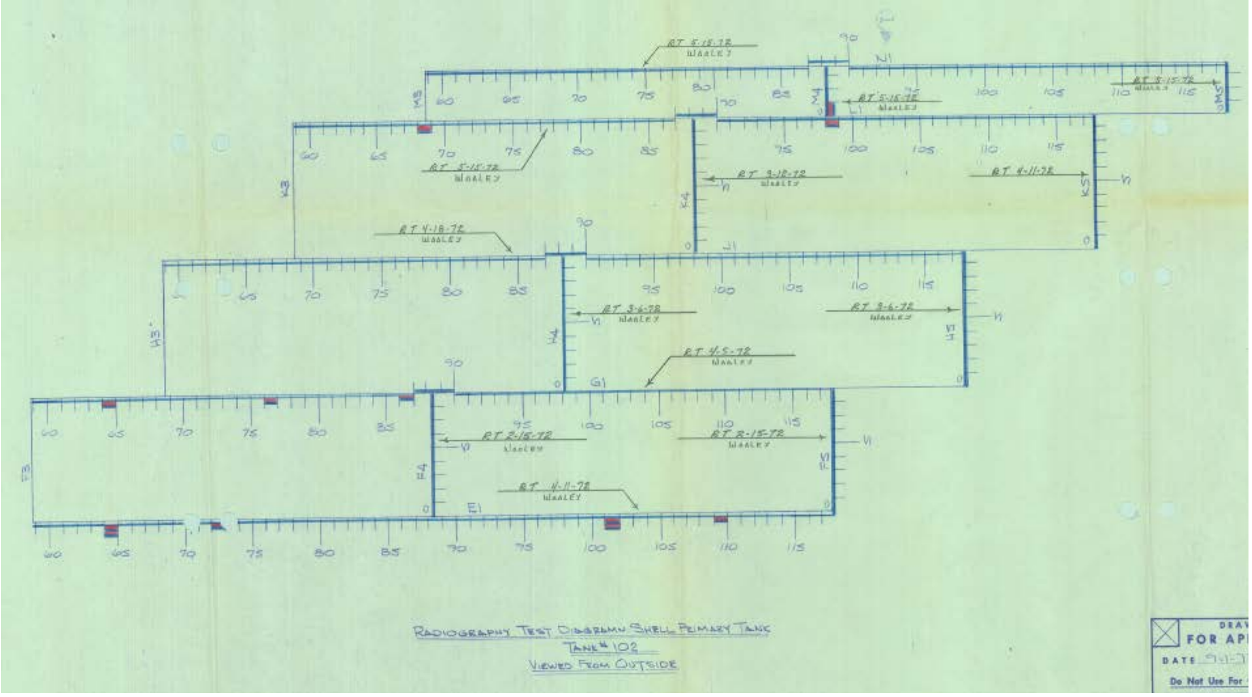
App Figure B-16. Tank AZ-101 Primary Shell Weld Map (4 of 4)



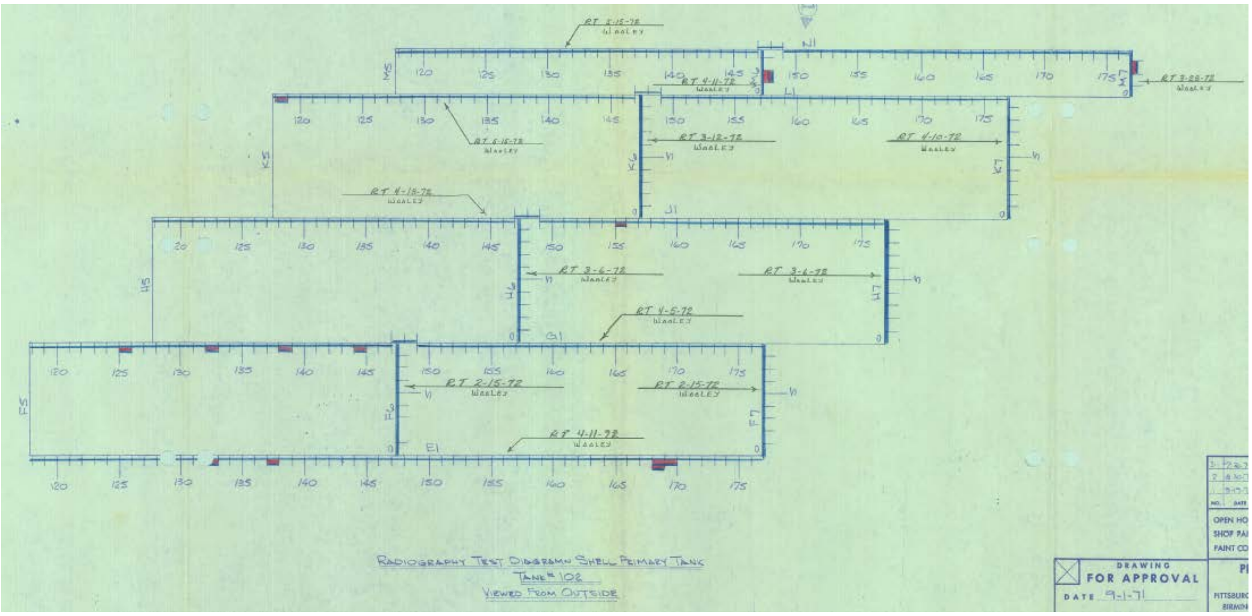
App Figure B-17. Tank AZ-102 Primary Shell Weld Map (1 of 4)



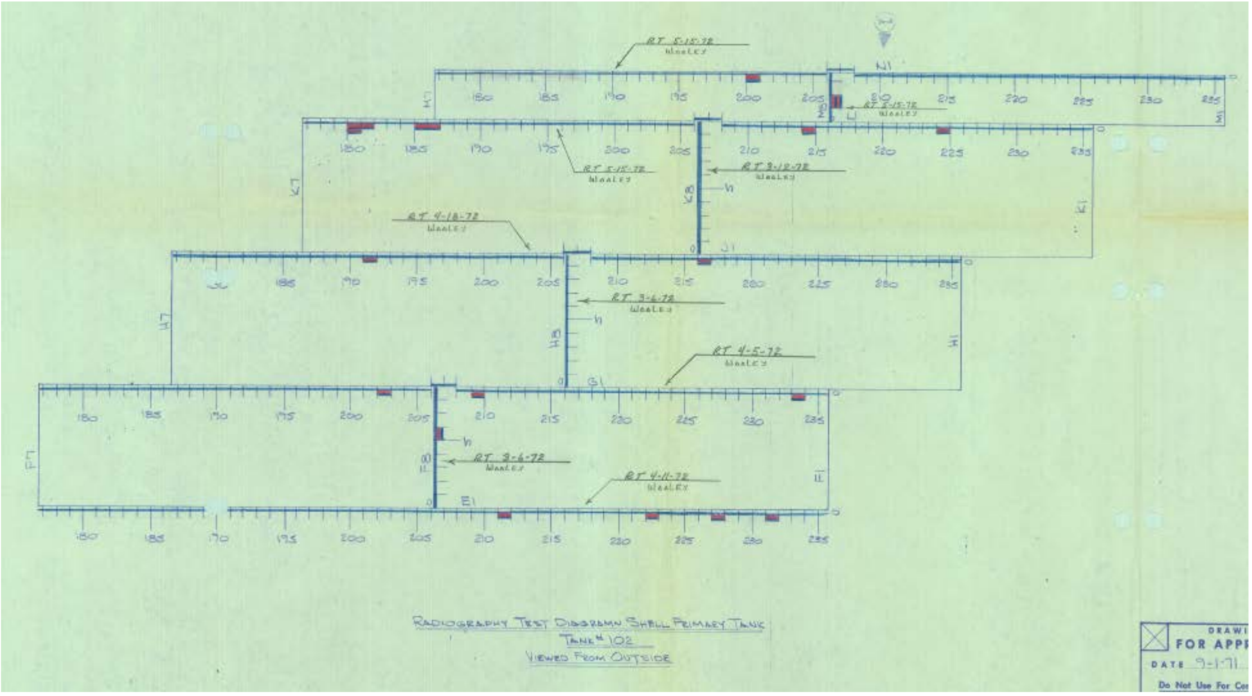
App Figure B-18. Tank AZ-102 Primary Shell Weld Map (2 of 4)



App Figure B-19. Tank AZ-102 Primary Shell Weld Map (3 of 4)



App Figure B-20. Tank AZ-102 Primary Shell Weld Map (4 of 4)



APPENDIX C Tank Deficiency Documentation

App Figure C-1. Plate Laminations Nondestructive Test Report 72-41 (Dated 3/17/72) (2 Pages)

WADCO CORPORATION

NONDESTRUCTIVE TEST REPORT
NONDESTRUCTIVE TEST APPLICATIONS
306 BLDG., 300 AREA – TEL. 3682

REPORT NO. 72-41
DATE 3/17/72

CLIENT: VITRO
CUST. P.O. NO.:
WORK ORDER NO.: B 51485

ATTENTION: D. Mager
ADDRESS: 2101M Bldg.
200 East Area

☐ PENETRANT
☒ ULTRASONIC
☐ MAGNETIC PARTICLE
☐ EDDY CURRENT
☐

ACCPT. STD.: Information only.

MATERIAL/PART/DWG. NO.: C/S/ 3/8" Plate Tank 102
Radioactive Waste Storage Tank

Witnessed by customer

SPEC.: None
TECH. DATA: HEDL UT-5

TEST EQUIPMENT: Branson Sonoray 5 mHz 3/4" FFT 10 mHz 1/4" Flat Faced Transducer

SET UP DATA: Set energy level to produce 10: saturated back surface reflections.

TEST RESULTS

For purpose of this report, plates inspected are referred to as plates #1 through #6 per attached sketch W-L-7. Ultrasonic examination in sample areas was performed on all six (6) of these plates. Results of this inspection recorded below:

Plate #1 HT 92B163 Slab 5-1 Result: Lamination two small areas. All other areas sampled had intermittent laminar type defects at .5 material thickness.

Plate # III HT 92B163 Slab 5-1 This plate had one area of complete lamination and all other areas inspected had intermittent laminar type indications .5 material thickness.

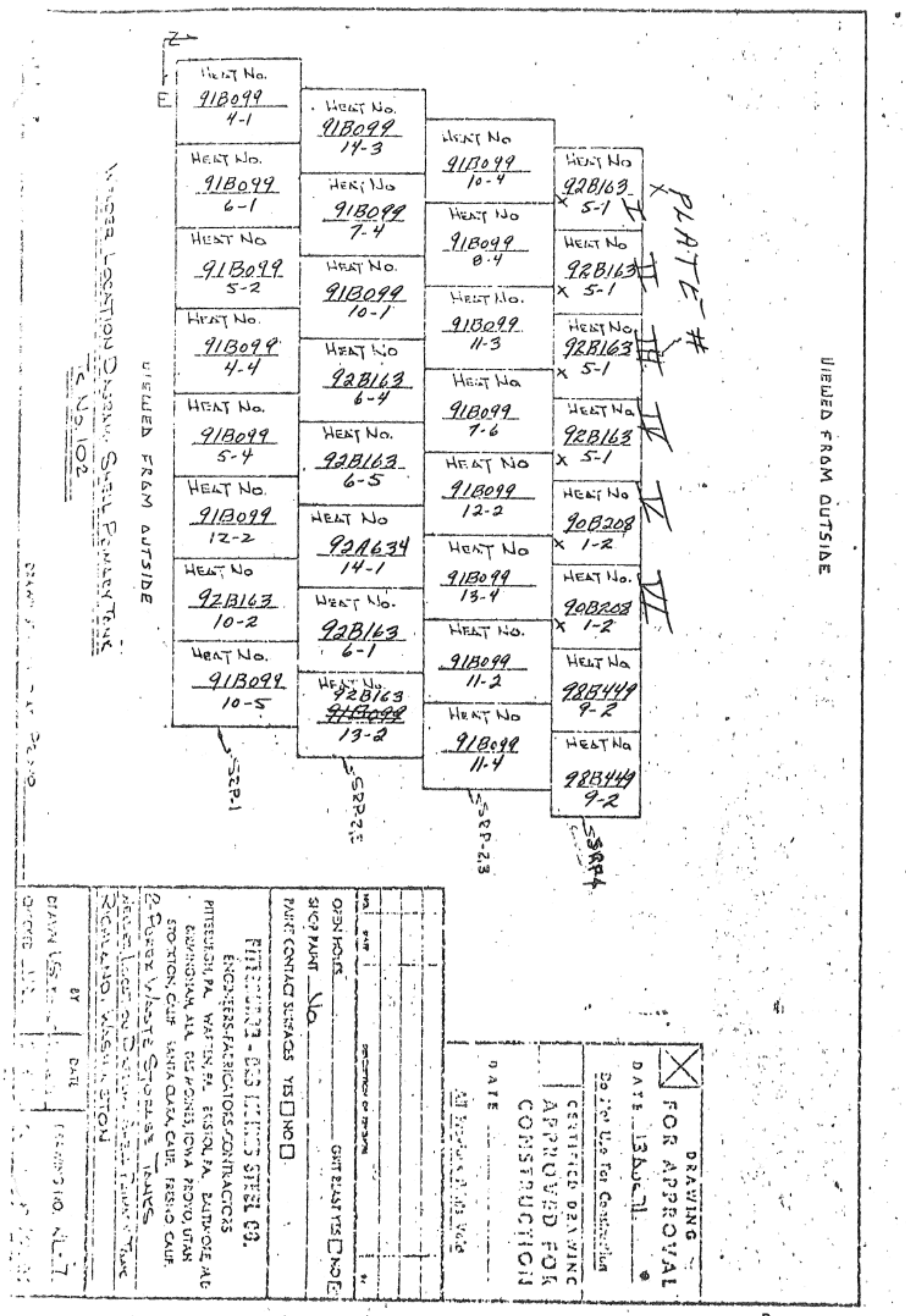
Plate # II HT 92B163 Slab 5-1
Plate # IV HT 92B163 Slab 5-1
Plate # V HT 90B208 Slab 1-2
Plate # VI HT 90B208 Slab 1-2

Results: All four of these plates had laminar type indications intermittently throughout the sampled areas at .5 material thickness.

SIGNATURE: G.F. Sheley - UT Level II [signature]
TITLE: NDT Technician

BD-7330-004 (10-70) AEC-RL RICHLAND, WASH.

PAGE 1 OF 2


VIEWED FROM OUTSIDE
VIEWED FROM OUTSIDE
PLATE #
HEAT No. 91B099 4-1
HEAT No. 91B099 6-1
HEAT No. 91B099 5-2
HEAT No. 91B099 4-4
HEAT No. 91B099 5-4
HEAT No. 91B099 12-2
HEAT No. 92B163 10-2
HEAT No. 91B099 10-5
HEAT No. 91B099 14-3
HEAT No. 91B099 7-4
HEAT No. 91B099 10-1
HEAT No. 92B163 6-4
HEAT No. 92B163 6-5
HEAT No. 92A634 14-1
HEAT No. 92B163 6-1
HEAT No. 92B163 13-2
HEAT No. 91B099 10-4
HEAT No. 91B099 8-4
HEAT No. 91B099 11-3
HEAT No. 91B099 7-6
HEAT No. 91B099 12-2
HEAT No. 91B099 13-4
HEAT No. 91B099 11-2
HEAT No. 91B099 11-4
HEAT No. 92B163 5-1
HEAT No. 92B163 5-1
HEAT No. 92B163 5-1
HEAT No. 92B163 5-1
HEAT No. 90B208 1-2
HEAT No. 90B208 1-2
HEAT No. 98B449 9-2
HEAT No. 98B449 9-2
SRP-1
SRP-2
SRP-2,3
SRP-4
DRAWING FOR APPROVAL
CERTIFIED DRAWING
APPROVED FOR CONSTRUCTION
SHOP PAINT No
RICHLAND, WASHINGTON

Page 2 of 2

App Figure C-2. Plate Laminations Nondestructive Test Report 72-41-1 (Dated 3/27/72) (3 Pages)

WADCO CORPORATION

NONDESTRUCTIVE TEST REPORT
NONDESTRUCTIVE TEST APPLICATIONS
306 BLDG., 300 AREA – TEL. 3682

REPORT NO. 72-41-1
DATE 3/27/72

CLIENT: VITRO	CUST. P.O. NO.	WORK ORDER NO.: B 51458
ATTENTION: D. Mager	☐ PENETRANT ☒ ULTRASONIC ☐	☐ MAGNETIC PARTICLE ☐ EDDY CURRENT
ADDRESS: 2101 M Bldg. 200 East Area	ACCPT. STD.: None Specified	
MATERIAL/PART/DWG. NO.: Carbon Steel 3/8" Plate (A 515) Tank 102 Radio Waste Storage		
SPEC.: None	TECH. DATA: ASTM A578 and B&PV SEC.V SA435 Modified	

TEST EQUIPMENT: Branson Sonoray, 5 mHz 3/4" diameter transducer and glycerin. No calibration sample was available.

SET UP DATA: Adjusted equipment to produce 4 back reflections, from the 3/8" material, displayed approximately 3/4" apart on the CRT.

TEST RESULTS

The following is the second of two reports regarding the inspection of the subject plate material.

During the first inspection, the inspector was given no specific test parameters, but was requested by the customer (VITRO) to ultrasonically examine the plate for laminations and to determine the "general condition" of the plate.

Using this generality as a guideline, the inspector scanned the random areas chosen by the customer. This inspection did disclose areas throughout the plate that could be termed laminar (by definition), but in this instance to avoid misinterpretation, a more suitable description may be as follows: "closely spaced intermittent reflections in a plane near midthickness of the plate". This condition could be caused by many small inclusions or actual micro laminations.

Subsequent to the first inspection, it was realized that a more specific type of information was required, so VITRO Engineering requested that the inspection be repeated using guidelines based on the ASME Boiler & Pressure Vessel Code, Section V, SA435 (Modified for 3/8" plate).

With definitive criteria now available to the inspectors, the plate was reinspected with the following results:

TEST DATA:

1. No laminar indications were noted during the UT spot examination on a 3 foot by 6 foot section between RT 23 thru RT 29 using a 2 inch step over pattern.

2. The area between RT9-10 was evaluated. An area approximately 2 inches square was marked below RT10 six inches from the bottom of the plate as being a laminar discontinuity.

SIGNATURE: RL George/WC Milliron-UT Level II TITLE: NDT Technicians

BD-7330-004 (10-70) AEC-RL RICHLAND, WASH.

PAGE 1 OF 2

WADCO CORPORATION	NONDESTRUCTIVE TEST REPORT NONDESTRUCTIVE TEST APPLICATIONS 306 BLDG., 300 AREA – TEL. 3682	REPORT NO. 72-41-1 DATE 3/27/72

3. A strip 2 inches wide by 3 feet long between RT 16-17 revealed no lamination.

4. In a 1 inch strip immediately below the longitudinal weld at top of the plate between RT 175 to 179, 187-188, 205-208, 213-214, 225-226, 234-235 no laminar type indications were noted.

5. A 1 inch area below longitudinal weld at top of plate RT 89-92 revealed sporadic or intermittent reflectors parallel to the weld. However, there was no loss of back reflectors.

6. Clockwise to the weld, bottom of the plate at RT 88 - a 4 inch long by 3 inch wide area was revealed to be laminated.

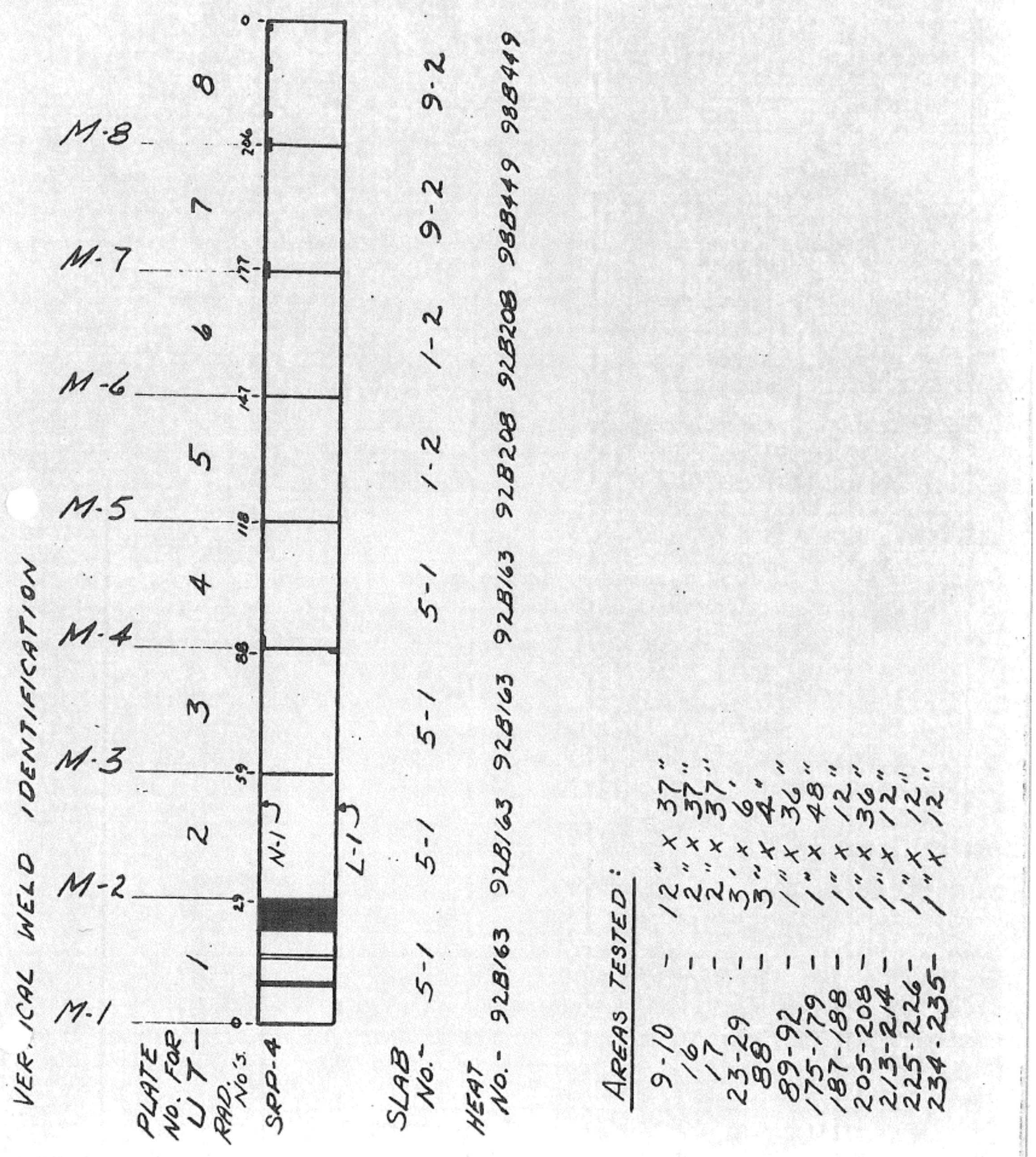
All measurements are larger than actual discontinuity as areas were marked at extreme edge of 3/4 inch diameter transducers.

BD-7330-005 (10-70) AEC-RL RICHLAND, WASH.

PAGE 2 OF 2

Vitro HANFORD ENGINEERING SERVICES
A DIVISION OF VITRO CORPORATION OF AMERICA
~~DESIGN ANALYSIS~~

FOR	AZ TANK FARM - TK 102	PAGE	
LOCATION	200 EAST	JOB NO.	HAP-647
SUBJECT	ULTRASONIC TESTING	DATE	3-27-72
		BY	D.S. MAGER



HES-37 (8-67) AEC-RL RICHLAND WASH

App Figure C-3. Plate Laminations Deficiency or Variation Report (Dated 4/27/72)

DEFICIENCY OR VARIATION REPORT

Customer Contract No. AT(45-1)-2176	PDM Contract No. 30582	
Component Name Tank 102	DVR No. 20	
Part Name SRP-4	Piece No. Ht. # D21723	Drawing No. Revision No.

Description of contract deviation/change/repair. Laminar type defects located in edge of parent material of SRP-4 Tank 102. Defects located in four plates with Heat No. 923163 Slab No. 5-1 (refer to WL Drawing #7 for position of plates).

RECOMMENDED DISPOSTION: Remove all four plates by oxy-acyteleyne burning, prepare joint to 68-4S welding Procedure for Horizontal and 68-5S for Vertical. Install new plates Heat No. D21723. Weld to 68-4S on Horizontal and 68-5S on Verticals. All prior X-rays on M1, M2, M3, M4, M5, are thus voided. Prior fitup sheet shall remain the same and add date of new fitup and refer to this DVR. Heat No. will be on additional WL Drawing #7 and reference made to this D.V.R. X-ray 100% of welds as previously required.

PDM QUALITY CONTROL S H Wooley DATE 4-27-72

Attachments: Procedures ☐ Drawings ☐ Additional Sheets ☑ Other ☐

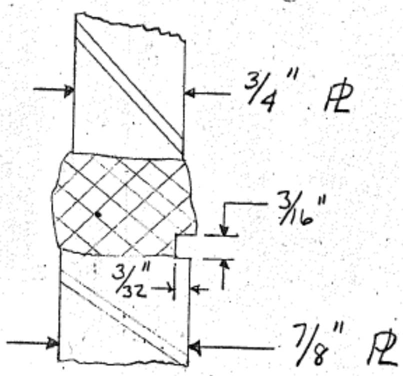
PROJECT MANAGER Brent B Harding DATE 4-27-72

App Figure C-4. Weld Seam E-1 Grind Out Deficiency or Variation Report (Dated 8/25/72)

Customer Contract No. AT(45-1)-2176	PDM Contract No. 30582
Component Name Tank 101	DVR No. #34

Part Name	Piece No. Weld Seam E-1 Footage 127 to 127'-6	Drawing No. RT-9C Revision No. 4

Description of contract deviation/change/repair.: Weld seam E-1 on the inside of Primary Tank 101 between weld footage 127'-0 to 127'-6 has a grind out approximately 5½" long by 3/16" wide by 3/32" deep (at deepest point). Which was over looked and not noticed until after Stress Relieving had been completed.



Length of groove = 5½" long

Inside of Tank

Recommended Disposition: Leave as is the groove caused by the grind out.

APPROVED AS INDICATED BY [X] BELOW

- [X] APPROVED
- [ ] APPROVED WITH EXCEPTIONS NOTED
- [ ] NOT APPROVED

Approved in general and checked for design only. Contractor is responsible for coordination, dimensions, quantities, etc.

Approval does not relieve the contractor of his responsibility of performance of the work in accordance with the contract drawings and specifications.

AUTOMATION INDUSTRIES, INC.
VITRO ENGINEERING DIVISION
RICHLAND, WA.

Job No. HAP-647

Checked by L.H. SLAUGHTER RMW

Date 9-8-72

PDM QUALITY CONTROL Brent B. Harding DATE 8-25-72

Attachments	Procedures ☐	Drawings ☐	Additional Sheets ☐	Other ☐

PROJECT MANAGER Brent B. Harding DATE 8-25-72

Form 17950-R

App Figure C-5. Letter from J.H. Slaughter to J.M. Frame Regarding Audit Findings (Dated 7/13/72)

592

UNITED STATES
ATOMIC ENERGY COMMISSION
RICHLAND OPERATIONS OFFICE
P. O. BOX 550
RICHLAND, WASHINGTON 99352

July 13, 1972

RECEIVED
JUL 13 1972
VITRO Engineering
RICHLAND, WASHINGTON

Vitro Engineering
ATTN: J. M. Frame, President
Richland, Washington

Gentlemen:

CONTRACT AT(45-1)-2176, STEEL TANKS AND RELATED WORK FOR WASTE STORAGE FACILITY NO. 241-AZ, 200-E AREA HAP-647

The subject work was recently audited and a list of findings was compiled. Among those findings are the following:

1. The substitute radiographs from the radiographer's misrepresentation were not filed along with those accepted.

2. An area about six inches long was found on the E 1 weld seam of tank #101 that appeared to be ground out, and not replaced with weld metal. The deepest indentation thereon was 3/32 inches.

3. The inside surfaces of the tanks have experienced pit corrosion.

Please file the missing radiographs in their appropriate places and proceed with a thorough study of items 2 and 3 above and recommend a course of action to be taken to assure that the tanks maintain the desired degree of integrity.

Very truly yours,

John H Slaughter

J. H. Slaughter, Field Engineer
Construction Management Division

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Vitro
JUL 14 1972
A.M. P.M.

cc: WC Armstrong-ARHCO

CAS Redistribution 7-14-72

B. Kirz
(JMF/GK Already Had Copy)
E. F. Smith

App Figure C-6. Letter from E.F. Smith to J.H. Slaughter Regarding Audit Findings (Dated 7/28/72) (2 Pages)

AUTOMATION INDUSTRIES, INC.
VITRO ENGINEERING DIVISION
P. O. BOX 296,
RICHLAND, WASHINGTON 99352
509—942-6423 942-6078

→ JJK/CAS ③
Edgar Smith ②
AUG 3 BzKing ①
8-9

July 28, 1972

few comments
I think * is
important JK

HAP-647

United States Atomic Energy Commission
Richland Operations Office
Richland, WA 99352

ATTN: JH Slaughter

Gentlemen:

CONTRACT AT(45-1)-2176, STEEL TANKS AND RELATED WORK TO PUREX WASTE STORAGE FACILITY NO. 241-AZ

REF: Letter, JH Slaughter to JM Frame, July 13, 1972

The referenced letter referred to an otherwise unidentified compilation of a "list of findings" resulting from a recent audit of the subject work and referred three of these findings to this office. The following comments are numbered in the same order as in the referenced letter.

1. Regarding the falsified radiographs that were detected by our inspection personnel, we do not believe such radiographs should be inserted in the same filing system used for ~~radiographs~~ ~~accepted~~. [official project] However, they will be suitably identified so that they will not be misconstrued and filed so they are ~~more~~ readily available ~~and associated with other radiographs.~~

2. With respect to the apparent grinding of the E-1 seam without replacement by weld metal, we find that this condition exists in a 5-1/4" length of the E-1 weld seam which joins the 3/4" shell plate to the 7/8" plate forming the vertical extension of the bottom knuckle. In this length there is an aggregate of approximately 2-1/2 inches of gouging adjacent to the 7/8" plate that is deeper than the extended surface of the 3/4" plate. The deepest penetration is .020". Inasmuch as the tank has been stress relieved it would be inappropriate to fill this gouge with weld metal at this time. However, the following corrective action will maintain the integrity of the tank and be within the parameters of allowable sharp gouge defects permitted under the specification:

The weld crown existing vertically above the gouge area should be ground flush with the surface of the 3/4" plate that constitutes the inner surface of the tank. Removal of any part of the 3/4" plate should be specifically prohibited. The edge of the 7/8" plate adjacent to the gouge should be tapered by grinding on a 1 to 4 ratio in the vertically downward direction. Removal of metal beyond the plane surface of the 3/4" plate

If we have an approved repair procedure - make ref to it. In any case you should review with and get concurrance of ARHCO metallurgist Ernie Moore & Armstrong. *

CAK 8/10/72

AUTOMATION INDUSTRIES, INC.
VITRO ENGINEERING DIVISION

that constitutes the inner surface of the tank should be prohibited. The same method and parameters for metal removal horizontally at the ends of the gouge should be employed. Recognizing that the tank has been stress relieved, extreme caution should be taken in implementing these procedures to avoid impact forces on the tank. and creating any local high heat zones.

3. As to pit corrosion on the inside surfaces of the tank, this, generally, is normal scaling rust action peculiar to the type of construction. In tank 101, however, a five foot depth of water was retained for a somewhat longer period than usual awaiting the time when it could be transferred to tank 102. In checking this area it has been found that pitted areas generally have depths of .007" to .008"; the deepest pit being .010". Other rusted areas appear to have lesser pitting. It is opined that this scaling has not violated the desired degree of tank integrity and no further action is recommended.

If this falls into the allowance of mill tolerance state so here. (spec for metal plates A-20 does allow .01")

Very truly yours,

Edgar R Smith

Edgar F. Smith
Project Engineer

EFS:mm

bcc: WC Armstrong
B. Kirz
GK/CAS
A. Short
EFS/files

App Figure C-7. Letter from W.C. Armstrong to J.H Slaughter Regarding Weld Seam E-1 Grind Out (Dated 8/24/72)

Atlantic Richfield Hanford Company
Federal Building
Richland, Washington 99352
Telephone 509 942 7411

August 24, 1972

U. S. Atomic Energy Commission
Richland Operations Office
Richland, Washington 99352

Attention: Mr. J. H. Slaughter
Engineering and
Construction Division

Subject: PROJECT HAP-647 - TANK FARM
EXPANSION 241-AZ TANK FARM
Contract AT(45-1)-2130

Gentlemen:

The structural effect of the unrepaired weld grindout in the E-1 seam inside the 101-AZ primary tank has been investigated by our structural engineer, F. R. Vollert, using the data of the geometry survey by Mr. A. Short, Vitro Engineering. As a result, it is considered that the grindout as it exists does not present a structural threat to the tank. The geometry of the grindout presents no stress riser condition, and a liquid penetrant test revealed no crack emanates from the grindout base. It is, therefore, recommended that no corrective action be attempted lest overgrinding result or the benefits of stress relieving be impaired by filler welding.

The very slight pits noted on the inside surfaces of the 101-AZ and 102-AZ primary tanks are considered by Mr. E. L. Moore, the Atlantic Richfield Hanford Company metallurgist, to have been caused by water during hydrostatic testing. The 101-AZ tank will be held in the empty condition which will not propagate pits. The 102-AZ tank will be held in a standby condition containing approximately five feet of water at a temperature of 180° F. It is recommended that the water be maintained at a pH of 10 or above by the addition of NaOH which experience has shown to inhibit pitting.

Very truly yours,

Wm C Armstrong

W. C. Armstrong
Project Engineer

WCA:mwe

App Figure C-8. Letter from E.L Moore to W.C. Armstrong Regarding Pitting (Dated 8/7/72) (2 pages)

* Box# 77868

647

Date: August 7, 1972

To: W. C. Armstrong

From: E. L. Moore ORIGINAL SIGNED BY E. L. MOORE

Subject: INSPECTION OF THE 101- AND 102-AZ WASTE TANKS

Recently, a quality assurance audit was made on the two new AZ waste tanks. At the conclusion of the audit, the auditor reported the presence of what appeared to be the slight pitting under patches of rust formed on the primary tank surface during hydrostatic testing. Subsequently, I was asked to examine the tanks and also found very slight pitting on some areas of welds on the floor and under rust spots on the walls. The pitting on the walls was found under rust patches formed at breaks in the mill scale oxide. No observed pit appeared visually to be more than 0.005 inch in depth.

Conditions in the tanks when filled with raw water during hydrotesting were ideal for promotion of pitting in carbon steel. This was quiescent water, undoubtedly containing chlorides, and breaks in the mill scale where rusting could occur. Pits can develop under this rust first as a result of differential aeration cells which then develop into passive-active cells. Hence, any crevice, such as under a rust deposit, is a place where the pit is likely to initiate. It is here that oxygen is first used up and the deficiency of oxygen with respect to the immediate surrounding area creates an anodic area, and a differential aeration cell is formed. The loss of passivity in this region follows, creating a potential difference with respect to the large surrounding cathodic areas richer in oxygen. This is the passive-active cell. This condition promotes corrosion of the anodic areas. Through current flow, chloride ions in the water transfer into the pit keeping the pit surface active. Pitting corrosion can be reduced and even eliminated by the addition of alkali to chloride containing water. This stifles

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AUG 8 1972
D. R. GUSTAVSON

W. C. Armstrong
Page 2
August 7, 1972

pit growth because hydroxyl ions move into the pit more rapidly than chloride ions precipitating basis metal chlorides. Oxygen can again diffuse into the pit and restore passivity.

The removal of the mill scale from the inside surface of the primary tanks has been suggested as a means of reducing pitting corrosion. I feel that the benefit received would not be worth the expense of the sand blasting.

It is my understanding that the 102-AZ tank will be put in an emergency standby condition at some future date. This will mean filling with approximately five feet of water and maintaining a temperature of 180°F. Rather than go to the expense of sand blasting, I would recommend that the water be adjusted to a pH of 10 or above by the addition of NaOH.

As a final note, some time ago I became interested in the extent of the passive-active cell set up between a carbon steel coupon covered with mill scale and one with the scale removed. Battelle ran a short test to measure the current generated when the two coupons were coupled in a $NaNO_3$ solution adjusted to a pH of 9. It was found that within a few hours the current fell to zero, and the pitting corrosion ceased. This demonstrates the values of the hydroxyl ion in reducing pitting type corrosion.

ELM:ncw

cc: JB Fecht
DR Gustavson
WP Ingalls
DD Wodrich

App Figure C-9. Refractory Thickness Deficiency or Variation Report (Dated 8/23/71)

DEFICIENCY OR VARIATION REPORT

PDM

Customer Contract No. AT(45-1)-2176		PDM Contract No. 30582
Component Name Secondary Tank TK101		DVR No. #5
Part Name Bottom Sump	Piece No. BS-2	Drawing No. 8 Revision No. 2

Description of contract deviation/change/repair.

DESCRIPTION OF DEVIATION: The depth of Kaolite 2000 will be increased due to the irregular surface of the secondary bottom. The depth will vary between 8" and 10". The center elevation of secondary bottom requires the depth of Kaolite to be approximately 9 1/2". The increased depth will cause the primary tank to be higher in elevation than design calls for.

RECOMMENDED DISPOSITION: The center sump will be welded to the secondary bottom with a temporary flat bar attached to the inside of the sump at the top to restrain the Kaolite during pouring (shown on sketch). The temporary flat bar will be removed after the Kaolite has been cured. Elevation readings on the surface of the Kaolite will be taken after pouring and the upper primary shell ring will be shortened accordingly (the difference between design thickness and actual).

APPROVED AS INDICATED BY [X] BELOW

[X] APPROVED

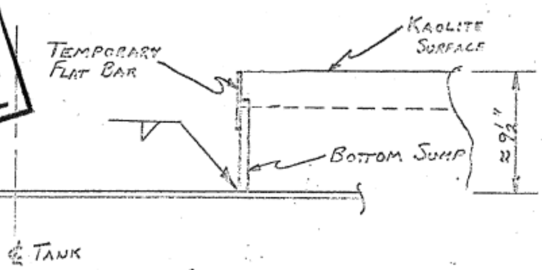
[ ] APPROVED WITH EXCEPTIONS NOTED

[ ] NOT APPROVED

Approval in general but checked for design only. ... responsible for coordination, ... contractor of his ... of the work in ... contract drawings and specifications.

HANFORD ENGINEERING SERVICES
A DIVISION OF VITRO CORPORATION OF AMERICA
RICHLAND, WASH.

Job No. HAP-647
Checked by R. Nixon / RIM'9
Date 9-30-71



PDM QUALITY CONTROL [signature] DATE 8/23/71

Attachments	Procedures [ ]	Drawings [ ]	Additional Sheets [ ]	Other [ ]

PROJECT MANAGER [signature] DATE 8/23/71

App Figure C-10. Refractory Retaining Band Installed Upside Down Deficiency or Variation Report (Dated 10/6/71)

DEFICIENCY OR VARIATION REPORT

PDM

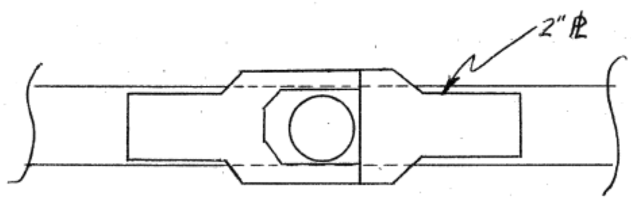
Customer Contract No. AT(45-1)-2176		PDM Contract No. 30582	
Component Name Secondary Tank TK 101		DVR No. #10	
Part Name Kaolite Retaining Band	Piece No. MB1		Drawing No. 9 Revision No. 2

Description of contract deviation/change/repair.

Description of Deviation: The Kaolite Retaining Band was inadvertently installed upside down on TK 101.

Recommended Disposition: The holes in TK 101 for the air distributor piping were slotted out towards the secondary bottom plates to facilitate the maintaining of the proper relative elevation. A 2" bar, per VITRO Engineering, will be welded to the back of the retainer band at the top to compensate for the removed steel below the band. (see below) The relative location of the pipe at the retaining band is as follows:

Location (TK 101)	Distance to ℄ of Pipe From Secondary Floor	From Top of Kaolite
SE	4"	5"
NE	4 3/4"	4 1/4"
NW	4 3/4"	4 1/4"
SW	4 1/2"	4"



TK 101 and TK 102

PDM QUALITY CONTROL G H Wooley DATE 10-6-71

Attachments | Procedures ☐ | Drawings ☐ | Additional Sheets ☐ | Other ☐

PROJECT MANAGER [signature] DATE 10-6-71

App Figure C-11. Retaining Band Slots and Drainage Holes Deficiency or Variation Report (Dated 11/12/71) (2 Pages)

DEFICIENCY OR VARIATION REPORT

PDM STEEL COMPANY

Customer Contract No. AT(45-1)-2176		PDM Contract No. 30582	
Component Name Secondary Tank . TK 101		DVR No. #15	
Part Name Kaolite Retaining Band	Piece No. MB-1 & MB-2		Drawing No. 9 Revision No. 2

Description of contract deviation/change/repair.

Description of Deviation: Per VITRO Drawing H-2-67295 Revision 0 a $\frac{1}{4}$" wide X $2\frac{1}{2}$" deep slot was to be cut where every thermocouple lead penetrates the Kaolite Retaining Band. These slots were not cut as detailed.

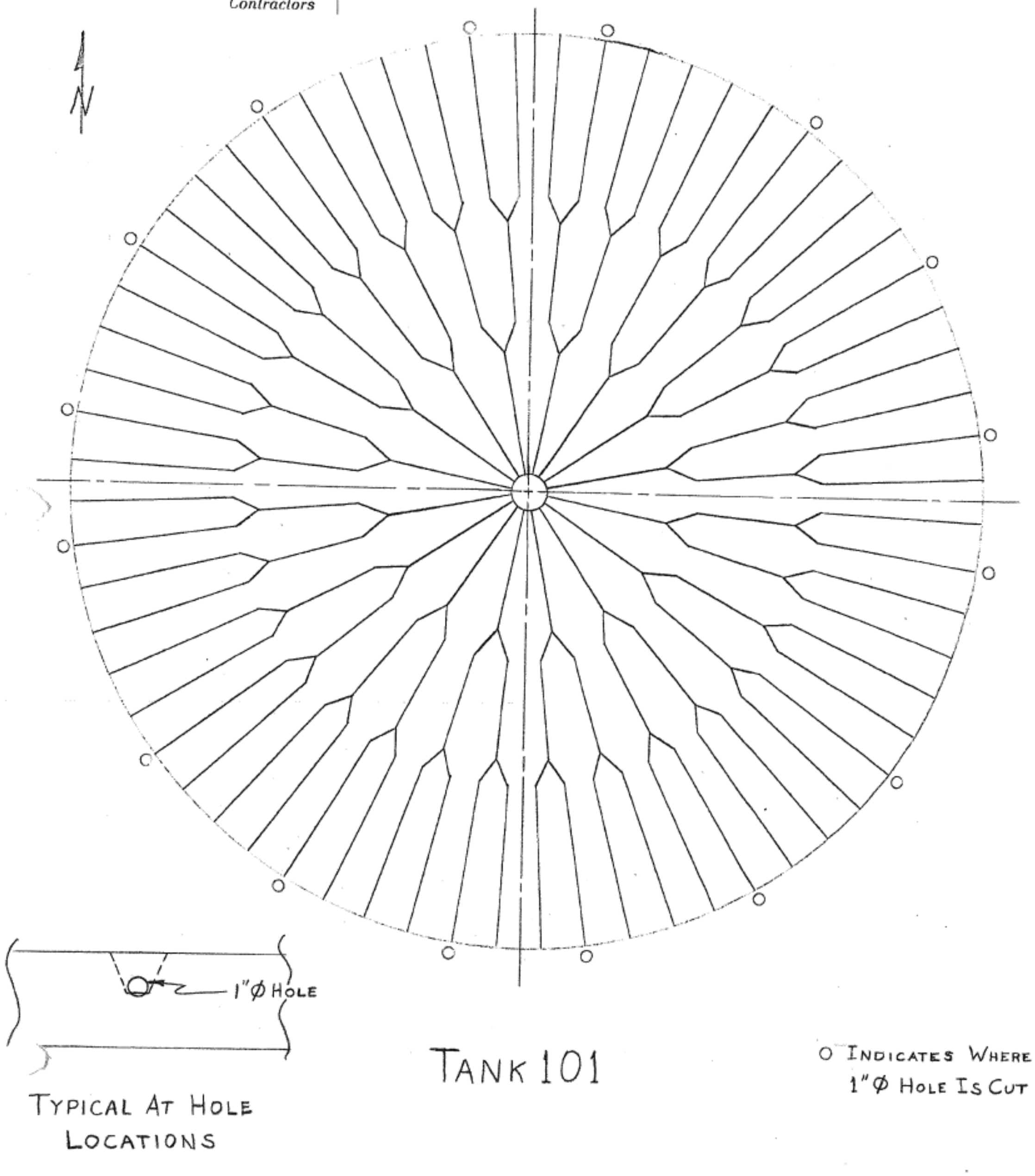
Recommended Disposition: A slot approximately $\frac{1}{4}$" deep X 2" wide will be cut in the Kaolite Retaining Band to facilitate the thermocouple penetration. In order to provide drainage a 1"Ø hole was cut in the Kaolite Retaining Band at the bottom of the air slots as shown on the attached sketch. The air slots selected for cutting of the holes will be at a different location than where the thermocouple leads penetrate the Kaolite Band thus reducing the possiblity of damaging the thermocouple lead.

PDM QUALITY CONTROL [signature] DATE 11-12-71

Attachments | Procedures ☐ | Drawings ☐ | Additional Sheets ☑ | Other ☐

PROJECT MANAGER [signature] DATE 11-12-71

Pittsburgh-Des Moines Steel Company
Engineers
Fabricators
Contractors
P. O. BOX 329 • SANTA CLARA, CALIFORNIA 95052 • (408) 296-0868



App Figure C-12. Refractory Guidance by Babcock and Wilcox (Dated 6/4/71) (4 Pages)

Babcock & Wilcox

Refractories Division

305 Norton Building, Seattle, Wash. 98104
Telephone: (206) 622-1496

June 4, 1971

Willard Smith, Inc.
3155 Elliott Avenue
Seattle, Washington 98121

Attention: Willard Smith

Dear Willard:

This letter will confirm our recent conversation in your office and will serve as our basic recommendations regarding the pending Nuclear Waste Tank Bottoms to be installed this summer at Hanford. By copies of this letter to those listed below I will attempt to out-line Babcock & Wilcox recommendations regarding the handling and placement of Kaolite 2000 and Kaolite 2200 LI.

In the first place I will attempt to answer some of the questions that you put to me during our conversation. Although we will acknowledge that large concentrations of gases such as CO2 and CO may have detrimental affects on castable materials it is extremly unlikely that these gases in the amount created by a kerosene space heater could produce detrimental affects with out adversely affecting the personnel working in the enclosure.

I have reviewed with E.J. Dickson the course of events leading up to the initial tank bottom project and would have the following comments on this matter. As you may recall when you originally discussed the use of detergent for fluidity with Mr. J.D. McCoullough, at that time Manager of Engineering Services, he recommended initially against the use of any detergent. At your insistence he ultimately yielded his objections stating that we had no knowledge of the affects created by addition of detergent and thus would not be held liable in any way for any problems related to the use of this addition to our castables.

You asked several questions regarding the two series of tanks that have been installed at Savannah River Project in Georgia. The original project at Savannah River in 1968 utilized Kaolite 20 Special which was specially formulated for this project.

The service rendered by the castable was said to be good with a possible exception of large sections near the perimeter which were pushed out by the pressure of the knuckle during stress relieving. None of the surface affects noted at Hanford were observed at Savannah River. The more recent tanks installed at Savannah River in 1970 were constructed of Kaolite 2000. These tanks have now been stressed relieved and I understand that everyone is happy with the results. None of the large cracks occured this time probably as a result of a solid steel band around the perimeter of the Kaolite pad.

You asked about the method of placement in both Savannah River projects. To the best of my knowledge the first project was accomplished by direct placement of material as discharged from a paddle type plaster mixer adjacent to the section being poured. The latter project was mixed in the same paddle type mixer and pumped to the appropriate pad site by a standard concrete pump. No lubricant materials such as detergent were utilized by the contractor, however on the first tank as a result of excessive water additions the strength of the placed castables became dangerously low. Subsequent to the discovery of this condition by Babcock & Wilcox the water additions were corrected to those recommendations and the strength of the second tank bottom was satisfactory.

You questioned me regarding the possibility of over mixing and finishing on the original job at Hanford. My observations which of course were for a relatively short time during the project were that your personnel were mixing and finishing the Kaolite in a manner acceptable to Babcock and Wilcox.

There are two aspects to the question as to whether or not freezing and thawing conditions have any affect upon castable refractories. Generally speaking freezing and thawing of cured castables which contain only the water used in their placement will not be adversely affected. We will concede however that these same cured castables completely saturated by additional quantities of water are subject to deterioration as a result of freezing and thawing. You have asked several times regarding the desirability of placing a dense castable 12 to 16 inches wide around the curcumference of the Kaolite pad. From a structural stand point this would seem desirable, however we are not in a position to run a heat flow study on the affects of temperature in this area upon the sub structural concrete foundation. The customer in this case would have to run a computor study on the heat flow.

Willard Smith, Inc.
June 4, 1971

Babcock & Wilcox

Page three

The following will be our general recommendations for installation of Kaolite 2000 or Kaolite 2200LI.

WATER ADDITION

For vibrating placement 11.5 to 12 US quarts per 40 lbs. bag. Over additions of water can be detrimental to the strength of the castable.

MIXING TIME

Before water addition, short duration of mixing is helpful but not mandatory this will help re-mix materials which may have segregated in the bag. After water addition mixing time should be long enough to achieve complete mixing of the water and materials but not to exceed five minutes.

MIXING

The most commonly used mixer is a paddle type plaster mixer, however other mixes can be used to achieve similar results.

PLACEMENT

There are three commonly accepted methods of curing castable refractories including commercial curing compounds, polyethylene cover and surface wetting. The length of curing time is dependent upon the ambient temperatures. At 60^{0}F the minimum desireable curing time (that time during which the castable should be kept wet) is twenty four hours. At lower temperatures hydration is slowed, therefore curing time should be extended. At no time during hydration period should the castable be permitted to go below freezing. If a castable is to be cured by external wetting burlap is usually placed on the surface and periodically dampenen with a hose, this method is least desireable as it requires round the clock surveillance. Curing with polyethylene is more practical and it would be permissable to remove the polyethylene from the castable for a short duration not to exceed forty five minutes for the purpose of form removal. It should subsequently be replaced over the castable for the balance of the minimum period dependent on the ambient temperature. The use of commercially available compounds if properly placed should be the most desireable curing means for and installation of this type. After the compound has been applied no additional concern is necessary about the desireable length of curing time as the curing compound will remain on the castable surface until it burns off during stress relieving by this latter means the only concern temperature wise, therefore will be that the ambient temperature does not go below the freezing point.

Babcock & Wilcox

DETERGENT ADDITIONS

It is our recommendation that the use of detergents be avoided. Our laboratory list data a copy of which is attached shows a significant reduction in strength resulting from relatively small additions of detergent. The detergent used in these tests is Tergex 400 as provided by you. The testing was done with a Hobart type laboratory mixer with a detergent addition proportioned to 1 cup of detergent per 200 lbs. of castable which was the ratio used during the original Hanford tank installation. I think it only fair, however to point out that no direct correlation between this laboratory testing techniques and the actual field condition created by your pumping equipment can be assumed. In other words I cannot understand why our laboratory test shows significant reduction in both density and strength when test samples taken from the first set of tanks at Richland showed increased density and strength significally higher than our published data.

In closing I would like to say and Babcock and Wilcox does not officially care which of the two materials Kaolite 2000 or Kaolite 2200 LI are utilized, however we would tend to favor Kaolite 2000 because of its higher compressive strength and the recent successful project utilizing this material at Savannah River. On this matter I would like to confirm that if these materials are to be on the job site by approximately July 22, 1971 as you have indicated an order should be placed soon to insure a place in our production schedule and at the same time allow sufficient time for rail-shipment. Should there be any questions regarding our recommendations by yourself or others receiving copies of this letter please let me know immediately and I will attempt to clarify it.

Very truly yours,

BABCOCK AND WILCOX

JAMES L. TRUMBULL
District Sales Manager

JLT:mtk

cc:
Mr. Bob Wendlandt
Mr. E.E. Smith
Mr. Neil Peterson
Mr. E.J. Dickson
Mr. J.H. Slaughter
Mr. W.C. Armstrong

App Figure C-13. Protection of Kaolite - Action Taken (Dated 12/16/71)

Vitro ENGINEERING
A DIVISION OF AUTOMATION INDUSTRIES, INC.

TO Al Short/Vitro
2101-M Bldg.

FROM EF Smith

DATE December 16, 19 71

SUBJECT Tank Farm Expansion, 241-AZ Tank Farm

JOB NO. HAP-647

Protection of Kaolite

Our telephone conversation at 3:30 pm, this date, is confirmed; you were directed to take immediate action (and implemented today) to protect Kaolite in Tank 102, as follows:

> Kaolite is to be covered with "Visqueen", propped up by horses or by other suitable methods with space heaters placed above the Kaolite. The warm air should be circulated by fans or other means.

These steps are taken in the interest of removing excess moisture so that frost action will not damage the Kaolite. Upon removal of the excess moisture, protective measures should be taken to prevent additional moisture entering the Kaolite.

It is understood that core samples are being taken and will be tested early tomorrow morning to determine potential damage from frost action. Preliminary information from Babcock & Wilcox's Seattle representative, Jim Trumbull, who was contacted this date as soon as the frost problem became known, indicates that excess moisture (that moisture in excess of the normal water for the cured mix) can reduce the strength of the Kaolite when it is subjected to freezing-thawing cycles. Further confirming data relating to frost problems will be sought from Babcock & Wilcox's technical personnel by telephone on December 17 at 10:30 am.

EFS:mm

cc: B Kirz/GW Knoeber
JH Slaughter
WC Armstrong
G. Kligfield
ES Davis
MH Piskadlo/DG Lien
WD Byrd
CA Sursaw
EFS/files

VE-8 (7-71)
AEC-RL RICHLAND, WASH.

App Figure C-14. Explanation of Frost Discovery and Actions Taken (Dated 12/20/1)

Vitro HANFORD ENGINEERING SERVICES
DIVISION OF VITRO CORPORATION OF AMERICA

INTER-OFFICE MEMORANDUM

DATE December 20, 1971

TO Distribution (LOCATION OR DEPARTMENT)

FROM E. S. Davis (LOCATION OR DEPARTMENT)

SUBJECT HAP-647 - Ambient Temperature @ 10:00 - 32°

On 12/16/71 while inspecting work being performed on kaolite in Tank 102, I noted that the outer edges of the kaolite contained frost crystals. Further investigation indicated that for a distance of approximately 10' from the outer edge toward the middle the surface of the kaolite was frozen. I picked up samples of the frosted material and placed them in a 72° environment. After thawing, the samples appeared damp. Later I placed the samples in an oven and dried them out. There appeared to be no damage to the material.

I called John Slaughter, AEC, and advised him of these conditions. Mr. Slaughter came to the job site and arranged for sample cores to be made. I also advised Edgar Smith of the conditions and he arranged to get heat applied to the kaolite overnight.

At 8 a.m., 12/17/71, I inspected the kaolite again in Tank 102. There was no frost indication remaining along the outer edges of the kaolite. There were numerous areas where the kaolite, for depths varying from 1/16" to 1/4", was either mushy or brittle and flaky. This variation seemed to depend upon the amount of moisture in the material. In addition, there were areas along the outer edges that sounded hollow when tapped with a steel tool. The contractor was advised that these areas would have to be repaired.

E. S. Davis
E. S. Davis

ESD:er

Note: No usable core sample could be obtained with the equipment supplied by J.A. Jones. Mr. Slaughter was notified and he directed the contractor to secure Willard Smith's equipment and secure cores on Monday.

Dist:
John Slaughter/AEC
WC Armstrong/ARHCO
EF Smith/GK
ES Davis
DS Mager
Proj File

HES-60 (6-67)
AEC-RL RICHLAND, WASH.

App Figure C-15. Application of Auxiliary Heat to Tanks AZ-101 and AZ-102 (Dated 12/20/71)

C - A&E

Vitro ENGINEERING
A DIVISION OF AUTOMATION INDUSTRIES, INC.

TO: B. Kirz/AEC
Fed. Bldg.

FROM: EF Smith

DATE: December 20, 1971

SUBJECT: Tank Farm Expansion, 241-AZ Tank Farm
Kaolite Protection

JOB NO. HAP-647

REF: Memo, EF Smith to A. Short, dated 12-16-71

Auxiliary heat has been provided in both tanks 101 and 102 to maintain temperatures above freezing and to drive out excess moisture from the Kaolite. Heat was applied in tank 102 on the evening of 12-16-71 (see referenced memorandum); additional heaters were obtained off-site and were available for both tanks on 12-18-71. Satisfactory temperatures have been maintained since that time.

Preliminary information regarding freeze--thaw cycles of Kaolite containing excess moisture (see referenced memorandum) is confirmed. Several telephone conferences with Edward Dixon, who heads up Technical Research for Babcock & Wilcox of Atlanta, Georgia, have pointed out that ice formation in fully saturated, light weight castables will break down the granular structure resulting in a loss of strength. A more detailed transcript of the telephone conference on 12-17-71 is in preparation. Mr. Dixon has been most cooperative and stands ready to assist us in every way possible with recommendations for repair of Kaolite that has been damaged by frost action. His contribution will be most valuable when the extent of damage has been determined by testing of core samples and the Kaolite has been dried sufficiently so that repairs can be made.

It was not possible to obtain core samples on 12-17-71 with available on-site equipment because of the restricted working height under the elevated bottom plate of tank 102. Willard Smith, the subcontractor who placed the Kaolite, is on-site today and has obtained four core samples (one from each quadrant). These core samples are now in the test laboratory and it is anticipated that strength tests will be conducted tomorrow after appropriate oven-drying to eliminate excess moisture.

Mr. James Trumbull, the Seattle representative of Babcock and Wilcox and who has been designated as Mr. Dixon's personal representative, will arrive in Richland tonight. He will visit the job site early tomorrow morning and will keep Mr. Dixon informed of actual conditions. It is anticipated that the strength test results will be available during his visitation at which time more detailed recommendations can be made. With the technical guidance and consultation with representatives of Babcock & Wilcox who furnished the Kaolite, satisfactory repair of the refractory damaged by frost action will be effected.

We will continue to keep you appraised of future developments.

EFS:mm

Edgar P. Smith

RECEIVED

cc: GW Knoeber/JH Slaughter
WC Armstrong
JM Frame/G Kligfield
ES Davis/A Short
MH Piskadlo/DG Lien
WD Byrd
CA Sursaw
EFS/files

VE-8 (7-71)
AEC-RL RICHLAND, WASH.

App Figure C-16. Stress Relieving Deficiency or Variation Report (Dated 5/4/72)

DEFICIENCY OR VARIATION REPORT

Customer Contract No. AT(45-1)-2176	PDM Contract No. 30582
Component Name Tank 101	DVR No. 21
Part Name Stress Relieving / Piece No.	Drawing No. / Revision No.

Description of contract deviation/change/repair. Stress Relieving attempt on April 7 thru 9 1972 was not able to conform to specification requirements HWS-8982 para 16.0 b (4).

Recommended Disposition: Voluntarily stop Stress Relieving Operation and make the following modification or addition to Stress Relieving Equipment:

1. Stuff insulation in Kaolite slots and up tight against Lower Primary Knuckles.
2. Extend vent tubes down to within a foot of the bottom.
3. Extend burner tunnels down 15 feet approximately to the spring line of secondary tank.
4. Install a 10" OD (top) and 2'-0 OD (bottom) 60° angle truncated cone, 12 inches below burner tunnels to deflect heat over to lower primary shell and knuckle.
5. Make Burner B operational.

Then perform Stress Relieving Operation in accordance with Stress Relieving Procedure SR-1.

PDM QUALITY CONTROL [signature] DATE 5-4-72

Attachments Procedures ☐ Drawings ☐ Additional Sheets ☐ Other ☐

PROJECT MANAGER [signature] DATE 5-4-72

App Figure C-17. Radiography Misrepresentation Memorandum (Dated 8/6/71) (2 Pages)

HANFORD ENGINEERING SERVIC
DIVISION OF VITRO CORPORATION OF AMERIC..

INTER – OFFICE MEMORANDUM

DATE August 6, 1971

TO A. Short (LOCATION OR DEPARTMENT)

FROM D. S. Mager (LOCATION OR DEPARTMENT)

SUBJECT AZ Tank Farm - HAP-647 - Radiography

I visited the AZ tank site on the morning of 8/3/71 and requested the opportunity to review the radiographs that were available at that time. The reason for this request was to allow me to update the status of weld acceptability and prevent possible delay of lowering the tank bottom as scheduled for 8/4/71. Gary Wooley, PDM Quality Assurance Manager, presented me with all of the radiographs requested, and indicated that eleven repairs were necessary prior to final weld acceptance and tank lowering.

Upon subsequent review of the radiographs received, it became evident on one weld, B-17, that the areas 12-13 and 13-14 did not match the adjacent areas, 11-12 and 14-15. I immediately notified G. Wooley (Neil Peterson, PDM Project Engineer present) of the weld misrepresentation, however, no explanation could be provided for the error. I further stated that I could recall the surface indication shown on the radiograph in question as being the same on another film, and I would attempt to positively identify the actual weld area. This I did, and found that the weld area identified as B-17, 12-13 and 13-14, were actually radiographs of weld B-15, 2-3 and 1-2 respectively. Further review of the remainder of the radiographs submitted this morning revealed a similar situation on weld B-13 (area 14-15).

The radiographer, Harvey Lambert, was summoned to the site by PDM to provide an explanation for the error. He could not clarify the cause for the error. At this point, I requested G. Wooley to re-x-ray the three areas in question.

The following morning, 8/4/71, G. Wooley reviewed the repair radiographs and the reshots requested at 2101-M Bldg. We noted that in addition to the three areas requested for re-x-ray, a fourth area had been radiographed. Film comparison revealed that there was no correlation between the four actual weld areas and the original film used to represent those areas.

As I investigated further, I found that the weld area identified as B-13, 13-14 and 14-15 were actually radiographs of weld B-15, 18-19 and 19-20 respectively.

It is significant to note that all four areas not radiographed correctly are under the temporary truss supports. This makes it necessary for the radiographer to move the equipment from the top side of the tank bottom to the underside of the tank bottom.

HES-60 (8-67)
AEC-RL RICHLAND, WASH.

HANFORD ENGINEERING SERVICE
A DIVISION OF VITRO CORPORATION OF AMERICA

INTER – OFFICE MEMORANDUM

A. Short HAP-647 P. 2

It is my conclusion, based on the evidence available, that the misrepresentation of weld areas was intentional, solely on the part of the radiographer and/or his assistant, and that his purpose for doing so was to save time and physical labor.

Action taken on my part to assure that the high quality of tank 101 has been maintained was:

a. review and verification of the radiographs of the four weld areas misrepresented.

b. Review of all radiographs previously accepted as a "double-check" of their authenticity.

Donald S. Mager

Donald S. Mager

DSM:er

cc: Proj File
DSM/file
LB

HES-59 (12-66)
AEC-RL RICHLAND, WASH.

App Figure C-18. AZ 102 Knuckle Plates Deficiency or Variation Report (Dated 10/15/71) (2 Pages)

DEFICIENCY OR VARIATION REPORT

Customer Contract No. AT(45-1)-2176	PDM Contract No. 30582
Component Name Primary Tank TK 101	DVR No. #13
Part Name Bottom Knuckles / Piece No. See below	Drawing No. 4 Revision No. 8

Description of contract deviation/change/repair.

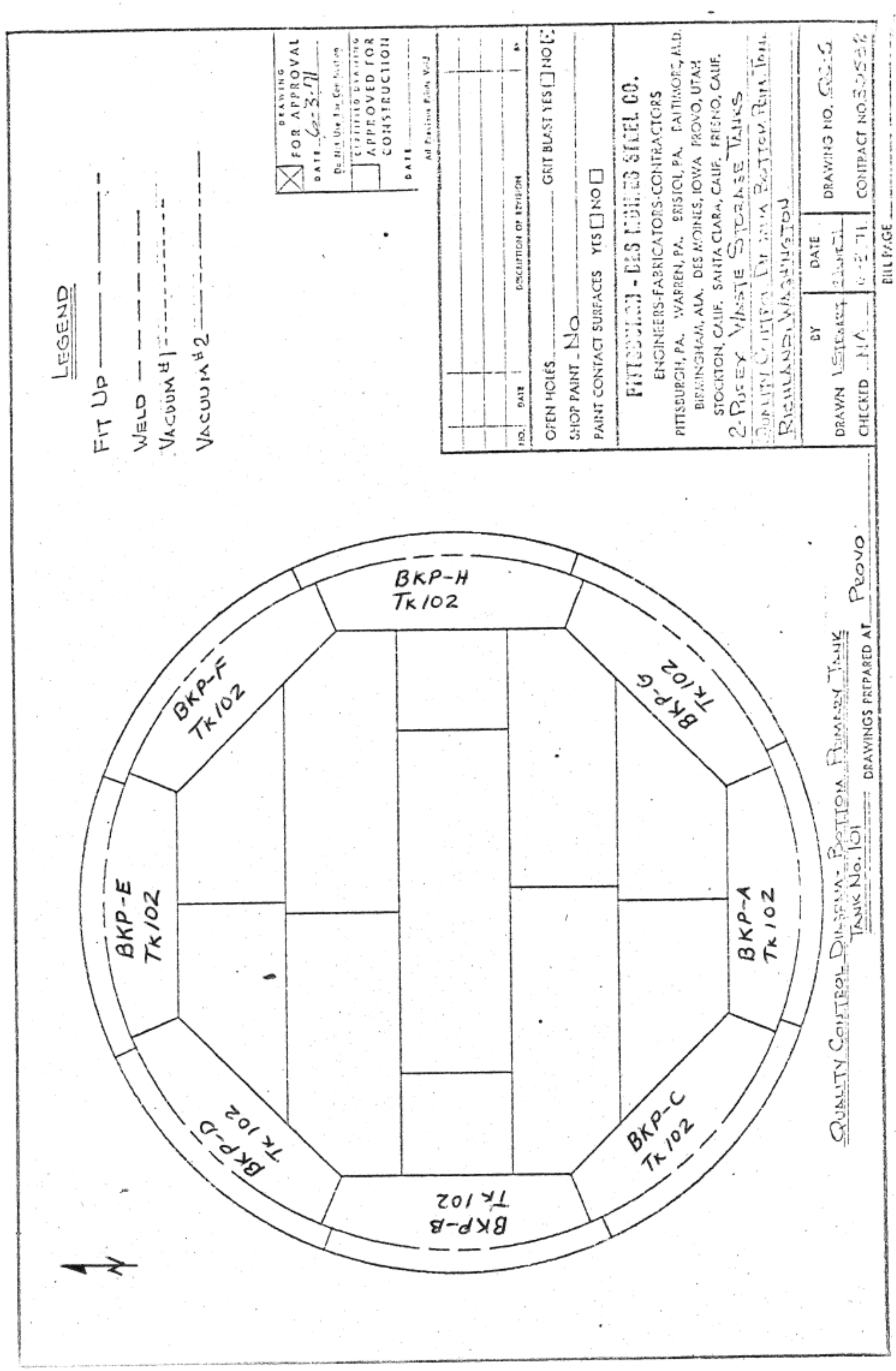
Description of Deviation: The primary knuckles, Piece Marks BKP-A, BKP-B, BKP-C, BKP-D, BKP-E, BKP-F, BKP-G, BKP-H, plus the corresponding X-rays made in Provo reflect Tank Number 102 on both the knuckles and the X-rays. These knuckles were used on Tank Number 101.

Recommended Disposition: The knuckles will be documented on the as-built drawings with the piece mark number and orientation as shown on the attached drawing. The X-rays will be filed in the Tank Number 101 X-ray Report File.

PDM QUALITY CONTROL S H Wooley DATE 10/15/71

Attachments Procedures ☐ Drawings ☒ Additional Sheets ☐ Other ☐

PROJECT MANAGER [signature] DATE 10/15/71


LEGEND
FIT UP
WELD
VACUUM #1
VACUUM #2
FOR APPROVAL
DATE 6-3-71
APPROVED FOR CONSTRUCTION
OPEN HOLES
GRIT BLAST YES NO
SHOP PAINT No
PAINT CONTACT SURFACES YES NO
PITTSBURGH - DES MOINES STEEL CO.
ENGINEERS-FABRICATORS-CONTRACTORS
PITTSBURGH, PA. WARREN, PA. BRISTOL, PA. BALTIMORE, MD.
BIRMINGHAM, ALA. DES MOINES, IOWA PROVO, UTAH
STOCKTON, CALIF. SANTA CLARA, CALIF. FRESNO, CALIF.
RICHLAND, WASHINGTON
DRAWN
CHECKED
BY
DATE
DRAWING NO.
CONTRACT NO.
BILL PAGE
BKP-H TK102
BKP-F TK102
BKP-G TK102
BKP-E TK102
BKP-A TK102
BKP-D TK102
BKP-C TK102
BKP-B TK102
QUALITY CONTROL DIAGRAM - BOTTOM PRIMARY TANK
TANK No. 101
DRAWINGS PREPARED AT PROVO

App Figure C-19. AZ 101 Knuckle Plates Deficiency or Variation Report (Dated 11/2/71) (2 Pages)

DEFICIENCY OR VARIATION REPORT

PDM

Customer Contract No. AT(45-1)-2176		PDM Contract No. 30582	
Component Name Primary Tank TK 102		DVR No. #14	
Part Name Bottom Knuckles	Piece No. See below		Drawing No. 4 Revision No. 8

Description of contract deviation/change/repair.

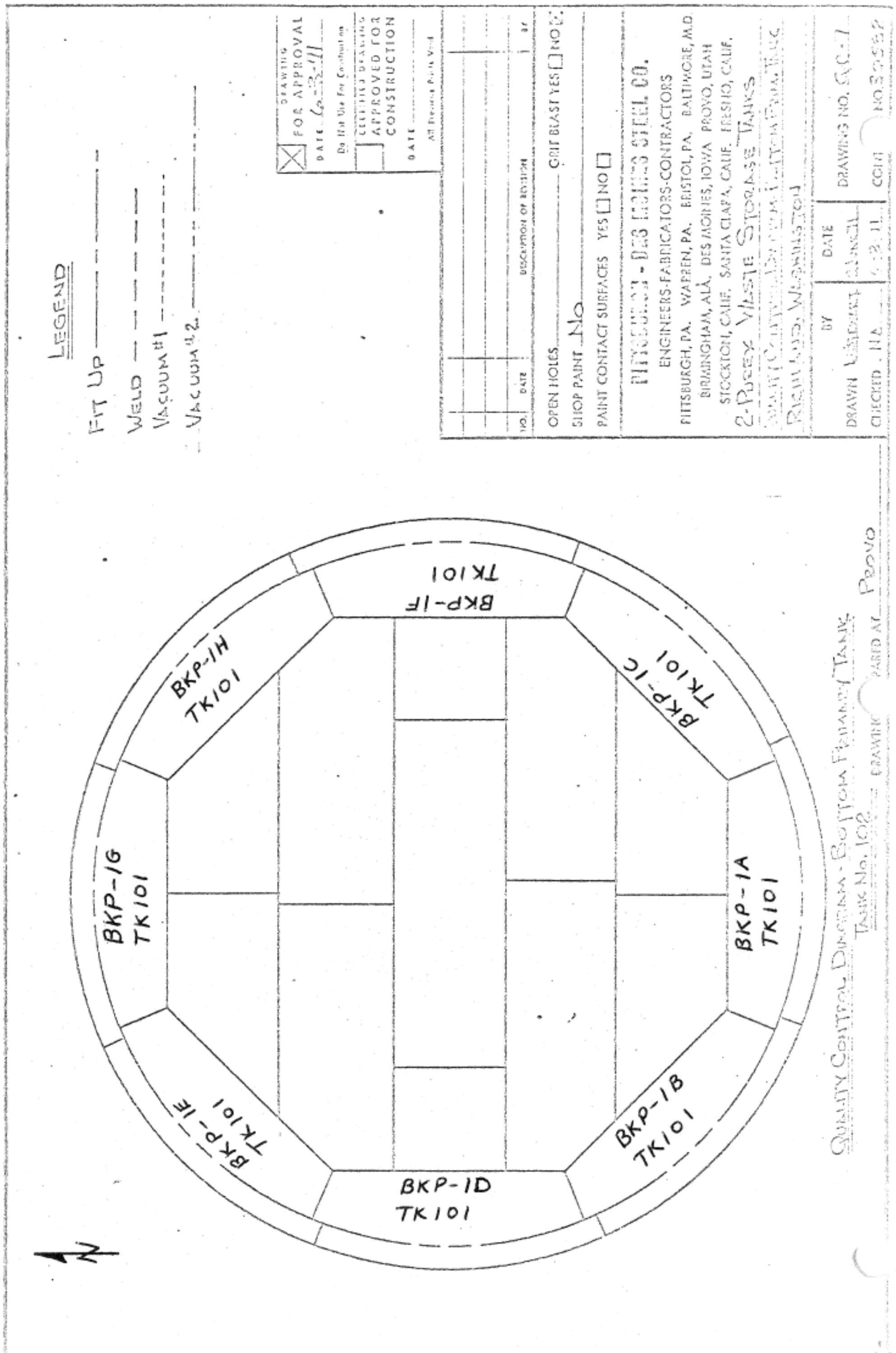
Description of Deviation: The Primary Knuckles, Piece Marks BKP-1A, BKP-1B, BKP-1C, BKP-1D, BKP-1E, BKP-1F, BKP-1G, BKP-1H, plus the corresponding X-rays made in Provo reflect Tank Number 101 on both the knuckles and the X-rays. These knuckles were used on Tank Number 102.

Recommended Disposition: The knuckles will be documented on the as-built drawings with the piece mark number and orientation as shown on the attached drawing. The X-rays will be filed in the Tank Number 102 X-ray Report File.

PDM QUALITY CONTROL [signature] DATE 11/2/71

Attachments | Procedures ☐ | Drawings ☒ | Additional Sheets ☐ | Other ☐

PROJECT MANAGER [signature] DATE 11/2/71


LEGEND
FIT UP
WELD
VACUUM #1
VACUUM #2
BKP-1A TK101
BKP-1B TK101
BKP-1C TK101
BKP-1D TK101
BKP-1E TK101
BKP-1F TK101
BKP-1G TK101
BKP-1H TK101
FOR APPROVAL
APPROVED FOR CONSTRUCTION
OPEN HOLES
SHOP PAINT No
PAINT CONTACT SURFACES YES NO
ENGINEERS-FABRICATORS-CONTRACTORS
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PROVO