U.S. Department of Energy
Office of River Protection
P.O. Box 450
Richland, Washington 99352

01-TOD-T002

JUL 18 2001

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 W. Fourth Avenue
Kennewick, Washington 99336

Dear Mr. Wilson:

COMPLETION OF ULTRASONIC TESTING AND STATIC LEAK TESTS OF MISCELLANEOUS WASTE (X-032-25) TANKS PER THE STATE OF WASHINGTON DEPARTMENT OF ECOLOGY (ECOLOGY) ADMINISTRATIVE ORDERS NO. 00NWPKW-1250 AND 1251

References:

1. Administrative Order, D. Silver, Ecology, to K. A. Klein, RL, R. T. French, ORP, and M. P. DeLozier, CHG, "Failure to Comply with Major Milestone M-32 or the Tri-Party Agreement; Administrative Order No. United States Department of Energy 00NWPKW-1250," dated June 13, 2000.

2. Administrative Order, D. Silver, Ecology, to K. A. Klein, RL, R. T. French, ORP, and M. P. DeLozier, CHG, "Failure to Comply with Major Milestone M-32 of the Tri-Party Agreement; Administrative Order No. United States Department of Energy 00NWPKW-1251," dated June 13, 2000.

3. ORP letter from J. E. Rasmussen to M. A. Wilson, Ecology, "Request for Approval of Test Results Obtained on the A-350 Lift Station and Catch Tanks AX-152 and AZ-151," 01-OPD-060, dated June 11, 2001.

In accordance with the agreements established in References 1 and 2, Sections 6.A. and 6.B., the U.S. Department of Energy, Office of River Protection (ORP) submits its report, "Engineering Report on Double-Shell Tank System Miscellaneous Tanks," completing X-032-25. Previous discussions with Ecology staff (Melinda Brown and Bob Wilson) and Reference 3 discussed ORP's issues with the test results of three miscellaneous tanks in attempting to meet the intent and to comply with Sections 6.A. and 6.B. of the referenced Administrative Orders. ORP requested Ecology's concurrence in Reference 3, but received no response by the requested date. Therefore, ORP submits the enclosed document as meeting the intent and compliance with the Administrative Orders.

JUL 1 8 2001

As discussed in the July 17, 2001, Tri-Party Agreement Project Managers Meeting, if Ecology has any outstanding concerns with Reference 3, or any other aspect of this deliverable, please contact me, or your staff may contact Victor Callahan, Technical Operations Division, (509) 373-9880.

Sincerely,

James E. Rasmussen

James E. Rasmussen, Director
Environmental Management Division

TOD:VLC

Enclosure

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CH2M HILL
Hanford Group, Inc.
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CH2MHILL
Hanford Group, Inc.

JUN 15 2001

CHG-0103044

Mr. J. J. Short, Contracting Officer
U.S. Department of Energy
Office of River Protection
Post Office Box 450
Richland, Washington 99352-0450

Dear Mr. Short:

CONTRACT NUMBER DE-AC27-99RL14047; COMPLETION OF FISCAL YEAR 2001-2006 PERFORMANCE INCENTIVE ORP-10, SECTION 3, SPECIFIC REQUIREMENT 1.b), AND SECTION 4, DEFINE COMPLETION, COMPLETION OF EXPECTATION 1.a) THROUGH 1.c.)

References:

1. Administrative Orders 00NWPKW-1250 and 00NWPKW-1251, State of Washington Department of Ecology, "Failure to Comply with Major Milestone M-32 of the Tri-Party Agreement," dated June 13, 2001.

2. Letter, D. I. Allen, CHG, to D. C. Bryson, ORP, "Contract Number DE-AC27-99RL14047; Request for Approval of Testing Performed on the A-350 Lift Station, and AX-152 and AZ-151 Catch Tanks," CHG-0102786, dated May 23, 2001.

Reply by: July 2, 2001

The purpose of this letter is to document completion of Performance Based Incentive (PBI) ORP-10, Rev. 0, Section 3, Specific Requirements 1.b), which states:

> "Submit a written report to ORP which meets the requirements of Section 6 of the above Administrative Orders by June 18, 2001 (Earn 5% of fee)."

Section 6 of Reference 1, requires on or before July 18, 2001, the U.S. Department of Energy and CH2M HILL Hanford Group, Inc. (CHG) must submit a written report to the State of Washington Department of Ecology (Ecology) documenting all of the following:

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A. Results of ultrasonic testing, or other testing as agreed upon with Ecology, of the primary tank walls of waste storage tanks within the 204-AR unloading station, A-350 lift station, 244-S double-contained receiver tank, and AZ-151 catch tank. This ultrasonic testing must include a scan of at least 12 inches wide of the vertical tank wall of each tank examined. If conditions within any tank structure prevent continuous wall examination, a spot check of wall thickness along the vertical axis of the tank, at intervals no greater than 6 inches, may be employed, upon prior approval by Ecology. This report must include a copy of the original ultrasonic testing data reports, and a tabular summary of thickness measurements and other observations made during ultrasonic testing. This report must include a comparison between the ultrasonic data obtained to specific material thickness, material specifications, and construction standards and codes. This report must include a listing of defects exceeding nominal wall thickness. This report must include a summary review and interpretation of data by a technical expert qualified, trained and experienced in interpreting ultrasonic data by a Non-destructive Examination (NDE) Level III Inspector. Any video surveillance employed in support of the ultrasonic examination must be retained in the facilities Operating Record, and be available upon request by Ecology.

B. Results of static leak tests of the primary tank for the following:

- Double contained receiver tanks; 244-BX, 244-TX, and 244-A
- Catch tanks; 241-ER-311, S-304, U-301B, TX-302C, AX-152, AZ-151, and UX-302A
- 204-AR unloading station
- A-350 lift station

Section 4 of PBI ORP-10, Section 4, Define Completion, Item 1, states:

> "Completion requirements for requirements 1.a) through 1.c), are defined in State of Washington Administrative Order 00NWPKW-1250 and -1251. ORP will provide comment to CHG within 10 days of report delivery. CHG will provide revised report to ORP with comments resolved at least 5 working days prior to required delivery date of the Administrative Orders."

Per PBI ORP-10, Section 4, Define Completion, Item 1, CHG requests the ORP comments within ten days of receipt of the report. CHG will provide a revised report to the ORP with comments resolved at least five working days prior to the required delivery date of the Administrative Orders.

"Engineering Report on Double-Shell Tank System Miscellaneous Tanks," (Attachment 1) RPP-6829, Revision 0, fulfills the requirements of the Ecology Administrative Orders 00NWPKW-1250 and 00NWPKW-1251 Section 6, deliverable due July 18, 2001, with the exceptions noted in Reference 1.

For your convenience, also attached (Attachment 2) is a draft transmittal letter to Ecology.

If you require further assistance, please contact Mr. J. W. Lentsch on 373-5252, or the undersigned on 373-4185.

Very truly yours,

R. F. Wood, Manager
Prime Contract Administration
CH2M HILL Hanford Group, Inc.

GPD/mmm

Attachments 2

CORRESPONDENCE DISTRIBUTION COVERSHEET

Author	Addressee	Correspondence No.
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Subject: CONTRACT NUMBER DE-AC27-99RL14047; COMPLETION OF FISCAL YEAR 2001-2006 PERFORMANCE INCENTIVE ORP-10, SECTION 3, SPECIFIC REQUIREMENT 1.b), AND SECTION 4, DEFINE COMPLETION, COMPLETION OF EXPECTATION 1.a) THROUGH 1.c).

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CHG-0103044

Attachment 1

TITLE – "ENGINEERING REPORT ON DOUBLE-SHELL TANK SYSTEM MISCELLANEOUS TANKS," RPP-6829, Draft, Revision 0

Consisting of 688 pages
including coversheet

Engineering Report on Double-Shell Tank System Miscellaneous Tanks

D. L. Becker, T. S. Hundal, E. B. Schwenk and K. V. Scott
CH2MHILL Hanford Group, Inc. and COGEMA Engineering Corporation
Richland, WA 99352
U.S. Department of Energy Contract DE-AC27-99RL14047

EDT/ECN: UC:
Cost Center: Charge Code: 500437
B&R Code: EW02J2030 Total Pages: 688

Key Words: Double-Shell Tank, Catch Tank, Double-Contained Receiver Tank, DCRT, Miscellaneous Tants, Ecology, WDOE, Administrative Order, Leak Test, Integrity Assessment, DST.

Abstract: This document provides the results of design evaluations and tank examinations of multiple catch tanks and double-contained receiver tanks that are part of the double-shell tank system of the Hanford Site. The report was prepared per WDOE Administrative Order 00NWPKW-1250 and -1251 and will be added to information yet to be collected to permit completion of an integrity assessment report in accordance with WAC 173-303-640(2) by March 31, 2006.

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ENGINEERING REPORT ON DOUBLE-SHELL TANK SYSTEM MISCELLANEOUS TANKS

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P.O. Box 840
Richland, WA 99352

Authors:
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Prepared for:
CH2M HILL Hanford Group, Inc.
Richland, WA
Contract Number 4848, Release Number 59

Date Published:
June 2001

ENGINEERING REPORT ON DOUBLE-SHELL TANK SYSTEM MISCELLANEOUS TANKS

Signature: _____ Date: _____
E. B. Schwenk, Author

Signature: _____ Date: _____
T. S. Hundal, P. E., Author

Signature: _____ Date: _____
K. V. Scott, P.E., Manager,
Facilities, Structures & Components

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INITIALIZATIONS AND ABBREVIATIONS

AF	ancillary facility
CCTV	closed circuit television
CFR	*Code of Federal Regulations*
CHG	CH2M HILL Hanford Group, Inc.
CVI	certified vendor information
DCRT	double-contained receiver tank
DST	double-shell tank
DOE-ORP	U.S. Department of Energy, Office of River Protection
Ecology	Washington State Department of Ecology
HLAN	Hanford Local Area Network
IQRPE	independent qualified registered professional engineer
RHA	Records Holding Area
RMIS	Record Management Information System
WAC	*Washington Administrative Code*

1.0 INTRODUCTION

Configuration and operation of Hanford's double-shell tank (DST) system is regulated under Washington State Dangerous Waste Regulations, *Washington Administrative Code* (WAC) 173-303-640 (WAC 1998) and 40 CFR 265, Subpart J (40 CFR 265). These environmental regulations require an integrity assessment of tank systems that store or treat dangerous waste. This report presents information needed to assess the multiple catch tanks, double-contained receiver tanks (DCRTs), and ancillary facilities (AFs) that are part of a network of interconnected underground piping and ancillary equipment that are within the DST waste storage systems in the 200 East and 200 West Areas of the Hanford Site. Some of these facilities have been in service for over 50 years. The facilities are operated by CH2M HILL Hanford Group, Inc. (CHG) and owned by the U.S. Department of Energy, Office of River Protection (DOE-ORP).

The regulations require that waste tank system integrity assessments include a design evaluation and testing sufficient to ensure the tank system will not collapse, rupture, or fail. The assessment is to be certified by an independent, qualified, registered professional engineer (IQRPE). Information needed for the integrity assessment to be certified has been provided in the guideline documents (Hundal 1998, Schwenk 2000). In addition, the Washington State Department of Ecology (Ecology) has provided further direction. Ecology issued administrative orders (Silver 2000a and 2000b) that require submittal of an integrity assessment report for the DST system by March 2006. At the time of this report, DOE-ORP and Ecology have tentatively negotiated a set of Tri-Party Agreement milestones that are equivalent to milestones specified in the administrative orders and upon incorporation into the Tri-Party Agreement, would cause the administrative orders to be voided.

In the meantime, both the information needed for certification and that specified in the administrative orders are being collected. This report, in addition to the *244-S Double-Contained Receiver Tank Facility Integrity Assessment Report* (Hundal and Schwenk 1998), present the information that has been collected to date for 13 waste tank facilities that are part of the DST system. Submittal of this information to Ecology by July 18, 2001 satisfies one of the requirements of the aforementioned administrative orders.

2.0 PURPOSE

Integrity assessment of existing tank systems that store or treat dangerous waste must comply with WAC 173-303-640(2). DOE-ORP or CHG must obtain and keep on file at the facility, a written assessment, reviewed and certified by an IQRPE that attests to the tank system's integrity. The WAC 173-303-640 (2) (c) states: "This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with waste(s) to be stored or treated, to ensure that it will not collapse, rupture, or fail."

The purpose of this report is to document the results of the tank tests and design evaluations conducted to date. The information presented here will be added to information yet to be collected to permit completion of an integrity assessment report by March 31, 2006, in accordance with the schedule in the administrative orders (Silver 2000a and 2000b).

3.0 SCOPE

The scope of this report includes the following waste tank facilities:

- Catch tanks - 241-S-304, 241-ER-311, 241-U-301B, 241-UX-302A, 241-TX-302C, 241-AX-152, and 241-AZ-151. [1]
- DCRTs - 244-BX, 244-A, 244-S, and 244-TX
- AFs - 241-A-350 Lift Station and 204-AR Waste Unloading Facility.

Information on the transfer piping associated with these tanks is not included in this report. The integrity assessment of transfer piping was reported in the *Double-Shell Tank Waste Transfer Piping/Pit System Integrity Assessment Report* (HNF 1997).

4.0 INTEGRITY ASSESSMENT

The requirements for assessment of an existing tank system's integrity are provided in 40 CFR 265.191 (40 CFR 265) and WAC 173-303-640(2) (WAC 1998). Section WAC 173-303-640(2)(c) states the following.

> *This assessment must determine that the tank system is adequately designed and has sufficient structural strength to ensure that it will not collapse, rupture, or fail. At a minimum, this assessment must consider the following:*
>
> *(i) Design standard(s), if available, according to which the tank system was constructed;*
> *(ii) Dangerous characteristics of the waste(s) that have been and will be handled;*
> *(iii) Existing corrosion protection measures;*
> *(iv) Documented age of the tank system, if available (otherwise, an estimate of the age); and*
> *(v) Results of a leak test, internal inspection, or other tank system integrity examination such that:*
>
> *(A) For nonenterable underground tanks, the assessment must include a leak test that is capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects; and*

[1] Tank 241-EW-151 was deleted from the scope of work identified in engineering task plan (Schwenk 2000), because the tank is not part of an active transfer route and there is no planned use for the associated cross-site transfer lines.

(B) For other than nonenterable underground tanks and for ancillary equipment, this assessment must include either a leak test, as described above, or other integrity examination, that is certified by an independent, qualified, registered professional engineer, in accordance with WAC 173-303-810 (13)(a), that addresses cracks, leaks, corrosion, and erosion.

Items *(i)* through *(iv)* require an assessment of design-related elements, whereas item *(v)* requires an assessment of examination-related elements. The approach that has been applied for compliance with the design-and examination-related elements is documented in *Double-Shell Tank Waste Transfer Facilities Integrity Assessment Plan* (Hundal 1998).

Further explanation of design evaluations and integrity examinations is presented separately below. The results of the design evaluations and integrity examinations for each of the tanks evaluated are presented in the Appendices A through M.

4.1 DESIGN EVALUATION

A thorough search was conducted to identify the available design requirements, and design and fabrication documents for the tanks. The following resources were searched for tank information:

- Records Management Information System (RMIS) on the Hanford Local Area Network (HLAN)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at the Document Control Center
- INSITE and Soft Reporting databases on HLAN
- Hanford Data Control System database on HLAN
- associated project files packed in boxes at the Record Holding Area (RHA)
- procedure information files in PROCINFO software on HLAN
- interviews with Tank Farm Engineering personnel.

The design evaluation considered the following elements:

- Design standards - Identified and evaluated the criteria used to design, construct, and test the system for sufficient structural strength.

- Dangerous characteristics of the waste(s) - Identified the waste (past and projected) and evaluated the adequacy of the design for compatibility of the waste and material to store or treat the waste.

- Corrosion protection measures - Identified the material and evaluated the design and the operational practices for corrosion protection.

- Age - Documented, estimated, or otherwise determined the approximate age of the system.

4.2 INTEGRITY EXAMINATION

The second part of integrity assessments, integrity examinations, were performed to identify the current condition of the component materials by means of leak testing, visual examination, or ultrasonic examinations.

The WAC 173-303-640 (2)(c) (v) (WAC 1998) requires, for "nonenterable" underground waste tanks, "a leak test that is capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects." For "other than nonenterable" underground tanks, this regulation requires either a leak test or other means of integrity examination, as an alternative to a leak test, "that is certified by an independent, qualified, registered professional engineer, in accordance with WAC 173-303-810 (13) (a) (WAC 1998), that addresses cracks, leaks, corrosion, and erosion." Because of radiological hazards, the DCRTs, catch tanks, and miscellaneous tanks are not enterable by personnel, but are enterable by means of remotely operated equipment. It is not clear which definition is intended in the WAC regulations in use of the terms "nonenterable" and "other than nonenterable." Therefore, because of the radiological hazards, the waste tanks addressed in this document are considered to be "nonenterable," because of the need to comply with 10 CFR 835, 29 CFR 1910 and 29 CFR 1926. Removal of waste and decontamination of the tanks to meet the general duty clauses of 29 CFR 1910 and 10 CFR 1926 and the occupational dose limits of 10 CFR 835 is not feasible at this time.

According to the stated requirements of WAC 173-303-640 (2)(c) above, the minimum requirement for examination of any tank (nonenterable or other than nonenterable) is satisfied by conducting a leak test. For leak testing presented in this document, acceptance criteria were established for each leak test. Historical liquid level monitoring data and data from leak detection instruments were documented and used for assessment of leak tightness and compliance with the leak test requirement. To minimize waste generation, and where historical liquid level data could not be used, leak tests were performed with liquid from normal process operations, i.e., without addition of liquid solely for the purpose of conducting the required leak test. The exceptions to this are 241-AX-152, which as discussed in Appendix F was declared a leaker after monitoring liquid level changes over a prolonged period with a small volume of raw water, and 204-AR, which required the addition of a small quantity of water.

In addition to meeting the minimum requirements for tank examination by leak testing, additional examinations were performed using closed-circuit television (CCTV) and video recording equipment, where practical, to address cracks, leaks, corrosion, and erosion. Deployment of remotely operated CCTV for examination of tank interiors, exteriors, pump pits, and vaults provides additional useful information to assess overall condition of a tank system, including identification of large cracks, coating failures, and structural deterioration. Given the age of many of these tanks, and the potential environmental, cost, and schedule impacts of tank failure, examination by CCTV, where practical, is considered prudent, even though not required by the regulations. The additional information obtained through deployment of CCTV allows a more inclusive assessment of the tank system and more appropriate recommendations for future operation and use. For some tanks, gaining such access for CCTV examination would be

particularly difficult, since tanks were in general not designed or constructed to permit personnel access. For such tanks, the value of the additional information to be gained may not be sufficient to justify cost, risk of worker exposure to radiation and chemical hazards, and potential impacts to operations. Because of these factors, internal CCTV examination of tanks 241-AX-152 and 204-AR was ruled out.

In addition, it is noted that the administrative orders (Silver 2000a and 2000b) required the ultrasonic testing of the wall thickness for 241-AZ-151, 204-AR, A-350 and 244-S. The results of these examinations are reported in Appendices G, I, J and M, respectively.

Ecology's guidance (Ecology 1994) for integrity assessment of tank systems addresses secondary containment, as well as primary tanks. This guidance suggests visual inspection alone is an adequate method of integrity examination for secondary containment. Thus, where vaults are provided for the tanks, the required visual examination was accomplished by CCTV.

4.3 DESIGN EVALUATION AND INTEGRITY EXAMINATION REPORTS

A general summary of the evaluations performed and general information about each of the facilities is shown in Table 1.

The reports for each facility are presented in Appendices A through M. Each facility report in these appendices includes design evaluation and integrity examination information.

5.0 RECOMMENDATIONS

The following recommendations were drawn from a larger set of recommendations presented in each of the appendices. These recommendations are the next actions that would be needed to assess the service life of the tanks and enhance the leak tightness evaluation of the tanks. These actions would require examinations or evaluations that are beyond the scope of the current effort.

- Internal visual inspection of tanks 244-A, 244-TX, 244-BX, U-301B, UX-302A, ER-311, and A-350, when the tanks are empty.

- Leak test of tanks 244-A, U-301B, UX-302A, ER-311, A-350, S-304, and TX-302C when the tanks are full or at their maximum allowed operating level limit.

In addition, in the applicable appendices it is recommended that the structural assessment analysis for certain structures be revised, with refined analysis methods using more appropriate and less conservative assumptions and loading conditions, to demonstrate adequate structural capacities and to justify the operation of the facilities. Accordingly, refined structural analyses of these tanks is now in process with completion scheduled in FY 2002.

Table 1, Integrity Assessment Summary Details: DCRTs, Catch Tanks and Ancillary Facilities

Appendix	Tank Information	Tank Visual Examination (VE)	Leak Testing & UT[10]	Tank Parameters	Tank Size	Vault Information
A	**241-S-304** Type: Catch Tank Location: 200 West, Hanford Site Age (2001): ~ 10 years (in service) Service Removal Date[5]: 6/2005	Date of VE: 4/22/1999 Waste Level: ~ 2 to 4 inches (<1%[6]) Comment: Limited camera lead length prevented proximal viewing of bottom region of tank.	Date of Leak Test: 2/1996 Waste Level: ~ 60 inches (~ 41%[6]) Type: PCSACS[7] Manual FIC[8] data Ultrasonic Testing: NA	Tank Volume[1]: ~ 6,300 gallons Orientation: Vertical Material: Carbon Steel (Type SA-516-70)	Horizontal: 9 feet diameter Vertical: 15 feet Thickness: 5/8 inch (Walls) 0.77-inch (Dished Ends)	Liner: Coated with sealant Liner Backing: Reinforced concrete (1-ft thick)
B	**241-U-301B** Type: Catch Tank Location: 200 West, Hanford Site Age (2001): ~57 years Service Removal Date[5]: 6/2005	Date of VE: 4/26/2000 Waste Level: ~ 42 inches (~ 28%[6]) Comment: Not possible to view tank bottom and lower side due to sludge layer (estimated to be ~ 12 inches deep).	Date of Leak Test: 8/2000 Waste Level: ~ 42 inches (~ 28%[6]) Type: PCSACS[7] ENRAF[9] data Ultrasonic Testing: NA	Tank Volume[1]: ~ 36,430 gallons Orientation: Vertical Material: Gunite[2] Lining with Prestressed Concrete Backing	Horizontal: 20 feet diameter Vertical: 19 feet Thickness: 3/4 inch (Lining) 5-inch (Backing)	NA
C	**241-UX-302A** Type: Catch Tank Location: 200 West, Hanford Site Age (2001): ~54 years Service Removal Date[5]: 6/2005	Date of VE: 3/8/2000 Waste Level: ~ 21 inches (~ 17%[6]) Comment: Not possible to view tank bottom and lower side because of sludge layer (estimated to be ~ 4 to 8 inches deep).	Date of Leak Test: 8/2000 Waste Level: ~ 24 inches (~ 21%[6]) Type: PCSACS[7] ENRAF[9] data Ultrasonic Testing: NA	Tank Volume[1]: ~ 17,670 gallons Orientation: Horizontal Material: Carbon Steel (Type A 285-46 Gr. B)	Horizontal: 39 feet Vertical: 9 feet diameter Thickness: 9/16 inch	NA
D	**241-TX-302C** Type: Catch Tank Location: 200 West, Hanford Site Age (2001): ~ 54 years Service Removal Date[5]: None stated	Date of VE: 5/1/2000 Waste Level: ~ 3.5 inches (~ 1%[6]) Comment: Not possible to view tank bottom and lower side because of salt cake or sludge layer.	Date of Leak Test: 4/1998 Waste Level: ~ 50 inches (~ 57%[6]) Type: PCSACS[7] ENRAF[9] data Ultrasonic Testing: NA	Tank Volume[1]: ~ 17,670 gallons Orientation: Horizontal Material: Carbon Steel (Type A 285-46 Gr. B)	Horizontal: ~ 39 feet Vertical: ~ 9 feet diameter Thickness: 9/16 inch	NA
E	**244-BX** Type: DCRT[4] Location: 200 East, Hanford Site Age (2001): ~ 20 years Service Removal Date[5]: 2004	Date of VE: 3/15/2000 Waste Level: ~ 74 inches (~ 63%[6]) Comment: Not possible to view tank bottom and lower side because of sludge layer (estimated to be ~ 24 to 36 inches deep).	Date of Leak Test: 5/29-30/1999 Waste Level: ~ 109 inches (~ 80%[6]) Type: Real-time Diptube data Ultrasonic Testing: NA	Tank Volume[1]: ~ 31,000 gallons Orientation: Horizontal Material: Carbon Steel (Type A 537 Cl. 1)	Horizontal: ~ 39 feet Vertical: 12-feet diameter Thickness: 3/8 inch	Liner: Coating of Amercoat[3] Liner Backing: Reinforced concrete
F	**241-AX-152** Type: Catch Tank Location: 200 East, Hanford Site Age (2001): ~ 39 years Service Removal Date[5]: 3/2001	Date of VE: NA. Waste Level: NA Comment: VE not conducted as no access to tank interior.	Date of Leak Test: 2000 Waste Level: ~ 11 inches (~ 8%[6]) Type: PCSACS[7] Manual Tape data Ultrasonic Testing: NA	Tank Volume[1]: ~ 11,000 gallons Orientation: Horizontal Material: Stainless Steel (Type 304L) Liner with Reinforced Concrete Backing	Horizontal: 6 feet x 22 feet Vertical: ~ 12 feet Thickness: 1/8 inch (Liner) ~ 18 inch (Backing)	NA

Table 1 (continued)

Appendix	Tank Information	Tank Visual Examination (VE)	Leak Testing & UT[10]	Tank Parameters	Tank Size	Vault Information
G	**241-AZ-151** Type: Catch Tank Location: 200 East, Hanford Site Age (2001): ~ 28 years Service Removal Date[5]: 6/2004	Date of VE: 5/2/2001 Waste Level: ~ 36 inches (~ 34%[6]) Comment: Not possible to view tank bottom and lower side below waterline because of opacity of liquid waste.	Date of Leak Test: 7/2000 Waste Level: ~ 114-inches (~ 106%[6]) Type: Real-time Manual FIC[8] data Ultrasonic Testing: 5/2/2001, unsuccessful due to surface roughness	Tank Volume[1]: ~ 12,000 gallons Orientation: Horizontal Material: Carbon Steel (Type A 569) Liner with Reinforced Concrete Backing	Horizontal: 6 feet x 24 feet Vertical: 11 feet Liner Thickness: 10-gage Liner Backing: Reinforced concrete (1 ft thick)	NA
H	**244-A** Type: DCRT[4] Location: 200 East, Hanford Site Age (2001): ~ 25 years Service Removal Date[5]: 6/2005	Date of VE: 6/6/2000 Waste Level: ~ 25 inches (~ 17%[6]) Comment: Not possible to view tank bottom and lower side because of murkiness of liquid waste (estimated to be ~ 24 inches deep).	Date of Leak Test: 1980 - 2000 Waste Level: See comment. Type: Real-time Diptube data Comment: Not feasible to use PCSACS[7] Diptube data due to non-static level. Ultrasonic Testing: NA	Tank Volume[1]: ~ 17,800 gallons Orientation: Vertical Material: Stainless Steel (ASTM A-167, Type 347)	Horizontal: 14 feet diameter Vertical: ~ 20 feet Thickness: 5/16 inch	Liner: Carbon Steel Liner Thickness: 1/4-inch Liner Backing: Reinforced concrete
I	**Waste Unloading Facility 204-AR** Type: Ancillary Facility Catch Tank Location: 200 E Age (2001): ~ 20 years Service Removal Date[5]: Indefinite use.	Date of VE: NA. Waste Level: NA Comment: VE not conducted as no access to tank interior.	Date of Leak Test: 7/2000 Waste Level: ~ 78 inches (~ 95%[6]) Type: Real-time Diptube data Ultrasonic Testing: 8/15/2000	Tank Volume[1]: ~ 1,500 gallons Orientation: Vertical Material: Stainless Steel (Type 304L)	Horizontal: 5.5 feet diameter Vertical: 8.5 feet Thickness: 1/4 inch	Liner: Stainless Steel Liner Thickness: 1/4 inch Liner Backing: Reinforced concrete
J	**Lift Station 241-A-350** Type: Ancillary Facility Catch Tank Location: 200 E Age (2001): ~ 57 years Service Removal Date[5]: 6/2005	Date of VE: NA. Waste Level: NA Comment: VE not conducted as no access to tank interior.	Date of Leak Test: 10/1999 Waste Level: ~ 29 inches (~ 44%[6]) Type: PCSACS[7] Diptube data Ultrasonic Testing: 3/7/2001	Tank Volume[1]: ~ 790 gallons Orientation: Vertical Material: Stainless Steel (Type 309Cb)	Horizontal: 4.5 feet diameter Vertical: 7 feet Thickness: 3/8 inch	Liner: Corrugated galvanized steel caisson Liner Thickness: 12 gauge Liner Backing: Grout
K	**241-ER-311** Type: Catch Tank Location: 200 East, Hanford Site Age (2001): ~ 57 years Service Removal Date[5]: 6/2004	Date of VE: 5/25/2000 Waste Level: ~ 51 inches (~ 63%[6]) Comment: Not possible to view tank bottom and lower side below waterline because of murkiness of liquid waste.	Date of Leak Test: 4/2000 Waste Level: ~ 51 inches (~ 63%[6]) Type: PCSACS[7] ENRAF data Ultrasonic Testing: NA	Tank Volume[1]: ~ 17,000 gallons Orientation: Horizontal Material: Stainless Steel (Type 18-8-S-Cb)	Horizontal: 36 feet Vertical: 9 feet diameter Thickness: 1/2 inch	NA

Table 1 (continued)

Appendix	Tank Information	Tank Visual Examination (VE)	Leak Testing & UT[10]	Tank Parameters	Tank Size	Vault Information
L	**244-TX** Type: DCRT[4] Location: 200 West, Hanford Site Age (2001): ~ 21 years Service Removal Date[5]: 6/2005	Date of VE: 6/22/2000 Waste Level: ~ 81 inches (~ 72%[6]) Comment: Not possible to view tank bottom and lower side because of opacity of liquid waste	Date of Leak Test: 8/2000 Waste Level: ~ 82 inches (~ 73%[6]) Type: PCSACS[7] Manual Tape data Ultrasonic Testing: NA	Tank Volume[1]: ~ 31,000 gallons Orientation: Horizontal Material: Carbon Steel (Type A 537 Cl. 1)	Horizontal: ~ 39 feet Vertical: 12 feet diameter Thickness: 3/8 inch	Liner: Carbon Steel Liner Thickness: 1/4 inch Liner Backing: Reinforced concrete
M	**244-S** Type: DCRT[4] Location: 200 West, Hanford Site Age (2001): ~ 20 years Service Removal Date[5]: 6/2005	Date of VE: 12/3/1998 Waste Level: ~ 18 inches (~ 11%[6]) Comment: Limited camera lead length prevented proximal viewing of bottom region of tank.	Date of Leak Test: 11/1998 Waste Level: ~ 114 inches (~ 69%[6]) Type: Real-time Diptube data Ultrasonic Testing: NA	Tank Volume[1]: ~ 22,840 gallons Orientation: Vertical Material: Carbon Steel (Type A 516 Gr. 55)	Horizontal: 15 feet diameter Vertical: 18 feet 3 inch Thickness: 1/4 inch	Liner: Carbon Steel Liner Thickness: 1/4 inch Liner Backing: Reinforced concrete

1) Nominal and also referred to as Maximum Volume
2) Gunite = cement and sand combination (no aggregate)
3) Amercoat is a product of Protective Coating Division of Ameron, Brea, CA
4) Double-Contained Receiver Tank (DCRT)
5) Memo R. F. Wood to J.J. Short - ORP, December 11, 2000, CHG-0006588 R1, CH2MHill Hanford Group, Inc., Richland, WA.
6) %-fill level reference to administrative maximum (typically 80% of maximum volume).
7) PCSACS - Personal computer surveillance analysis computer system, waste height versus time data.
8) FIC - Food Instrument Corporation (liquid level gauge)
9) ENRAF - Enraf-Nonius Series 854 ATG (liquid level gauge)
10) UT - Ultrasonic Testing for wall thickness of tank
NA = not applicable

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APPENDIX A

241-S-304 CATCH TANK

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LIST OF TERMS

ACI	American Concrete Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CVI	Certified Vendor Information (file)
DCRT	double-contained receiver tank
DOE	U. S. Department of Energy
DST	double-shell tank
ENRAF	Enraf – Nonius Series 854
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System
HLAN	Hanford Local Area Network
KEH	Kaiser Engineers Hanford
mpy	mils per year (uniform corrosion rate)
OD	outside diameter
PCSACS	Personal Computer Surveillance Analysis Computer System
PFP	Plutonium Finishing Plant
PUREX	Plutonium Uranium Extraction (Facility)
RHA	Records Holding Area
RMIS	Records Management Information System
S-151	241-S-151 (a diversion box)
S-302	241-S-302-A catch tank
S-304	241-S-304 catch tank
SDC	Standard Design Criteria
SS	stainless steel
SST	single-shell tank
VITIS	Video In-Tank Inspection System
WAC	Washington Administration Code
WHC	Westinghouse Hanford Company
WT-SNL-350	a new cross-site transfer line

1.0 INTRODUCTION

The 241-S-304 catch tank (S-304) is located in the 200 West Area of the Hanford Site (Figure A1). The catch tank was designed and installed to replace and isolate the failed 241-S-302-A catch tank (S-302-A). The catch tank also provides secondary containment for the 241-S-151 diversion box and the pump pit.

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the S-304 catch tank components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the S-304 pump pit, annulus vault, and the catch tank. The scope of the examinations includes a visual examination of the S-304 catch tank internal surface, the annulus vault, pump pit, and a leak test of the tank.

4.0 DESCRIPTION

The S-304 facility is an underground concrete structure consisting of two main structural components, the pump pit and the annulus vault. The pump pit houses the transfer pump and other piping and electrical components, and the annulus vault (also called a caisson) houses the receiver catch tank. The pump pit sits directly above the annulus vault. The facility is located north of the 241-S-151 diversion box (see Figures A1 and A2).

4.1 PUMP PIT

The pump pit is located on top of the annulus vault. It is a reinforced concrete structure; 13-ft-square by 8-ft 2-in. deep with 12-in.-thick walls and a 15-in.-thick floor slab. The pump pit has three 2.5-ft-thick removable concrete cover block sections at ground level for access into the pit and the receiver tank. These cover blocks also serve as shielding against radiation. The pump pit houses the submersible pump, jumpers, and other ancillary equipment and serves as secondary containment to the transfer lines. Its floor drain directs any leaked liquid (i.e., transfer waste, rainwater, or snowmelt) into the S-304 receiver tank below.

4.2 ANNULUS VAULT

The annulus vault is directly below the pump pit. It is an 18-ft diameter by 33.5-ft-deep reinforced concrete caisson (vault) with a 1-ft-thick wall, 15-in.-thick roof slab (part of it also forms the pump pit floor slab), and 2-ft thick reinforced concrete foundation slab. The sloping vault floor has a 2-ft-deep sump for collection of any spilled liquid. The sump is provided with a leak detector, an automatic liquid level sensor from Food Instrument Corporation (FIC), and a submersible pump for pumping out any collected liquid.

4.3 RECEIVER CATCH TANK

The S-304 catch tank is vertical, single-walled, freestanding cylindrical vessel constructed of carbon steel (type SA-516-70). It consists of flange, dish heads and a cylindrical shell. It has an outer diameter (OD) of 108 in. The cylindrical shell is 0.625-in.-thick while the flange and dish heads are 0.771-in. thick. The flange and dish heads are each 20.25-in. in height and the cylindrical shell is 139.50 in. in height. Thus the total height of catch tank is 180.0 in. The following service connections (pipe) are attached at the top of S-304 catch tank: one 24 in. connection for insertion of a submersible pump, two 4 in. connections for drain lines, one 4-in. connection for liquid level instrumentation, one 4 in. connection for tank vent, one 4-in. connection serves as a spare riser, and one 2-in. connection for recycle pump discharge by-pass. The bottom of the S-304 catch tank is welded to a 108-in. OD by 29.75-in.-high base skirt that is anchored to the vault floor slab with eight 5/8-in.-diameter Hilti Kwik bolts.

5.0 DESIGN EVALUATION

This section discusses the design requirements and other information used in assessing the integrity of the S-304 facility and the catch tank.

5.1 DESIGN STANDARDS

A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the S-304 facility. The resources searched for information are listed below:

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) database
- associated project files packed in boxes at Records Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Cognizant Engineering personnel.

The following paragraphs provide the design requirements and other factors used in assessing the integrity of S-304 catch tank which was the replacement for S-302-A This replacement was performed as Project CR9541 (Neilsen 1992). The project's design specifications and calculations provided the design, construction, and inspection requirements for S-304 catch tank. The installation and tie-in of S-304 catch tank was undertaken in August 1991.

5.1.1 Tank

The original tank (an existing air surge tank) was designed, fabricated, inspected, and tested in accordance with the *American Society of Mechanical Engineers* (ASME) *Boiler and Pressure Vessel Code*, Section III, Division 1 (ASME 1977) requirements. The air surge tank (Serial # 63641-4) was manufactured by Welks Bros. Metal Product, Inc. in 1981. This tank was procured and modified to comply with ASME Section VIII, Division 1 requirements (KEH 1991a). It also met the requirements of the Dangerous Waste Regulations, Chapter 173-303, of the *Washington Administrative Code* (WAC) (WAC 1998). In addition the tank and supporting components and systems were designed and installed according to the Standard Design Criteria (SDC) Sections 1.2, 1.3, 4.1, 7.4 and 7.7, of the Hanford Plant Standards; and applicable sections of the U.S. Department of Energy (DOE) General Design Criteria DOE 6430.1A (Hurley 1991).

The air surge tank was modified (designed) to operate for a minimum of ten years as a catch tank. The tank was designed for an internal pressure (calculated via the maximum static head expected on the tank). The tank was tested at a hydrostatic pressure of 26 psig (+3, -0 psig) (Kaiser Engineers Hanford [KEH] 1991a). In addition, the catch tank was designed to meet the following requirements:

- Containment - The tank had to contain a worst-case spill of approximately 5,840 gallons, caused by a failure during a cross-site transfer. The S-304 catch tank's nominal design capacity is 6,300 gallons.

- Temperature - Maximum design temperature had to be 90 degrees F.

- Corrosion - The tank had to meet the design corrosion allowance of 0.0625 in. for the tanks design life, a minimum of 10 years (KEH 1991b).

The tank replacement calculations and drawings for Projects CR9541 detail the design configuration and inspection requirements. The tank's fabrication and inspection were documented on ASME Form N-1A N: Certificate Holders Data Report for Nuclear Vessels. This is an alternate (ASME Code Rules, Section III Division 1) form that applies only to "single chamber completely shop-fabricated vessels" (KEH 1991b).

In summary, the design standards requirements for the tank were found to be adequate for the service intended. Structural calculations relating to the tank foundation design, soil requirements, and codes and standards used are on record in the project files (KEH 1991b).

5.1.2 Vault

The below-ground catch tank is located in a reinforced concrete structure. The project's tank replacement calculations and drawings for S-304 catch tank established requirements for the construction and inspection of the vault according to applicable national codes and standards. Also, the project's tank replacement calculation and drawing specified design/operational requirements (i.e., the capability to withstand live loads, and lateral soil pressures) (KEH 1991b).

The inside of the vault walls and floor, including the sump bottom, is covered with a protective sealant (EN-25 Coating System) manufactured by Koch Corrosion Control Co (KEH 1993). The sealant protects against groundwater intrusion and chemical corrosion as required for the expected service life of the catch tank and supporting equipment. In the event that the sump must be pumped, the submersible pump assembly contains components capable of spraying water, air, or steam to aid in the cleaning/pumping out of the sump area (Hurley 1991).

5.1.3 Pump Pit

The reinforced concrete pump pit is coated with protective sealant to mitigate seepage through its walls and floor. The pit contains a 3-in. drain to route any liquid from its floor to the catch tank below. The pump pit is provided with a shielded cover (i.e., three removable concrete cover blocks), which is resistant to rain, snow, and water intrusion.

The reinforced concrete structures (pump pit and vault) were designed and constructed to comply with the American Concrete Institute (ACI)-318-89 Code requirements.

A structural assessment analysis (Westinghouse Hanford Company [WHC] 1996) of numerous facilities subjected to various accident loading conditions was performed for a safety analysis report. This assessment determined that S-304 facility components could fail as follows; 1) because of high sludge temperature and due to 2) seismic event, and gasoline ignition.

Review of the WHC 1996 document indicates that the assumptions made for these load conditions are unrealistic and hence its conclusions are unrealistically conservative. A recent refined analysis (Julyk 1999) was performed to assess a similar structure (244-A double-contained receiver tank [DCRT]). This analysis shows that the 244-A DCRT structure has sufficient strength to withstand higher loads than the ones determined in WHC 1996 assessment. This kind of refined analysis will most likely also disposition the other conclusions drawn in WHC 1996. The WHC 1996 document should be revised using realistic loading conditions and using refined analysis methods.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

Catch tanks generally handle a relatively low volume of waste fluid in comparison to other tanks associated with single-shell tank (SST) and double-shell tank (DST) waste systems. Catch tanks function as secondary containment in that they receive spilled or leaked waste from diversion boxes. In addition, catch tanks directly receive less aggressive waste, such as process condensate, flush water, and rain or snowmelt ingress.

Catch tank 241-S-302A, the predecessor tank to S-304, was designated an "assumed leaker" in 1989. The failure of this tank is important to its S-304 descendant because the same corrosion conditions that caused the failure in S-302A may be still in existence (see Section 5.3).

The S-302-A catch tank failed in 1989 after about 40-years of service. During that time, it provided secondary containment for the 241-S-151 (designated S-151) diversion box and condensate drain from two jet discharge lines and drainage from the pipe encasement for the jet discharge lines. Hurley (1991) specifically cited the S-151 diversion box as being required for handling the aforementioned condensate, as well as potential spills from waste transfers involving the 222-S labs, the T Plant Facility, and the 244-TX DCRT. In addition, the

244-TX DCRT received waste from the Plutonium Finishing Plant (PFP), and the T, TX, and TY single-shell tank farms. Therefore, a wide-range of spilled waste fluid could have collected in S-302-A Personal Computer Surveillance Analysis Computer System (PCSACS) records on waste surface level exist from only about 1980 onward. From that time, until the tank was taken out of service (1991), the PCSACS comments report shows that rainwater/snowmelt, pressure test, and drain water represented the majority of times that fluid ingress to the tank occurred.

Concerning other potential hazards, according to Freeman-Pollard (1994), there was little potential for hydrogen generation to result in a gas release event in S-302-A, even though a wide range of waste may have collected in it. Furthermore, concerning potential safety issues (Freeman-Pollard 1994), S-302-A had low ratings for the safety categories of hydrogen buildup, ferrocyanide, flammability, vapor emission, and criticality safety. Only the categories of organic salts and radiological hazard received a moderate rating. None were rated high. Concern for tank integrity was rated high because of its subsequent leakage problem.

In August 1989, an unexplained decrease in the fluid level in S-302-A was observed and the tank was classed as an "assumed leaker." Liquid level fluctuations had been observed as early as 1977 (Freeman-Pollard 1994) indicating that through-wall corrosion of some form probably occurred after about 28 years of service. This corrosion is discussed further in Section 5.3.

The S-304 catch tank was installed to replace the failed S-302-A catch tank. The S-304 catch tank became operational on September 30, 1991 after the drain lines from the 241-S-151 Diversion Box (S-151) to the S-302-A were rerouted to the S-304 catch tank (Hurley 1991). The jet discharge lines were isolated from the catch tank (Hurley 1991). The operability test of S-304 was completed and reported in December 1991 (Cunningham 1991). It is assumed that potential waste-inflows, to the new tank, could have started in January 1992.

The amount of waste that could potentially enter the 241-S-151 diversion box, and subsequently leak or spill to S-304 is likely to be less than the amount collected in S-302-A According to the tank farm engineering, the new cross-site transfer line (WT-SNL-350) does not go through the S-151 diversion box and thus any leakage or flushings from it will go elsewhere. Leakage and flushing from the old transfer line did pass through S-151 but it is presently not in use; and no future use is expected. Waste from 222-S Labs now flows to 219-S facility and does not go to S-151, and, as noted earlier, the jet discharge lines are disconnected. Saltwell pumping from S farm is still taking place but is expected to be completed by 2003, according to the program director. Rainwater and snowmelt ingress will still occur periodically. With the new S-304 tank, the concerns for the various aforementioned safety categories still remain low. All transferred wastes, however, must now meet new requirements that did not exist when the tank was designed and built.

Waste that is transferred through the S-151 diversion box (and spillage into the new S-304 catch tank) now meets current compatibility requirements, waste categories, waste codes, and downstream tank safety concerns. These concerns are based on a result of mixing waste streams that could lead to undesirable interactions. The interactions include flammable gas (hydrogen, methane, and ammonia) organic and energetic reaction, corrosivity, and heat generation.

Waste compatibility requirements are defined in more detail in (Mulkey and Miller 1997; Mulkey 1998; Cox 1997; and Fowler 1995). Because waste spillage volumes from diversion box S-151 into S-304 are expected to be low, interaction problems of the type noted above are also small. The PCSACS comment reports show that rainwater/snowmelt and raw water additions (to test the leak detector) are still occurring and thus, will dilute any spilled waste.

To estimate if the 90-degree F maximum temperature for S-304 was ever exceeded, a review was made of the largest volume of high-temperature waste that could have spilled into S-302-A on its way to receiver SST farms. This approach was taken because historically catch tank temperature levels have not been monitored and because a database exists for temperature levels in the receiving SST farms, T, TX and TY. Data from Brown (1997), on temperature levels for 36 of the subject receiver SSTs, showed an average maximum temperature of 104 degrees F and an overall average tank temperature of 73 degrees F. Based on these early temperature levels, and that cooled-down saltwell wastes from SSTs are relatively low, it is unlikely that S-304 has experienced any significant amount of spilled-waste temperature as high as 90 degrees F. As a result, the tank design is considered to be adequate to handle wastes with the noted characteristics.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided primarily by the combination of good design, appropriate material selection, and corrosion control. Both design and material selection were adequate for original catch tank S-302-A (which has since been replaced by S-304). Effective corrosion control, however, was not implemented until 1984 (Kirch 1984). An assessment of the corrosion behavior of the earlier catch tank S-302-A was done to provide a basis to estimate the corrosion behavior of the new tank S-304.

Catch tank S-302-A was constructed from American Society for Testing and Materials (ASTM) A 285-46 carbon steel and was 9/16-in. thick. As noted earlier (Section 5.2) the tank probably began to leak in 1977 (28 years after installation). Thus, it is assumed that the waste was not effectively corrosion-inhibited. Assuming that the corrosion degradation was uniform over the 28-year period, and that the failure was from the inside-out, the average corrosion rate could have been as low as

Average corrosion rate = (9/16-in.) / 28-yr., ~0.02-in/yr., or 20 mils/yr.

If however, the tank failed from pitting corrosion, the pitting would likely have been dormant for an undefined period (incubation time) before it started to grow through-wall. Thus, the pitting corrosion rate would have been slightly greater than 20 mils/year (mpy). Stress-corrosion cracking cannot be eliminated as a source of leakage. Stress-corrosion cracks, however, once initiated (also after an incubation time) generally grow rapidly. The highest (uniform) corrosion rate found for iron in soft water was 10 mpy (ASTM 1987). Thus, the relatively long time before leakage (28 year) suggests that the tank failed primarily because of pitting corrosion.

The replacement catch tank S-304 was designed for a maximum temperature of 90 degrees F and a service pH range of 12 or higher (See Hanford Drawing H-2-85036, sheet 1 of 1). The tank exterior was painted with one coat of zinc-chromate primer, FS-TT-P-645, 1.5-mil minimum dry film thickness and two finish coats of gray enamel, FS-TT-E-489, 1.5-mil dry film thickness each coat. The corrosion allowance was 0.0625 in. over 10 years. The carbon steel material of construction was ASME SA 516-70 and is 5/8-in. thick. Because dilution of leaked waste could be caused by line flushings or rainwater/snowmelt ingress, it is possible that uniform corrosion rates up to an estimated maximum of 10 mpy (ASTM 1987) could occur in S-304. However, as noted in Section 6.1.3, the tank interior had been coated with an Amercoat™-type material. Thus, both uniform corrosion and pitting corrosion would have been deterred until the coating started to peel.

For S-304, the service life thus far is about ten years (1991 - 2001). Currently, saltwell transfers from the S-Farm are expected to continue until about 2003, for a total of at least 12 years. Because corrosion controls have been in effect since about 1984, all waste transfers will be controlled and any spills or leakage will also be controlled. However, any line flushings and any rain/snowmelt ingress are not likely to have any corrosion controls applied and, as noted above, they could act to increase the corrosion rate of the leaked waste. If uniform corrosion was occurring at 10 mpy, say during the last five-years (1998-2003) of its anticipated 12-year service life, the 0.065 in. corrosion allowed would not have been exceeded. Further, if pitting corrosion was occurring at 20 mpy during the same timeframe (5 years), the majority of the tank wall thickness will remain.

Presently, the only way to transfer waste from S-304 catch tank is to pump it into a tank truck. It could be pumped from the truck into DCRT 244-S or 204-AR for a subsequent transfer to a double-shell tank.

At least two approaches could be used to ensure that no significant uniform and pitting corrosion rates are continuing to occur in S-304 catch tank because of the possible corrosion controls dilution factor noted earlier. Either the tank should be dried out, so that no corrosion will occur, or treated water (water with adequate levels of nitrite, nitrate, and hydroxide) should be added to the tank. Samples would have to be taken to ensure that the corrosion controls (concentrations) are adequate. Further, increasing the treated waste depth to several feet should move any waterline pitting corrosion to higher levels in the tank.

Integrity examinations performed in Section 6.0 show that the S-304 facility is in good condition.

5.4 AGE OF THE TANK SYSTEM

The age of the tank is approximately 20 years (it was constructed in 1981). However, the tank has been serving as a catch tank for less than 10 years. An integrity assessment of the tank and its associated components has not been performed since the time of construction.

™ Manufactured by Protective Coating Division of Ameron, Brea, California

6.0 INTEGRITY EXAMINATIONS

The integrity examinations (visual and leak test) were performed in 1999. These examinations were done to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since the 20-year-old tank was put in service about ten years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the pump pit and vault interior on June 16, 1999 by use of a remotely controlled closed circuit television camera system. Examination of the catch tank interior occurred earlier on April 22, 1999. Visual examination details and data sheet findings are included in a series of twenty-eight photographs (Figures A3 through A29) and Tables A1 through A3, respectively, that appear at the end of this appendix. The 28 individual photographs, taken from the examination videotapes and presented in the noted figures, show that the facility is in very satisfactory condition.

6.1.1 Pump Pit Visual Examination Details

Access to the pump pit was obtained through a valve handle penetration in one of its cover blocks. A Video In-Tank Inspection System (VITIS II) videocamera, with attached light, was used to view the pit interior and its ancillary equipment. The videocamera has a zoom telephoto lens capable of wide-angle scanning and close-up or higher magnification viewing. Camera 'pan' and 'tilt' angles along with the pit designation (e.g., S-304PP) and time and date were omnipresent within the field of view of the camera

Details of the examination can be found in Table A1. Five photographs of the pump pit interior region were taken and are shown in Figures A3 through A7. In general, the pit interior surfaces, joints, and ancillary equipment appeared to be in very satisfactory condition.

6.1.2 Annulus or Vault Visual Examination Details

Access to the catch tank vault was through riser number 9 which extends from the top of the cover block region down through the floor of the pump pit into the annulus. Riser number 9 is located in the southeast cylindrical sector of the annulus.

Thirteen photographs of the annulus were taken, and details regarding each photo are presented in Table A2. The photographs are presented in Figures A8 through A20. The areas viewed appeared very satisfactory.

6.1.3 Catch Tank Internal Visual Examination Details

Access to the catch tank was through riser number 4. This riser penetrates the tank in its southwest cylindrical sector and is about 1-ft from the tank wall.

Nine photographs were taken of the catch tank interior. Table A3 presents details regarding each photo. The majority of the tank was visible and the remaining liquid appeared to be only several inches deep. Thus, the dished bottom end of the tank was also visible. The photographs are presented in Figures A21 through A29.

Based on the visual examination, it can be seen that the tank had also been coated with an Amercoat-type coating prior to its service. The tank interior and internal components appeared relatively clean with some waterline bands or marks apparent on the sidewall coating. Apparently the last waste received by the tank (around the 60-64-in. height, see Figure A30 for a plot of waste surface level versus time) slightly attacked the top 4 in. (or so) of the coating, causing some of it to peel-off. In addition, this led to narrow band of circumferential corrosion of the tank wall. While the amount of corrosion could not be measured visually, it appeared very small.

The limited length of the camera electrical leads prevented lowering of the camera to below, approximately, the middle of the tank. Thus, direct-on viewing of the bottom sidewall of the tank was not possible. Those photographs of the tank bottom region, taken from approximately the tank's mid-height, tend to exaggerate those images. In other words, the amount of peeling of the coating is less than it appears.

In general, however, the tank inner surface and internal components appear in very satisfactory condition.

6.2 LEAK TEST

To assess the leak tightness of S-304 catch tank, a review of fluid level records was conducted. These data are available on the PCSACS.

Two measurement systems (Manual FIC, and Manual Enraf – Nonius Series 854 [ENRAF]) were used to monitor the surface level in S-304. Only the Manual FIC tape measurement system was used from the first waste incursion (about December 1991) up to, and including the maximum waste height (about February 1997), as shown in Figure A30. The more sensitive Manual ENRAF system was used only after the waste was pumped down to several inches deep. Thus the Manual ENRAF system would not indicate if a leak had occurred at a greater waste height.

A 10-hour duration is considered the minimum time over which the leak check would have to be conducted to satisfy the established detection criterion for a volume change. A review of level data over 24 days was selected within the time-period between February to July 1996. During this 24-day period, the waste height remained between 60.35 and 60.49-in. Figure A31, is a time-expansion of Figure A30 for the selected time-period. Thus, the tank did not leak, below approximately, the 60-in. level.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. Although the pump pit was designed to be resistant to rain/snow/water intrusion, water may have entered into the pump pit adding to the waste inventory and increasing the potential for corrosion to the tank, vault, and pump pit. In order to mitigate rainwater/snowmelt intrusion, it is recommended to seal cover block seams.

2. Although the tank system was required to be designed, constructed, inspected, and operated as a Safety Class 3 facility (Hurley 1991), no seismic analysis was found among the project documents.

3. The structural assessment analysis (WHC 1996) should be revised with refined analysis methods using realistic assumptions and loading conditions to demonstrate and justify the operation of the facility.

4. The tank is not leaking at the leak test level of 60.40 in. However, to demonstrate its leak tightness at a higher level, another leak test should be conducted at that higher level.

   Soft water conditions, that may have been responsible for failure of the S-302A predecessor tank, also appear to exist for the replacement S-304 catch tank. Based on a 10 mpy uniform corrosion rate for the last five years of its anticipated life (1998 to 2003), the new tank probably will not lose its corrosion allowance. Correspondingly, if a 20 mpy pitting corrosion rate was occurring over the same timeframe, the majority of the tank wall (~0.43 in.) would remain.

5. The facility is relatively new, and is in relatively good condition. Conducting another set of visual examinations (when the tank is empty) and a leak test should be considered prior to completion of the tank integrity assessment in 2006.

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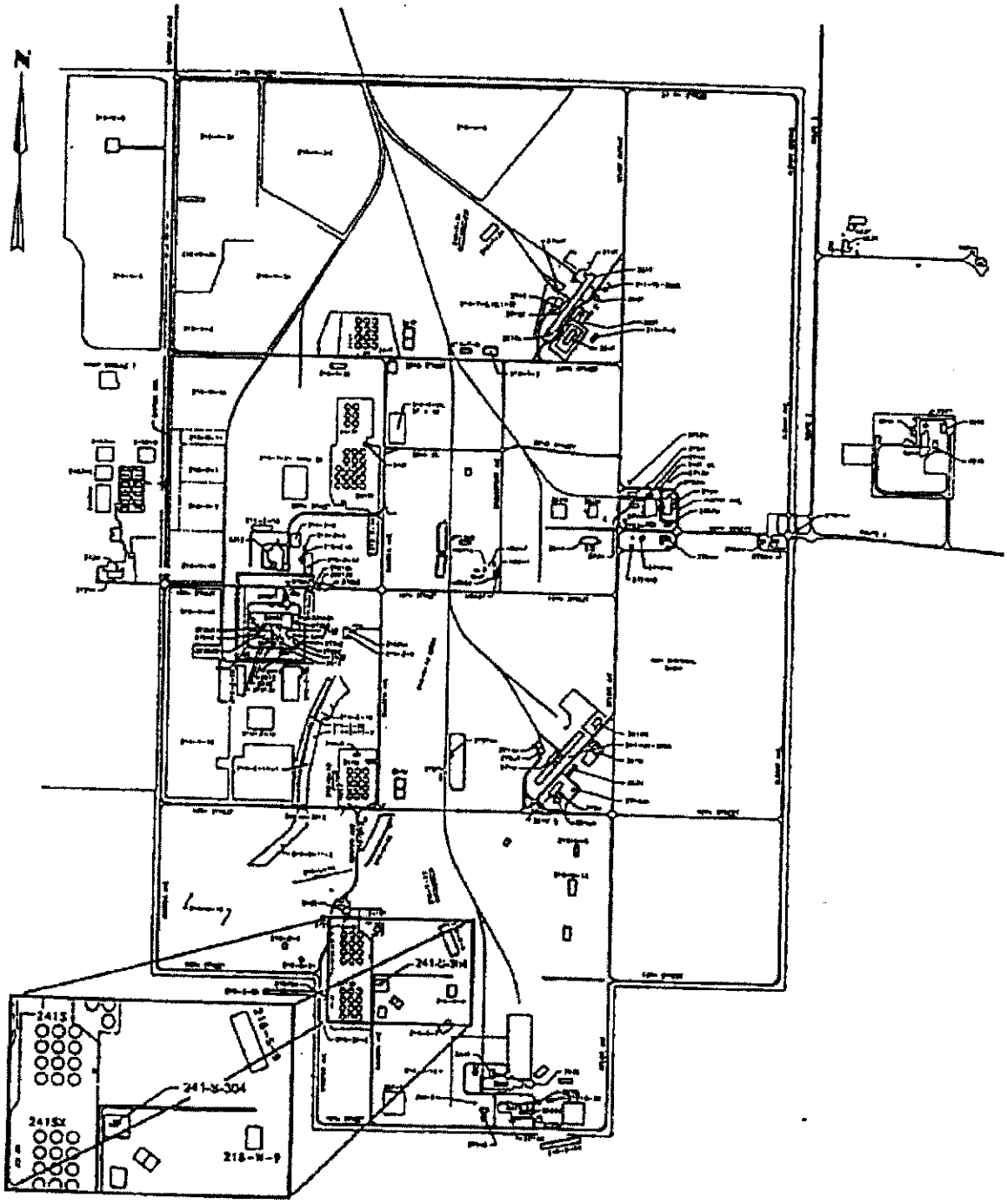

Figure A1. Location of 241-S-304 on the Site Plan

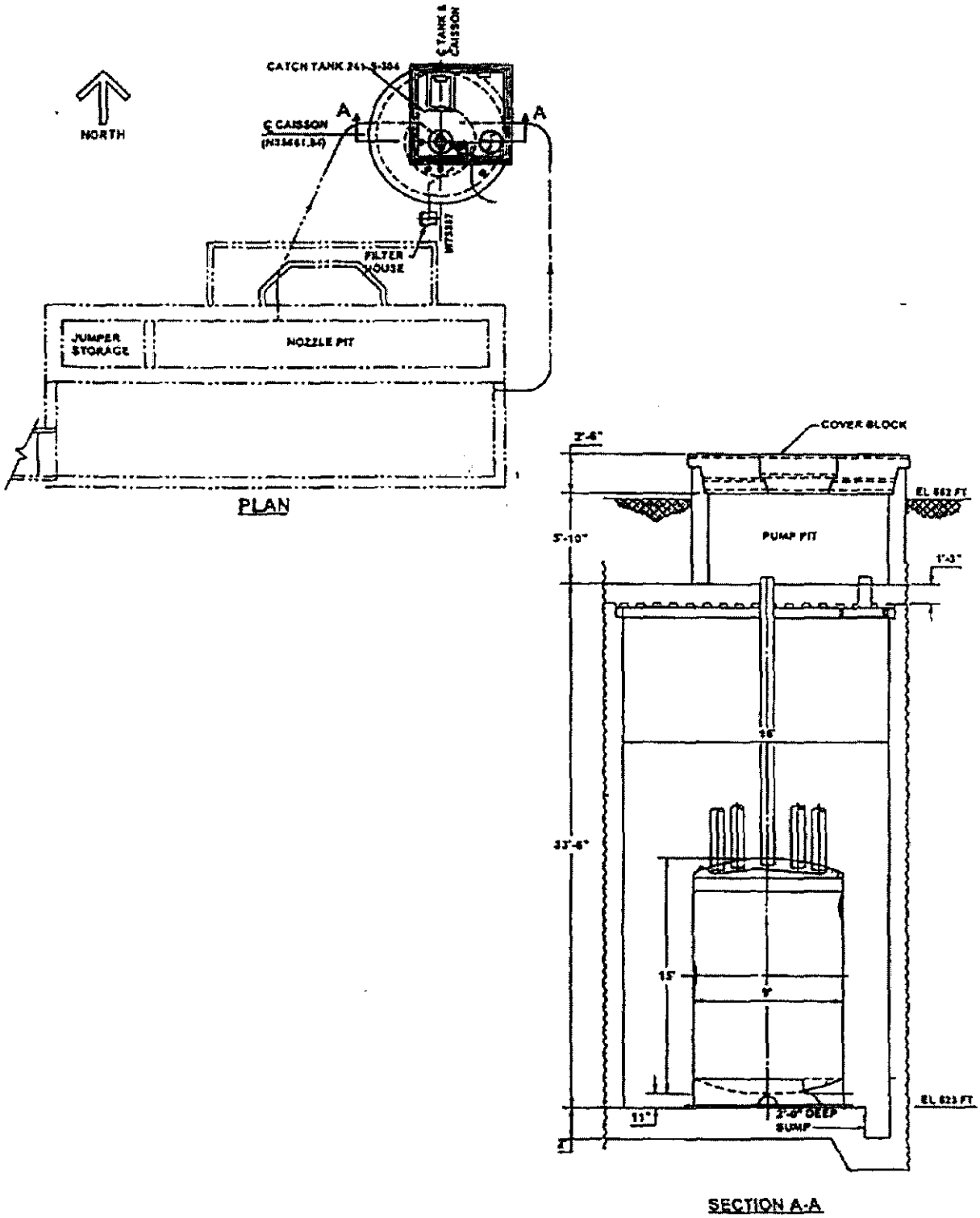

Figure A2. 241-S-304 Catch Tank

Table A1. Video Examination Data Sheet, 241-S-304 Pump Pit

Examination Date: June 16, 1999

Person In Charge: D. P. Niebuhr Camera Operator: Bert Wright Video Examiner: T. S. Hundal

Riser: Valve Handle Penetration

Video Tape Reviewer: E. B. Schwenk Date: 9/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Visual examination of the pump pit, for the 241-S-304 facility, was provided by a VITIS III video camera, that was entered through its valve handle penetration. The pump pit is approximately 11 ft square, and about 6 ft deep, below its reinforced concrete cover blocks.
					The following narrative and photographs demonstrate that the approximately nine-year old pump pit and its ancillary equipment, are in very satisfactory condition.
1052 AM		199	114		Figure A3 shows both some of the ancillary equipment as well as the intersection (joint) of the west wall and floor. All appear in very good condition. A leak detector unit is in the middle foreground. The floor is clean except for some minor stains, probably produced by prior rainwater/snowmelt ingress.
1054 AM		185	096		A view of the west wall, of the pit, its northwest corner, along with two vapor seal-covered nozzles are shown in Figure A4. The braided stainless steel hose, draped across the vapor-seals, may be part of a flush assembly, not presently in use.
1056 AM		174	141		A plan view of the top of the catch tank's submersible pump is shown in Figure A5. The pump discharge piping / PUREX (Plutonium Uranium Extraction [Facility]) fitting combination, exits to nozzle number 13 (not shown). One end of the stainless steel (SS) braided hose (not seen in Figure A4), and its ball valve is attached to the pump, as shown in Figure A5.
1057 AM		335	126		The southeast corner of the pit, along with the sump pump riser cover and PUREX fitting for nozzle number 13 are shown in Figure A6.
1059 AM		161	069		Figure A7 shows the very satisfactory condition of the pump pit roof and walls at its northeast corner.

Figure A3.
Leak Detector Unit (middle foreground), Waste Transfer Pump Lifting Lug (foreground), and West Wall (background), 241-S-304 Pump Pit

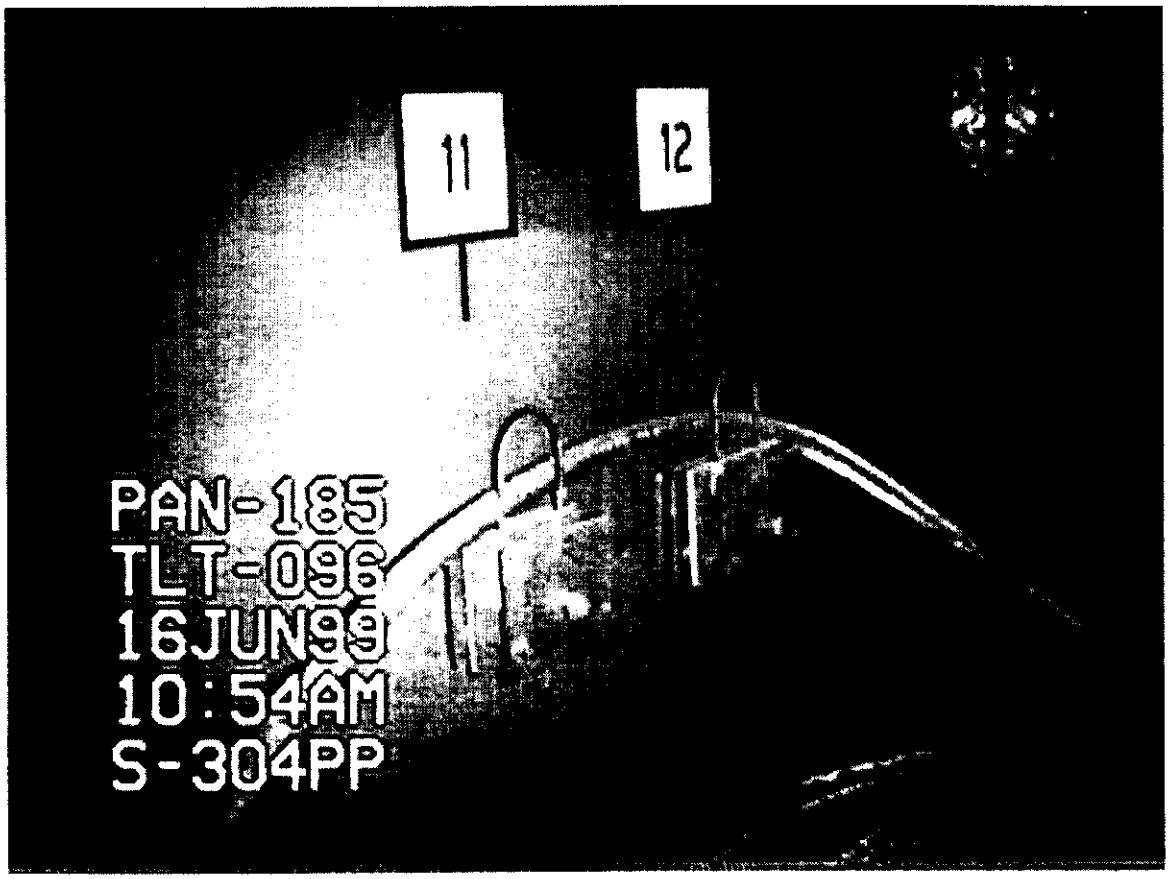

Figure A4.
Vapor Seals at Two Nozzle Openings, 11 and 12, West Wall,. Northwest Corner (right side), 241-S-304 Pump Pit

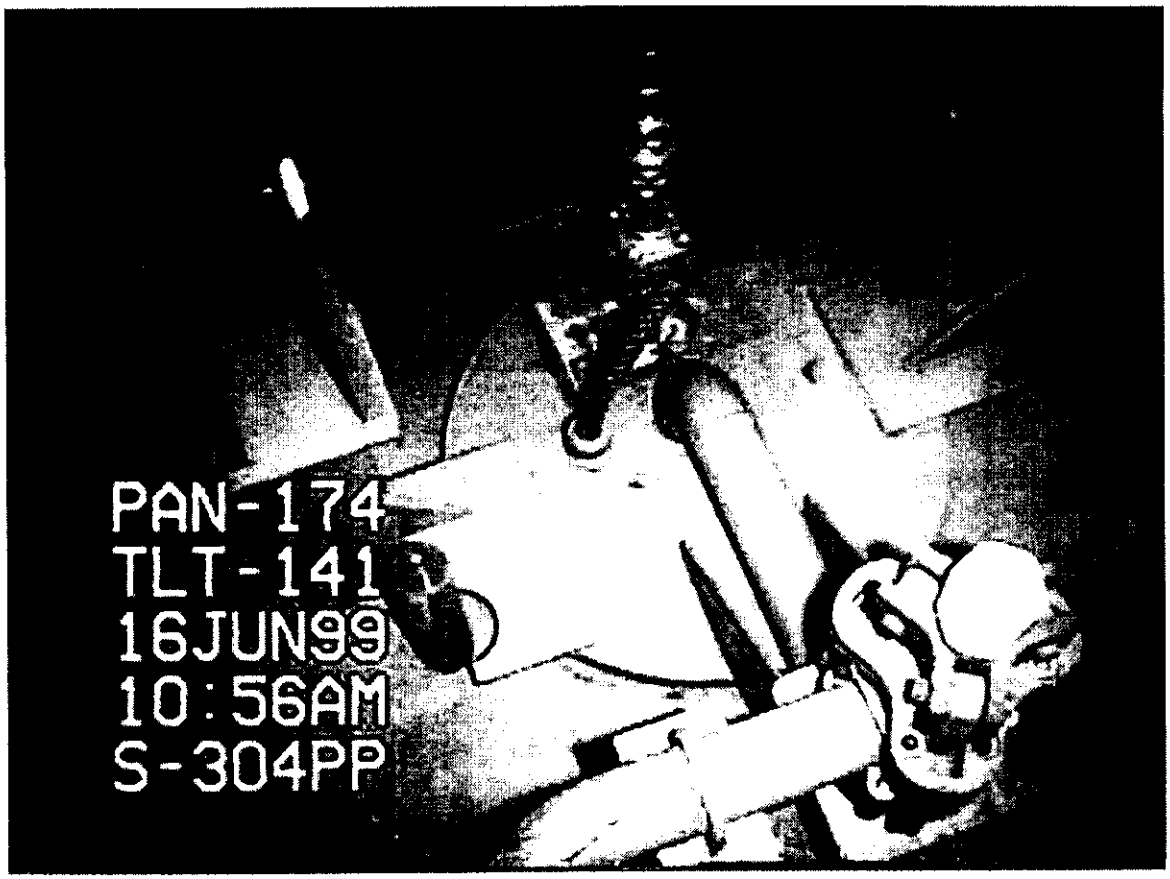

Figure A5.
Plan View, Top of Submersible Pump: PUREX Fitting (foreground), Two Stainless Steel Locator Pins (at 8 and 2 o'clock), One of Two Lifting Lugs (left), 241-S-304 Pump Pit

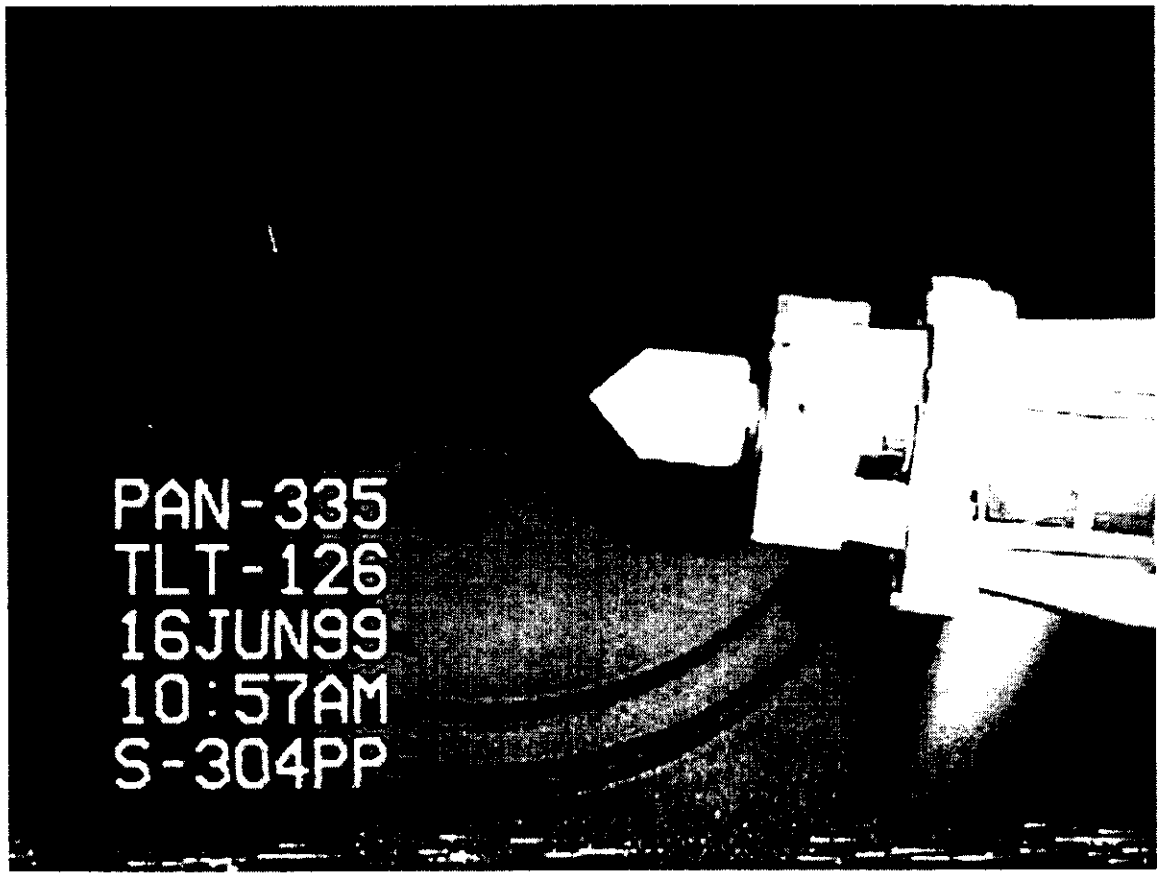

Figure A6.
View of Sump Pump Riser Cover, PUREX Nozzle No. 13 for Discharge Pump (foreground), Southeast Corner (upper right), 241-S-304 Pump Pit

Figure A7.
View of Pump Pit Roof and Walls at Northeast Corner, 241-S-304 Pump Pit

Table A2. Video Examination Data Sheet, 241-S-304 Catch Tank Annulus

Examination Date: 6/16/99

Person In Charge: D. P. Niebuhr Camera Operator: Jim Massen Video Examiner: T. S. Hundal

Riser # 9

Video Tape Reviewer: E. B. Schwenk Date: 9/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The 241-S-304 catch tank annulus is a vertical cylinder about 16 ft in diameter with an interior height of about 32 ft. A video camera (VITIS II) was entered through riser number 9.
					The following photographs and narrative reveal that the exterior walls, floor and roof of the annulus and the outside surface of the catch tank are in very satisfactory condition. Areas within the field of view of the camera were observed (walls, ceiling, tank exterior, visible tank welds tank foundation, and risers.)
1004 AM		287	158		Figure A8 presents a downward looking view of the catch tank exterior (left), the bottom foundation and triangular-shaped sump, and the coated sidewall of the annulus. All appear new and in very good condition.
1004 AM		286	174		A closer view of the sump is presented in Figure A9. An apparent electrical attachment is shown in the bottom of the sump.
1010 AM		175	178		A close-up view of the electrical connection is presented in Figure A10.
1012 AM		198	117		Figure A11 is a side view of the opposite end of the sump. Some minor in-leakage (probably rainwater or snowmelt) staining can be seen. The coating appears bright and intact.
1014 AM		089	093		A typical tank hold-down bolt (foreground) and additional evidence of some minor rainwater/snowmelt in-leakage can be seen on the sidewall and the bottom of the annulus, in Figure A12.

Table A2. Video Examination Data Sheet, 241-S-304 Catch Tank Annulus (continued)					
1014 AM		065	090		Figure A13 is a close-up view of the annulus sidewall/floor at the site of probable rainwater/snowmelt ingress, as shown in Figure A12.
1001 AM		151	033		The top of the reinforced concrete annulus and a portion of the corrugated steel roof of the annulus can be seen in Figure A14. Again, some evidence of minor in-leakage is seen near the pipe-wall penetration.
947 AM		000	144		An overall view of the top of the catch tank and risers is presented in Figure A15. The central pipe riser contains the waste transfer pump assembly.
1006 AM		199	122		Figure A16 is a close-up view of the weldment intersection of the tank and the central pump riser. The minor stains are likely the result of rainwater/snowmelt ingress.
1017 AM		163	077		The sidewall of the catch tank, several feet above the annulus floor, is shown in Figure A17. The bottom girth weldment attaches the bolted-down support skirt to the tank. The other girth weldment is the tank bottom weldment.
1026 AM		114	057		Intersection of one of the tank's vertical and girth weldments is shown in Figure A18. The apparently mechanically-ground region may have been done for an ultrasonic examination of the weldment, prior to coating the tank.
1031 AM		034	077		Another tank vertical weld, along with a circular patch weld is shown in Figure A19. The circular weld probably represents a normal structural modification made in adapting of the already-made Welk Brothers tank to Hanford catch tank requirements.
1036 AM		142	056		Figure A20 shows the tank top girth weldment intersection with an axial weldment. All appear in very satisfactory condition.

Figure A8.
View of Tank Exterior (left), Bottom and Sump, and Coated Sidewall, 241-S-304 Annulus

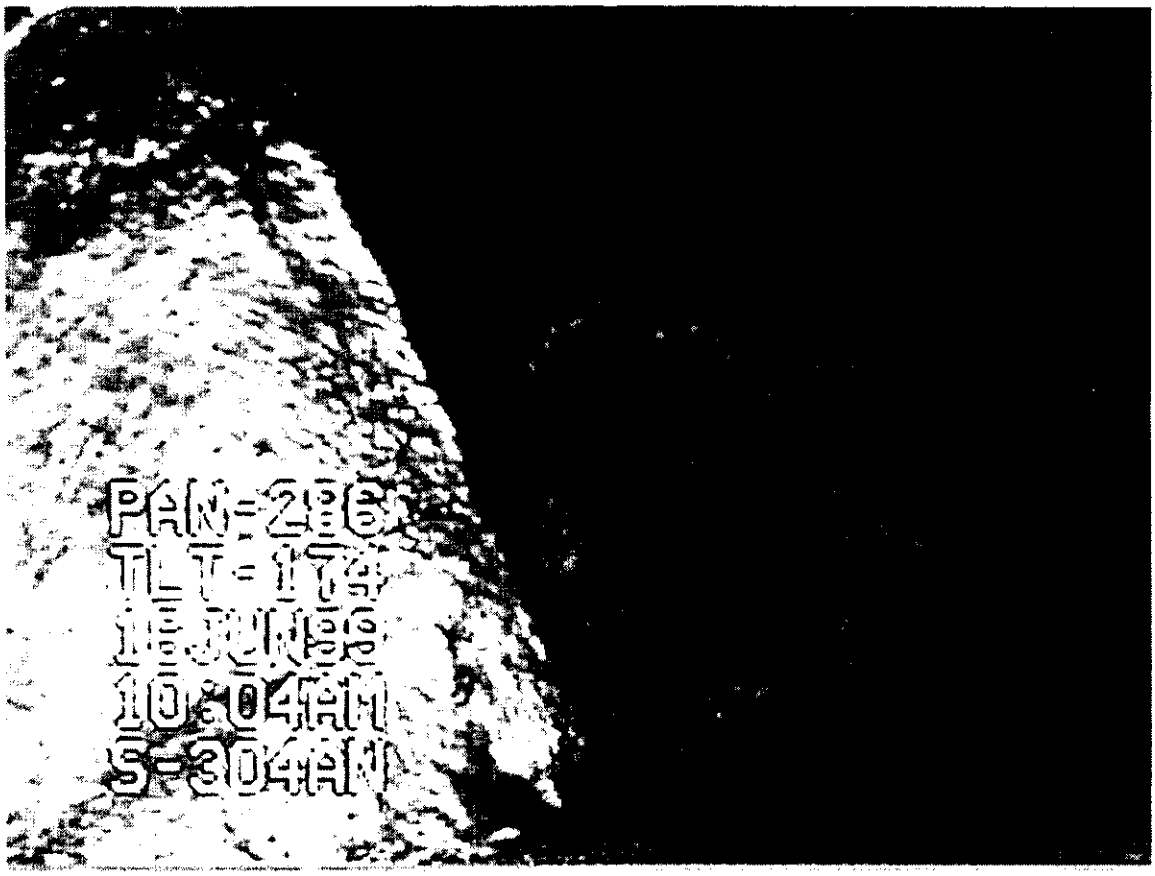

Figure A9.
Closer View of Either an Electrical Ground or Part of a Cathodic Protection System, 241-S-304 Annulus

Figure A10.
Close-up View of Electrical Connection in Bottom of Sump, 241-S-304 Annulus

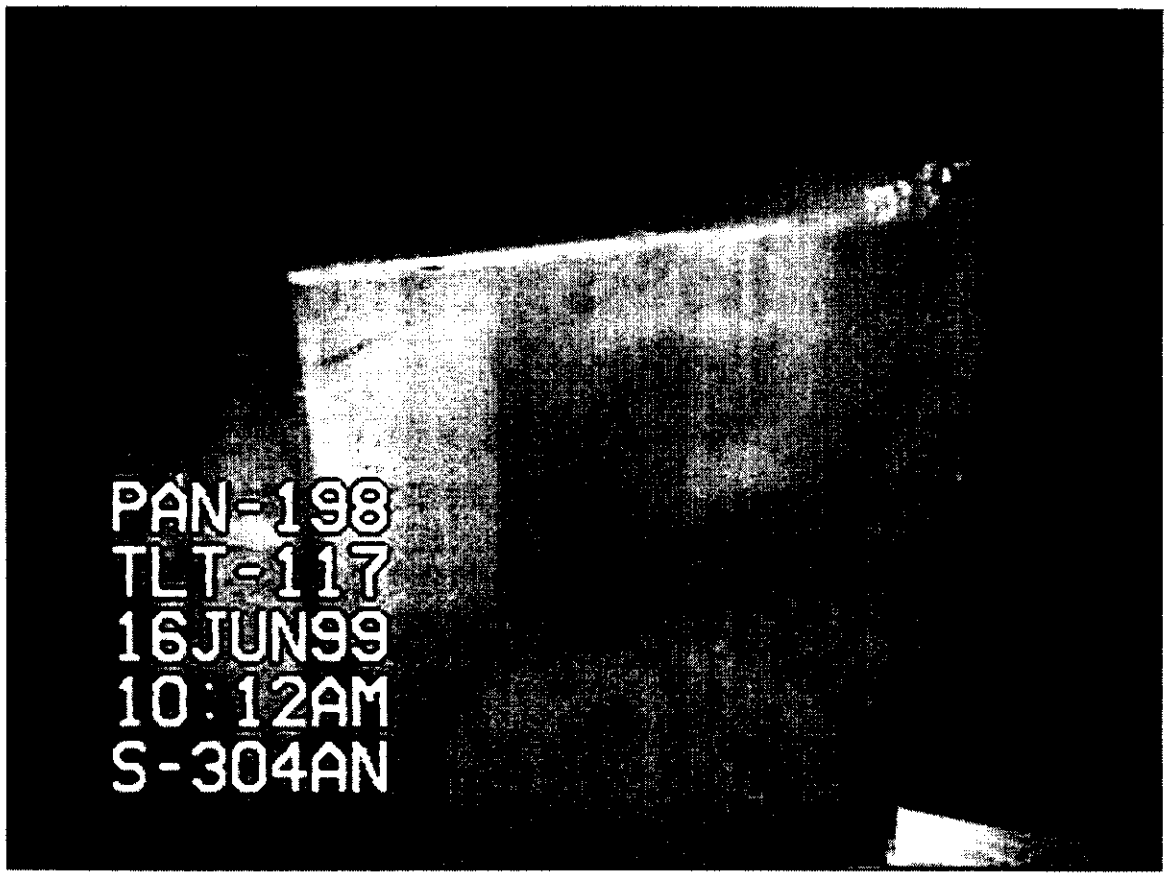

Figure A11.
Sideview of Opposite End of Sump, 241-S-304 Annulus

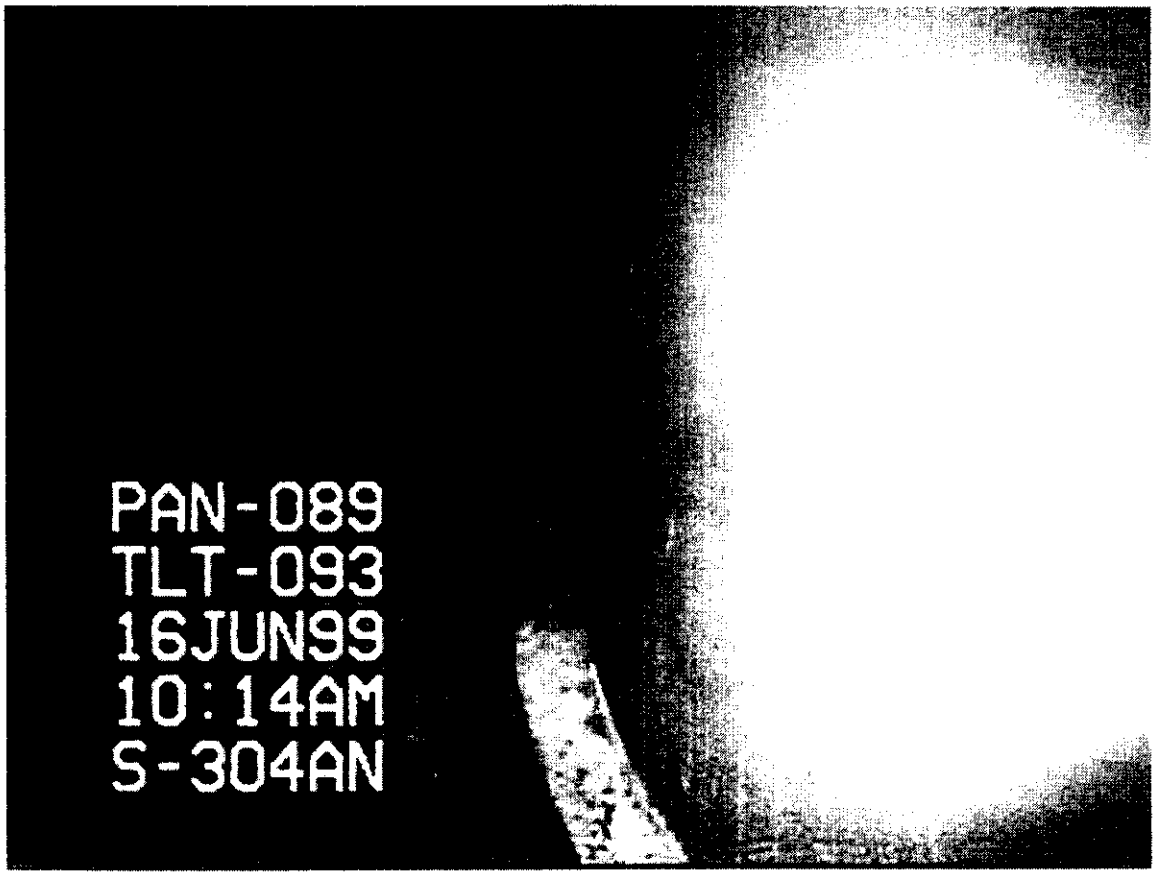

Figure A12.
Typical Tank Hold-Down Bolt (foreground) and Evidence of Probable Past Rainwater/Snowmelt Ingress (background)

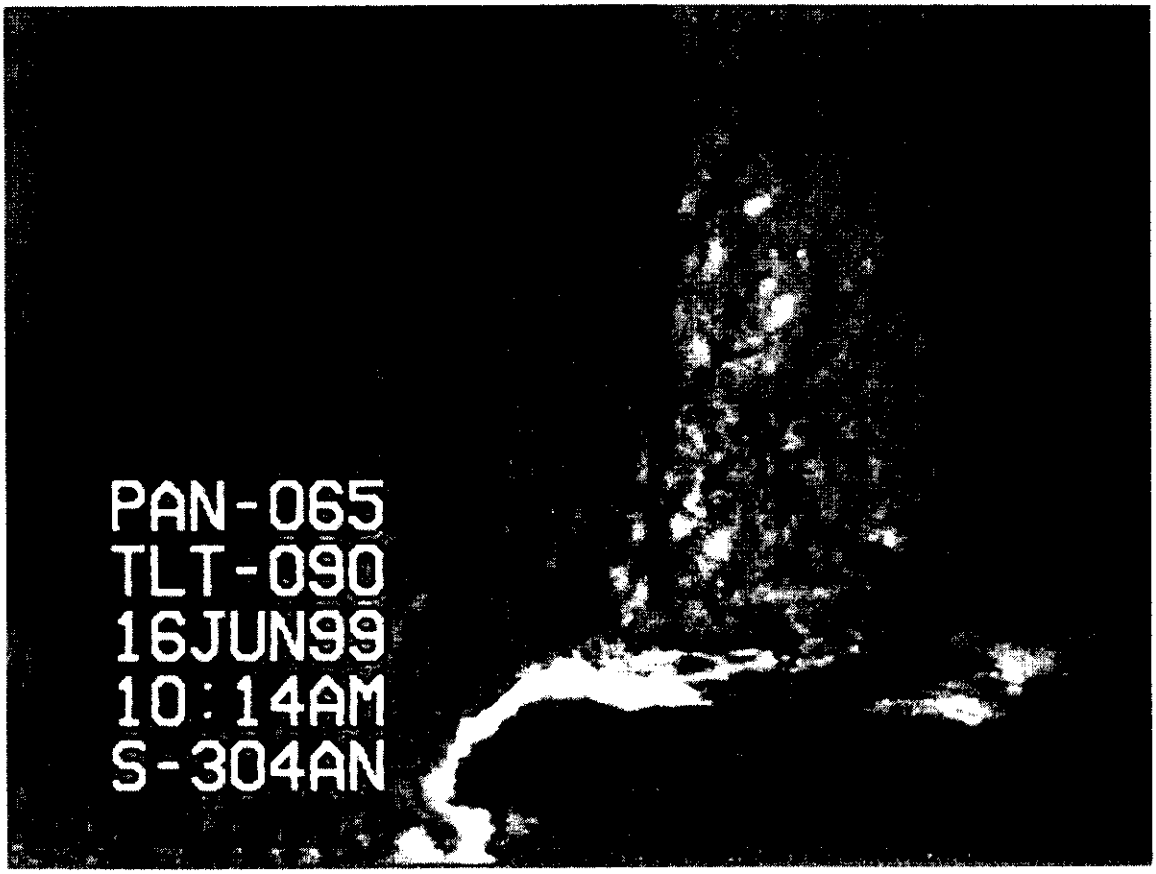

Figure A13.
Close-up View of Annulus Sidewall and Floor, at Site of Probable Rainwater/Snowmelt Ingress, 241-S-304 Annulus

Figure A14.
Sidewall of Reinforced Concrete Annulus and Corrugated Steel Ceiling, 241-S-304 Annulus

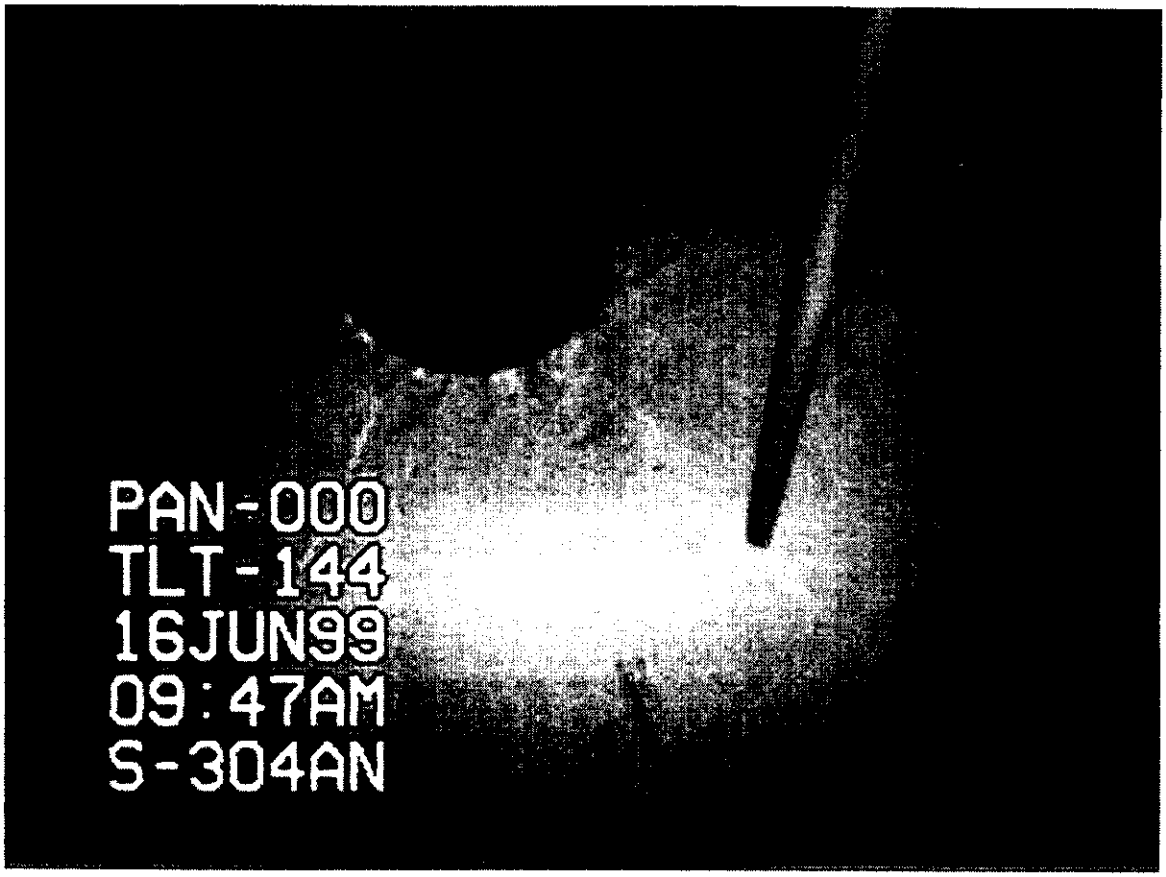

Figure A15.
Top of Catch Tank Showing Central and Outer Risers, 241-S-304 Annulus

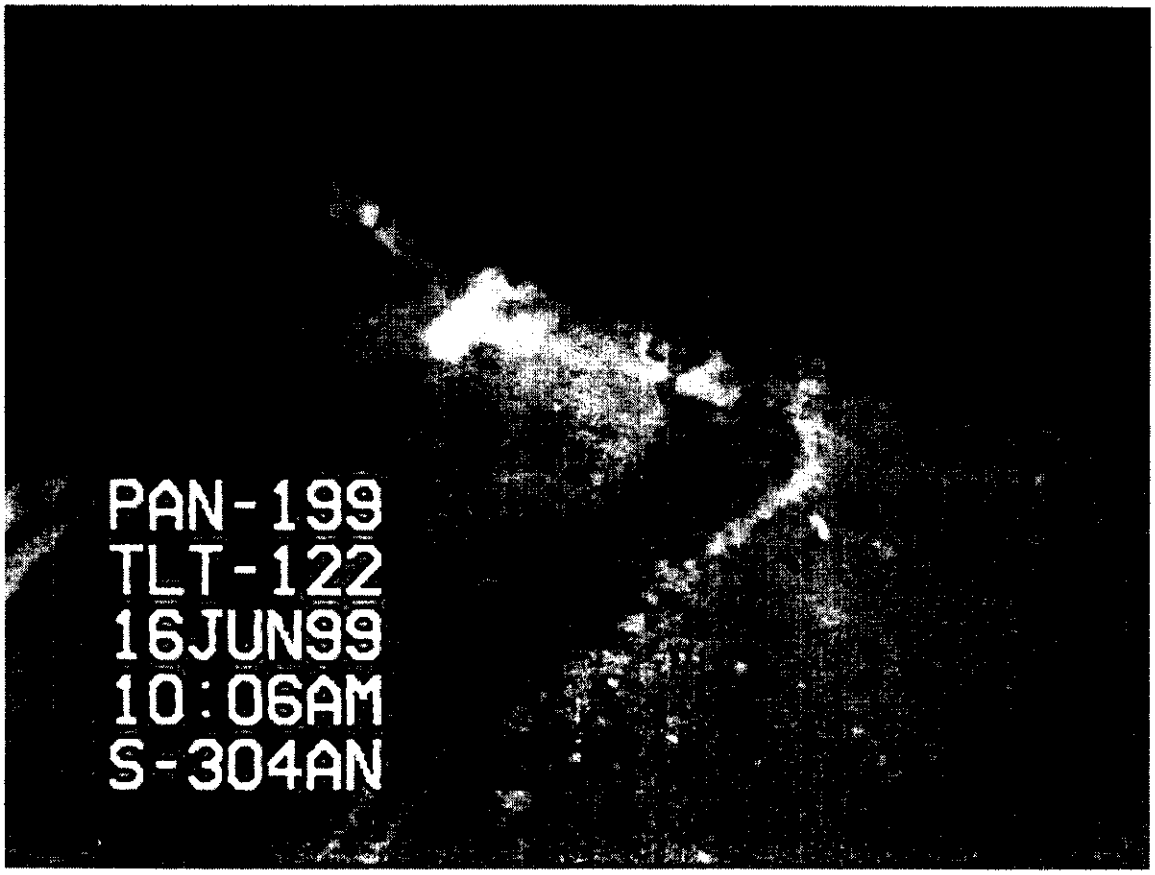

Figure A16.
Close-up of Weld Between Central Pump Riser and Tank Top, 241-S-304 Annulus

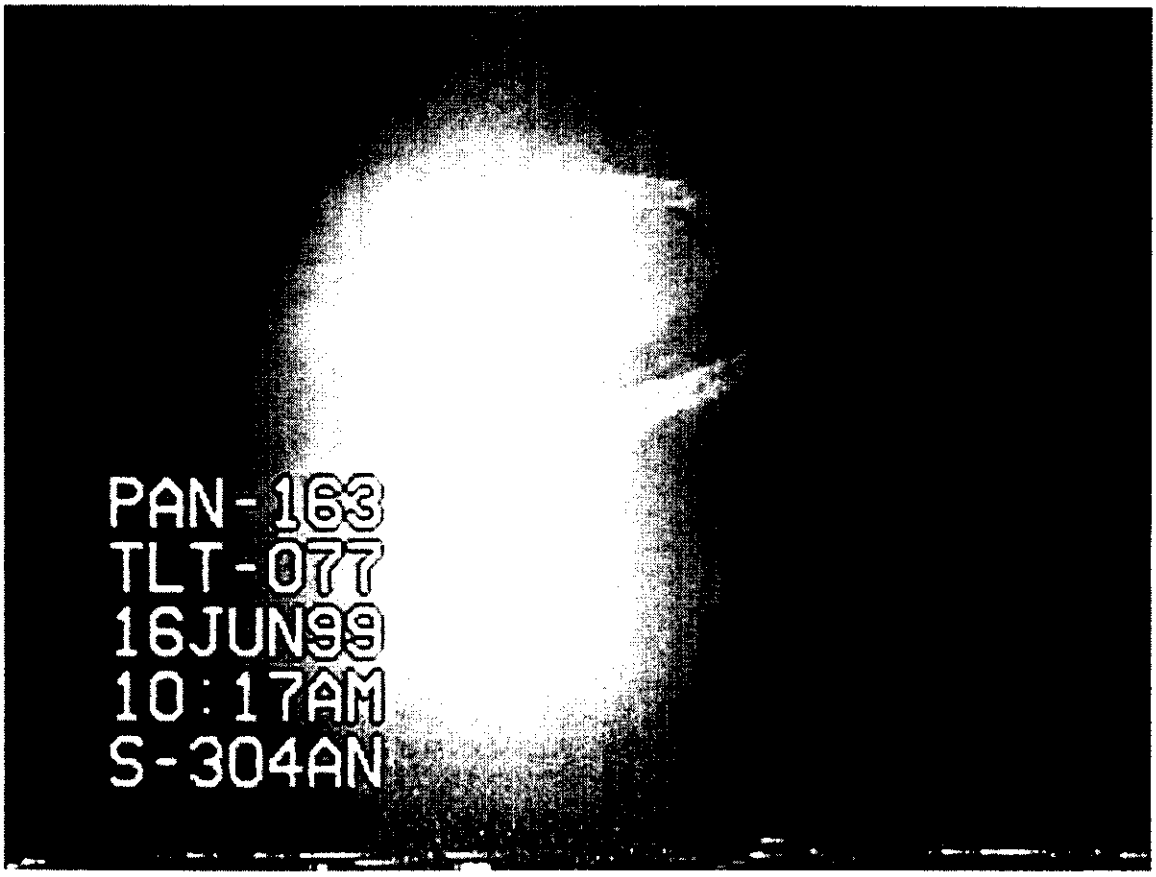

Figure A17.
Sidewall of Catch Tank About Several Feet Above Floor. Bottom Girth Weldment Connects Support Skirt to Tank; Upper Weldment is a Bottom Tank Girth Weldment, 241-S-304 Annulus

Figure A18.
View of Near-Central Horizontal Double-Weldment Intersecting a Vertical Weldment: Note Mechanically Ground Region at Intersection, 241-S-304 Annulus

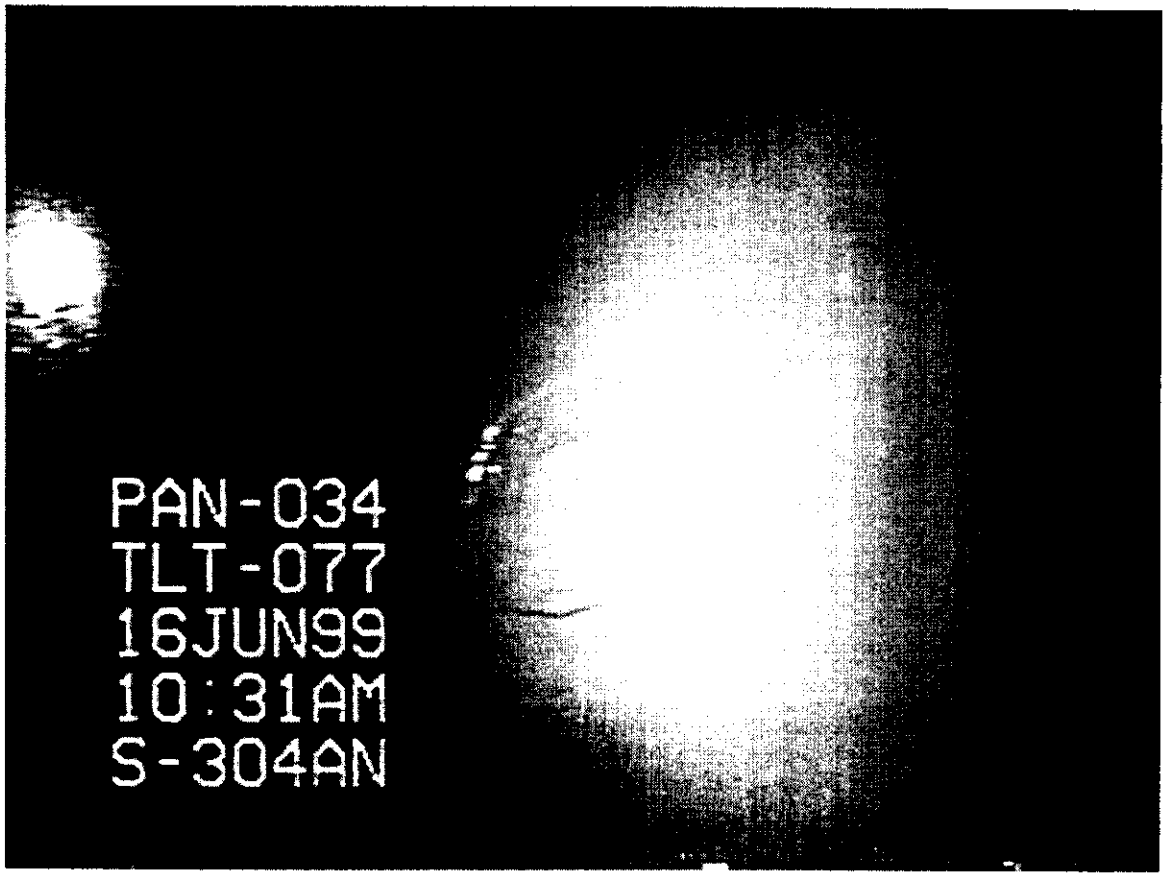

Figure A19.
View of Circular Patch Weld and Double Vertical Weld, 241-S-304 Annulus

Figure A20.
Catch Tank Top Girth Weldment Intersecting with Axial Weldment, 241-S-304 Annulus

Table A3. Video Examination Data Sheet, Catch Tank 241-S-304

Examination Date: 4/22/99

Person In Charge: D.P. Niebuhr Camera Operator: Jim Massen Video Examiner: T.S. Hundal

Riser Number: 4

Video Tape Reviewer: E. B. Schwenk Date: 9/00

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The 241-S-304 Catch Tank was entered through its riser number 4. It is located south and east of the tank center and is less than 1 ft from its cylindrical shell. The VITIS II video camera was used for examining the tank interior. S-304 is about 9 ft in diameter and approximately 15 ft high.
					The following photographs and narrative demonstrate that this youngest catch tank (fabricated in 1981 and in use since about 1992), and its associated internal equipment, appear to be in very satisfactory condition. PCSACS level records indicate that the maximum fluid height was slightly over 5 ft Observation of the tank interior showed a number of very light waterlines above 5 ft These are believed to have been associated with discontinuous filling for the initial hydrotest. Further, the tank interior appears to have been coated with an Amercoat-type of coating, and is discussed below.
1123 AM		163	125		A northerly view, of the tank bottom, sidewall, and waste transfer pump assembly, is shown in Figure A21. Commensurate with the PCSACS level records, the waste height is low (several inches). Light staining of the tan coating and one broad-band, circumferential water mark are also seen.
1113 AM		177	142		Figure A22 provides a closer view of the relative cleanliness of the flange connection, braided hose, and electrical lead for the pump.

Table A3. Video Examination Data Sheet, Catch Tank 241-S-304 (Continued)

1113 AM		177	148		A close-up view of the pump enclosure is seen in Figure A23. The rubber-wired electrical lead entrance is in the upper right and the pump exit hose in the upper left. The enclosure appears to be made of stainless steel.
1119 AM		257	056		Figure A24 provides a view of a plastic pipe riser inlet pipe, and a major vertical weldment in the wall of the tank.
1131 AM		166	106		The "high" watermark band, shown in Figure A25, appears to show some chemical attack of the coating. The topmost region appears to be lightly corroded base metal. The sideways '4' may have been a construction chalk or paint mark.
1140 AM		261	129		Figure A26 shows the intersection of a nominally degraded coating (in the water-mark band), along with a major tank vertical weldment. A minor amount of corrosion can be seen around the weldment.
1151 AM		278	142		Some locally heavy peeling of the tank inner coating can be seen in Figure A27. This peeling is located in the water-mark band noted above.
1205 PM		176	180		Figure A28 is a near-tangential view of the coating peel-off from the waste water-mark band and on down toward the bottom of the tank.
1201 PM		208	049		Figure A29 shows what appears to be riser number 6 and a distinct waterline near the top of the tank. Additional faint waterlines were seen above the waste high-water mark. These are believed to result from discontinuous filling of the tank, with water, during its acceptance hydrotest.

Figure A21.
Overall View of Tank Bottom, Sidewall and Waste Transfer Pump Assembly, 241-S-304 Catch Tank

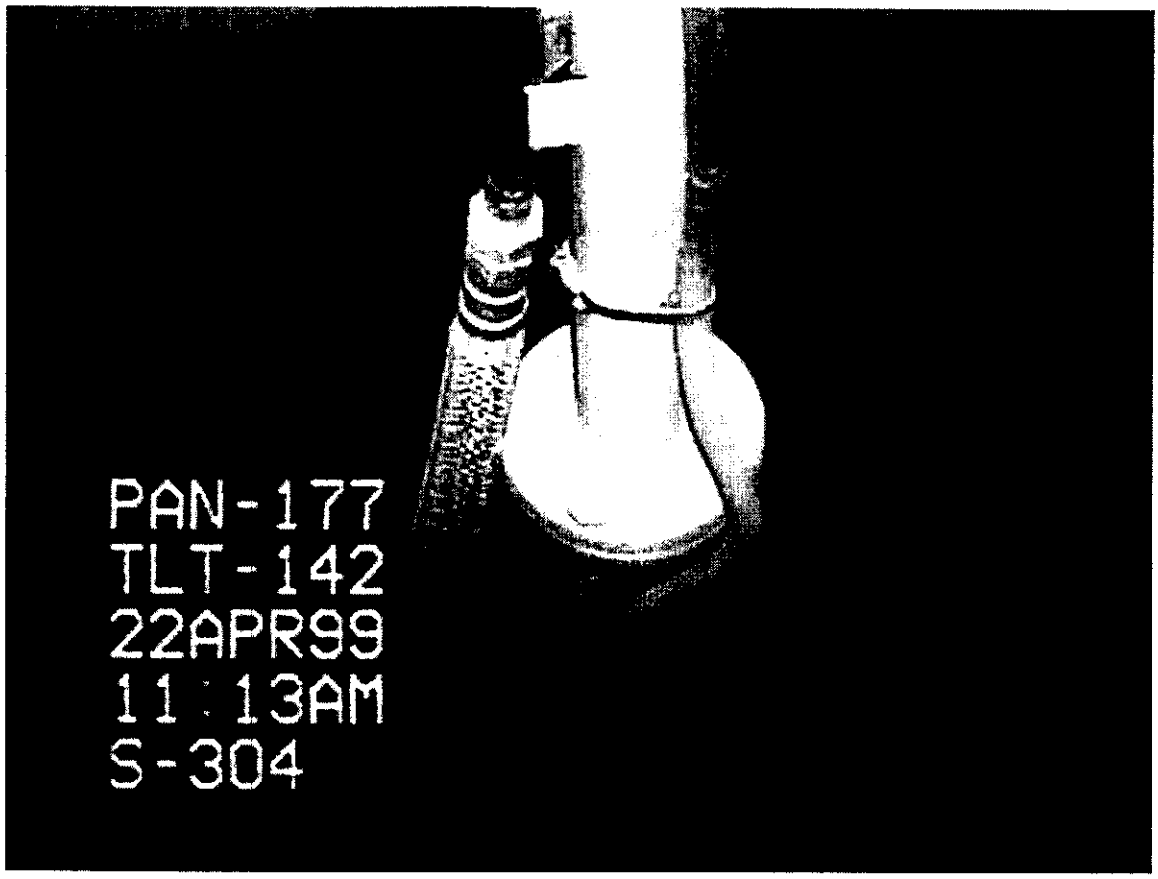

Figure A22.
Closer View of Pump Flange Connection, Braided Hose, and Electrical Lead, 241-S-304

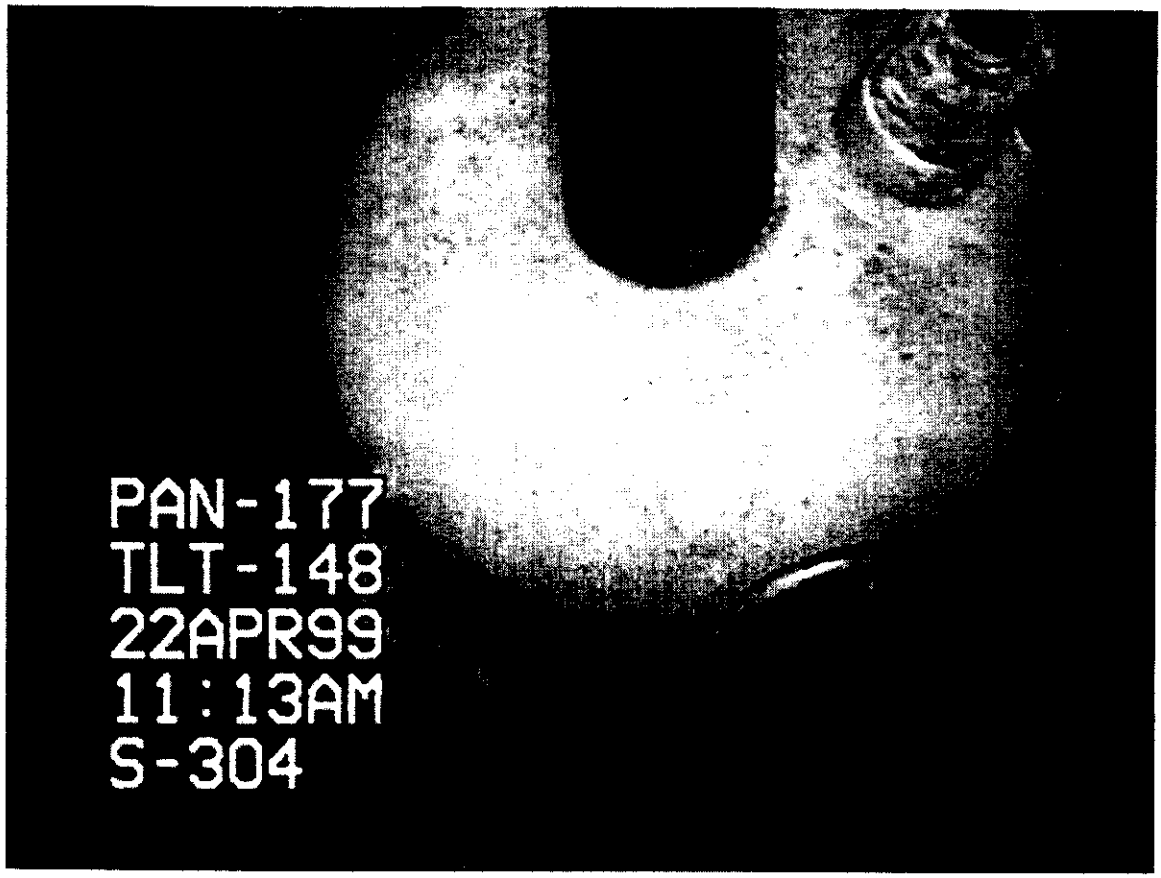

Figure A23.
Close-Up View of Waste Transfer Pump Enclosure, 241-S-304 Catch Tank

Figure A24.
Vertical Weldment in Tank Wall and Plastic Pipe Riser Inlet, 241-S-304 Catch Tank

Figure A25.
View of Top Waste Watermark Band and Peeling Coating with Apparent "4" Chalk Mark, 241-S-304 Catch Tank

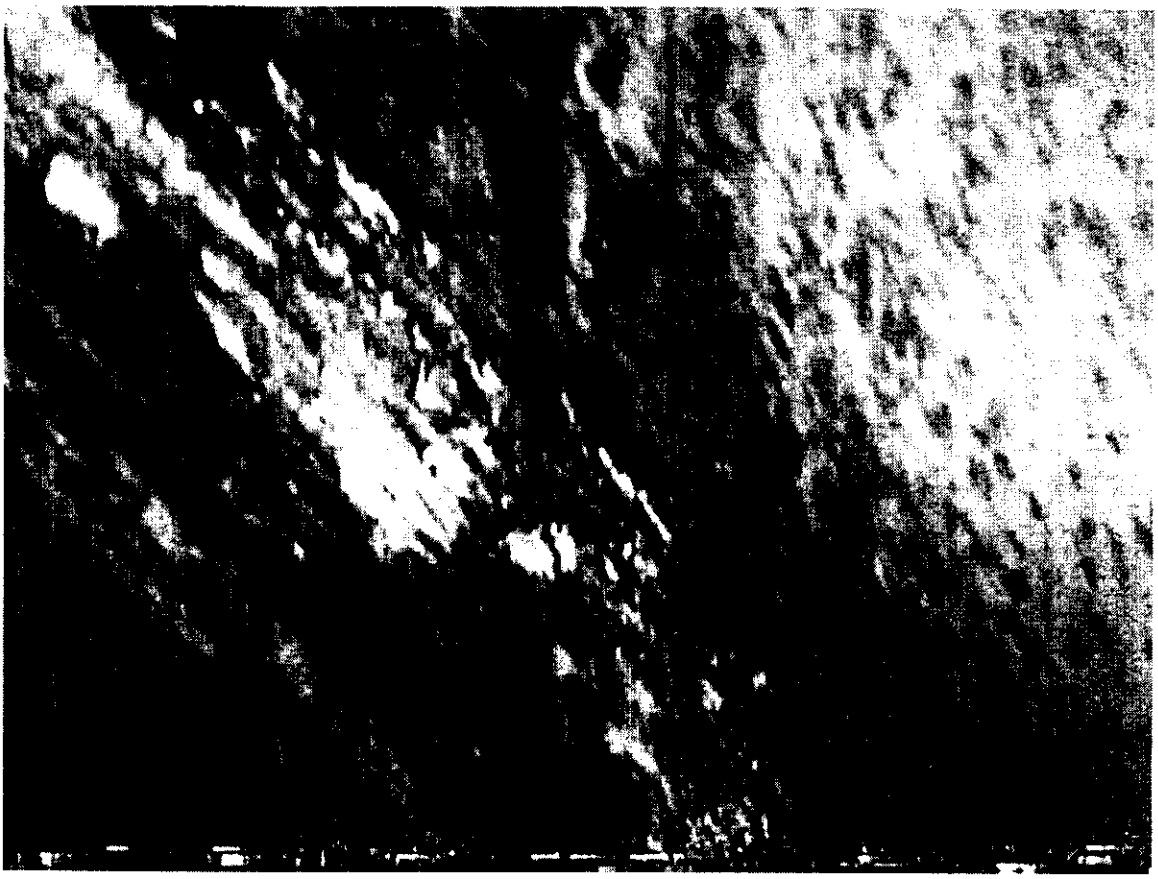

Figure A26.
Intersection of Watermark Band Degradation in Coating and Minor Corrosion in Vertical Weldment, 241-S-304 Catch Tank

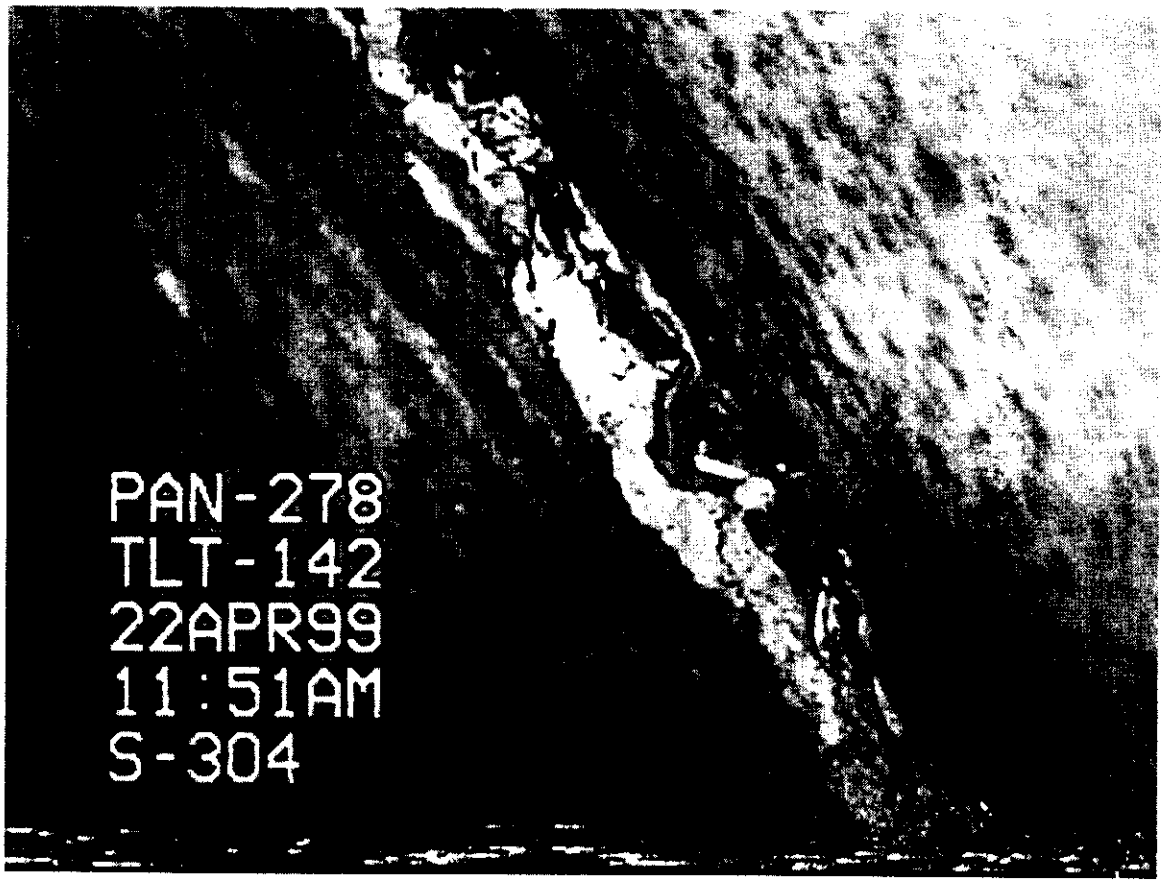

Figure A27.
Locally Heavy Peeling of Catch Tank Inner Coating at Waste Watermark Band, 241-S-304 Catch Tank

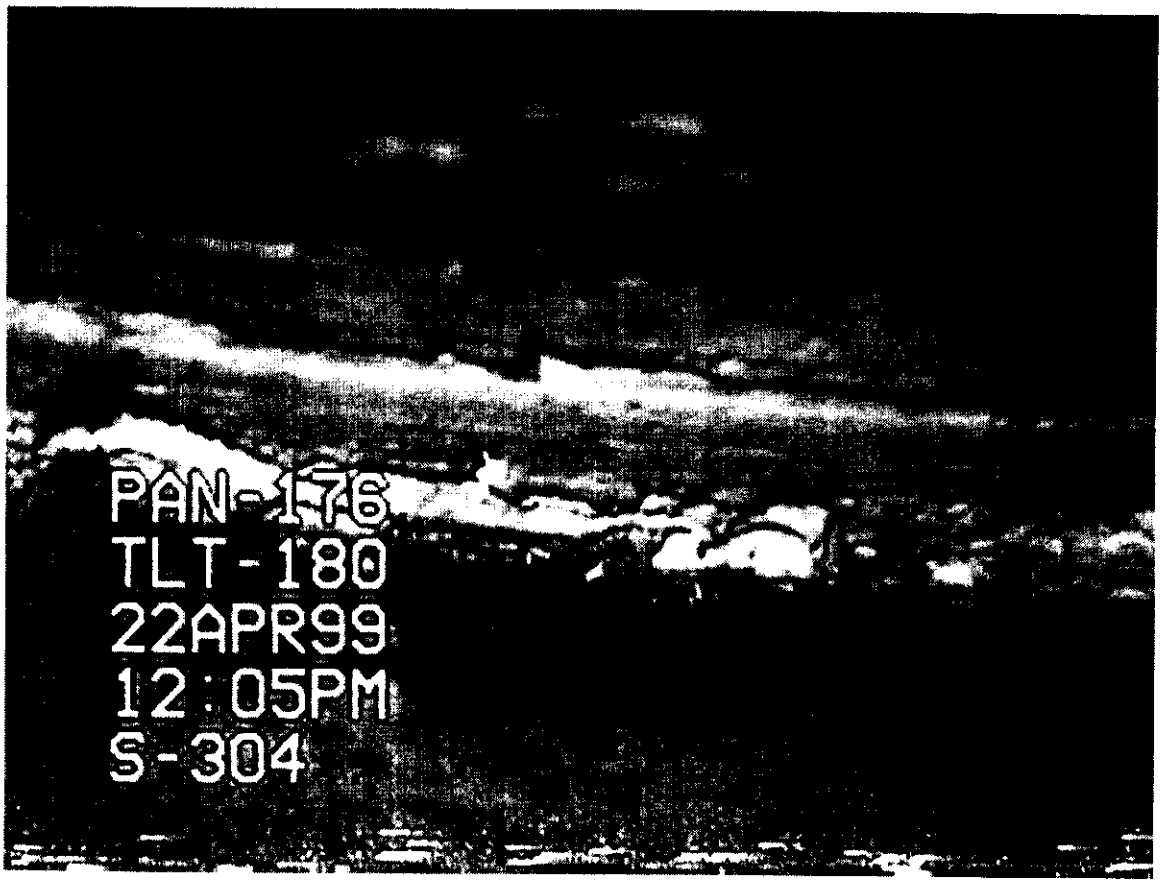

Figure A28.
Tangential View of Coating Peel-off from Waste Watermark Band Looking Toward Bottom of Tank, 241-S-304 Catch Tank

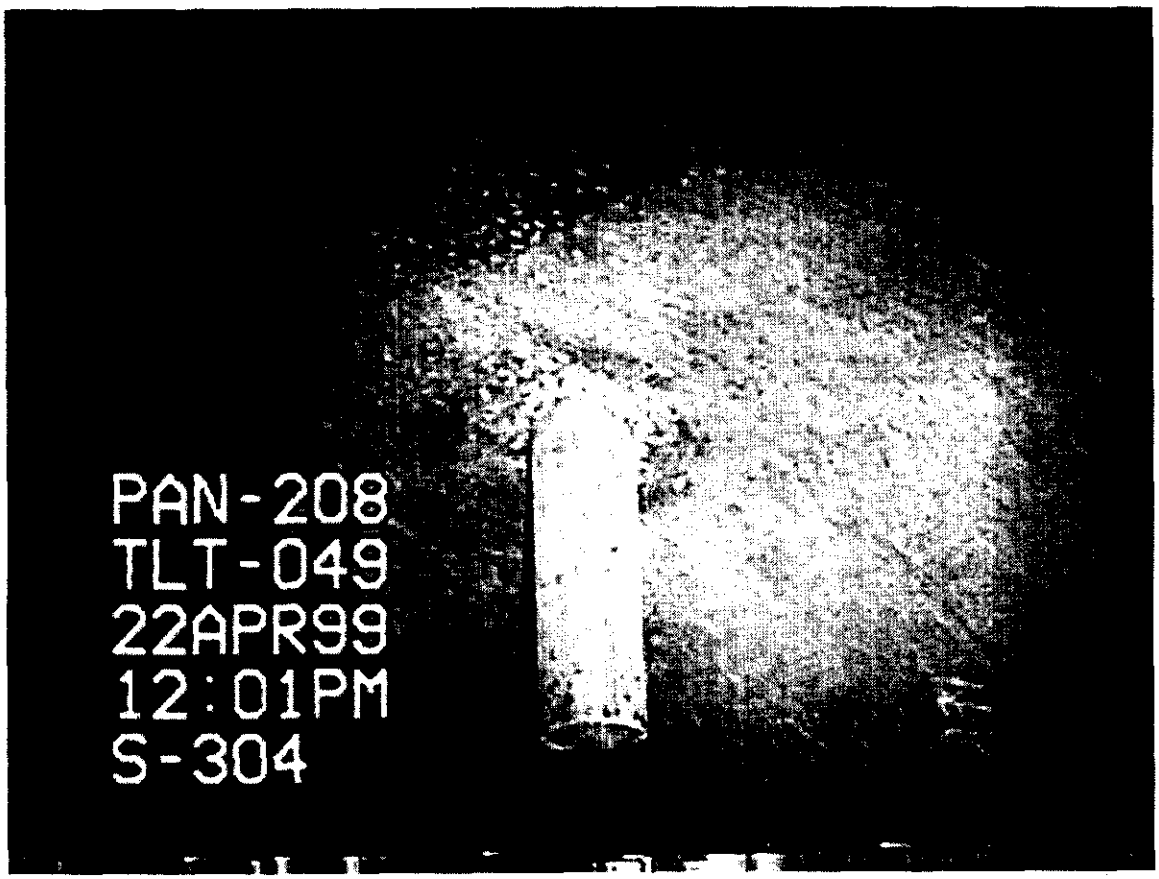

Figure A29.
Near Top of Tank, Riser Inlet and Possible Hydrotest Waterline (upper left), 241-S-304 Catch Tank

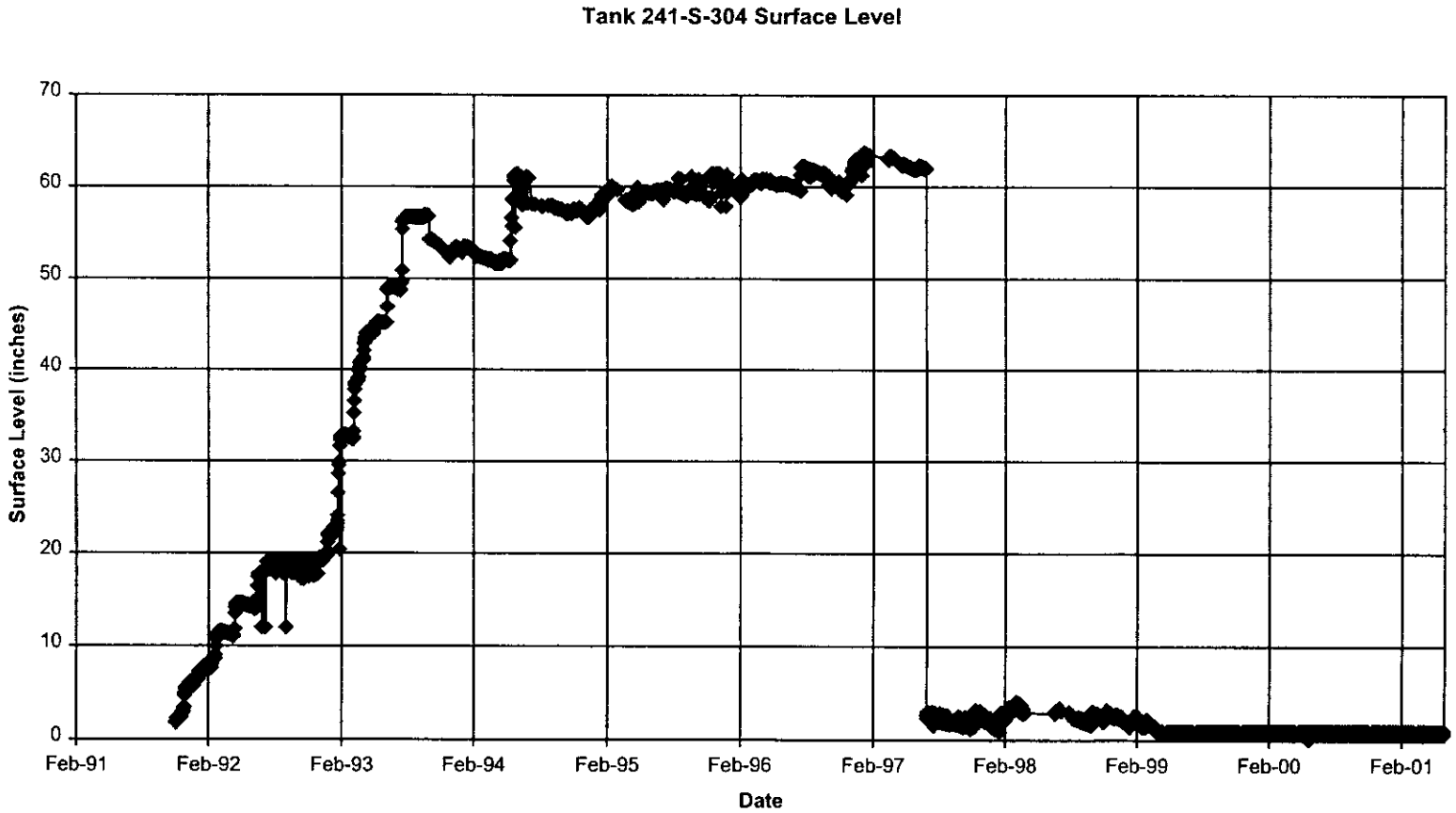

Figure A30. Surface Level versus Time, 1991 to 2001, S-304 Catch Tank (see also referenced Figure A31)

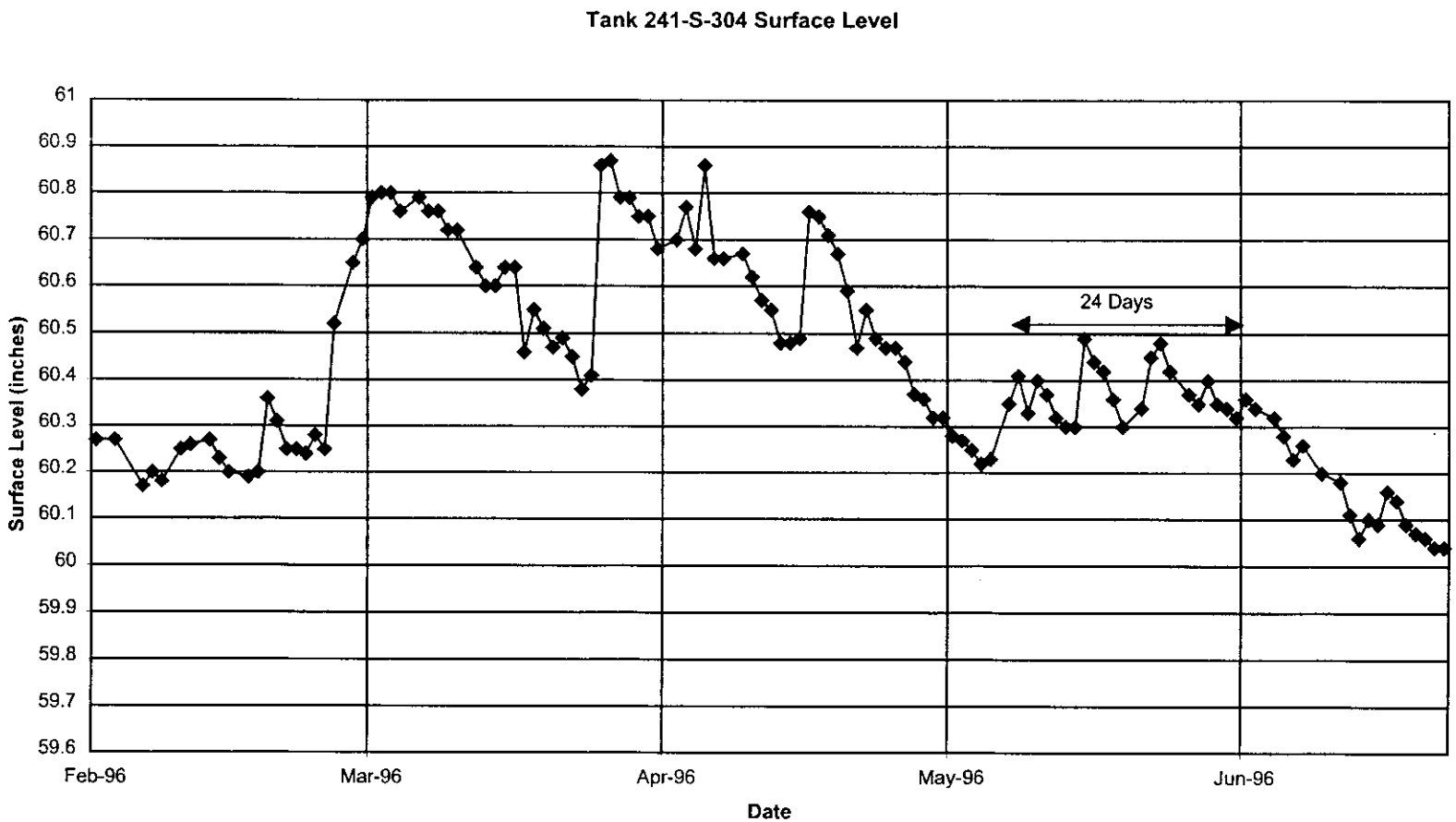

Figure A31. Near-constant Waste Level over a Period of About 24 Days (5/14/96 to 6/8/96), S-304 Catch Tank

APPENDIX B

241-U-301B CATCH TANK

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LIST OF TERMS

ACI	American Concrete Institute
CHG	CH2M HILL Hanford Group, Inc.
CVI	Certified Vendor Information (file)
DCRT	double-contained receiver tank
DOE	U.S. Department of Energy
Ecology	Washington State Department of Ecology
ENRAF	Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge)
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System
HLAN	Hanford Local Area Network
HLW	high level waste
LFL	lower flammability limit
NGC	Nationwide Gunite Corporation
PCSACS	Personal Computer Surveillance Analysis Computer System
PFP	Plutonium Finishing Plant
RHA	Records Holding Area
RMIS	Records Management Information System
SST	single-shell tank
TRU	transuranic
U-301B	241-U-301B catch tank
VITIS	Video In-Tank Inspection System
WAC	Washington Administration Code
WHC	Westhinghouse Hanford Company

1.0 INTRODUCTION

The 241-U-301B catch tank (U-301B) is located in the 200 West Area of the Hanford Site (Figure B1). The catch tank was designed and installed to be used as the secondary containment to diversion boxes.

The examinations and design evaluation of the facility presented here provide information for assessing the integrity of the system.

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the U-301B components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the U-301B pump pit and catch tank. The scope of examinations include a visual examination of the U-301B catch tank internal surface, its pump pit, and a leak check of the tank.

4.0 DESCRIPTION

The 241-U-301B catch tank is a direct-buried underground tank. The pump pit sits above the northern perimeter of the tank, but at ground level. The tank was installed in 1944, and it was modified in 1984 under Project B-231 primarily by addition of the pump pit and an underground pump-out capability (Vitro 1980). The location of the facility on the Hanford site is shown in Figure B1 and a sketch of the facility is shown in Figure B2.

4.1 PUMP PIT

The pump pit is a 5-ft inside diameter galvanized corrugated metal pipe, which is 4-ft 6-in. deep. A 12-in.-diameter schedule 40 riser, made of carbon steel pipe, descends approximately 8 ft from the bottom of the pump pit to the tank. If any leaks were to occur within the pump pit, the pit is designed so that leaks would drain to the catch tank below. A round steel plate provides a cover to the pump pit and is resistant to rain and snowmelt intrusion. Addition of the pump pit occurred in 1984 under Project B-231 (Vitro 1980).

4.2 CATCH TANK

The tank is a vertically oriented, reinforced pre-stressed concrete cylindrical vessel. It has a domed height of 19 ft, a maximum fill level of 15 ft, with an inside diameter of 20 ft, and an average wall thickness of 5 in. Internally, the waste-exposed surface is made of 3/4-in. thick Gunite™, essentially a cement-sand mixture that was coated in-place, during construction.

Two groups of two 4-in. and two 12-in.-diameter pipe risers enter the tank at north-south antipodal positions, each about 1-1/2 ft (average) from the tank's sidewall. The pump pit sits over four risers in the northern group; all are capped except for the one 12-in.-diameter pipe that is used for the submersible pump. Three of the four southern groups of risers remain accessible.

This tank is used to collect drainage from 241-U-151, and 241-U-152, diversion boxes. These are secondary containment functions. The diversion boxes support transfers from the 244-TX double-contained receiver tank (DCRT), which will be needed through at least 2006 (Mattichak 1997).

5.0 DESIGN EVALUATION

The design standards for the 241-U-301B catch tank and pump pit, the waste characteristics and compatibility for past and future transfers, corrosion protection, and the age of the system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide the design requirements and other factors used in evaluating the integrity of U-301B. A thorough search was conducted to identify the available design

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requirements and design and fabrication documents of the tank. Listed below are the resources searched for tank information are listed below:

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at the Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network) [HLAN])
- Hanford Data Control System (HDCS) database
- associated project files packed in boxes at the Record Holding Area (RHA)
- PROCINFO software on HLAN
- interviews with the Tank Farm Engineering personnel.

5.1.1 Tank

U-301B was installed in 1944. The original records of construction, construction specifications and testing were not found. However, some design information was found on the original construction drawings.

The tank was made of reinforced concrete in accordance with the specification for pre-stressed concrete tanks on or underground (Portland Cement Association Bulletin ST-58 [Drawing W-72903]).

The concrete was required to have a 2500 psi compressive strength at 28 days and a design allowable compressive stress of 900 psi (CVI file 9536).

The Gunite was required to have a 5000 psi compressive strength at 28 days and a design allowable compressive stress of 1200 psi (CVI file 9536).

The preloaded bars were required to have 60,000 psi minimum yield point and were pre-stressed to 45,000 psi (CVI File 9536). The reinforcing steel was required to have an allowable tensile stress of 20,000 psi (CVI file 9536).

The inside of the tank was coated with Gunite in accordance with Portland Cement Association Bulletin ST-17 (Drawing W-72903).

The tank was designed to contain liquid contents with specific gravity of 1.2 (Drawing W-72903).

The tank was designed for 6 feet of soil overburden with 100 pounds per cubic foot fill density and a bearing value of soil of 8,000 pounds per square foot (Drawing W-72903).

5.1.2 Pump Pit

The pump pit and associated piping installed in U-301B under Project B-231 were built and tested in accordance with construction specification B-231-C1 (Vitro 1980).

The pump pit has a 6-in.-thick concrete floor that connects to the 5-ft-inside-diameter galvanized corrugated metal pipe according to Federal Specification WW-P-405A, Class 1 Series B, 14 Gage. The pit contains a 3-in. floor drain to route any spilled liquid to U-301B below. The pump pit is provided with a steel cover, which is resistant to rain and snowmelt intrusion.

A structural assessment report (Westinghouse Hanford Company [WHC] 1996) of numerous facilities subjected to various accident loading conditions was performed for the safety analysis reporting. This assessment determined that U-301B tank could fail because of: 1) internal transient pressure caused by hydrogen deflagration, and 2) high sludge temperature of 600 degrees F.

Review of this document (WHC 1996) indicates that the analysis methods used were crude and simple with very conservative assumptions and unrealistic loadings, which are also mitigated by design and administrative controls, therefore failure resulting from the two loading conditions noted above should not be of concern. The facility has been in operation for 57 years without any incident and the recent internal examinations discussed in Section 6.0, reveals that the tank is in good condition.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

In this section, past waste transfers are described and the issues concerning future waste transfers to U-301B are discussed.

5.2.1 Past Waste Transfers

Historically, catch tank U-301B accepted spilled waste from four diversion boxes, two of which remain as active waste management units. The four boxes are 241-U-151, 241-U-152, 241-U-153, and 241-U-252. 241-U-151 and 241-U-152 have operated since 1946 (U.S. Department of Energy [DOE] 1992) and are associated with the 241-U single-shell tank (SST) farm. Diversion boxes 241-U-153 and -241-U-252 both began operating in 1946, but stopped operation in 1981 and 1983, respectively. Hanford Drawing H-2-71653 shows three drains (from 241-U-151, -152, and –252) connecting to U-301B. All the diversion boxes were involved in transferring "processing and decontamination wastes/high level waste (HLW)" (see Table 2.1, DOE 1992).

A wide range of wastes could have drained into U-301B on their way to the 241-U SST farm. The primary wastes transferred include (Brevick et al. 1997):

- first cycle decontamination waste from the bismuth phosphate process at T Plant, which was subsequently sluiced back to the tributyl phosphate recovery process in U Plant
- decontamination waste from equipment decontaminated at T Plant

- metal waste from the bismuth phosphate process
- N-Reactor phosphate decontamination waste
- NIT* waste ($HNO_3/KMNO_4$ solution added during evaporator operation)
- REDOX* high-level waste (1952-1957)
- REDOX cladding waste CWR1* (1952-1960) and CWR2* (1961-1972
- diatomaceous earth for absorbing residual liquids
- water (flush water and rain/snowmelt) and waste obtained from other tanks but stored for processing in 242-Evaporator (Leach and Stahl 1993).

Brevick et al. (1997) lists other lesser volume wastes that had been transferred to U-Farm, including a definition of the wastes noted above.

U-301B (also referred to as 241-U-301 in some documents and drawings) is a pre-stressed reinforced concrete tank that is lined with Gunite. From a waste compatibility viewpoint, it is the lining that would influence any waste interaction with the tank. According to the present-day Nationwide Gunite Corporation (American Concrete Institute [ACI] 1995), Gunite is essentially a cement-sand aggregate that was sprayed on the tank interior during construction. Thus, chemical compatibility tables, based on Portland cement concrete, are adequate to assess any chemical interactions.

The initial design drawings (NGC 1944) were provided by the National Gunite Corporation (now called Nationwide Gunite Corp. [NGC]). The date on the drawings is January 12, 1944, with revisions noted on March 2, 1944.

Records of tank fill level are available on the Personal Computer Surveillance Analysis Computer System (PCSACS) from 1981 to the present. Records prior to 1981 are reputed to be in DOE warehouse storage in King County, Washington. Plots of surface level and comment information cover the time period from about 1981 to present. These same data (but only from 1981 to 1995) can be found in a record logbook at Building MO-281, 200 West Area. Since 1995, all record data are stored in the PCSACS system.

During the 1981 to present time period, only two waste transfers were noted (July 1981 and July 1984) in the "comments" information; but three may have actually occurred based on the surface level plots. The two noted transfers occurred by the use of a tanker truck. Approximately 27 incursions of rain and snowmelt occurred and drain-back from pressure tests occurred six times. No indication of any waste leakage or spills was noted although the pump downs in 1981 and 1984 suggest that prior waste input had occurred. From about mid-year 1984 to the present

* For definition see Brevick et al. 1997

(about 17 years), the waste accumulated slowly and is now about 41-in. deep. This slow accumulation (following the last pump down) suggests that the fluid input has mainly resulted from rain and snowmelt.

Prior to any waste transfer, a waste compatibility assessment must be conducted. According to K. Fowler, of CH2M HILL Hanford Group, Inc. (CHG), this requirement has been in effect since 1995 (Fowler 1995). This assessment meets the Washington State Department of Ecology (Ecology) requirements that the waste not be ignitable, reactive, or corrosive (Washington Administration Code [WAC] 1998). Because no waste transfer has occurred since 1984, no compatibility assessment has been conducted. Prior to the next transfer, however, the compatibility assessment will cover requirements based on waste categories, waste codes, and tank safety concerns that could potentially be created as a result of mixing the subject waste streams.

5.2.2 Future Waste Transfers

For future waste transfers, compatibility compliance will center on requirements noted in five documents: Fowler (1995), Mulkey (1998), Cox (1997), Mulkey and Miller (1997), and HNF (1997). These compatibility compliance requirements include those for flammable gas (hydrogen, methane, and ammonia), nuclear criticality, organic and energetic reaction, watch list tanks, corrosivity, chemical compatibility, tank waste type, transuranic (TRU) segregation, heat generation, complexant waste segregation, phosphate waste, radiological source control, toxic chemical source term controls, and the wastes' Reynolds number. Flammable gas is particularly important in that for any future saltwell transfer(s), the catch tank vapor space concentration must remain controlled. Specifically, the minimum time to reach 25 percent of the lower flammability limit (LFL) is required to be seven days or more, assuming loss of primary tank ventilation.

According to Mattichak (1997), future waste transfer needs will extend to 2006 for waste transfers through 244-TX DCRT that are routed through 241-U-151 and 241-U-152. Plutonium Finishing Plant (PFP) transfers are anticipated until 2006.

Ten tanks at U-Farm, U-101, U-103, U-104, U-105, U-110, U-112, and U-201, U-202, U-203 and U-204, have all been interim-stabilized. Six tanks, U-102, U-106, U-107, U-108, U-109, and U-111, remain to be stabilized.

Pumping waste from three of the remaining tanks (U-102, U-106, and U-109) has begun. Pumping of all tanks is to be complete by November 30, 2002. All of these wastes are expected to be transferred to DST 241-AY-102 (Vladimiroff et al. 1999). Single-shell tanks U-102, U-111, and U-112 are noted as watch list tanks (Hanlon 2000).

The long-term, slow accumulation of waste (mainly dilute solutions) for the last 15 years and the apparent lack of leakage during that time indicate that the design of U-301B has also been adequate for handling the waste over its prior 40 years of service. Future service will probably involve more concentrated waste solutions as compared to the past transfers. Spills of this waste

into U-301B could degrade the tank's concrete structural material, if the waste is not diluted or removed.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided by the combination of good design, appropriate material selection, and corrosion control. Both design and material selection were initially adequate for 241-U-301B, relative to codes and requirements and available compatibility data in 1943-44.

Effective corrosion control is possible if the type of dissolved salt, its concentration and its temperature are controlled. No specific corrosion control specification for concrete exists. However, it should be noted that Portland cement concrete is resistant to a number of salts, including caustic chemicals (such as sodium hydroxide), if their concentration and temperature level are limited (PCA 1989).

Complete immersion of Portland cement concrete specimens in elevated-temperature, simulated Hanford waste, is known to cause failure in less than six months (Stark 1976). Correspondingly, exposure of the same specimens, but limited to a localized area and to a lesser amount of simulated Hanford waste, produced little damage (Karr and Stark 1980). Catch tanks have the least amount of data available of any of the miscellaneous tanks, and affiliation of a given tank with its proximal tank farms and plants is one logical approach to establish the range of waste type(s) that could have resided in U-301B. Section 5.2 lists some of the possible types of wastes that drained into U-301B.

The long-term, slow increase in waste level (about 35 in. from June 1984 to April 1999) in U-301B indicates that the tank is not leaking. Moreover, the primary fluid entering the tank over that range is water from rain and snowmelt and line flushings or pipeline pressure testing. Portland cement concrete is known to be resistant to dilute solutions where the pH ranges from neutral to nominally caustic (NACE 1981) and when temperature levels are not excessive. Although no catch tank temperature levels are recorded, they are probably not high, and more likely to be influenced by normal, annual ambient temperature variation. Furthermore, the tank's pH level is likely to be neutral to nominally caustic (estimated between seven to 12). Thus, it is unlikely that U-301B has undergone any deleterious or corrosive-type reaction since the mid-1980s. Portland cement concrete, however, is not resistant to acids or more concentrated caustics and salts.

In the past (i.e., from 1944 to 1981), when waste transfers were more frequent, more concentrated solutions of waste could have entered U-301B. Furthermore, while waste transfers were primarily caustic, it is possible that some accidental acidic transfers could have occurred. Vaults 244-BXR, 244-TXR, 244-UR, and 241-WR were used to acidify wastes (with nitric acid) that were subsequently transferred to U-Plant (Freeman-Pollard 1994). In addition, 241-U farm tanks U-103, U-105, U-108, and U-109 are reported to have been associated with those same vaults (Freeman-Pollard 1994). Thus, it remains possible that some accidental acidic degradation of the tank's concrete (Gunite) could have initiated earlier in its life. Visual

examination (see Section 6.1.2) however, showed that only minor, insignificant attack had occurred.

Correspondingly, when more concentrated saltwell waste begins to flow (beginning in 2000) these solutions are likely to be more corrosive to concrete. These latter wastes will be controlled to certain levels of nitrite, nitrate, and hydroxide mainly for the control of corrosion in steel piping and tanks. However, the concentration levels of nitrite, nitrate, and hydroxide can be corrosive or detrimental to Portland cement concrete, as well (PCA 1989).

5.4 AGE OF THE TANK SYSTEM

The age of the tank is approximately 57 years (constructed in 1944). An integrity assessment of the tank and its associated components has not been performed since the time of construction.

6.0 INTEGRITY EXAMINATIONS

The visual integrity examinations were performed in April 2000. The leak check analysis was performed in May 2000, based on 1998 surface level data. They were conducted to identify possible degradation of the tank system, and to determine the extent of that degradation, that could have occurred since completion of construction approximately 57 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the catch tank interior and in the pump pit. The examination for both facilities was conducted on April 26, 2000. Visual examination details are shown in 13 photographs and data sheet findings are included in two tables. The photographs and tables appear at the end of this appendix. The 13 individual 'still' photographs, taken from the videotapes and presented in Figures B3 through B15, show the satisfactory condition of the facility.

6.1.1 Pump Pit Visual Examination

Access to the pit was obtained by removing its round metal cover (see Figure B2). The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing the facility components) were lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Azimuthal movement of the camera is provided by manual manipulation of the camera's suspended pole. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or a narrower-angle setting) used to more closely view details of interest.

The videotape, and the four 'still' photographs, showed that the condition of the corrugated and galvanized pit wall and lid appeared very satisfactory. Various pieces of ancillary equipment, within the pump pit, also appeared in good condition. Table B1 provides a description of the visual examination findings along with a discussion of the photographs (Figures B3 through B6).

6.1.2 Catch Tank Internal Visual Examination

Access to the catch tank interior was provided by opening riser number 3 (12-in.-diameter pipe) in the southern group of risers. This allowed access for the VITIS II video camera. Essentially the entire tank interior could be seen.

The videotape, and nine 'still' photographs showed that the tank interior surfaces and internal components are in satisfactory condition. A coal tar enamel (or equivalent) appears to have coated the tank dome and risers. From about the diversion box inlet (15-ft elevation) down, the enamel either did not exist or degraded with time and disappeared. Table B2 provides a description of the visual examination findings along with a discussion of the nine photographs (Figures B7 through B15).

Light-colored waterlines (or bands) appear at several levels in the tank. Their character suggests a possible light acidic attack or, possibly a more concentrated caustic attack. Whatever the reasons, the attack regions are very shallow and do not appear to have penetrated through the 3/4-in. thick Gunite layer.

In about 1984, the tank was pumped last, the level was down to less than 10-in. deep. Fluid depth increased an average of about 2-in. per year until about 1996, and remained virtually constant (around 41-in.) to the present time. Light-colored attack markings, beneath the drain line sidewall opening, and in the bottom-residing sludge, suggest that the minor attack may have occurred between 1985 and 2000. Erosion does not appear to be a likely mode of attack because the waste level changed so little each year.

6.2 LEAK TEST

To assess leak tightness of 241-U-301B, a review of historical fluid level records was conducted. Tank surface level records exist from about 1981 to present (Figure B16). For tank U-301B, four types of catch tank liquid level measurement system data are available on the PCSACS: manual tape, manual Food Instrument Corporation (FIC), auto FIC, and manual Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge (ENRAF). The manual ENRAF data were selected for the leak check analysis for two reasons: they provide the most sensitive level measurement capability and they cover the most recent time periods (1998 and 2000) when the tank was at its fullest (about 28 percent full or approximately 8,000 gallons). A time-expanded view of the ENRAF surface level plot from January 1998 to September 2000 is shown in Figure B17.

A minimum of 49 hours (approximately 2 days) is considered the minimum time over which the historical leak check could be conducted to satisfy the detection criterion of a volume rate of change.

Figure B17 also shows two extended time periods of a virtual near-constant surface level. A fluid depth of 41.61 $\pm$ 0.01 in. existed from April 20 to August 20, 1998, or about 111-days. The second, and most recent near-constant level, occurred at 41.16 +0.01 – 0.00 in. from August 1 to September 18, 2000, or about 48 days. The slow decrease in depth (approximately 0.5 in.) over a

2 year period, between the two long-term constant depths (Figure B17), could result from normal varying amounts of flush water and rain/snowmelt intrusion combined with normal evaporation. Thus, the tank is judged to not be leaking, based on the two time periods examined.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and observations in Section 6.0, the findings, conclusions, and recommendations are listed below.

1. The tank system was adequately designed to withstand the applicable design loads.

2. The tank has been in service for approximately 57 years without any leaks reported, which proves that good design controls were used at its construction.

3. The U-301B tank was evaluated under several accident scenarios (WHC 1996) and found to be unsatisfactory when subjected to internal transient pressure resulting from hydrogen deflagration and high sludge temperature. Failure of the tank due to these loading conditions is precluded by administrative control.

4. The tank is not leaking at the leak check level of 41.61-in. However, to demonstrate its leak tightness at a higher level, another leak test should be conducted.

5. Because the facility is relatively old, but is in good condition, another set of visual examinations (when the tank is empty) and a leak test are recommended within the next five years. This is based on the assumption that any highly concentrated saltwell waste (i.e., waste containing high-levels of caustic, nitrate, and nitrite) spilled into the catch tank are either diluted to concrete-compatible levels or removed.

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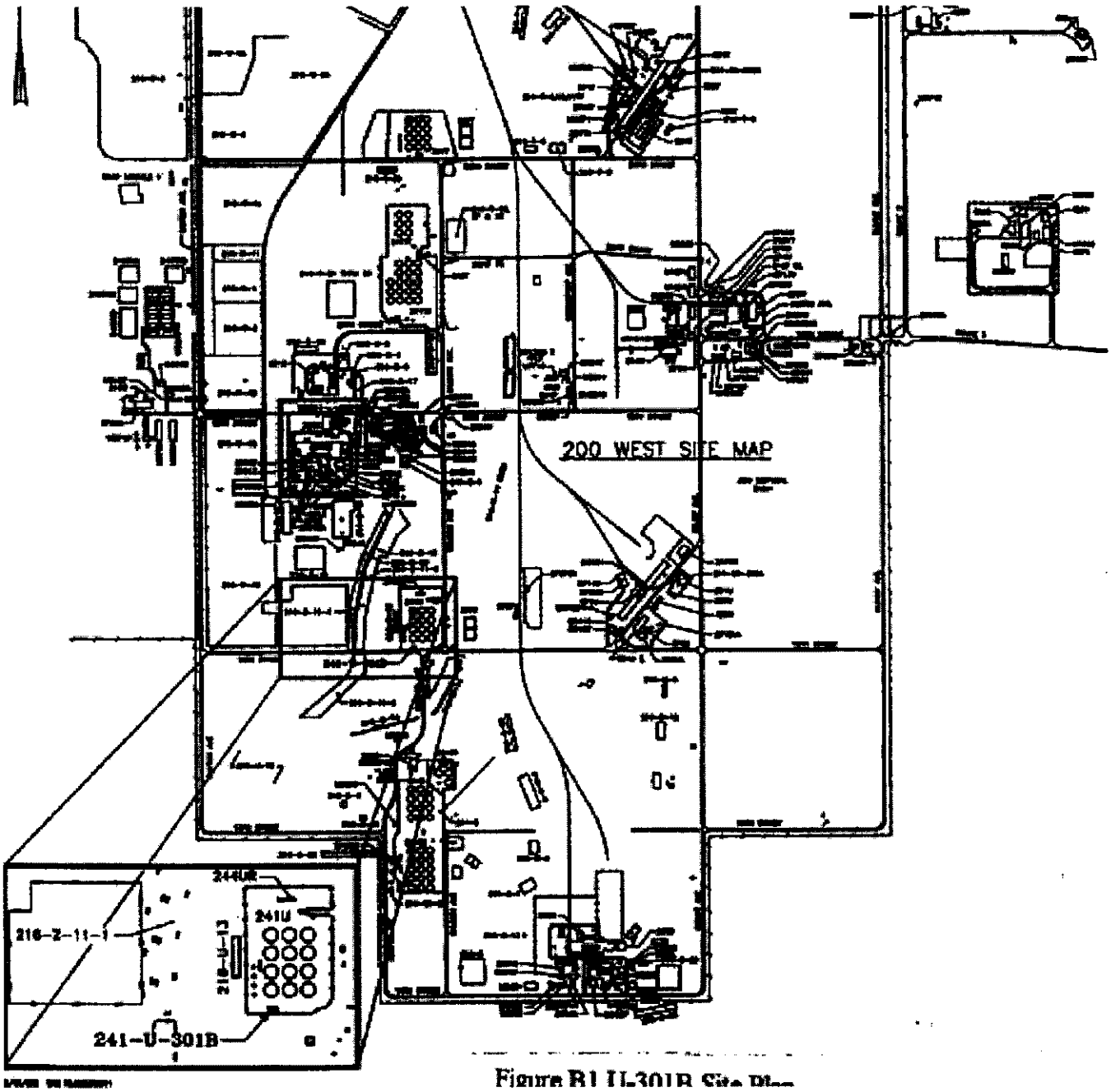


Figure B1. Location of 241-U-301B on the Site Plan

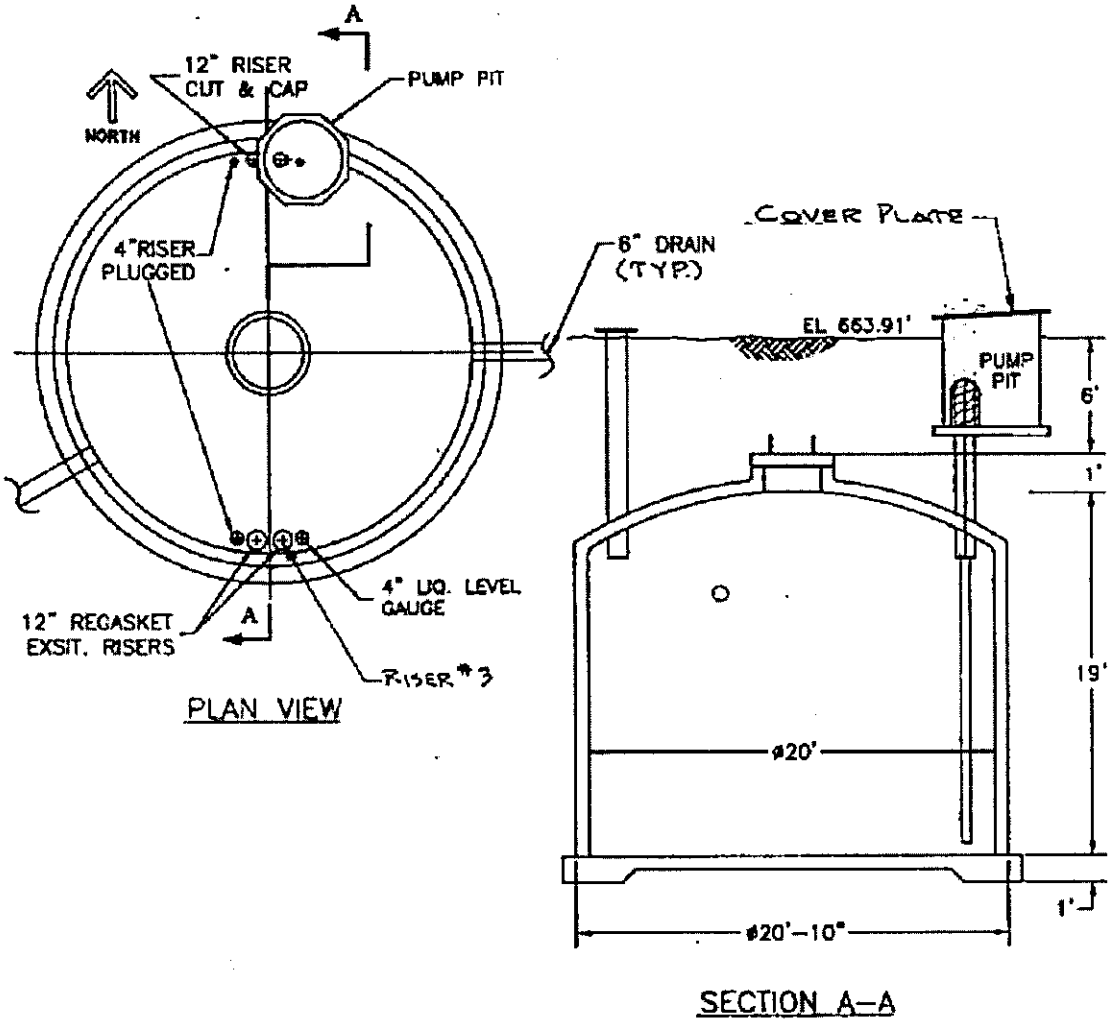


Figure B2. 241-U-301B Catch Tank

TABLE B1-VIDEO EXAMINATION DATA SHEET OF 241-U-301B PUMP PIT

Examination Date: 4/26/2000

Person In Charge: Steve Chapman Camera Operator: Bert Wright Video Examiners: T. S. Hundal

Riser: Penetration in Pit Lid

Video Tape Reviewer: E. B. Schwenk Date: May 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs, and accompanying narrative demonstrate that the approximately 20-year old pump pit is in very satisfactory condition and that it is fit for continued service.
					The interior of the 241-U-301B pit was entered through a small opening (5-in. diameter floor drain access hole) on the top of its metal lid. Dimensions of the pit are 5 ft inside diameter by approximately 4.5 ft deep. A VITIS II video camera, with attached light, was used for the visual examination. Approximately 10 minutes of the 45-minute videotape is devoted to examination of the pump pit (the remaining 35 minutes covers the catch tank internals).
BY		113	163		In general the pit appeared sound. Some dust and light dirt was on the floor. Figure B3 shows a 'blind' or vapor seal covering the 2-in. discharge line as it passes through the pit wall.
738 PM		359	162		Figure B4 shows a floor drain (triangular plate) and its integral leak detection unit appear clean and in good shape. Also shown is the corrugated pipe sidewall and partly stained floor.
740 PM		258	147		Figure B5 shows the yellow lifting yoke for the pump riser cover (foreground). In the background is a nozzle, with a lifting yoke, that is secured in place.
742 PM		000	069		Figure B6 provides a partial view of the very satisfactory condition of both the yellow pit cover and the galvanized pipe wall.

Figure B3
Vapor Seal Covering 2-in. Discharge Line in 241-U-301B Pump Pit

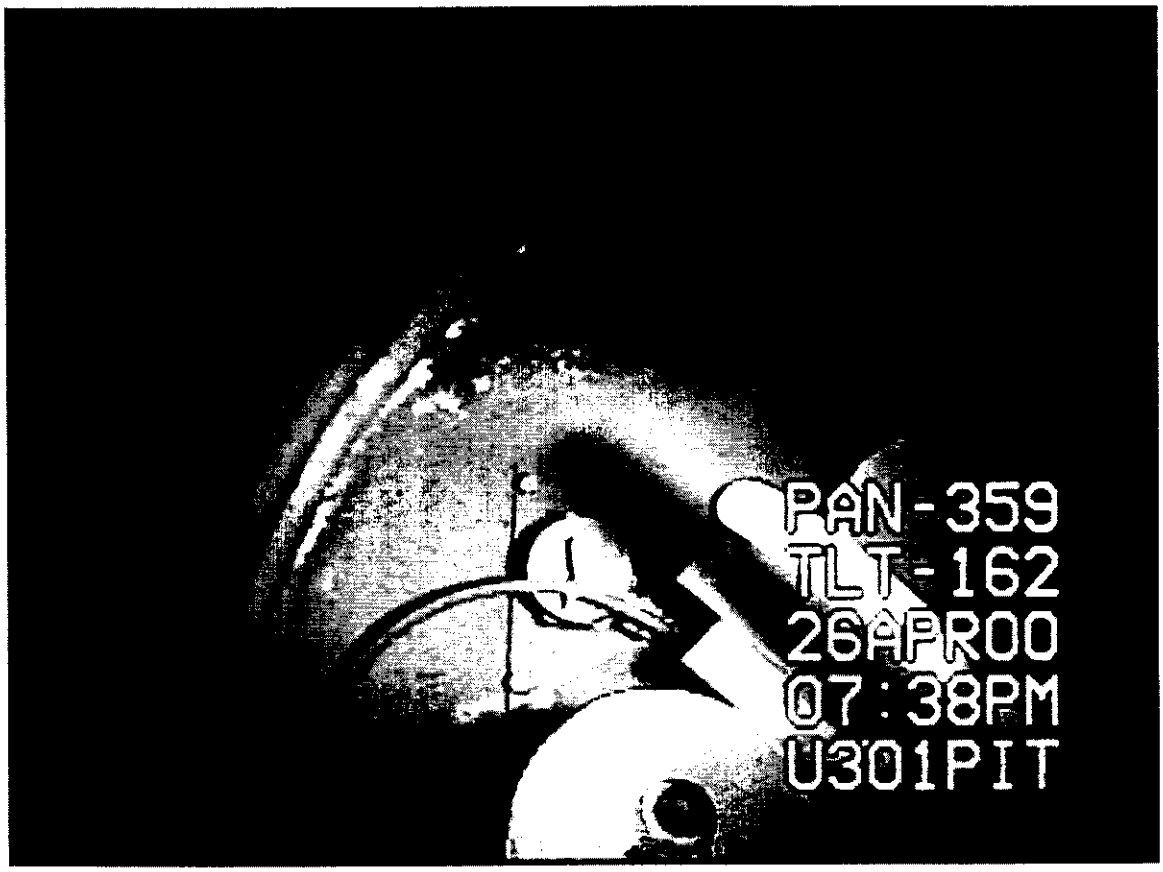


Figure B4
Connected Leak Detection Unit and Floor Drain, Pump Pit 241-U-301B

Figure B5
Lifting Yokes for Pump Riser Cover (left) and Nozzle (center), 241-U-301B Pump Pit

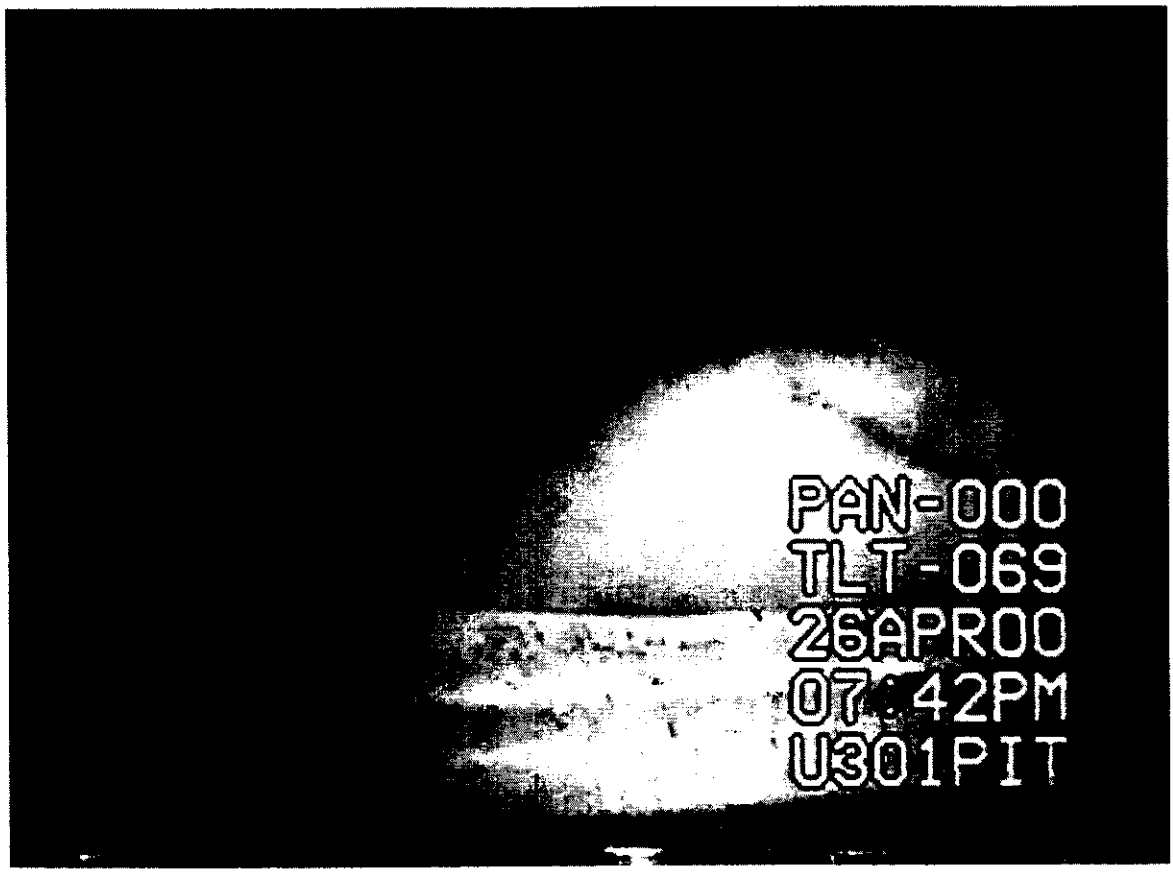


Figure B6
View of Pit Sidewall and Top Cover Plate, 241-U-301B Pump Pit

TABLE B2 VIDEO EXAMINATION DATA SHEET, 241-U-301B CATCH TANK

Examination Date: 4/26/00

Person In Charge: Steve Chapman Camera Operator: Bert Wright Video Examiners: T. S. Hundal

Riser # 3 (12"ø)

Video Tape Reviewer: E. B. Schwenk Date: May 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The 241-U-301B catch tank was entered through riser number 3 (12-in.-diameter pipe). The same video camera (VITIS II) that was used for the pump pit visual examination was also used here.
					The following photographs and narrative demonstrate that this oldest, reinforced concrete catch tank (56 years old) is in satisfactory condition. Visual water-line markings on the 3/4-in.- thick Gunite sidewall layer (cement-sand mixture covering a reinforced, prestressed concrete structure) indicate that some form of chemical attack has occurred in the past. The degree of attack however appears minor, in that it does not appear to have extended through the Gunite layer into the aggregate concrete. It is suggested that the attack, whenever it occurred, may have resulted from either nominally acidic or more strongly basic waste. Liquid waste level data (PCSACS) show that the level has been relatively low (< 10 in. deep about 1985) with an average increase of about 2 in. per year increase until 1996, after which it remained nearly constant.
0759 PM		102	097		Figure B7 shows the generally good condition of the submersible pump and a portion of the sidewall. One 'attack' waterline is evident in the photo.
0759 PM		100	081		Continuing further up the submersible pump pipe and electrical line, additional chemical attack waterlines can be seen (Figure B8). One, at the top appears to be about 4 to 6 in. high. Figure B9 is a closer view of the larger attack region.

Table B2 Video Examination Data Sheet, 241-U-301B Catch Tank (continued)					
0801 PM		352	082	`	The top of the tank was coated with coal tar-type enamel. Figure B10 suggests that the coating either covered only the top region of the tank or, that its remaining lower portion, degraded with time and disappeared.
0801 PM		248-359	053-113		Figures B11, B12, and B13 are related collinear photos, taken at different elevations from the 15 ft elevation (Figure B12), to the slightly attacked region just below the drain line on the tank wall (Figure B11) and down to Figure B13 which shows some possible attack by the sludge. That this attack may have occurred between 1985 and 2000, is suggested by the slow, dripping-like flow that appears to have emanated from the outstanding pipe (Figure B12) and trailed back under the drain and down the Gunite surface of the tank. Figure B11 shows the wider extent of the waterlines and stains directly below the drain line. The light-color of the sludge, also below the drain line, suggests that a possible transient acidic character of the waste may have chemically changed the surface color of the sludge. Erosion, of the sidewall and the sludge, seems less likely because of the very slow change in fluid depth as shown in the surface level versus time curves of Figures B16 and B17.
0815 PM		210	059		Figure B14 is a close-up of the pump riser showing that part of the coal tar enamel has degraded and fallen off.
0807 PM		040	180		The approximate 40-in. deep clear liquid waste atop the sludge layer is shown in Figure B15. Depth of the sludge layer is estimated to be about 1 ft

Figure B7
Submersible Pump Immersed in Waste, Catch Tank 241-U-301B

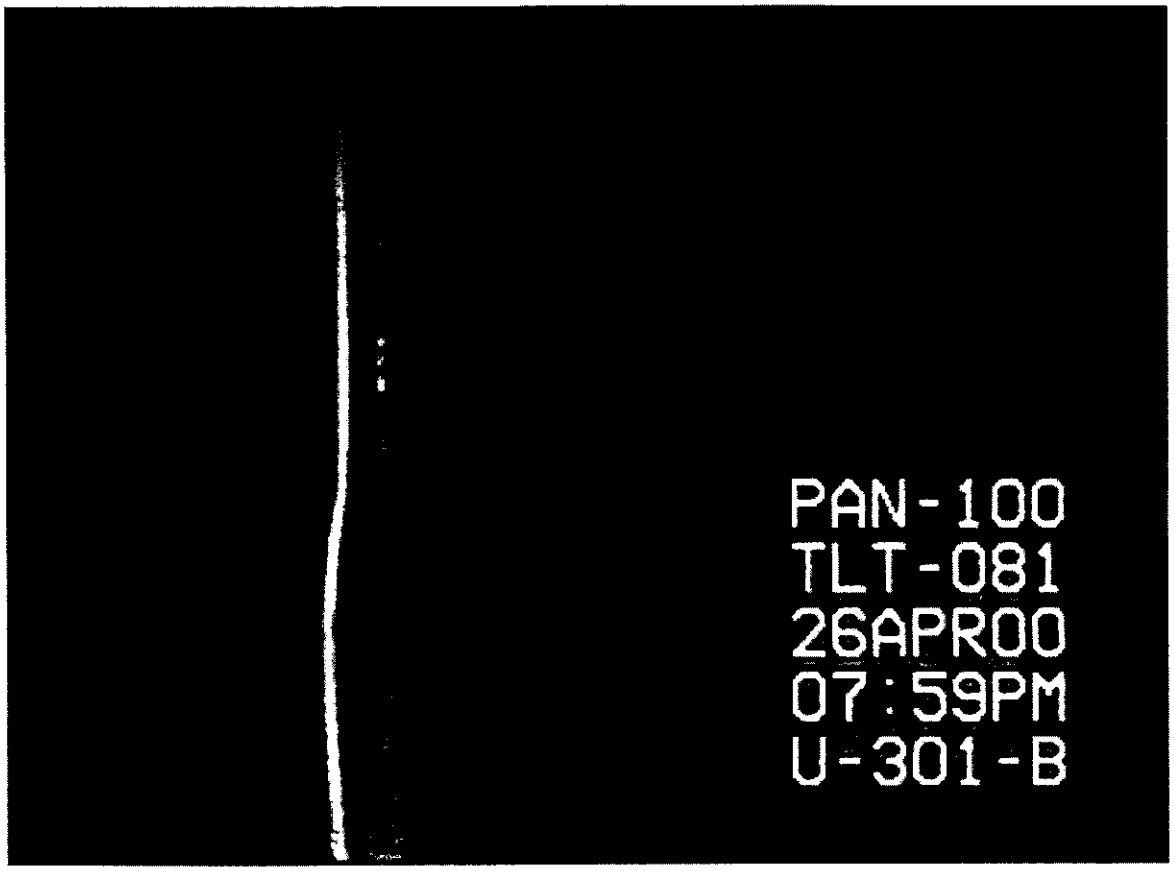


Figure B8
Submersible Pump Pipe and Electrical Connection, Areas of Waterline Attack, Catch Tank 241-U-301B

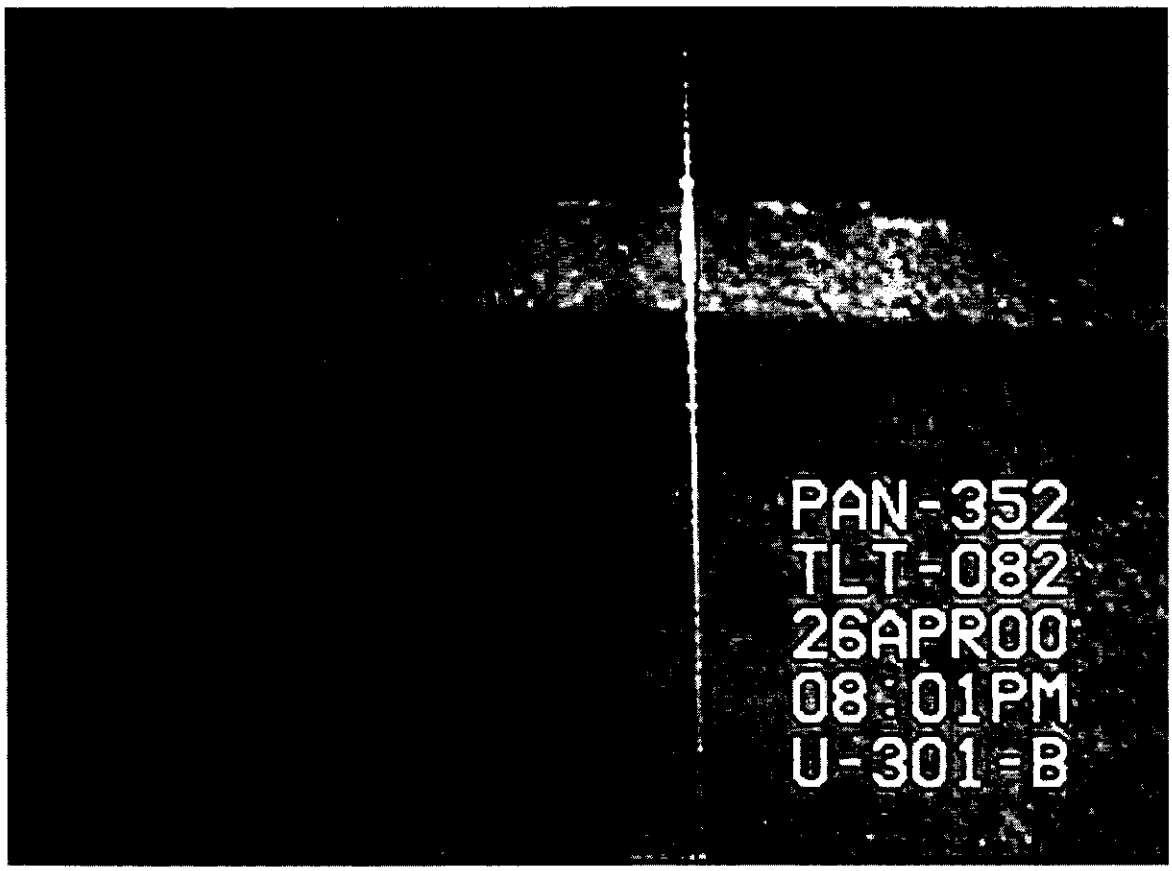


Figure B9
View of Sidewall Watermark "Attack" and Vertical ENRAF Line, Catch Tank 241-U-301B

Figure B10
View of upper Portion of Tank Showing Gradient in Black Coating, Catch Tank 241-U-301B

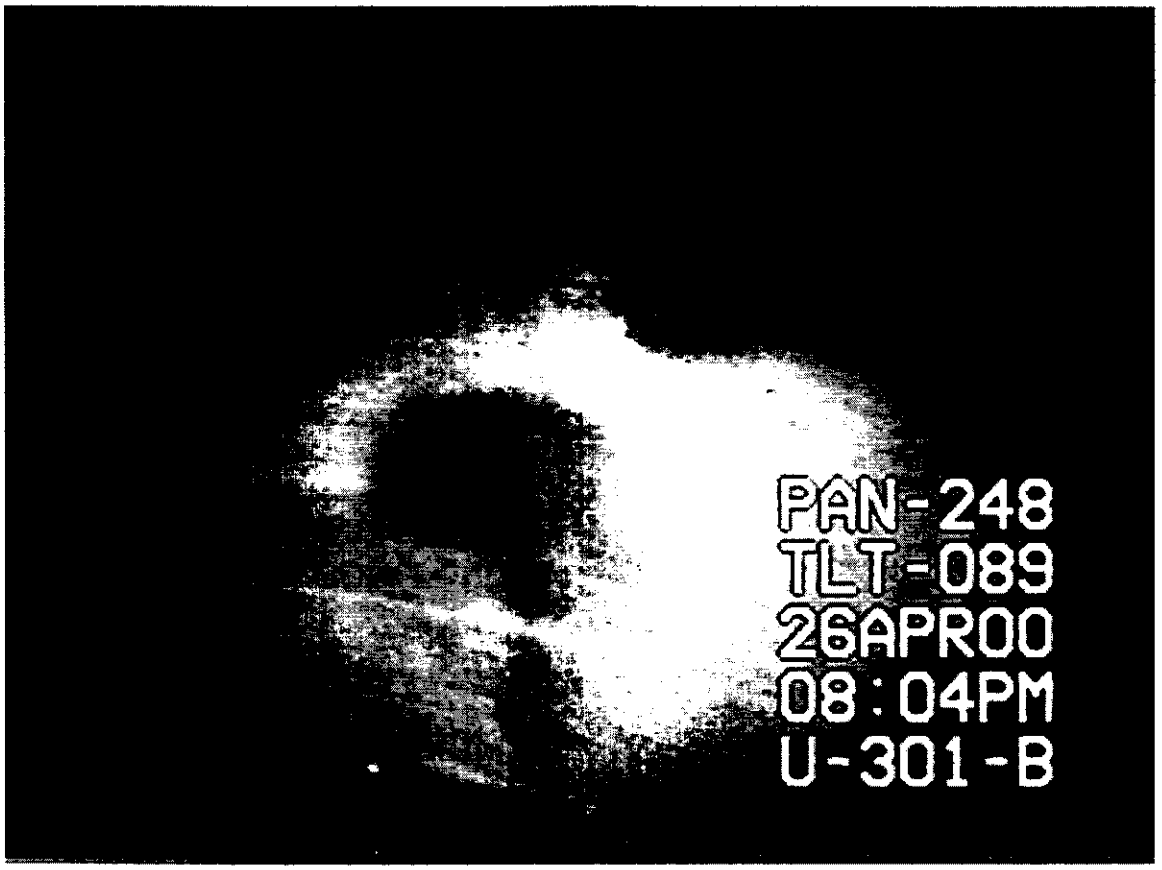


Figure B11
Waterlines and Stains on Sidewall Below Drain Line from Diversion Boxes U-151 and U-152, Catch Tank 241-U-301B

Figure B12
Drain Line at 15 ft Elevation, from Diversion Boxes U-151 and U-152. Catch Tank 241-U-301B

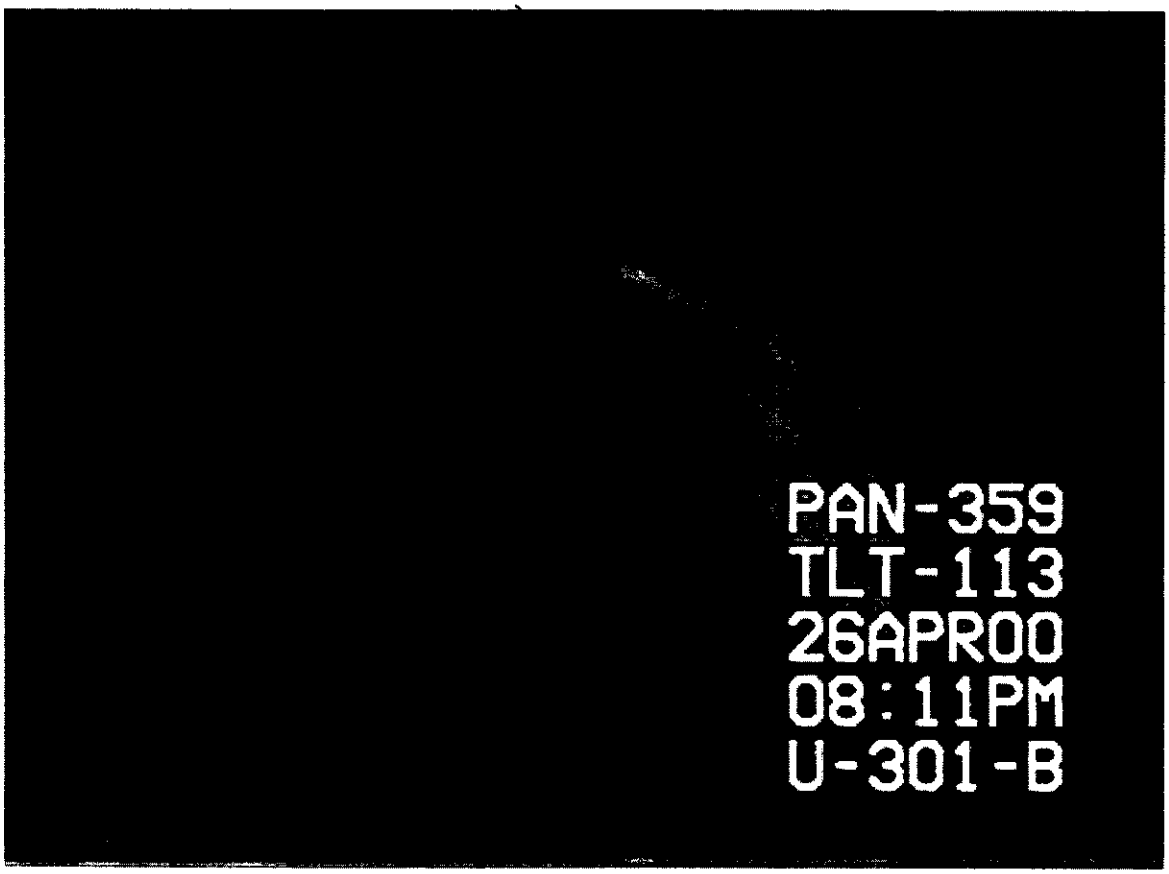


Figure B13
View of Tank Sludge Below 6-in. Drainline from Diversion Boxes U-151 and U-152, Catch Tank 241-U-301B

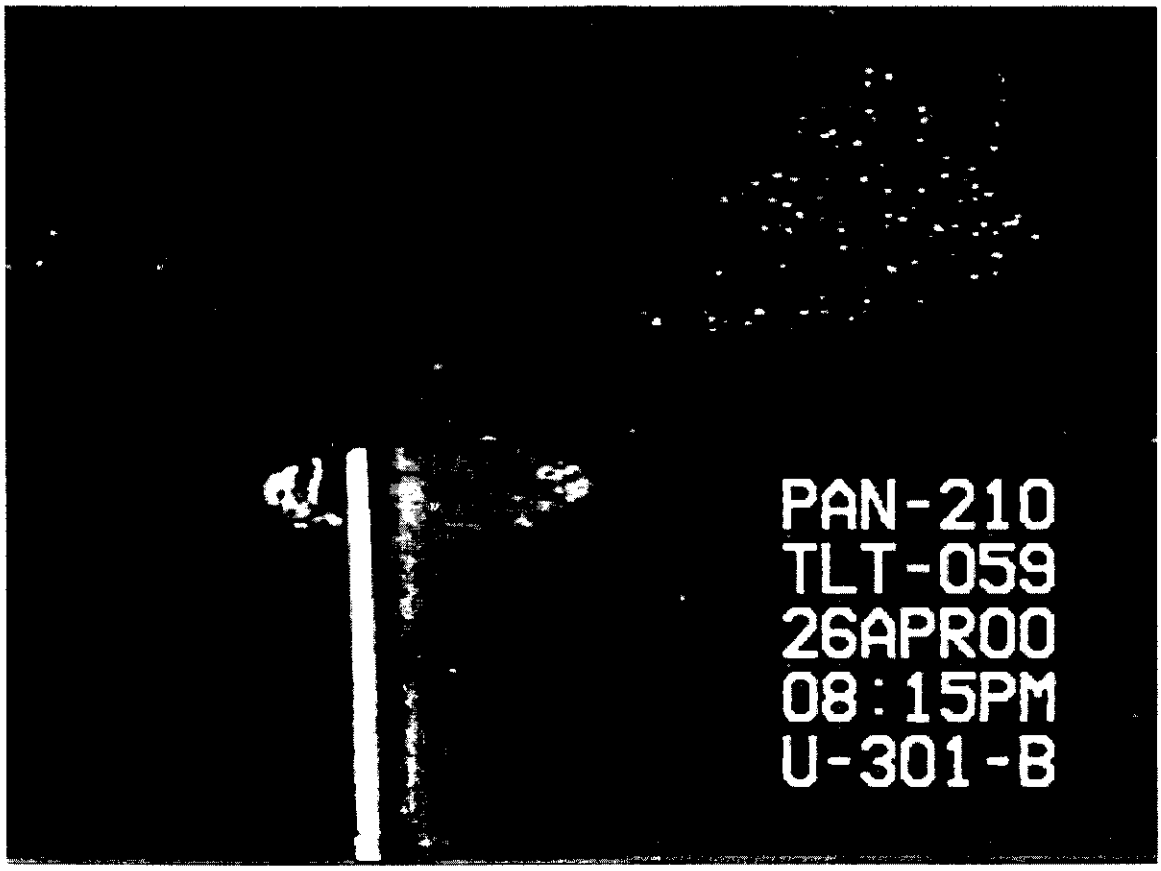


Figure B14
Close-up of Pump Riser Tank Inlet, Catch Tank 241-U-301B

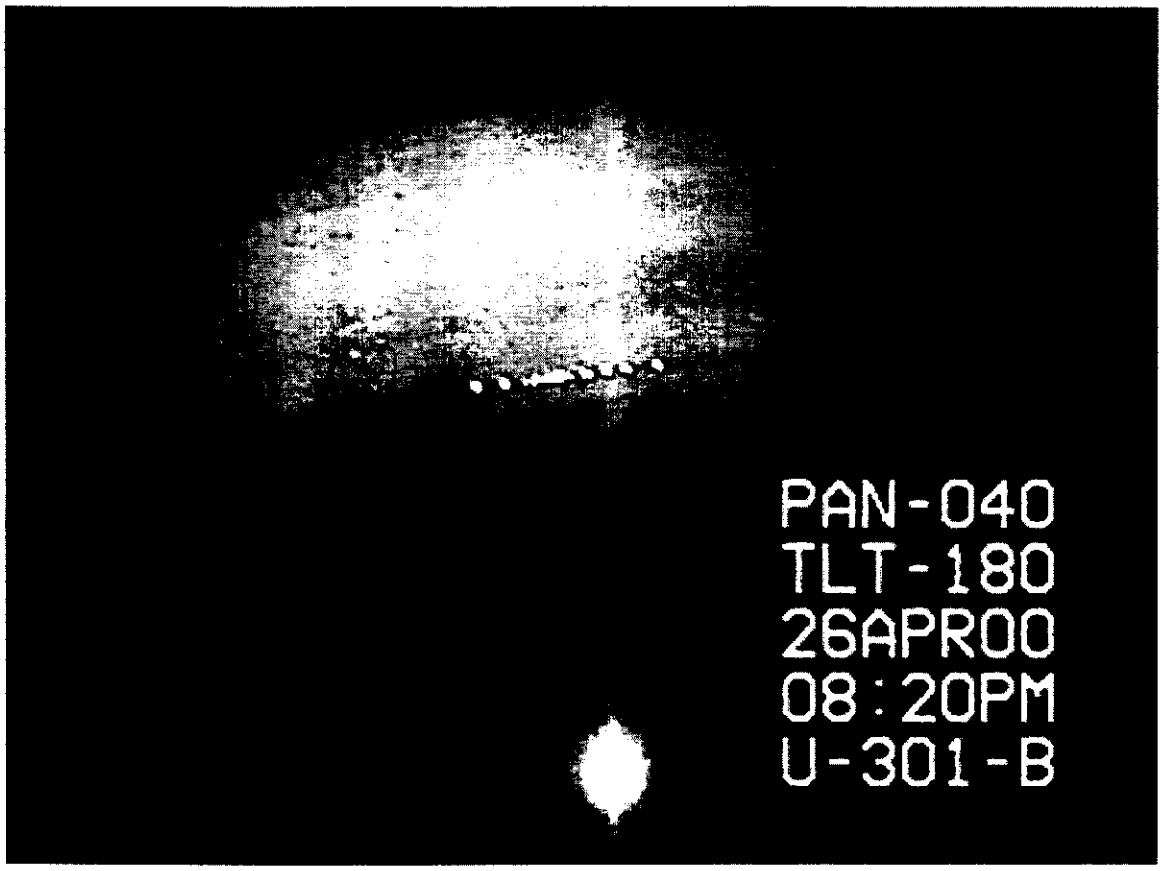


Figure B15
View of Sidewall and Clear Liquid Waste and Sludge Regions, Catch Tank 241-U-301B.

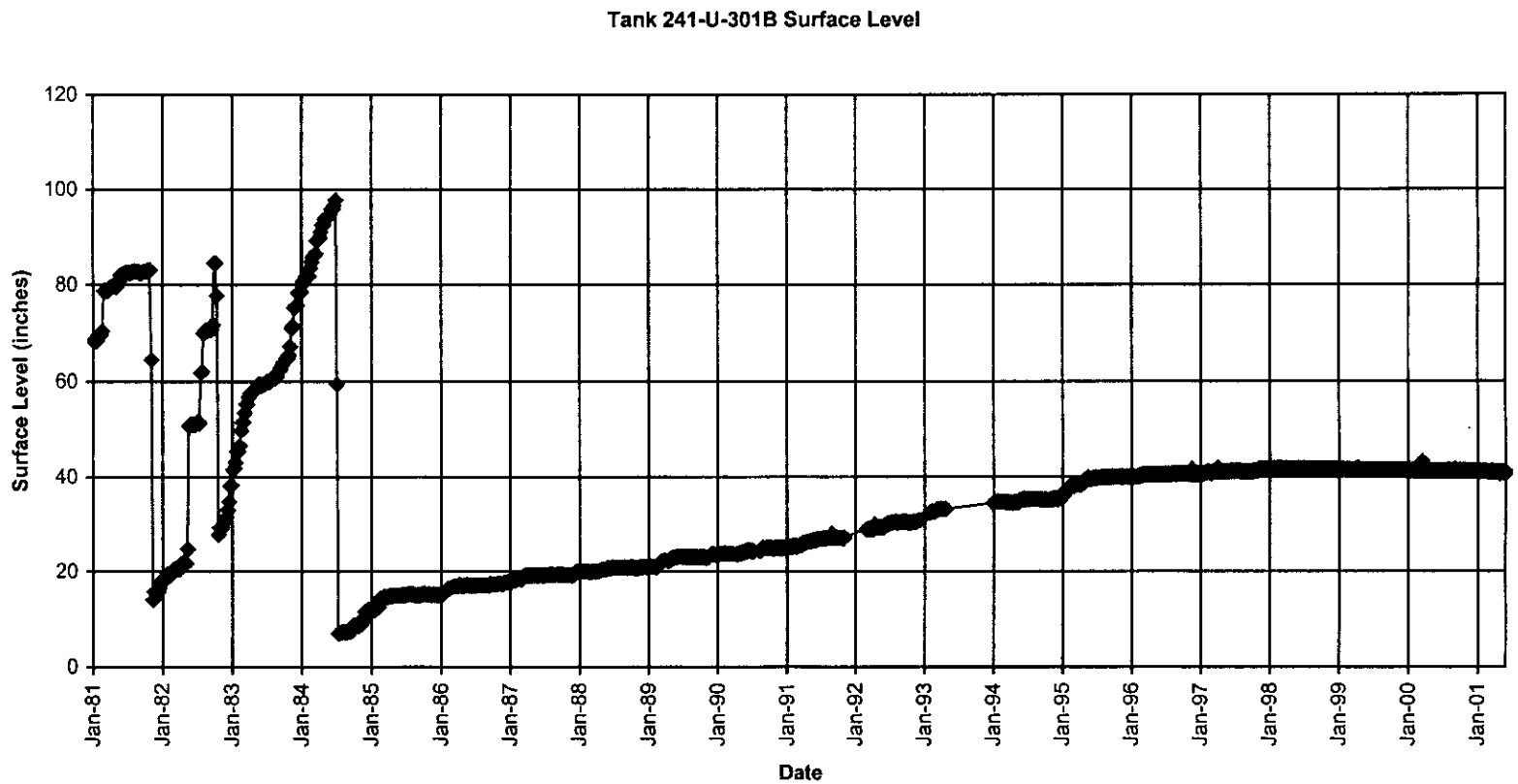
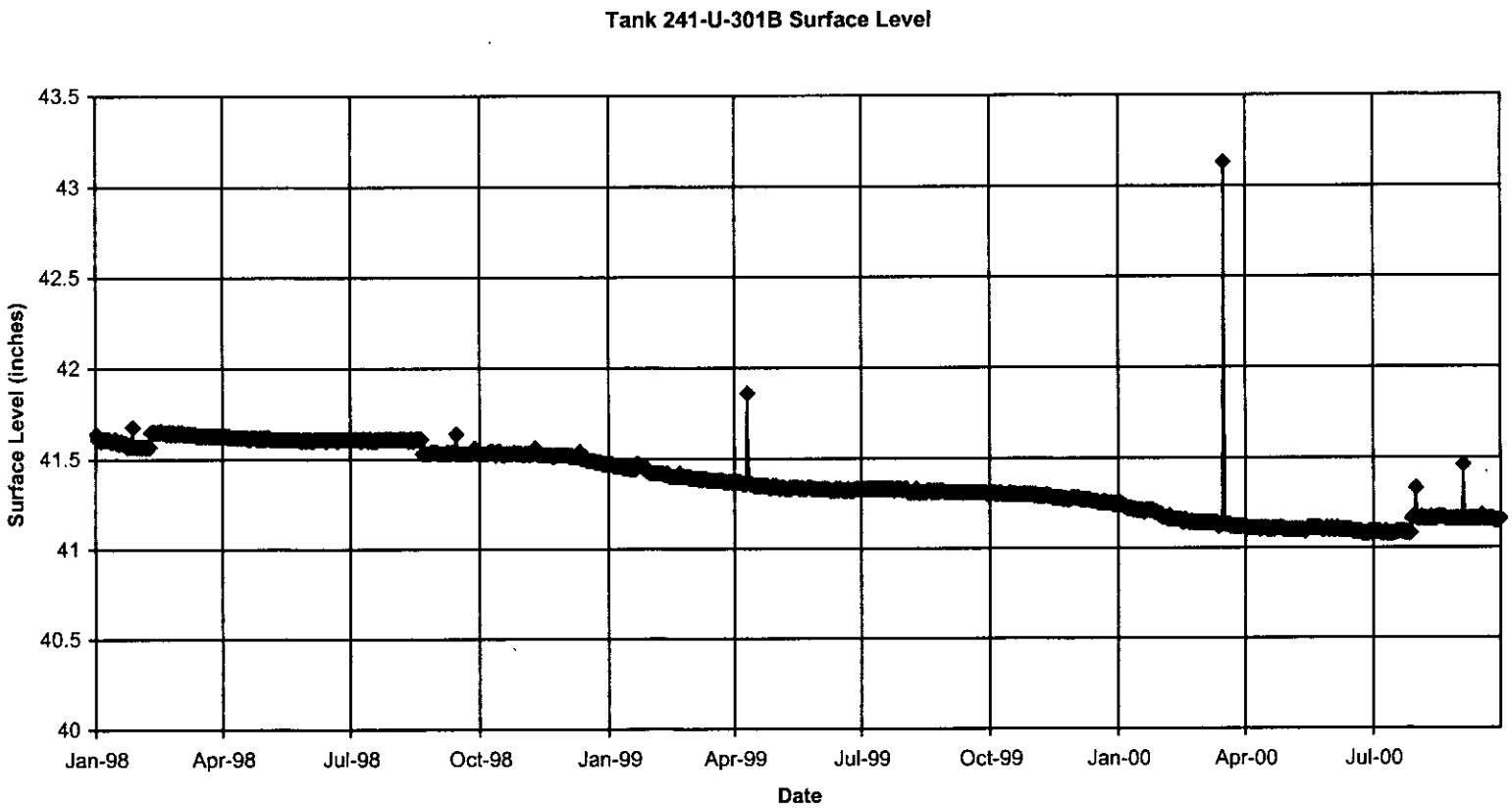


Figure B16 Composite Surface Level Versus Time Curves, 1981 to 2001, 241-U-301B



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APPENDIX C

241-UX-302A CATCH TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
$BiPO_4$	bismuth phosphate
CVI	Certified Vendor Information (file)
DOE-RL	U.S. Department of Energy Richland Operations Office
ENRAF	Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge)
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System
HLAN	Hanford Local Area Network
ID	inside diameter
NON-GRE	non-gas release event
PCSACS	Personal Computer Surveillance Analysis Computer System
PUREX	Plutonium Uranium Extraction (Facility)
RHA	Records Holding Area
RMIS	Records Management Information System
SS	stainless steel
SST	single-shell tank
TBP	tributyl phosphate
UO_3	Plutonium Uranium Extraction Support (PUREX Conversion)
U Plant	221-U
UPR-200-W-24	unplanned release
UX-302A	241-UX-302A catch tank (Drawing 1947b)
VITIS II	Video In-Tank Inspection System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

The 241-UX-302A Catch Tank (UX-302A) is located in the 200 West Area of the Hanford Site (Figure C1). The catch tank was designed and installed to be used as the secondary containment to diversion box 241-UX-154.

2.0 PURPOSE

The purpose of this design evaluation and examinations is to determine if the UX-302A components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the UX-302A pump pit and the catch tank. The scope of the examinations includes a visual examination of the UX-302A catch tank internal surface, its pump pit, and a leak test of the tank.

4.0 DESCRIPTION

The 241-UX-302A catch tank is a direct-buried underground tank. A pump pit sits directly above the center of the tank at ground level. Installation of the tank occurred in 1947; it was modified in 1984 under Project B-231 primarily by addition of the pump pit and an underground

pump-out capability (Vitro 1980). The location of the facility on the Hanford site is shown in Figure C1 and a sketch of the facility is shown in Figure. C2.

4.1 PUMP PIT

The pump pit is a 5-ft-inside-diameter (ID) galvanized corrugated metal pipe, which is 4-ft 6-in deep. A 12-in.-diameter schedule 40 riser, made of carbon steel pipe, descends approximately 20-ft from the bottom of the pump pit to the tank. This riser houses the submersible waste transfer pump. If any leaks were to occur within the pump pit, the pit is designed so that leaks would drain to the catch tank, below. A round steel plate provides a cover to the pump pit and is resistant to rain and snowmelt intrusion. Addition of the pump pit occurred in 1984 under Project B-231 (Vitro 1980). The modifications of Project B-231, Phase I, provided UX-302A with permanent underground pump-out capability via a direct-buried pump-out line to the 241-UX-154 diversion box.

4.2 CATCH TANK

The UX-302A catch tank is a horizontal cylindrical vessel, 8-ft 10-7/8-in. ID by 39-ft 4-1/4-in. long, buried approximately 24 ft. (to centerline of tank) below grade. The tank was fabricated of 9/16-in. carbon-steel plate. On the ends are flanged and dished heads with a radius of 8 ft 6-in. On the top of the tank are six penetrations with flanged connections. There are five 4-in. and one 18-in. flanged connections on the tank. Two of the 4-in. connections are the inlets to the tank and come from the drains of the 241-UX-154 diversion box. The third 4-in. connection is for a liquid level-measuring device. The fourth 4-in. connection was originally for a steam jet siphon pumpout and is now isolated. The fifth 4-in. connection is a sealed spare. The 18-in. connection flanges down to a 12-in. riser that is connected to a pump pit (see Figure C2). The inner surface of the tank is coated with Amercoat #55 and its outer surface is coated with coal tar to protect it from corrosion.

This catch tank is used as secondary containment to diversion box 241-UX-154, which supports the old cross-site transfer system. This catch tank is also tied to the 291-U stack and encasement drains. The 291-U facility has been turned over for decommissioning and demolition and it is unlikely that there is any need for the encasement drain lines. The 291 U stack is a probable source of ingress.

5.0 DESIGN EVALUATION

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of UX-302A. A thorough search was conducted to identify the available design requirements of the tank. The resources searched for tank information are listed below.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files

- drawings in the Hanford drawing list at Document Control Center
- INSIGHT or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) database
- Associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farms Engineering personnel.

5.1.1 Tank

UX-302A was installed in 1947, and the original records of construction and testing were not found. However, some design information was found on the original construction drawings (Drawing 1947a, Drawing 1947b).

The tank was welded and stress-relieved in accordance with paragraphs U69 and U76 respectively of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII (Drawing 1947b).

The tank was tested to 125 psig hydrostatic pressure after standing full of water for at least 24 hours. The tank was to be absolutely leak-proof under test (Drawing 1947b).

All materials used in the construction of the tank were carbon steel under the American Society for Testing and Materials (ASTM) A-285-46 Grade B (Drawing 1947b).

The tank's exterior and interior surfaces were cleaned of all mill scale and grease by sandblasting. The interior surfaces were coated with six coats of light-colored Amercoat # 55, (Hanford Drawing H-2-43068). The exterior surfaces were to be coated with coal tar enamel similar and equal to that manufactured by the Barrett Company to specifications for underground tanks (Drawing 1947b).

The UX-302A tank was installed on a sand bed with no timbers, sleepers or saddles and leveled to within ½-in. of 36-ft length, sloped downwardly to the jet box end (Drawing 1947b).

5.1.2 Pump Pit

The pump pit and associated piping installed in UX-302A under Project B-231 was built and tested in accordance with construction specification B-231-C1 (Vitro 1980).

The pump pit has a concrete floor that connects to the 5-ft-ID galvanized corrugated metal pipe per Federal Specification WW-P-405A, Class 1 Series B, 14 Gage (Hanford Drawing H-2-71643). The pit contains a 3-in. floor drain to route any liquid to UX-302A below. The pump pit is provided with a steel plate cover, which is resistant to rain and snowmelt intrusion.

Structural assessment of numerous facilities subjected to various load conditions were performed recently (Westinghouse Hanford Company [WHC] 1996). This assessment determined that UX-302A tank could fail under three load conditions: 1) existing soil dead load, 2) internal static vacuum of -8 psig, and 3) high waste sludge temperature of 600 degrees F. The evaluation concluded that the failure mode due to soil dead load was by the tank buckling inwards.

However, the tank has been in service for 53 years and the recent internal visual examination (described in Section 6.0) reveals that the tank is intact and in good condition.

Review of the (WHC 1996) analysis methods for calculating the effect of soil loads showed the analysis to be unrealistic and over-simplified. A refined analysis of the tank performed in 1998 (Schlosser 1998) for the allowable dome loads showed that the catch tank is within allowable design limits with significant added live loads. Failure of the tank by the second and third noted loading conditions is precluded by administrative controls.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The catch tank UX-302A was primarily provided to receive and contain spilled, leaked, or flush water waste through two 4-in gravity-flow drain lines from diversion box 241-UX-154. The design drawing for catch tank UX-302A (Drawing 1947b) was dated July 1947 and the tank is estimated to have started to receive waste by 1948 from diversion box 241-UX-154. This diversion box received waste only from U Plant (221-U) and is in buried proximity to the plant. Identical to T and B Plants, U Plant was constructed in 1943 to support the bismuth phosphate ($BiPO_4$) process. However, B Plant and T Plant provided sufficient processing capacity and U plant was never used for plutonium separations. U Plant began operations as a uranium recovery plant in 1952 and operated as such until 1958 (U.S. Department of Energy Richland Operations Office [DOE-RL] 1992). After 1958, UX-302A has mainly received waste from the 291-U stack and encasement drains, spills or leaks associated with the old cross-site transfer lines (V360/V361), and precipitation, runoff, and pipe line flushings (Mattichak 1997).

A number of different types of waste (spillage) could have drained from the 241-UX-154 diversion box during its primary years of operation (from 1952 to 1958). The operation of U Plant involved several other facilities. A description of the process operations of these facilities, and their associated periods of operation are discussed in the following sections. These facilities include (DOE-RL 1992):

Facility	Process	Period of Operation
221-U Building	Uranium Recovery Process	1952-1958
224-U Building	UO_3 Conversion Process	1952-1955
	Plutonium Uranium Extraction (PUREX) Support (UO_3 Conversion)	1952-1992
276-U Building	Solvent Treatment	1952-1958

U Plant received acidified bismuth phosphate metal waste from the 244-BXR, 244-TXR, 244-UR, and 241-WR vaults and uranium was extracted. The process separated the uranium into an organic phase (tributyl phosphate in a kerosene diluent), which was then stripped using nitric acid (DOE 1992). The separated uranium was routed to the 224-U facility for conversion to UO_3. The solvent was transferred to the 276-U building for sulfate scrubbing and recycled to U Plant for further processing.

According to the *U Plant Source Aggregate Area Management Study Report* (DOE 1992), the uranium recovery process waste stream included fission products with a high radioactivity level, low organic content, bismuth phosphate, nitrate salts, and neutralized acid waste. The operation of the UO_3 conversion process generated an acidic to neutral process waste containing nitrates, low organic level, and low radioactivity level. The solvent treatment process generated a high organic content waste stream with a low salt content, acidic to neutral pH and an intermediate radioactivity level. The waste streams sent to tank farms were, in all cases, made alkaline (Anderson 1990), thus it is unlikely that any acidified waste spilled into UX-302A, during these transfers to tank farms.

Leakage or spillage from the above processes could have wound up in catch tank UX-302A. Some of the above processing involved nitric acid, which, if spilled would have been highly corrosive to carbon steel piping and tanks. One indication of this possibility was demonstrated by a problem in the 244-U, 244-BXR, and 244-TXR vaults. These vaults were constructed in 1951 for use in conjunction with uranium recovery processing in U Plant. The function of the vault included reception of uranium-bearing waste slurries from single-shell tanks (SSTs) U-101, U-102, U-103, and U-107 in the 241-U tank farm (Freeman-Pollard 1994). The vaults were used for subsequent blending, pH adjustment (acidification) and conditioning of this waste as feed material for the tributyl phosphate (TBP) process for uranium extraction in the U Plant canyon.

According to the *U Plant Source Aggregate Area Management Study Report* (DOE 1992) one unplanned release occurred for this vault. The unplanned release (UPR-200-W-24) occurred in 1953 and was the result of a violent chemical reaction in the 244-UR-002 blending tank involving metal waste supernatant. Visual examinations of the interior of UX-302A tank (described below) indicate that if any acidic spills did occur, they were of no significance to the integrity of the tank.

The Personal Computer Surveillance Analysis Computer System (PCSACS) has been used to track waste input and output in catch tank UX-302A since about 1980. As noted earlier, the catch tank has received waste mainly from the 291-U stack and encasement drains spills or leaks associated with the old cross-site transfer line (V360/V361). According to Mattichak (1997), spills and leaks from the old line were eliminated in the first half of 1999, with the startup of the new cross-site transfer system Project W-058. Like other catch tanks it also can receive line flushings, hydrotest water, and rain and snowmelt. From the PCSACS readout, dilute solution line flushings have occurred four times (as much as 350 gallons for one flushing), one hydrotest, one line drainage, two jumper leaks, and about 40 rain and snowmelt incursions. Pump out of waste, from the catch tank, occurred on 11/6/97, 9/23/97, 3/3/95, 12/7/84, 11/2/84, 2/5/83, and 11/13/82. Line V-379 can be used to pump out the tank although it should be noted that the pump out on 11/13/82 was to a tanker. Based on the last approximate 19 years of PCSACS records, the majority of the fluid input to UX-302A appear to have been dilute water solutions.

Because of the relatively small amount of waste left in the tank, and the high ratio of void volume to waste volume (including sludge), there is little potential for hydrogen generation to result in a gas release event. In addition, *Tank Farms Administrative Controls* (Cox 1997)

declared that catch tank UX-302A is a non-gas release event (NON-GRE) facility. As noted earlier the uranium waste recovery streams associated with the 221-U, 224-U building, and 276-U building contained varying amounts of low-to-high radioactivity levels, low-to-high organics, bismuth phosphate, nitrate salts and neutralized acid waste. Because these streams ceased operation in 1958, and because the tank has been pumped out at least seven times since dilute waste has been entering it, it is unlikely that any significant amount of organics or radioactive material remain. Further, no compatibility assessments have been done on its contained waste because no samples have been taken.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided primarily by the combination of good design, appropriate material selection, and corrosion control. Design for UX-302A was adequate. Material selection was adequate, based on results of the tank visual examination described below. Effective corrosion control, however, was not implemented for the majority of waste processing in U Plant. Corrosion testing did occur in the 1940s (Leach and Stahl 1993) that was directed toward minimization of corrosion in single-shell tanks for wastes pumped from U Plant. With the exception of the UO_3 campaign, major processing operations in U Plant were shut down before more effective corrosion controls were introduced (Kirch 1984). Before 1984, the majority of the waste transferred was caustic, which is generally not corrosive to carbon steel in concentrations characteristic of Hanford waste. After 1984, corrosion controls would have further mitigated the potential for any corrosive attack of UX-302A.

Catch tank UX-302A was constructed from ASTM A 285-46 carbon steel plate, 9/16-in. thick (Drawing 1947b). Both exterior and interior surfaces of the tank were cleaned of all mill scale and grease by sandblasting. Interior surfaces were coated with six coats of Amercoat #55. The exterior surfaces were coated with coal tar enamel similar and equal to that manufactured by the Barrett Co., to specifications for underground tanks (Drawing 1947b). Application of cathodic protection to the catch tank is unclear. According to Mattichak (1997), no (external) cathodic protection has been applied to this tank for exterior surface corrosion control while Freeman-Pollard (1994) indicates that it is applied. Soil is in contact with the tank's exterior coated surface.

5.4 AGE OF THE TANK SYSTEM

The age of the tank is approximately 54-years (constructed in 1947) with an estimated use of 53 years. An integrity assessment of the tank and its associated components has not been performed since the time of construction.

6.0 INTEGRITY EXAMINATIONS

The visual integrity examinations, visual and leak test, were performed in March 2000 and July 2000, respectively. They were conducted to identify possible degradation of the tank system, and to determine the extent of that degradation that could have occurred since completion of construction, about 54 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the catch tank interior and in the pump pit. The date of examination for both was March 8, 2000. Visual examination details and data sheet findings are included in a series of figures and table that appear at the end of this appendix. Seventeen individual 'still' photographs, taken from the videotapes and presented herein, show the satisfactory condition of the facility

6.1.1 Pump Pit Visual Examination

Access to the pit was obtained by removing a plug in the floor drain access riser in the cover plate (see Figure C2). The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing the facility components) was lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Azimuthal movement of the camera is provided by manual manipulation of the camera's suspended pole. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or a narrower-angle setting) used to more closely view details of interest.

Table C1 provides a description of the visual examination findings and discusses the photographs. The videotape, and the four 'still' photographs (Figure C3 through Figure C6), showed that the condition of the corrugated and galvanized pit wall and lid appeared very satisfactory. Various pieces of ancillary equipment, within the pump pit, also appeared in good condition.

6.1.2 Catch Tank Internal Visual Examination

Access to the receiver tank interior was provided through a 4-in.-diameter pipe spare riser. This riser projects into the tank adjacent to its south dished-end and several feet south of the liquid level measurement instrument (ENRAF, see Figure C2 for its location in the tank). Most of the tank interior was seen. In addition, the tank walls could be viewed, through the clear liquid waste, to the top of the bottom-lying sludge layer. At the time of inspection, the waste level was reported as 21 in.

The videotape showed that the tank interior surfaces are in very satisfactory condition. The top one-fourth to one-third of the tank, which no liquid waste has ever apparently touched, shows only spotty vapor phase corrosion, some minor pitting, and light blemishes. Nearly all of the tank wall surfaces below its top waterline, are covered with a whitish deposit, estimated to be about 1/8-in. thick. In some areas the white deposit has spalled-off, leaving black-colored tank wall regions that appear innocuous. These various regions described in the attendant data sheet Table C2 are shown in Figure C7 through Figure C19.

6.2 LEAK TEST

To assess leak tightness of 241-UX-302A, a review of historical fluid level records was conducted. One time-period in 2000 was chosen to assess the leak tightness of UX-302A, a nearly constant fluid depth for 33 days. The accompanying plots of waste surface levels are shown in Figure C20 to Figure C22.

For UX-302A, three types of catch tank liquid level measurement data are available on the PCSACS at Hanford: manual tape, manual Food Instrument Corporation (liquid level gauge) (FIC), and manual Enraf Nonius series 854 ATG (Advanced Technology Servo Tank Gauge) (ENRAF). For the dates of August 8, 2000 through September 9, 2000 (a 33 day period) the manual ENRAF liquid level remained nearly constant, between 23.36 to 24.40 inches.

Forty-six hours (less than 2 days) is considered the minimum time over which the leak test needs to be conducted to satisfy the established leak detection criteria.

Based on the level holding at about 23.40 in. for 33 days (August-September 2000), the tank was determined to not be leaking. Figure C22 is a plot of the Manual ENRAF data for the noted time-period.

7.0 FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The tank has been in service for about 54 years without any leaks reported and no visual evidence of significant deformation, which proves that at the time of its construction adequate design controls were used to withstand applicable loads.

2. The tank is not leaking at the leak test level of 23.40-in. However, to demonstrate its leak tightness at a higher level, a leak test should be conducted at that higher level.

3. Because the facility is relatively old, but is in relatively good condition, another set of visual examinations when the tank is empty and a leak test are recommended within the next 10 years.

8.0 REFERENCES

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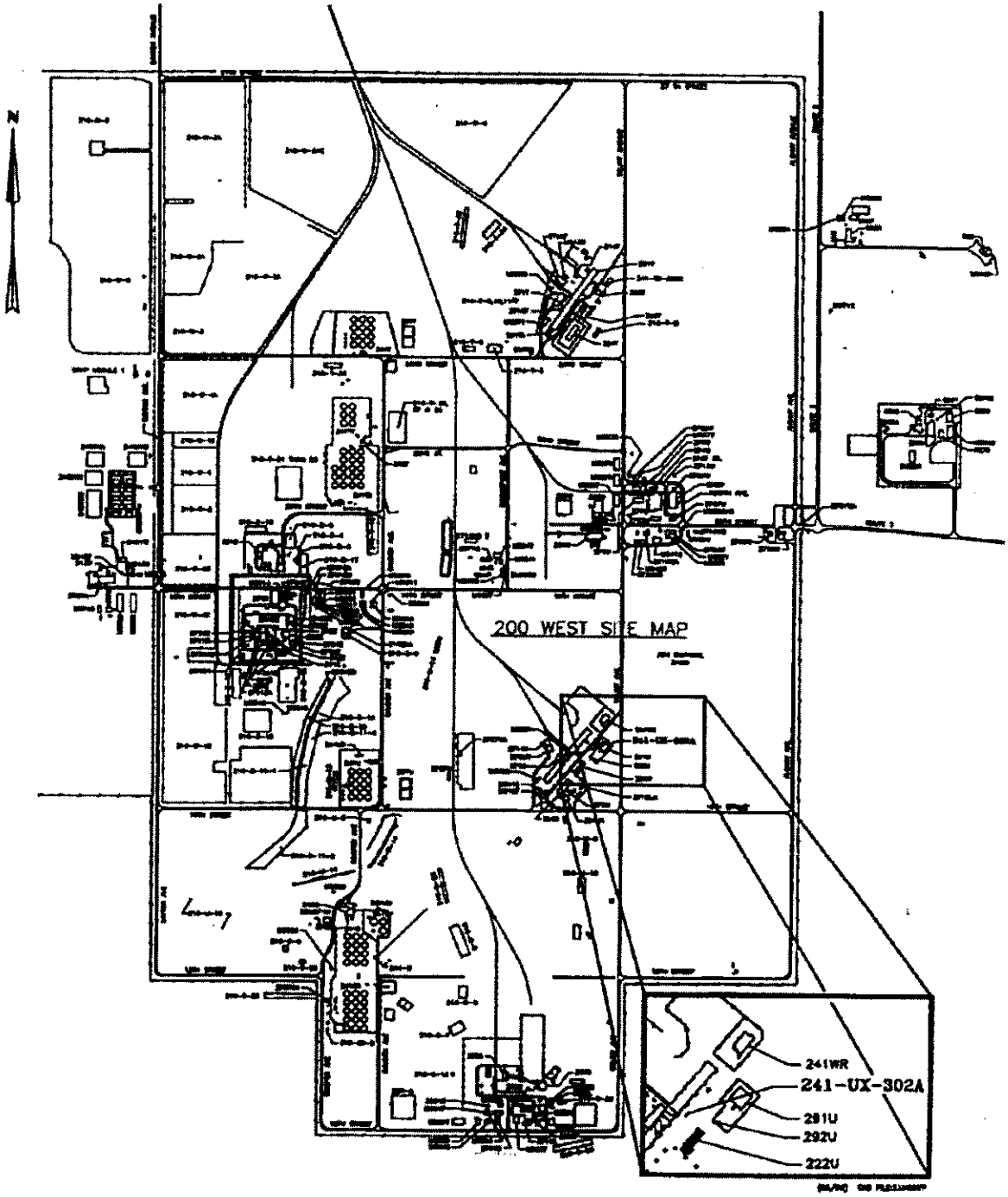

Figure C1
Location of 241-UX-302A on the Site Plan

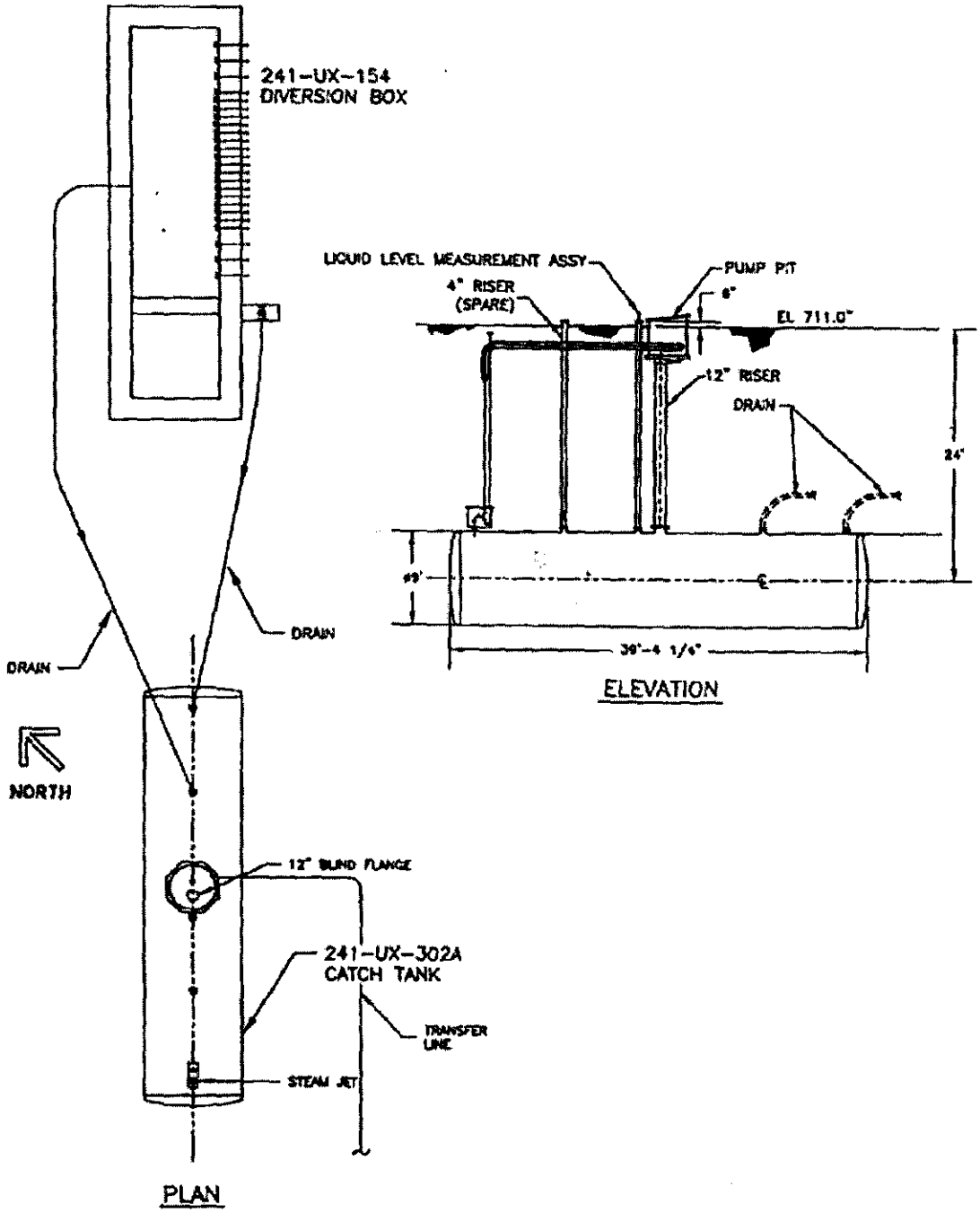

Figure C2
UX-302A Catch Tank

Table C1. Video Examination Data Sheet, 241-UX-302A Pump Pit

Examination Date: March 8, 2000

Person In Charge: K. A. Baird Camera Operator: M. G. Robbert Video Examiners: T. S. Hundal and K. A. Baird

Opening: Floor Drain Access in Cover Plate

Video Tape Reviewer: E. B. Schwenk Date: July 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following narrative and photographs will demonstrate that the approximately 20-year old pump pit tank, and its internal components, are in very satisfactory condition. Based on this video examination the pit appears structurally sound and adequate for continued service.
					The pump pit was entered through a floor drain access in the pump pit's cover plate (see Hanford Drawing H-2-71643). The corrugated metal pipe that makes up the inner liner of the pit is 5 ft in diameter and about 5 ft deep, with a tapered cover plate. In general, the interior is relatively clean with spotty amounts of minor rust occurring on component painted surfaces. A small amount of gravel is on the bottom of the pit; the galvanized sides (of the corrugated pipe) are unattacked. A small amount of rust is present near the floor drain; its concentric leak detection module appears satisfactory. A round, carbon steel cover plate is tilted up against the side of the pit; this device was probably used to cover the pump opening before the pump was installed around 1980. All electrical connections, lines, and piping appear satisfactory.
8	27 PM	012	044		Figure C3 presents a view of the very satisfactory condition of the pit cover plate, vertical valve handle, and corrugated pipe sidewall.
8	28 PM	116	120		The similarly good condition of the circular pump hole cover plate and pump electrical control line, are shown in Figure C4.
8	32 PM	051	183		A small amount of rust appears on the painted floor around the drain and concentric leak detection unit, shown in Figure C5.
8	33 PM	025	130		In Figure C6, more electrical lines, the pump exit piping and nozzle, and yellow lifting straps are shown.

Figure C3
View of Catch Tank 241-UX-302A Corrugated Pipe Sidewall and Horizontal Cover Plate

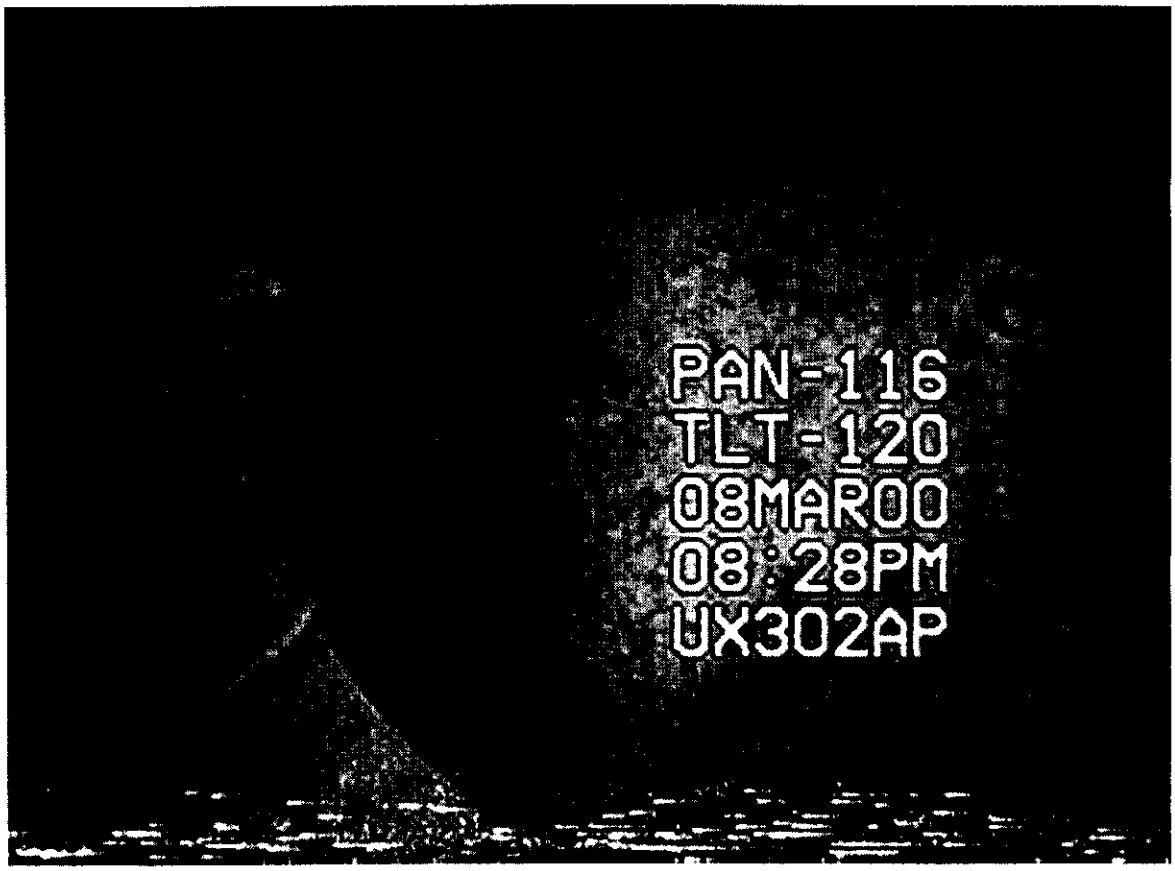

Figure C4
View of Circular Pump Hole Cover Plate and Pump Electrical Control Line in 241-UX-302A Pump Pit

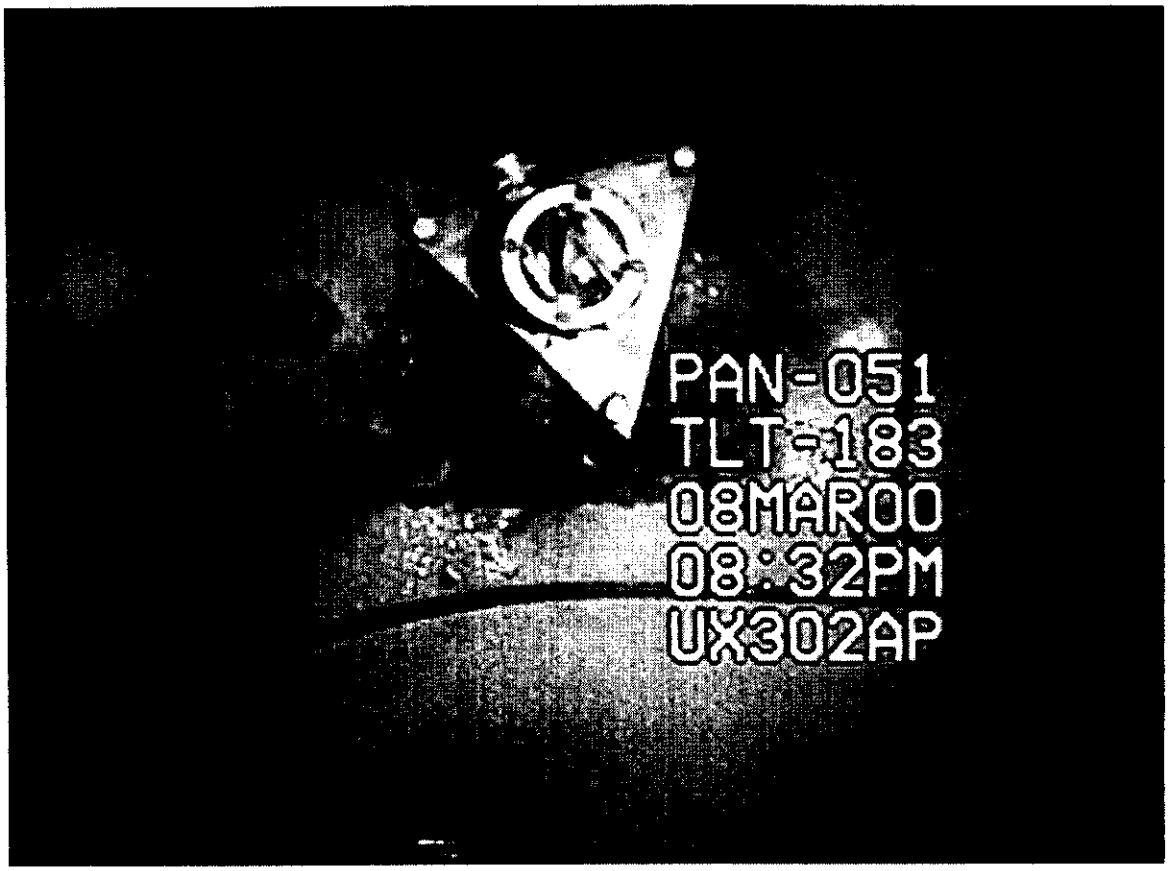

Figure C5
View of Leak Detection Module Secured Atop the Pit Drain and an Electrical Connection Fitting in 241-UX-302A Pump Pit

Figure C6
View of Pump Exit Piping, Nozzle, Electrical connection and One of Two Yellow, Pump Module Lifting Straps in 241-UX-302A Pump Pit.

Table C2. Video Examination Data Sheet, Catch Tank 241-UX-302A

Examination Date: March 8, 2000

Person In Charge: K. A. Baird Camera Operator: M.G. Robbert Video Examiners: T. S. Hundal and K. A. Baird

Riser or Opening: 4 in.ch Spare Riser

Video Tape Reviewer: E. B. Schwenk Date: March 16-20, 2000

Tape Time		Complementary Information			Reviewer's Comments
Hour	Minute	Pan (deg.)	Tilt (deg.)		
					Catch Tank 241-UX-302A was entered with a VITIS II video camera through a 4-in. diameter pipe riser. That riser enters the 39 ft long tank approximately midway between the central 12 in. diameter riser and the end of the tank above which the steam jet siphon sits. The distances are about 9-ft (from the central riser) and 11 ft. (from the tank end), respectively.
					The following narrative and photographs will demonstrate that the approximately 50-year old tank, and its internals (including its pump pit), are in very satisfactory condition. Based on this video examination, the tank is structurally sound. The pump pit also appears very satisfactory.
					Almost the entire tank interior was in the field-of-view of the wide angle-to-zoom telephoto lens of the video camera. The tank interior displayed a number of variegated colors. They ranged from dark region, near the bottom approximately 2-ft., to a near uniform tan/white for the next approximately 1-ft high strip. This changed to a spotty tan/white area with rust-brown borders and with many pieces of a tan/white coating peeling off the tank, as one progressed to its top. The bottom contained a finely divided sludge layer (estimated at approximately 4-8 in. deep), with a small amount of debris, and a clear layer of water (estimated at approximately 1 to 1-1/2 ft. deep) on top of the sludge. Initial review of tank drawings (dated 1947), for the catch tank design evaluation integrity assessment, indicated that the tank was coated on the outside (coal tar) but only sandblasted and cleaned in the interior. Further review of Hanford site files (3/14/00) revealed additional drawings showing that another interior sandblasting occurred (onsite), followed by application of six coats of light-colored Amercoat # 55, in 1950 (Hanford Drawing H-2-43068). About 1980, modifications were made to UX-302A (Project B-231). This included addition of a pump pit near ground level and a submersible pump through the central riser. Details regarding specific conditions noted in the tank, with attendant photographs, follow.
6	52 PM	150	151		Figure C7 is a view of some debris on the tank bottom. It includes a bottom-lying sludge layer, a broken manual tape, a possible piece of rebar, and a layer of clear water. The sludge layer appeared to be finely divided except where pieces of tank wall coating had more recently fallen to the bottom and had not yet become finely dispersed.

Table C2. Video Examination Data Sheet, Catch Tank 241-UX-302A (continued)

7	01 PM	013	087		Figure C8 shows a front view of the stainless steel submersible pump and ENRAF liquid level detector. No corrosion attack of any significance was seen on the stainless steel (SS) pump body or its SS downcomer. The pump and downcomer are about 20 years old while the tank is around 50 years old.
7	13 PM	041	083		Figure C9 shows some porous, granular sludge deposited around the top of the SS pump body where its electrical control line enter the pump. There is no apparent corrosion attack or structural problems associated with the porous-deposited connector. About 3-5 ft. above the pump the SS downcomer changes to carbon steel. The flat, horizontal surface of the carbon steel flange (not shown) also has an innocuous, porous sludge layer deposited on it.
7	18 PM	070	075		Figure C10 is a view of the tank sidewall from near the present water line (near the bottom) to about 2 + ft. above the tank midplane. A number of waterlines (bathtub rings) can be seen but no significant corrosion attack is associated with them. It is not clear what may have caused the dark, innocuous, capillary-climbing-type regions near the tank bottom. An approximate 2-in. wide (est.), horizontal tan-colored band occurs around the tank midplane. This band appears to be associated with a weldment.
7	24 PM	134	056		Figure C11 is a view of the tank mid-sidewall area showing patches of remaining Amercoat #55 intermingled with areas of minor rust.
7	23 PM	126	059		Figure C12 is a higher-magnification view of some of the patches of still-attached Amercoat #55 with regions of minor, but more distinct areas of general corrosion and pitting corrosion. Breaks in the coating did not appear to increase local corrosion.
7	25 PM	224	055		A view of the far end of the tank, from slightly below its midplane to its top, is shown in Figure C13. It shows the patchiness of the remaining coating, the deposit-coated stainless steel downcomer pipe for the steam-jet siphon, and minor corrosion attack on the tank top. The slightly different texture/color stain near the tank opening for the siphon pipe may indicate that some rainwater/snowmelt periodically enteredthe tank and collected on its top before dripping into the tank. No areas of significant corrosion attack were noted anywhere in the tank.
7	27 PM	231	064		The downcomer pipe for the submersible pump was difficult to recognize as most of its surface was either covered with a deposit or was stained. One dark area that might be deeply corroded is shown in Figure C14. Even if this area had corroded through-wall, the remaining material is of adequate strength (and toughness) to resist failure, although it might bypass some of the pumped fluid back into the tank (see also Figure C18 below).
7	34 PM	165	074		Figure C15 shows a range of horizontal colors/stains from near the bottom (dark), progressing to tan/white to spotty corrosion areas above the tank midplane. The horizontal band (about 2-in. high), appears to be associated with a weld as noted in Figure C10.
7	37 PM	123	098		In Figure C16 a satisfactory-appearing, circumferential weld can be seen. This weld is also traceable toward the top of the tank (not shown), even when passing under some of the remnant coating and corrosion product cover.
7	40 PM	057	052		Some pieces of the remnant coating are seen partially peeled-off the tank wall, in Figure C17. The figure covers a region slightly below the tank midplane to near its top. Regions around the peeling pieces of Amercoat were examined for evidence of crevice corrosion (essentially deep pitting); none was observed.
7	53 PM	238	063		Figure C18 is a view of the SS steam-jet siphon pipe as it enters the tank (see also Figure C14). Some deep pitting appears about 1-2 in. down from the riser entrance. Additional pitting may also have occurred around the remaining circumference. The corrosion pits do not appear to have gone through-wall, but could be deep relative to its schedule 40 thickness. The most likely detriment is waste fluid bypass during pumping, when the pit penetrates through the wall. Structural strength will not be significantly impaired because austenitic SS alloys have both a consistent high degree of toughness and a low level of notch sensitivity.
7	38 PM	129	042		A region of more intense, but innocuous, pitting/general corrosion attack is seen in Figure C19. Although the depth cannot be readily measured, it is estimated to be less than 5-10% of the initial tank-wall thickness (9/16-in.).

Figure C7
View of Detritus on UX-302A Tank Bottom: Sludge Layer, Manual ENRAF Tape, Possible Piece of Rebar, and Clear Water (estimated at 12-18 in. deep)

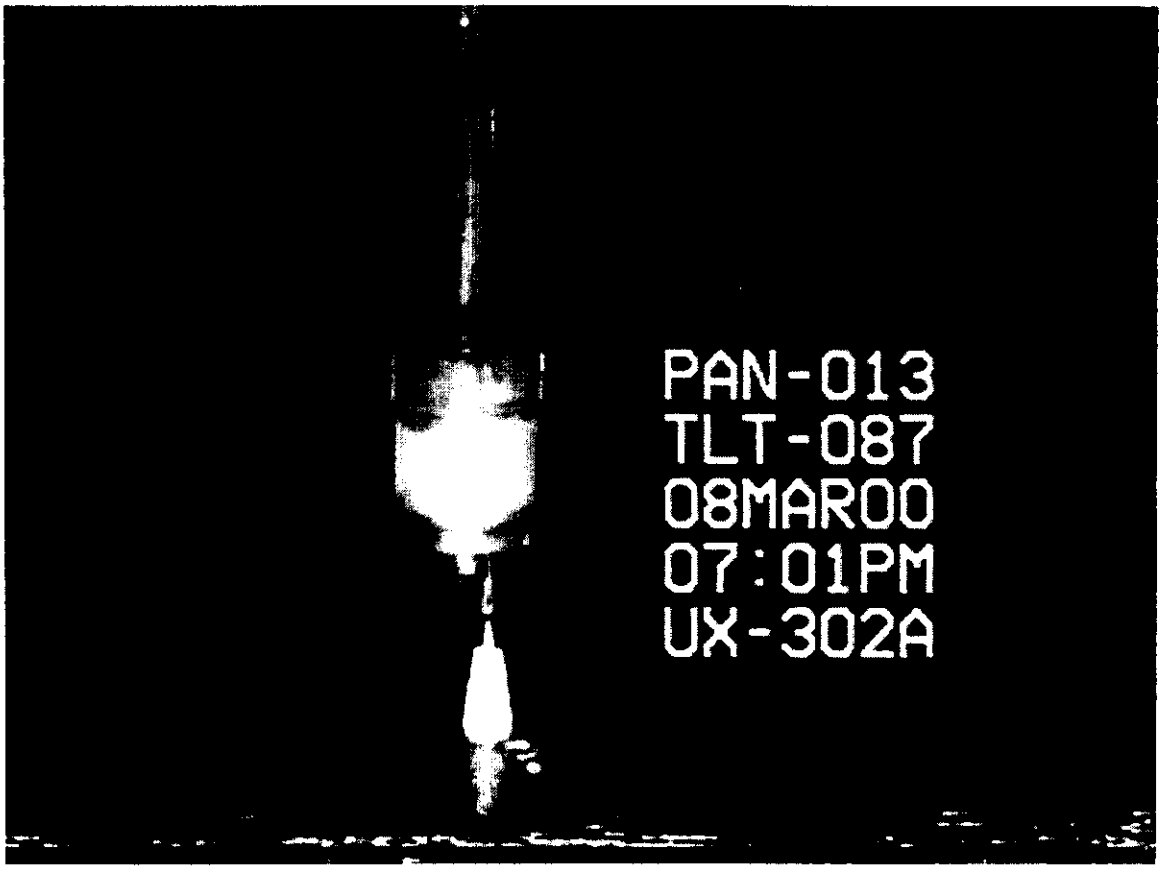

Figure C8
View of ENRAF Liquid Detection Device (foreground) and Submersible Pump, Catch Tank 241-UX-302A

Figure C9
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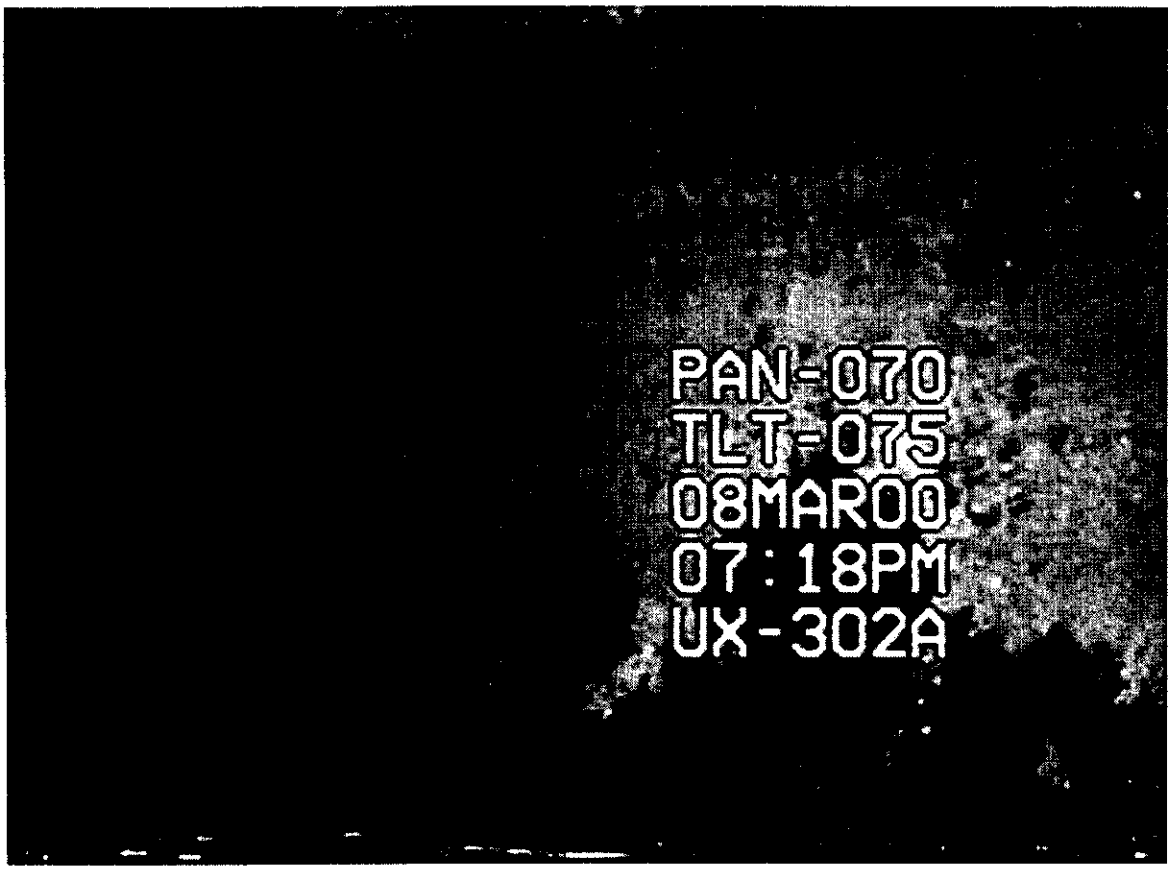

Figure C10
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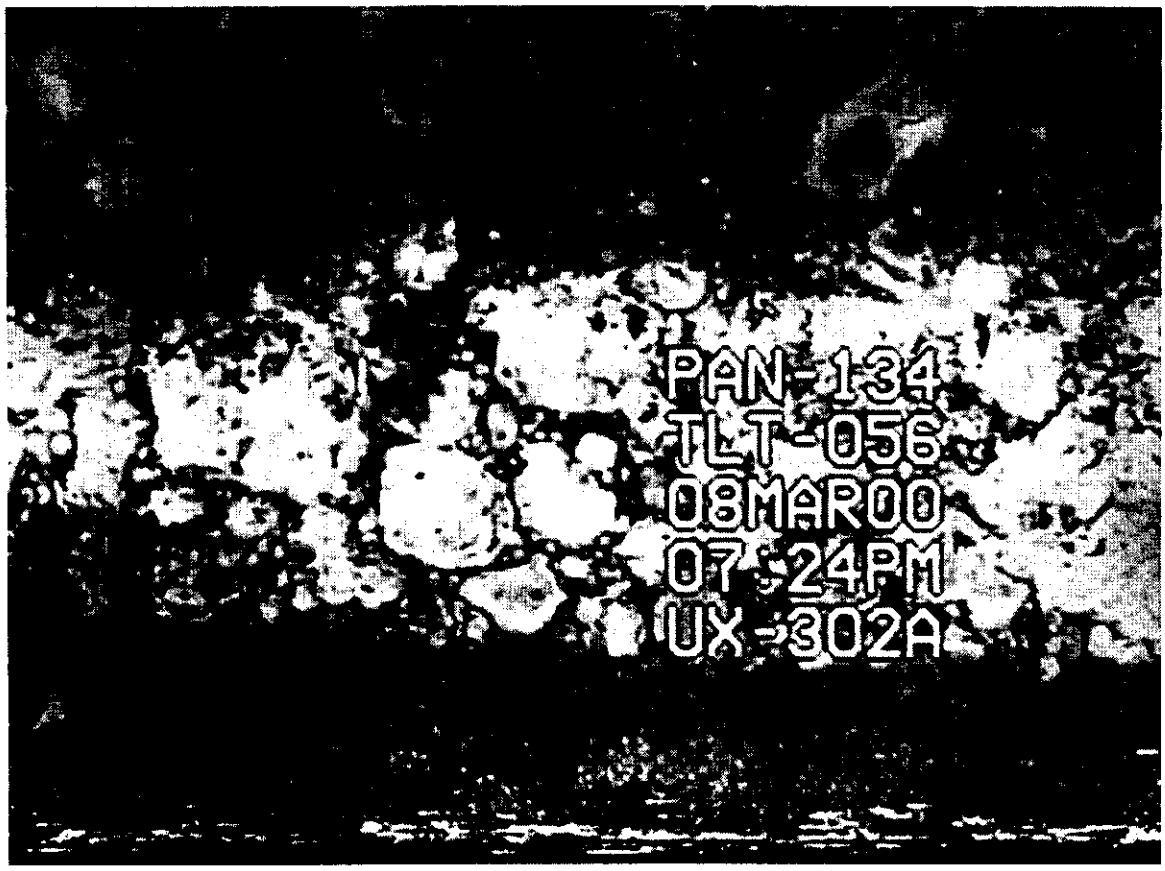

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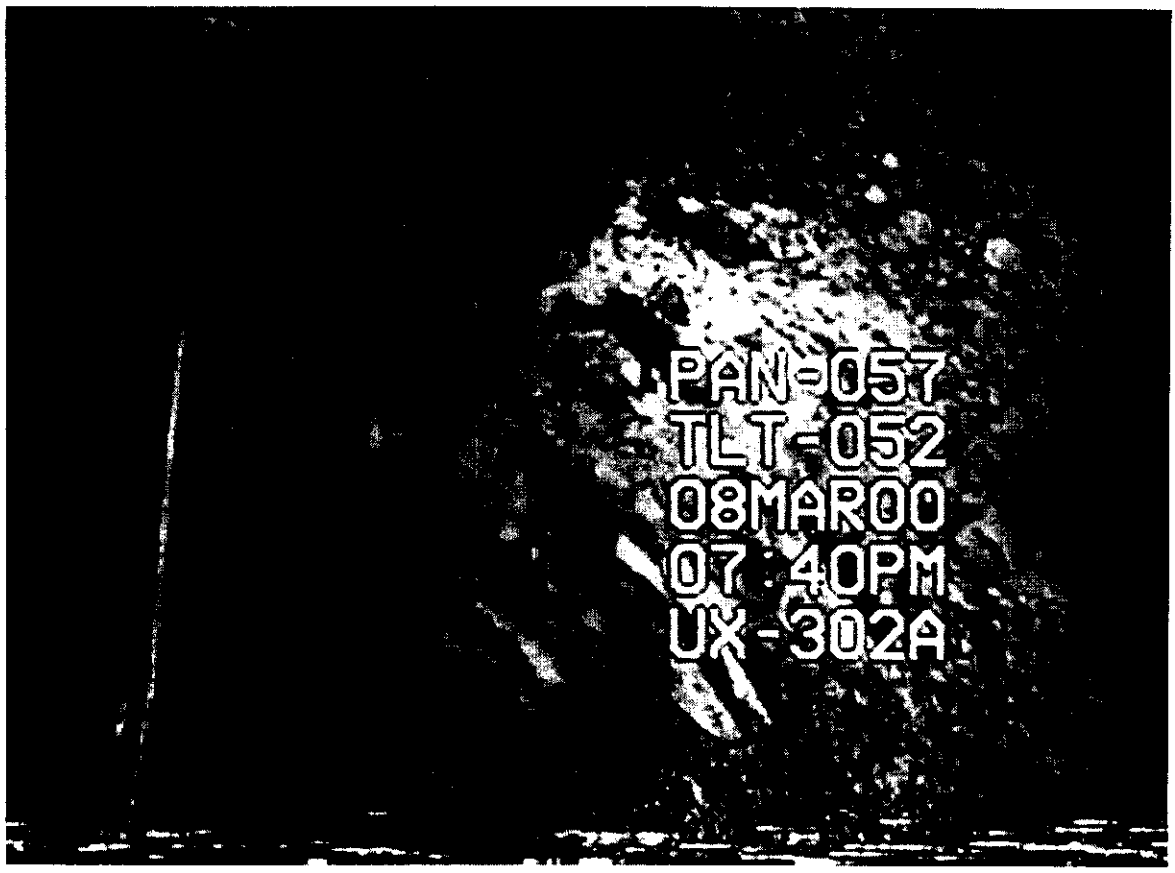

Figure C17
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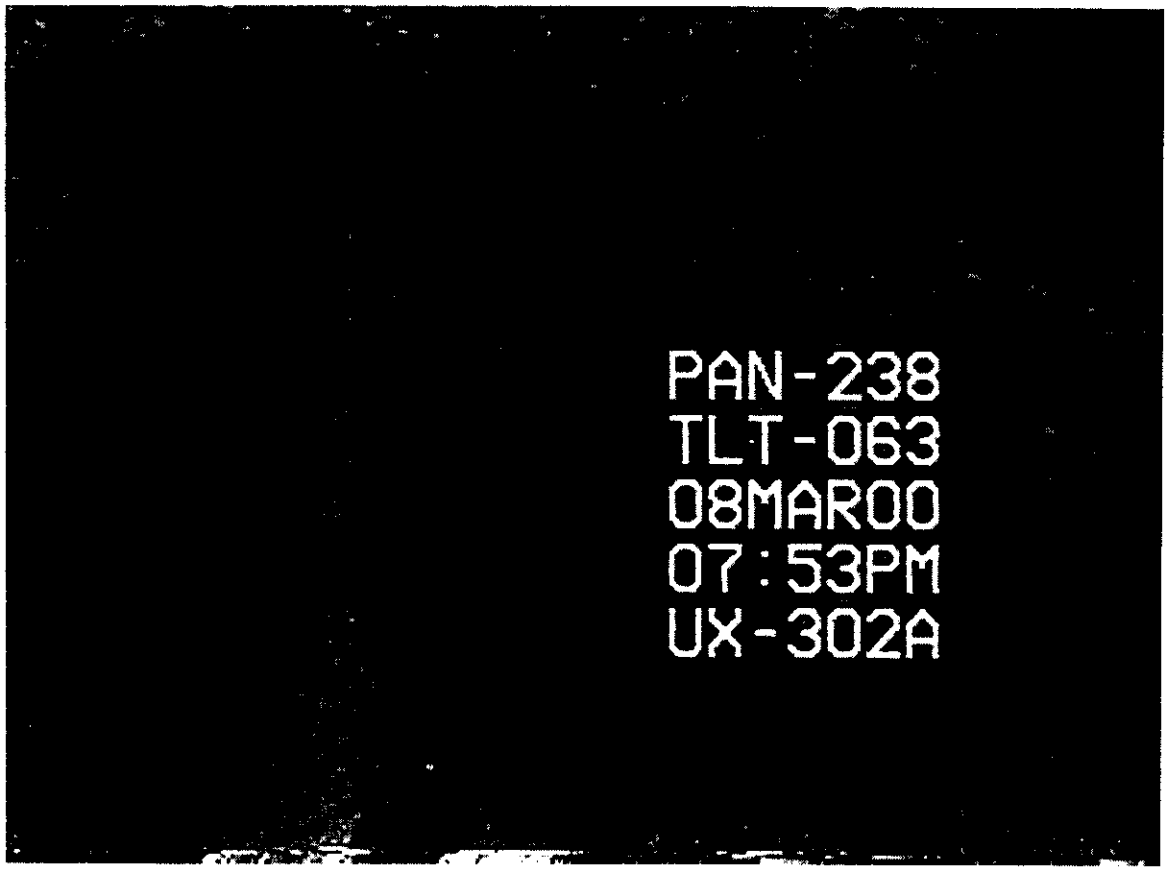

Figure C18
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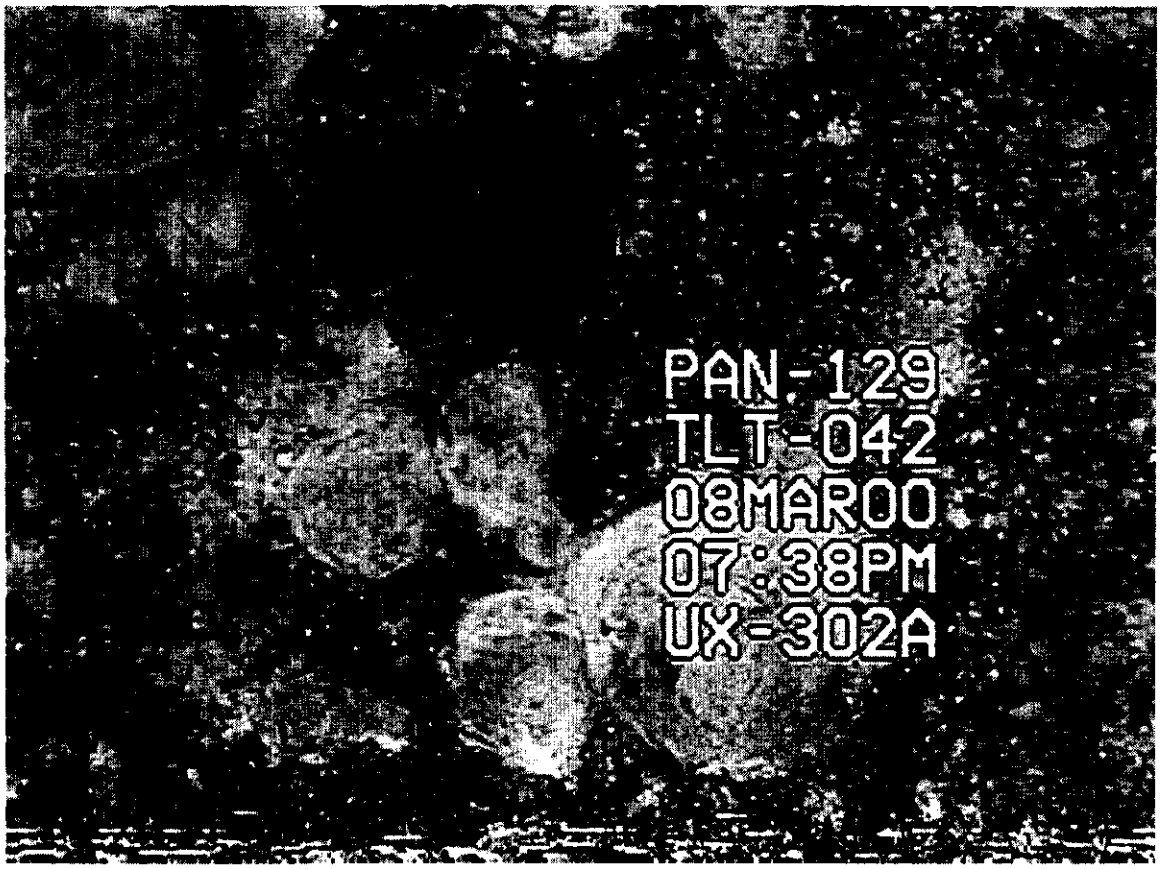

Figure C19
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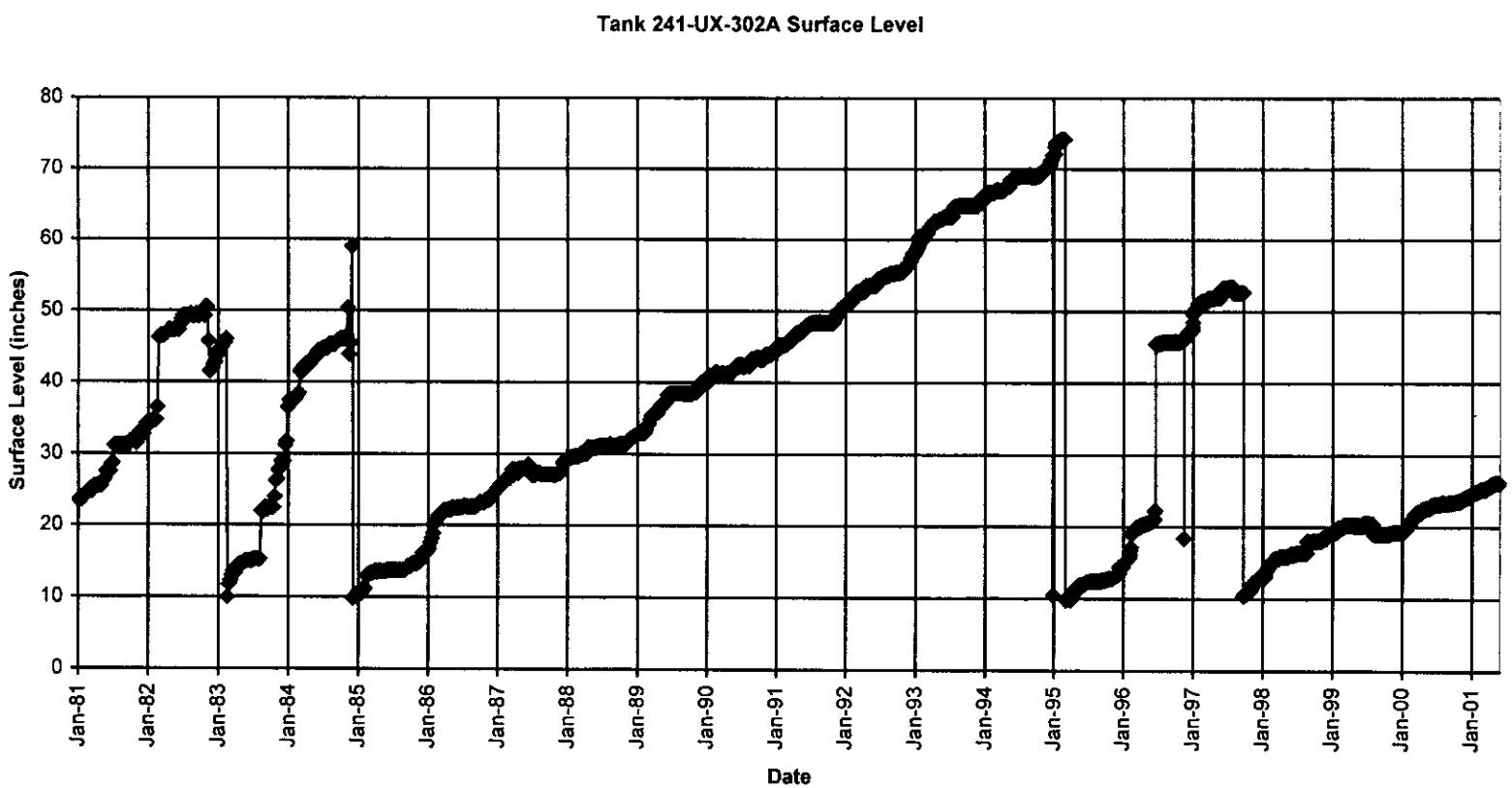


Figure C20
Composite Surface Level versus Time Curves, 241-UX-302A

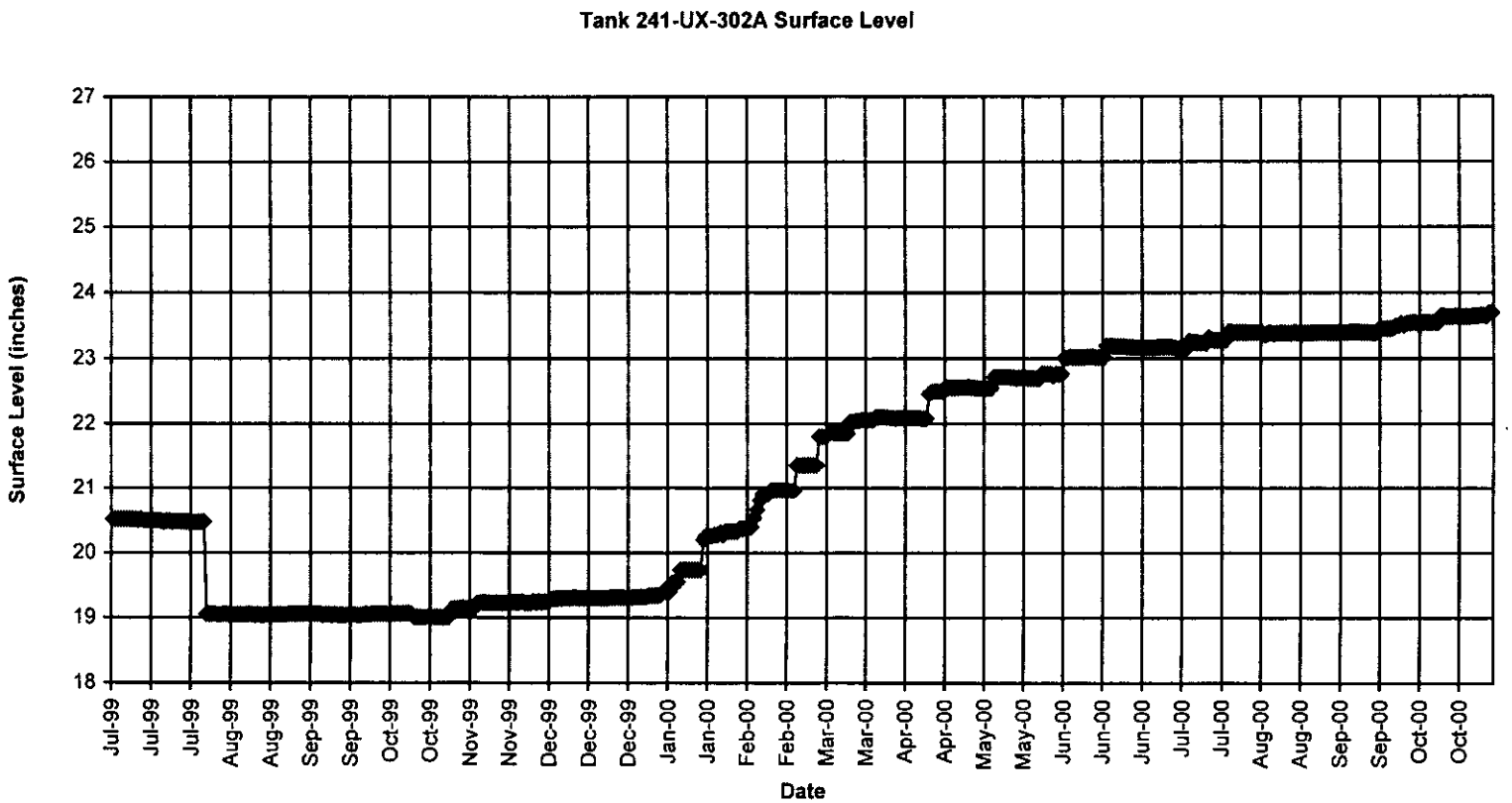
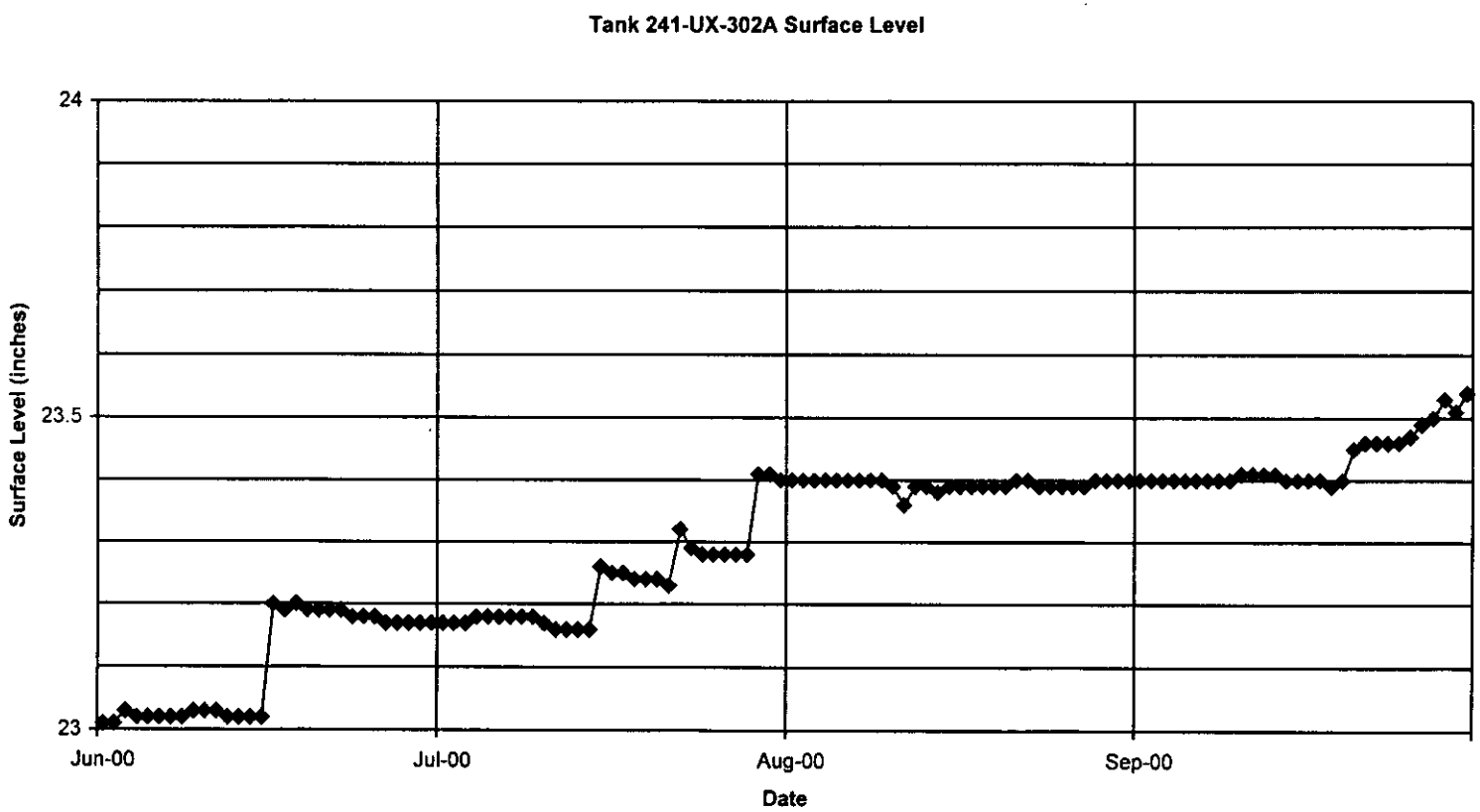


Figure C21
ENRAF Surface Level versus Time Plot July 99 to October 2000, 241-UX-302A



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APPENDIX D

241-TX-302C CATCH TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and materials
$BiPO_4$	bismuth phosphate
CVI	Certified Vendor Information (file)
ENRAF	Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge)
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System
HLAN	Hanford Local Area Network
ID	inside-diameter
NON-GRE	non-gas release event
PCSACS	Personal Computer Surveillance Analysis Computer System
RHA	Records Holding Area
RMIS	Records Management Information System
SS	stainless steel
TX-302C	241-TX-302C catch tank
VITIS	Video In-Tank Inspection System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

The 241-TX-302C catch tank (TX-302C) is located in the 200 West Area of the Hanford Site (Figure D1). The catch tank was designed and installed to be used as the secondary containment to diversion box 241-TX-154.

2.0 PURPOSE

The purpose of this design evaluation and examinations is to determine if the TX-302C components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the TX-302C pump pit and the catch tank. The scope of the examinations includes a visual examination of the TX-302C catch tank internal surface, its pump pit, and a leak test of the tank.

4.0 DESCRIPTION

The 241-TX-302C catch tank is a direct-buried underground tank. A pump pit sits directly above the center of the tank at ground level. Installation of the tank occurred in 1947; it was modified in 1984 under Project B-231 primarily by addition of the pump pit and an underground pump-out capability (Vitro 1980). The location of the facility on the Hanford Site is shown in Figure D1 and a sketch of the facility is shown in Figure D2.

4.1 PUMP PIT

The pump pit is a 5-ft-inside-diameter (ID) galvanized corrugated metal pipe, which is 4-ft by 6-in. deep. A 12-in.-diameter schedule 40 riser, made of carbon steel pipe, descends approximately 23 ft from the bottom of the pump pit to the tank. This riser houses the submersible waste transfer pump. If any leaks were to occur within the pump pit, the pit is designed so that leaks would drain to the catch tank, below. A round steel plate provides a cover to the pump pit and is resistant to rainwater and snowmelt intrusion. Addition of the pump pit occurred in 1984 under Project B-231 (Vitro 1980). The modifications of Project B-231, Phase I, provided TX-302C with permanent underground pump-out capability via a direct-buried pump-out line to the 241-TX-154 diversion box.

4.2 CATCH TANK

The TX-302C catch tank is a horizontal cylindrical vessel 8-ft, 10-7/8-in. inside diameter by 39-ft, 4 1/4-in. long, buried approximately 28-ft (to centerline of tank) below grade. An additional 3-ft-high soil berm was added around the new pump pit. The tank was fabricated of 9/16-in.=thick carbon steel plate. On the ends are flanged and dished heads with a radius of 8-ft, 6-in. On the top of the tank are six penetrations with flanged connections. There are five 4-in. and one 18-in. flanged connections on the tank. Two of the 4-in. connections are the inlets to the tank and come from the drains of the TX-154 diversion box. The third 4-in. connection is for a liquid level measuring device. The fourth 4-in. connection was originally for a steam jet siphon pump-out and is now isolated. The fifth 4-in. connection is a sealed spare. The 18-in. connection flanges down to a 12-in. riser that is connected to a pump pit (see Figure D2). This central 12-in. diameter riser, houses the submersible waste transfer pump and connects the pump pit with the tank. The outer surface of the tank is coated with coal tar to protect it from corrosion.

This tank is used as secondary containment to diversion box TX-154, which supports waste transfers from T Plant. This diversion box is no longer used because of non-compliant transfer lines, and all transfers from T Plant are now being performed by rail car.

5.0 DESIGN EVALUATION

The design standards for the 241-UX-302A catch tank and pump pit, the waste characteristics and compatibility, corrosion protection, and the age of the tank system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of TX-302C. A thorough search was conducted to identify the available design requirements of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford Drawing list at Document Control Center
- INSIGHT or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base
- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farms Engineering staff members.

5.1.1 Tank

Since TX-302C was installed in 1947, the original records of construction and testing were not found. However, some design information was found on the original construction drawings.

The tank was welded and stress-relieved in accordance with paragraphs U69 and U76 respectively of American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code Section VIII (Drawing 1947a, Drawing 1947b).

The tank was tested to 125 psig hydrostatic pressure after standing full of water for at least 24 hours. The tank was to be absolutely leak-proof under test (Drawing 1947a, Drawing 1947b).

All materials used in the construction of the tank were carbon steel under American Society of Testing and Materials (ASTM) A-285-46 Grade B (Drawing 1947a, Drawing 1947b).

The tank's exterior and interior surfaces were cleaned of all mill scale and grease by sandblasting. The interior surfaces were left to be unpainted. The exterior surfaces were to be coated with coal tar enamel similar and equal to that manufactured by the Barrett Company to specifications for underground tanks (Drawing 1947a, Drawing 1947b).

The TX-302C tank was installed on a sand bed with no timbers, sleepers or saddles and leveled to within 1/2-in. of 36 ft length, sloped downwardly to the jet box end (Drawing 1947a, Drawing 1947b).

5.1.2 Pump Pit

The pump pit and associated piping installed in TX-302C under Project B-231 was built and tested in accordance with construction specification B-231-C1 (Vitro 1980).

The pump pit has a concrete floor that connects to the 5 ft ID galvanized corrugated metal pipe according to Federal Specification WW-P-405A, Class 1 Series B, 14 Gage. (Hanford Drawing H-2-71643). The pit contains a 3-in. floor drain to route any liquid to TX-302C below. The pump pit is provided with a steel plate cover, which is resistant to rainwater and snowmelt intrusion.

A structural assessment of numerous facilities subjected to various load conditions were performed recently (Westinghouse Hanford Company [WHC] 1996). This assessment determined that TX-302C tank could fail under three load conditions: 1) existing soil dead load, 2) internal static vacuum of -8 psig, and 3) high waste sludge temperature of 600 degrees F. The evaluation concluded that the tank failure mode due to soil dead load was by the buckling inwards. However, the tank has been in service for 53 years and the recent internal visual examination (results are presented in Section 6.0) reveals that the tank is intact and in good condition. Review of the WHC 1996 analysis methods for calculating the effect of soil loads showed the analysis to be unrealistic and over-simplified. A refined analysis of the tank was performed in 1998 (Schlosser 1998) for the allowable dome loads, and showed that the catch tank is within allowable design limits with significant added live loads. Failure of the tank by the second and third noted loading conditions is precluded by administrative controls.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The catch tank TX-302C was primarily provided to receive and contain spilled, leaked, or flush-water waste through two 4-in. gravity-flow drain lines from diversion box TX-154. The design drawing for catch tank TX-302C (Drawing 1947a, Drawing 1947b) was dated July 1947 while the TX-154 diversion box (Hanford Drawing H-2-836) was dated January 1948. By implication the catch tank did not receive any spilled waste earlier than January 1948. T Plant began its operation in 1943 and ran until 1956 (Freeman-Pollard 1994).

A number of different wastes could have drained from the TX-154 diversion box to TX-302C during its primary years of operation from 1948 to 1956. At that time T Plant was operated identically to B Plant for the purpose of plutonium separations operations. After 1956, T Plant became a decontamination and experimental facility only, and very little waste was transferred to the tank farms.

The T Plant's earliest waste came from plutonium recovery of irradiated uranium fuel using the bismuth phosphate ($BiPO_4$) process (Freeman-Pollard 1994). Four distinct wastes were produced by the $BiPO_4$ process: metal waste, coating waste, first-cycle decontamination waste, and second-cycle decontamination waste. More details on these wastes can be found in Freeman-Pollard (1994). Metal waste contained plutonium (1 percent by mass) and a high

quantity of uranium. Coating waste contained dissolved fuel rod cladding (aluminum), plutonium (1 percent by mass), and > 2 Molar concentration sodium salts. First and second cycle waste also contained dissolved fuel rod cladding (aluminum), plutonium (0.4 percent), uranium (0.4 percent), and sodium salts. While these wastes were primarily caustic (pH > 7) more optimal corrosion controls, for the purpose of minimizing uniform corrosion, pitting corrosion, and stress-corrosion cracking, were not applied to waste processing in general until about 1984. Major processing in T Plant ended in 1956 (see Section 5.3).

The decontamination and experimental facility waste was very dilute because of the nature of decontamination operations (washing and flushing). The Personal Computer Surveillance Analysis Computer System (PCSACS) data for the last 18 years, has shown that one water line break (291-C stack building), several flushings, and numerous rainwater and snowmelt intrusions now make up the bulk of the waste passing into TX-302C. Pumpout from the tank appeared to have occurred only in 1985 and 1998. As of February 1999, about 5- to 6-in. of likely dilute waste remains in the tank.

According to 200 West Area engineering personnel, the T Plant stack drain is the only line left draining into the catch tank. If any pumping-out is to occur in the future, it will be done using a tank truck because of concern over the leak tightness of the pump-out line, V-739.

Because of the relatively small amount of waste left in the tank, and the high ratio of void volume to waste volume (including sludge), there is little potential for hydrogen generation to result in a gas release event. This same finding was made for seven other proximal catch tanks 241-T-301B, 241-TX-302A, 241-TX-302B, 241-TX-302BR, 241-TX-302XB, 241-TY-302A and 241-TY-302B, that had also been associated with T Plant, and that had been declared inactive (See Freeman-Pollard 1994). In addition, *Tank Farms Administrative Controls* (Cox 1997) declared that catch tank TX-302C is a non-gas release event (NON-GRE) facility. Regarding other risks, the Freeman-Pollard 1997 report indicates that these related catch tanks also have low risks associated with flammability, ferrocyanide, organic salts, vapor emission, criticality, heat generation, and radiological hazard. Finally, no compatibility assessments have been done on its contained waste because no samples have been taken.

According to 200 West Area engineering personnel, there is no present plan for deactivating the current diversion boxes and thus there is also no such plan for the catch tanks either. Consequently, there is no fixed end of service date for catch tank TX-302C at this time.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided primarily by the combination of good design, appropriate material selection, and corrosion control. Both design and material selection were initially adequate for TX-302C. Effective corrosion control, however, was not implemented for the majority of waste processing in T Plant. Corrosion testing did occur in the 1940s (Leach and Stahl 1993) that was directed toward minimization of corrosion in single-shell tanks. Major processing operations in T Plant were shut down in the same year that corrosion controls were introduced (Kirch 1984).

Catch tank TX-302-C was constructed from ASTM A 285-46 carbon steel plate, 9/16-in. thick (Drawing 1947a, Drawing 1947b). Both exterior and interior surfaces of the tank were cleaned of all mill scale and grease by sandblasting. Interior surfaces were left unpainted. The exterior surfaces were coated with coal tar enamel similar and equal to that manufactured by the Barrett Co., to specifications for underground tanks (Drawing 1947a, Drawing 1947b). According to Mattichak 1997 and Freeman-Pollard 1994, no (external) cathodic protection has been applied to this tank for exterior surface corrosion control. Soil is in contact with the tank's exterior coated surface.

5.4 AGE OF THE TANK SYSTEM

The tank is approximately 54 years old (constructed in 1947) with and had an estimated use for 53 years. An integrity assessment of the tank and its associated components has not been performed since the time of construction.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations, visual and leak test, were performed in May 2000 and April 1998, respectively. They were conducted to identify possible degradation of the tank system, and to determine the extent of that degradation that could have occurred since completion of construction approximately 54 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the catch tank interior and in the pump pit. Date of examination, for both facilities, was May 1, 2000. Visual examination details and data sheet findings for the pump pit and the tank are included in twelve photos and two video examination data sheet tables that appear at the end of this appendix. The twelve individual 'still' photographs, taken from the videotapes and presented in the above figures, show the generally satisfactory condition of the facility

6.1.1 Pump Pit Visual Examination

Access to the pit was obtained by removing its round metal cover (See Figure D2). The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing the facility components) was lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Azimuthal movement of the camera is provided by manual manipulation of the camera's suspended pole. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or a narrower-angle setting) used to closely view details of interest.

The color videotape showed that the condition of the corrugated and galvanized pump pit walls, cover lid and floor appeared very satisfactory. Various ancillary equipment within the pump pit

also appeared very satisfactory. Table D1 provides a description of the visual examination findings and Figure D3 through Figure D5 show the condition of the pump pit.

6.1.2 Catch Tank Internal Visual Examination

Access to the receiver tank interior was provided by lifting, moving aside, and suspending the pump module several feet above the bottom of its supporting pump pit. This allowed access for the VITIS II video camera, which is less than 4.0-in. in diameter, even though the pump discharge piping and its electrical supply still remained inside, but offset in the 12-in. diameter pipe. This riser projects downward into the top center of the tank. Most of the tank interior could be seen although there were some occasional minor limitations on the panning range caused by the proximity of the pump discharge pipe. In addition, the tank walls could be viewed all the way from the bottom–lying dry sludge layer to the top of the tank. The Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge) (ENRAF) level measurement device recorded a height of 3.69 in. at the time of inspection.

The color videotape showed that the tank interior surfaces and internal components are in very satisfactory condition. Table D2 provides a description of the visual examination findings for the catch tank, and Figure D6 through D14 show the condition of the catch tank. The tank appears to have been filled to as high as about 95 percent of its capacity based on the presence of visible waterlines near the top.

There may be no fluid (or at least very little) remaining in the tank as shown by the "mud-cracked" surface of the dry sludge. Also, there are some whitish deposits on portions of the tank below its mid-plane. Light, insignificant rusting was evident on much of the tank's interior. Weldments appear to be satisfactory.

The visual examinations of the pump pit and catch tank show generally satisfactory results.

6.2 LEAK TEST

To assess leak tightness of 241-TX-302C, a review of fluid level records was conducted. For TX-302C, four types of catch tank liquid level measurement system data are available on the PCSACS system; manual tape, manual Food Instrument Corporation (FIC), auto FIC, and manual ENRAF. The manual ENRAF data were selected for the leak-check analysis for two reasons. They provide the most sensitive level measurement capability, and they cover the most recent time period (January 1997 to April 1998) when the tank was at its fullest (about 57 percent full or approximately 8,000 gallons). Level data for the tank are plotted in Figures D15 through D17.

A minimum of 46 hours (approximately 2 days) is considered the minimum time over which the leak check would have to be conducted to satisfy the established leak detection criteria.

Based on the waste level holding at 50.06-in. for 9 days in early April 1998, the tank was determined to not be leaking. Figure D17, is a plot of the constant manual ENRAF level, in the March-April 1998 time frame.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The tank has been in service for approximately 53 years without any leaks reported, which proves that at the time of its construction, adequate design controls were used to withstand applicable loads.

2. The tank is not leaking at the leak test level of 50.06-in. To demonstrate its leak tightness at a higher level, a leak test should be conducted at that higher level.

3. Because the facility is relatively old, but is in relatively good condition, another set of visual examinations and a leak test are recommended within the next 10 years.

8.0 REFERENCES

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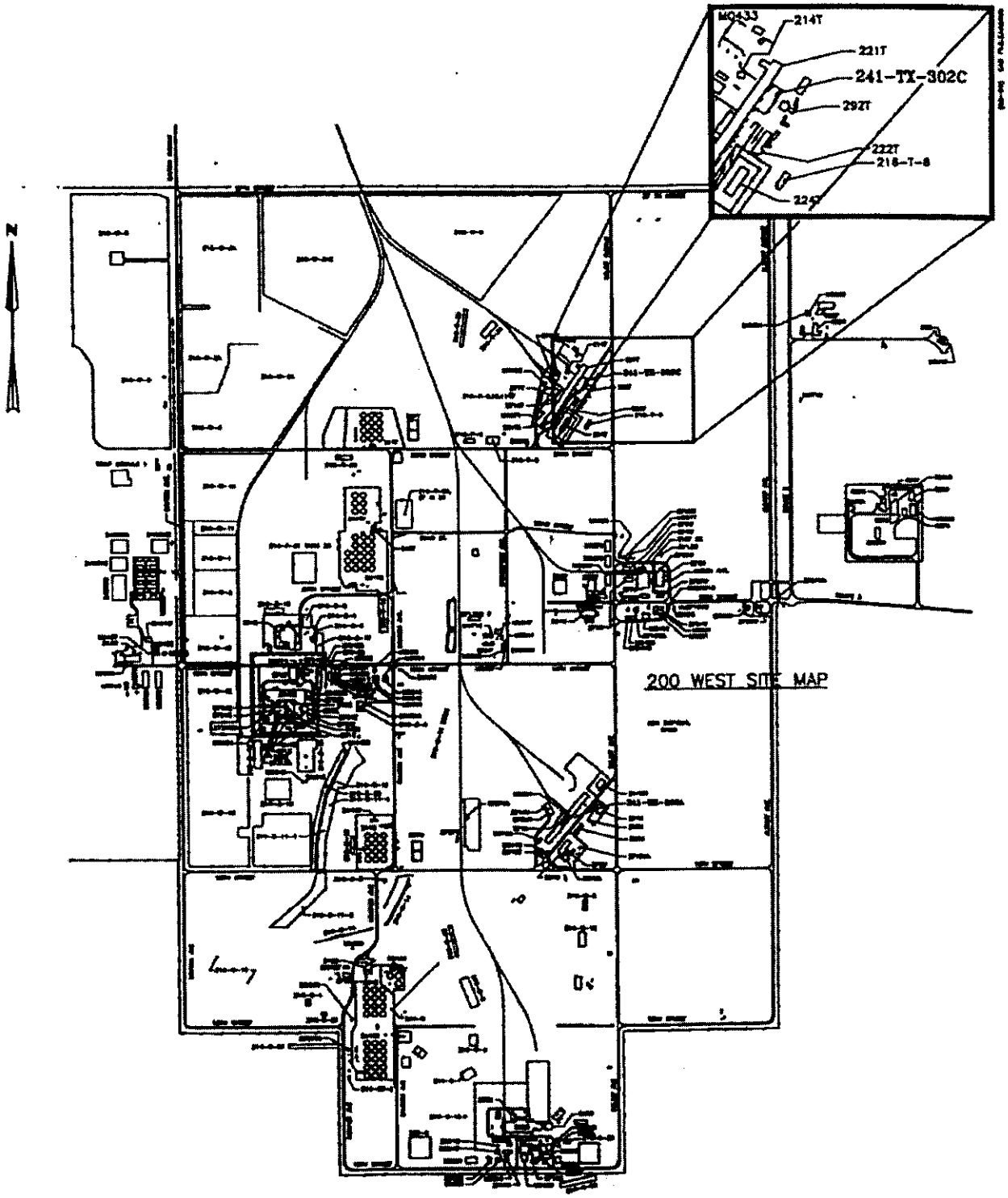

Figure D1
Location of 241-TX-302C on the Site Plan

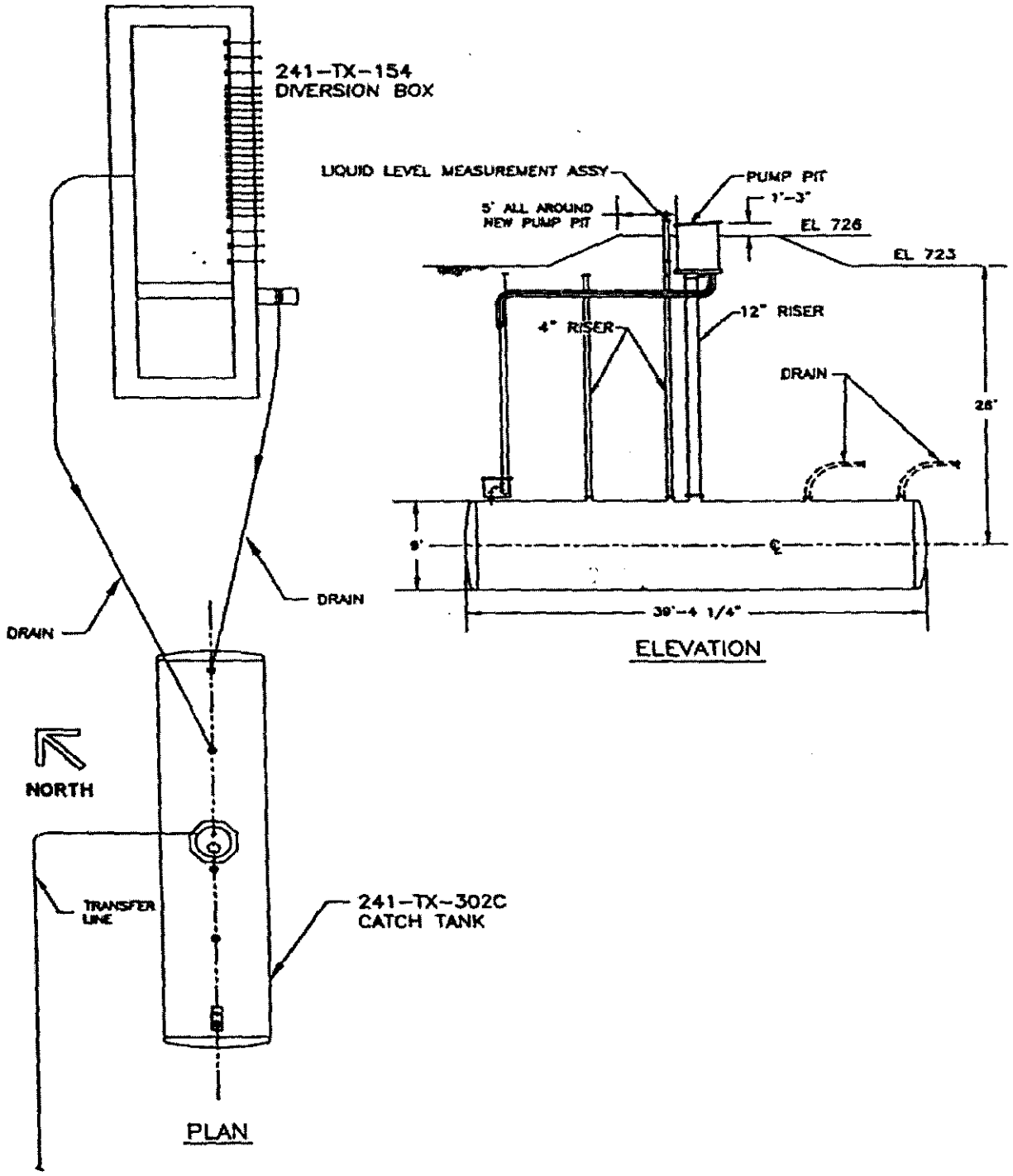

Figure D2
TX-302C Catch Tank

Table D1. Video Examination Data Sheet, 241-TX-302C Pump Pit

Examination Date: 5/1/2000

Person In Charge: Ken Baird Camera Operator: Tom Miller Video Examiners: T. S. Hundal

Opening: Lid on top of pump pit.

Video Tape Reviewer: E. B. Schwenk Date: 5/15/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The interior of the 241-TX-302C pump pit was attained by removal of its round metal lid. The pit is about 5 ft in diameter and about 4-1/2 ft deep. The VITIS II Video Camera was used for the visual examination. The surface-level pit was added to the facility in 1984 and is connected to the tank with a 12-in. diameter pipe, which houses a suspended pump. All components of the pump pit appeared in very satisfactory condition.
1136 hours		088	176		Figure D3 provides a view of the pump pit floor and the pump module, which had been lifted several feet above is normal position, to allow camera access for the subsequent visual examination of the tank interior. The floor drain and leak detector combination were free of any significant debris.
1137 hours		031	106		A view of the galvanized, corrugated pipe sidewall of the pit and half of the pump module lifting yoke are shown in Figure D4. Minor white stains on the left of the photograph probably came from rainwater/snowmelt in-leakage over an extended period of time.
1140 hours		092	132		Figure D5 shows the adequacy of instrument electrical connections and a nozzle assembly, both located behind one of the lifting yokes.

Figure D3
View of 241-TX-302C Pump Pit Floor and Suspended Pump Module; Floor Drain and Leak Detector Unit in Middle Foreground

Figure D4
View of 241-TX-302C Pump Pit Corrugated Wall and One of Two, Pump Module Lifting Yokes

Figure D5
View of 241-TX-302C Lifting Yoke, Electrical Connections, and Nozzle Assembly (both in background).

Table D2. Video Examination Data Sheet, 241-TX-302C Catch Tank Internals

Examination Date: May 1, 2000

Person In Charge: Ken Baird Camera Operator: Tom Miller Video Examiners: T. S. Hundal

Riser: 12-inch Pump Riser

Video Tape Reviewer: E. B. Schwenk Date: July 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					241-TX-302C Catch Tank internal region was entered through the facility's pump pit (as described in Table D1), and then down through the pump's centrally located 12-in. diameter opening. The same VITIS II video camera was used for the tank-internal visual examination. A description of the pump pit visual examination is presented in Table D1, above.
					The following narrative and photographs will demonstrate that the approximately 50-year old catch tank, and its internals are in very satisfactory condition. Based on this video examination and design evaluation, the catch tank, and its associated equipment, all appear structurally sound and capable of continued service.

Table D2 Video Examination Data Sheet, 241-TX-302C Catch Tank Internals (continued)					
					The tank appears to have been filled to as high as about 95 percent of its capacity. This observation is based on the presence of visible waterlines located near the top of the tank. In addition, the top-most region of the tank has probably undergone some minor amounts of normal vapor phase corrosion as well as possibly some rainwater and snowmelt in-leakage corrosion (from the pump pit). There is no definitive boundary between the last watermark and the top vapor phase/in-leakage corroded area. Presently, the uneven (and dry cracked) sludge appears to be about 3 to 6-in. deep. Before dry-out, however, the sludge layer (on top of the waste liquid) probably had an uneven thickness or distribution. As a result of a likely 'even' evaporation of the majority of the waste liquid, an uneven 'sludgeline' was left near the bottom of the tank. PCSACS surface level records (for manual ENRAF), indicate that significant evaporation started around May 1998 (around 7-in. depth) and leveled off at about 3.5-in. on May 1999. Dryout started following weather covering of UX-154 diversion box T-plant ventilation tank and likely continued the (to April 1999) but no movement of the ENRAF occurred, probably because the ENRAF float was locked in the dry sludge.
1147 hours		016	143		The top of the sludge layer has significantly cracked (see Figure D6), and this indicates that very little fluid (if any) is left at the bottom of the tank.
1153 hours		000	089		An overall view of the north end of the tank, including the salt-coated sidewall and heavily "mud-cracked" sludge is shown in Figure D7. A relatively large amount of sludge had collected at the south end of the tank during sludge settling with the liquid and left a slope of sludge when liquid evaporated.
1216 hours		050	073		An intersection of weldments (girth and horizontal) toward the westside and at the approximate midplane of catch tank 241-TX-302C, is shown in Figure D8; its condition appears very satisfactory.
1216 hours		059	078		Figure D9 is typical of a combination of whitish deposits (around the tank midplane) along with some minor areas of corrosion; region is just below image in Figure D8.

Table D2 Video Examination Data Sheet, 241-TX-302C Catch Tank Internals (continued)					
1218 hours		202	049		Nominal light rusting can be seen around a girth weldment in Figure D10. The weldment is above the tank midplane and appears very satisfactory. During videotaping the camera appears to have been reoriented to allow a greater range of panning. As a result, the pan angle has changed although the image locations have not.
1233 hours		000	078		A wide-angle view of the south end of the tank is shown in Figure D11. A vertical ENRAF tape is seen just to the left of the stainless steel (SS) steam jet siphon pipe (now disconnected).
1233 hours		000	052		A closer view of the top of the tank toward its south end is seen in Figure D12. Here the relatively high waterline(s) can be seen along with some probable vapor phase or in-leakage corrosion on the very top.
1238 hours		149	060		Figure D13 shows the presence of some corrosion pits in the SS steam jet siphon pipe. This view of the pipe is above the tank midplane.
1245 hours		128	078		Figure D14 shows a relatively large amount of sludge at the northeast corner of the tank; a similar amount can be seen in the northwest corner (not shown).

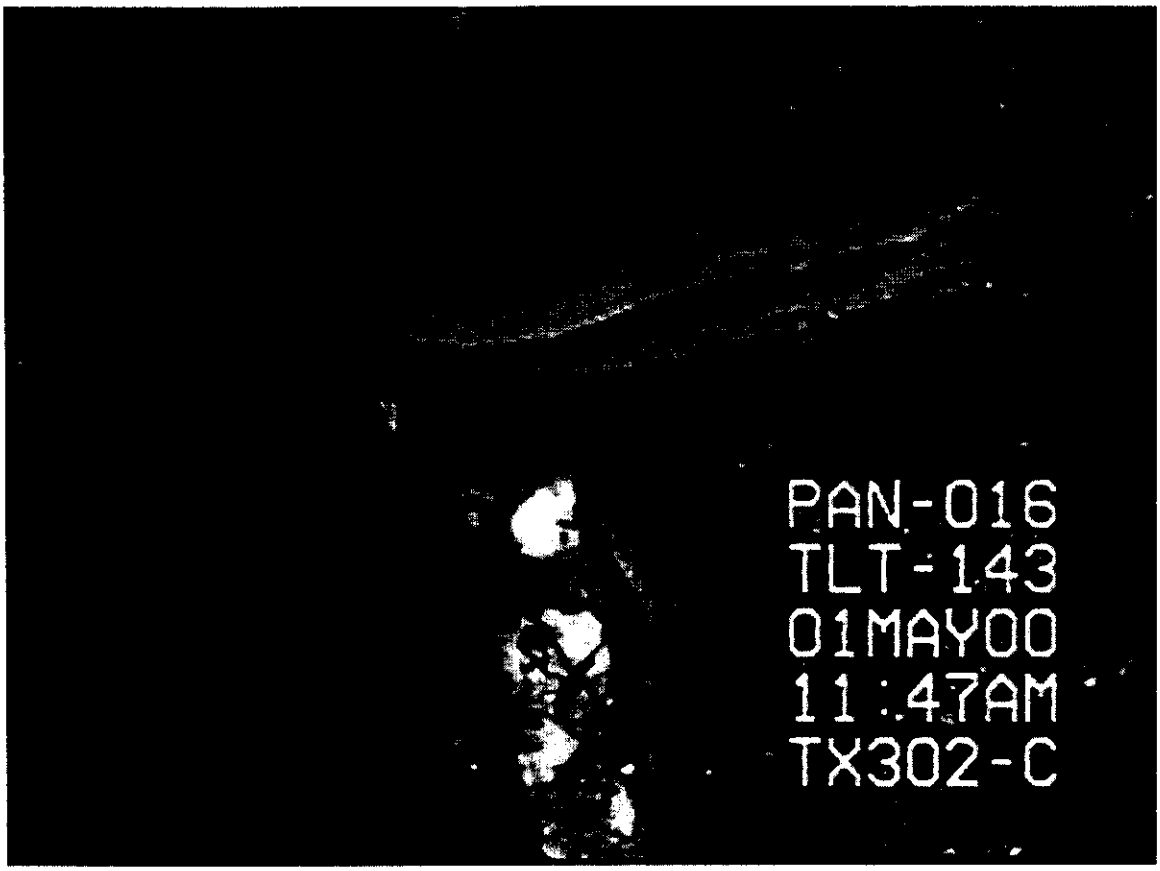

Figure D6
Dry, Cracked Sludge Layer in Bottom of Catch Tank 241-TX-302C

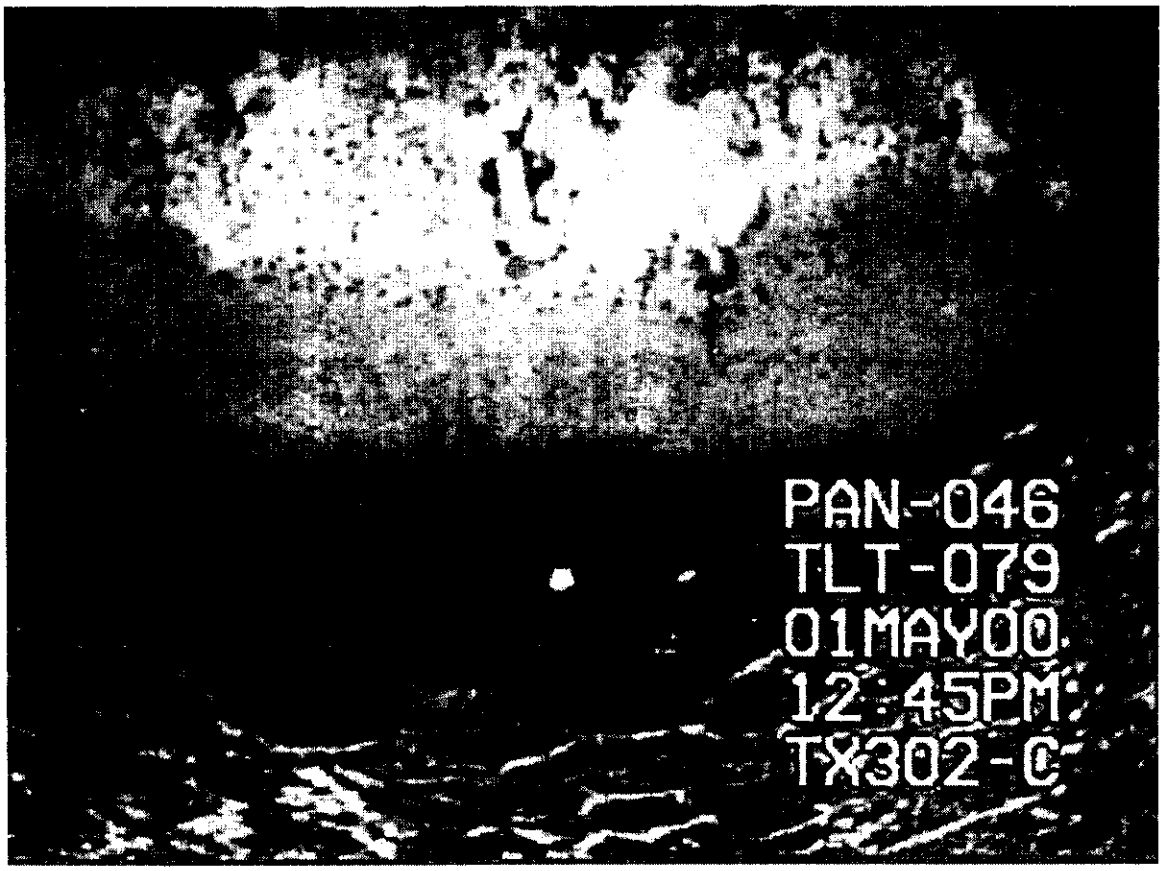

Figure D7 View of North End of Catch Tank 241-TX-302C Including Sludge Layer

Figure D8
Weld Intersection in Catch Tank 241-TX-302C

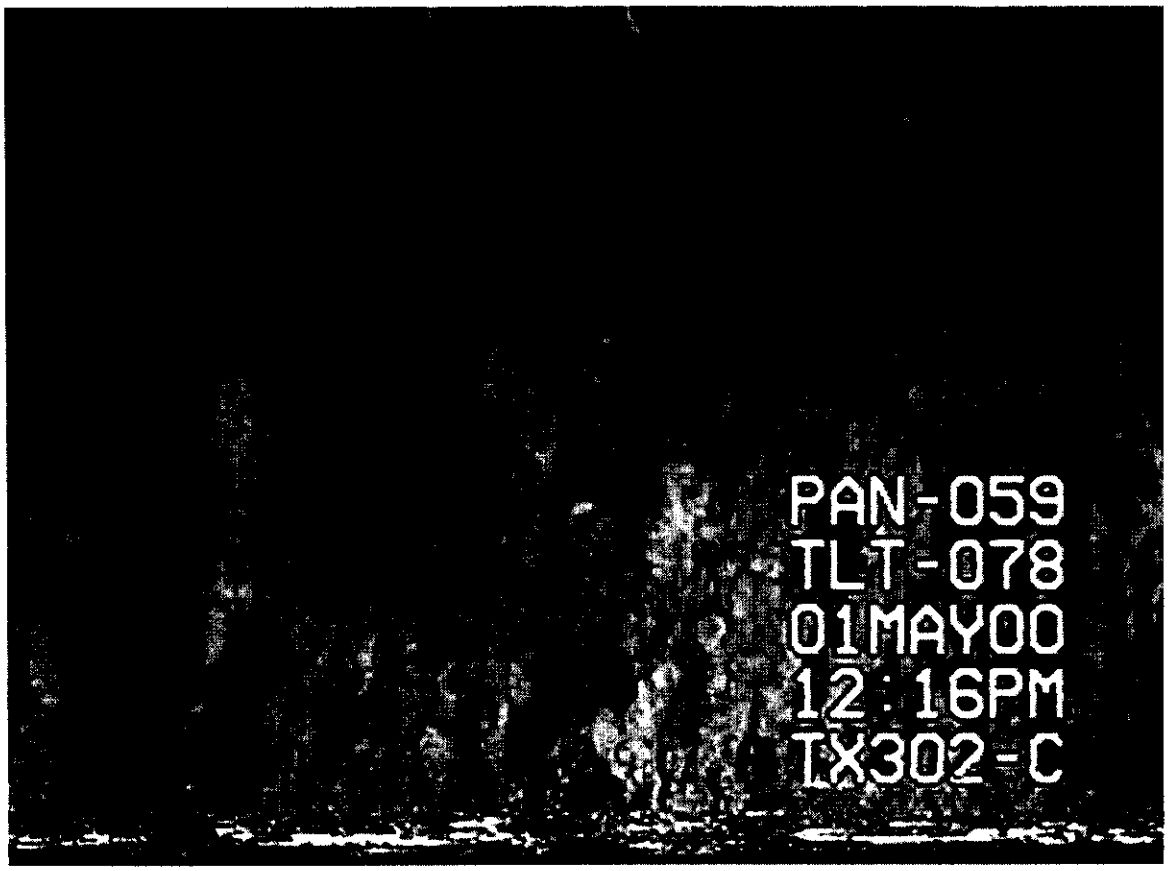

Figure D9
View of a Combination of Whitish Wall Deposits and Some Minor Areas of Corrosion, Catch Tank 241-TX-302C

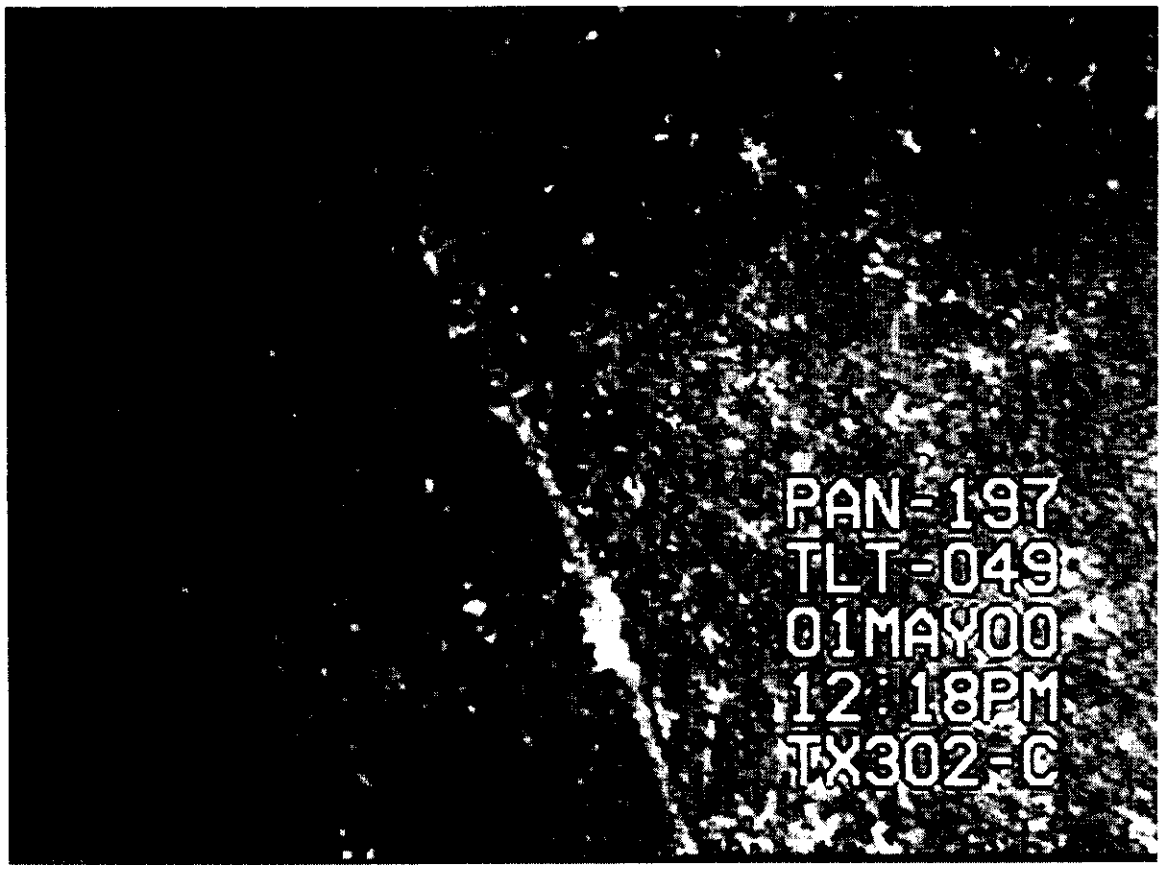

Figure D10
Light Rusting Around 241-TX-302C Catch Tank Girth Weldment

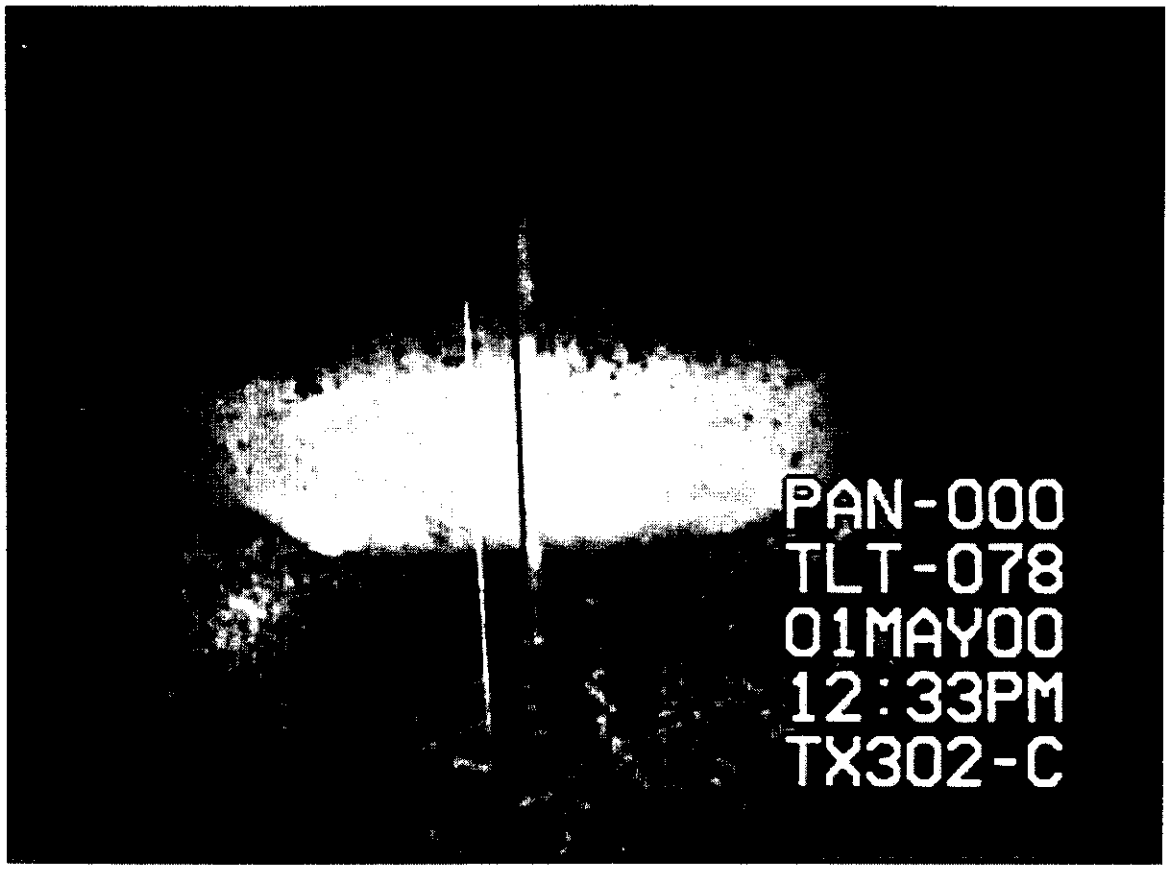

Figure D11
View of South End of Catch Tank 241-TX-302C Showing ENRAF Tape (left) and Stainless Steel Steam Jet Siphon Pipe (disconnected).

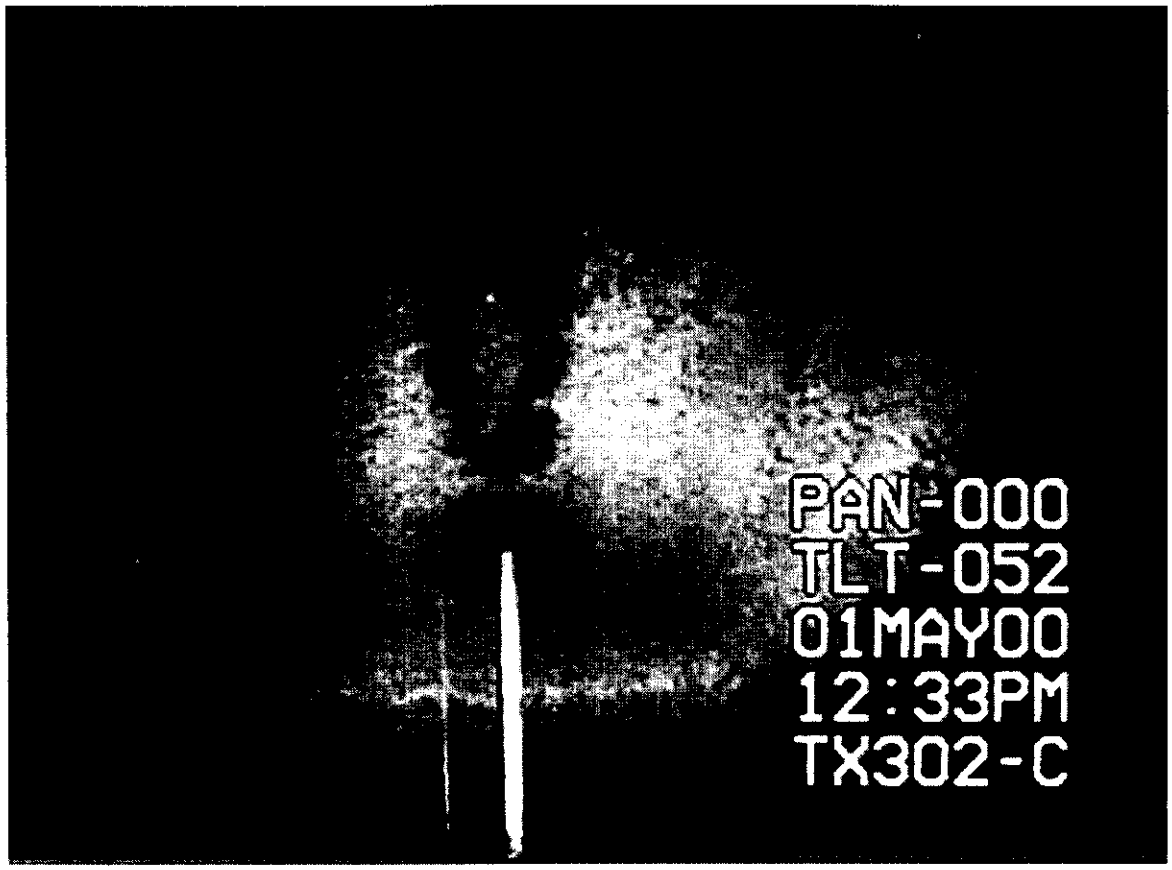

Figure D12
View of Top of 241-TX-302C Catch Tank, South End

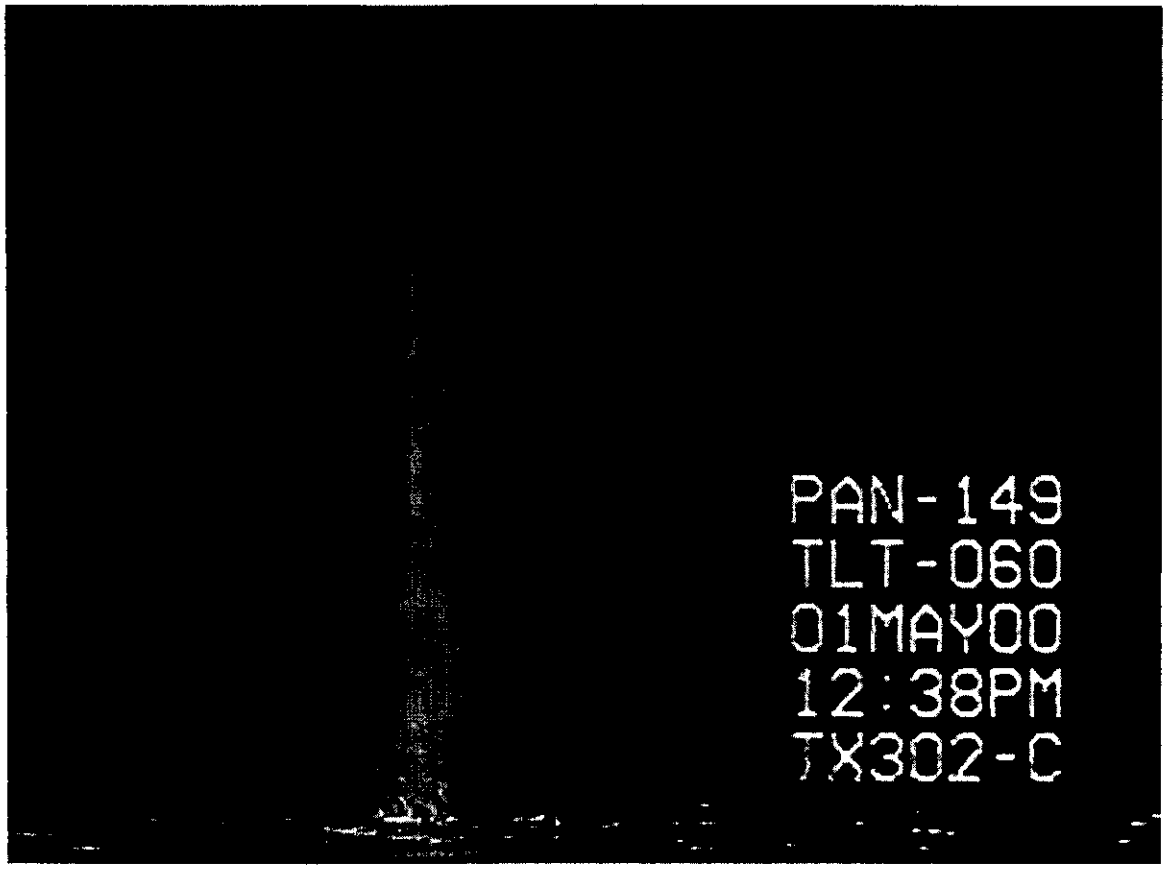

Figure D13
View of Vertical Stainless Steel Steam Jet Siphon Pipe (disconnected) at South End of Catch Tank 241-TX-302C

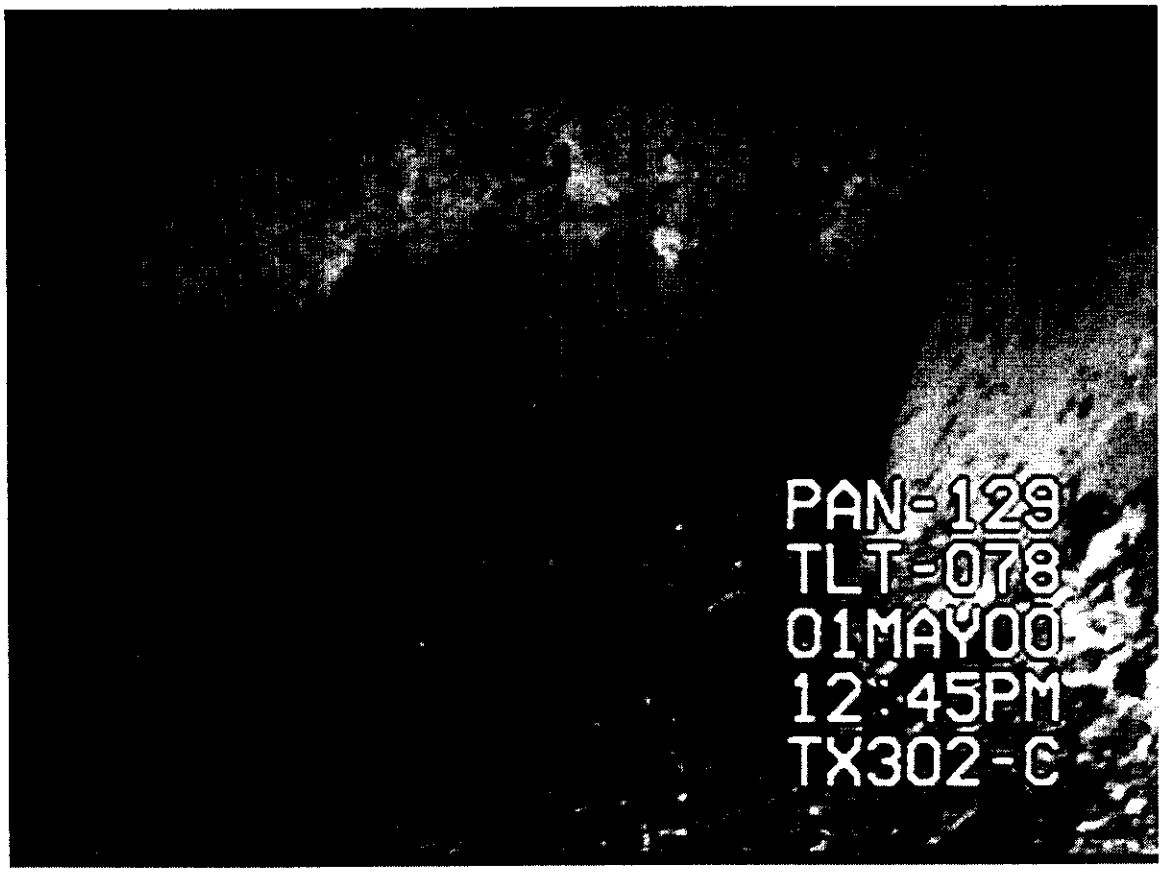

Figure D14
View of Catch Tank 241-TX-302C Showing Larger Amount of Sludge at the Right Side, North End.

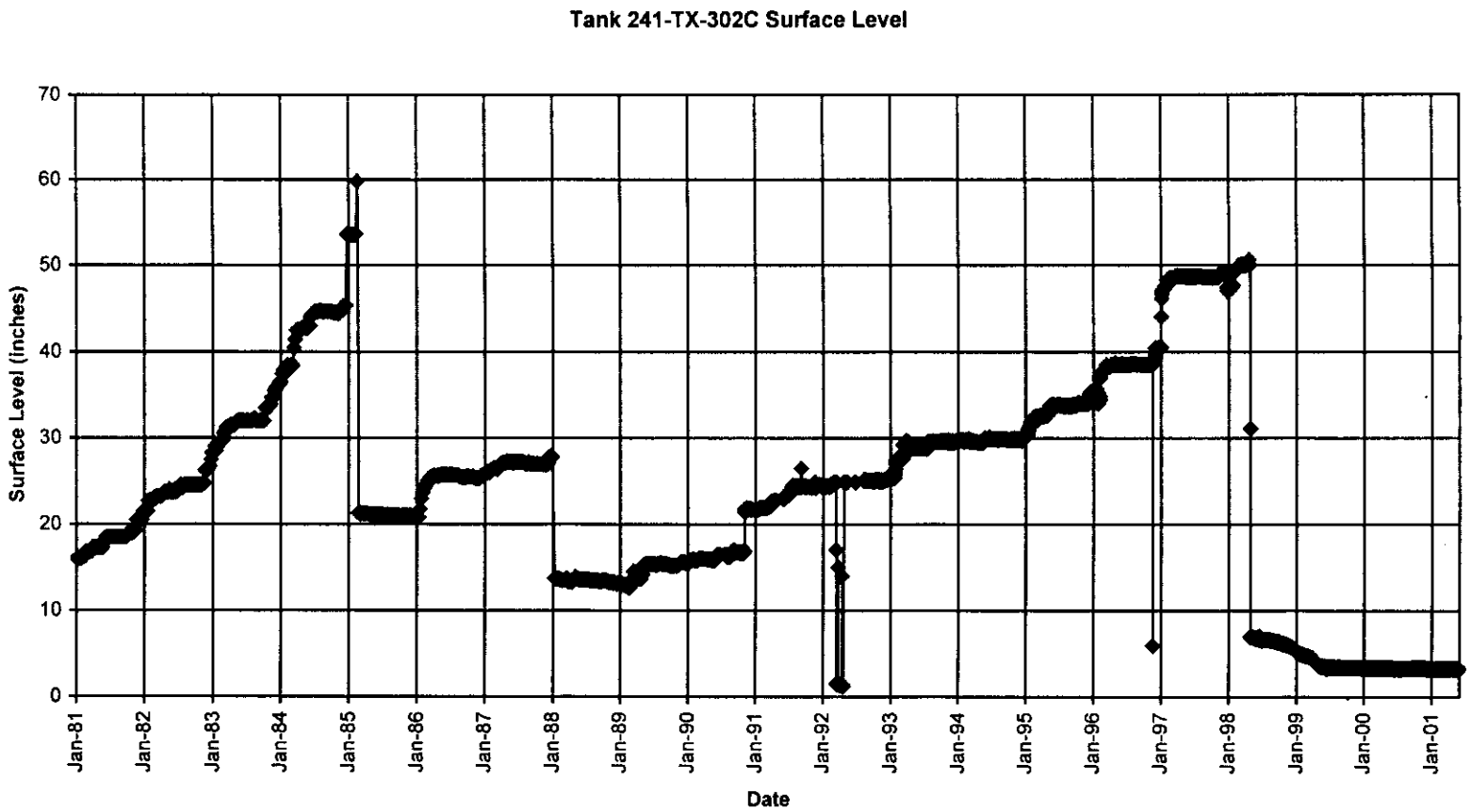

Figure D15
Surface Level versus time for Four Measurement Systems, 241-TX-302C

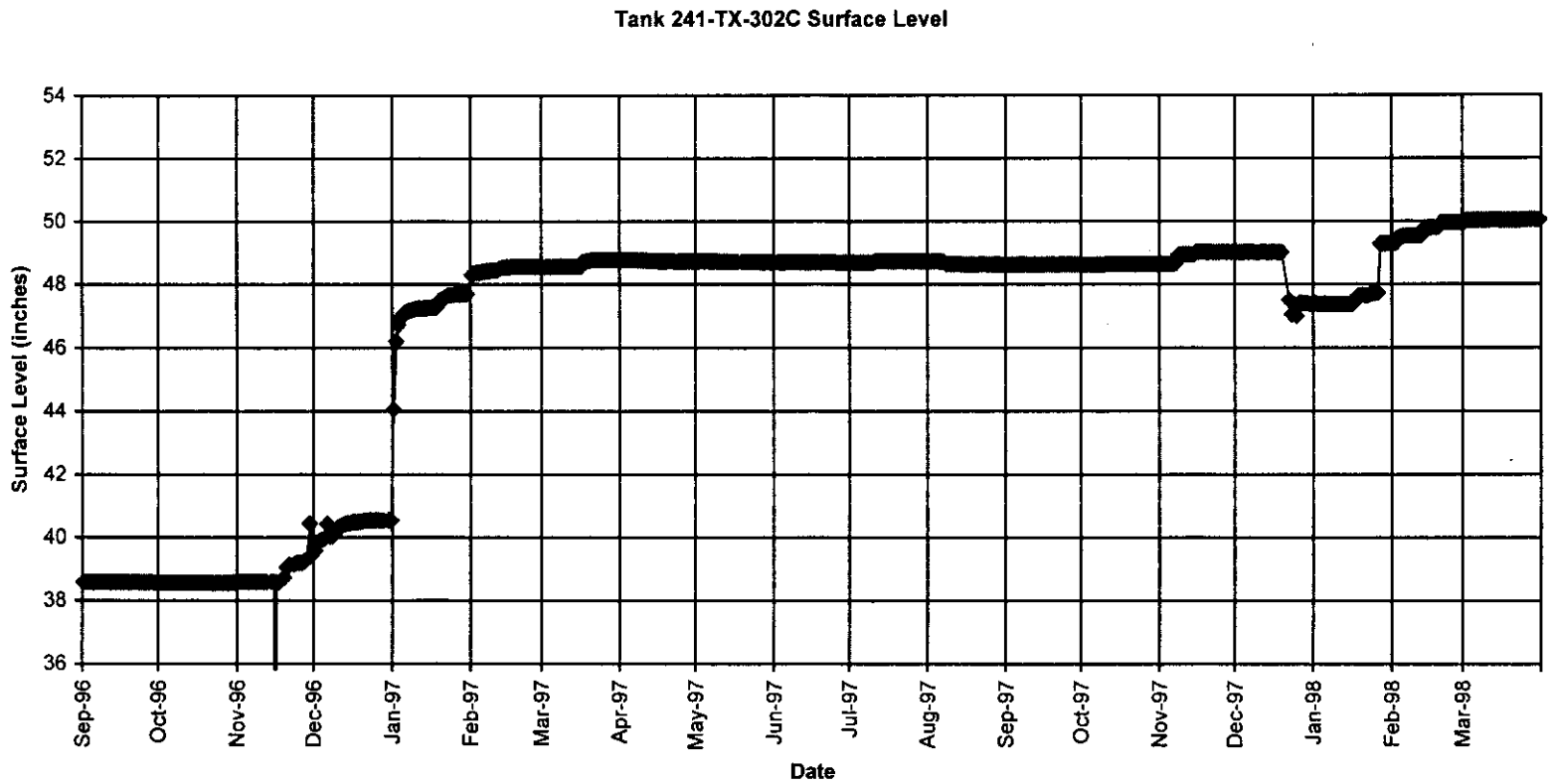

Figure D16
Manual ENRAF Surface Level versus Expanded Time, 241-TX-302C

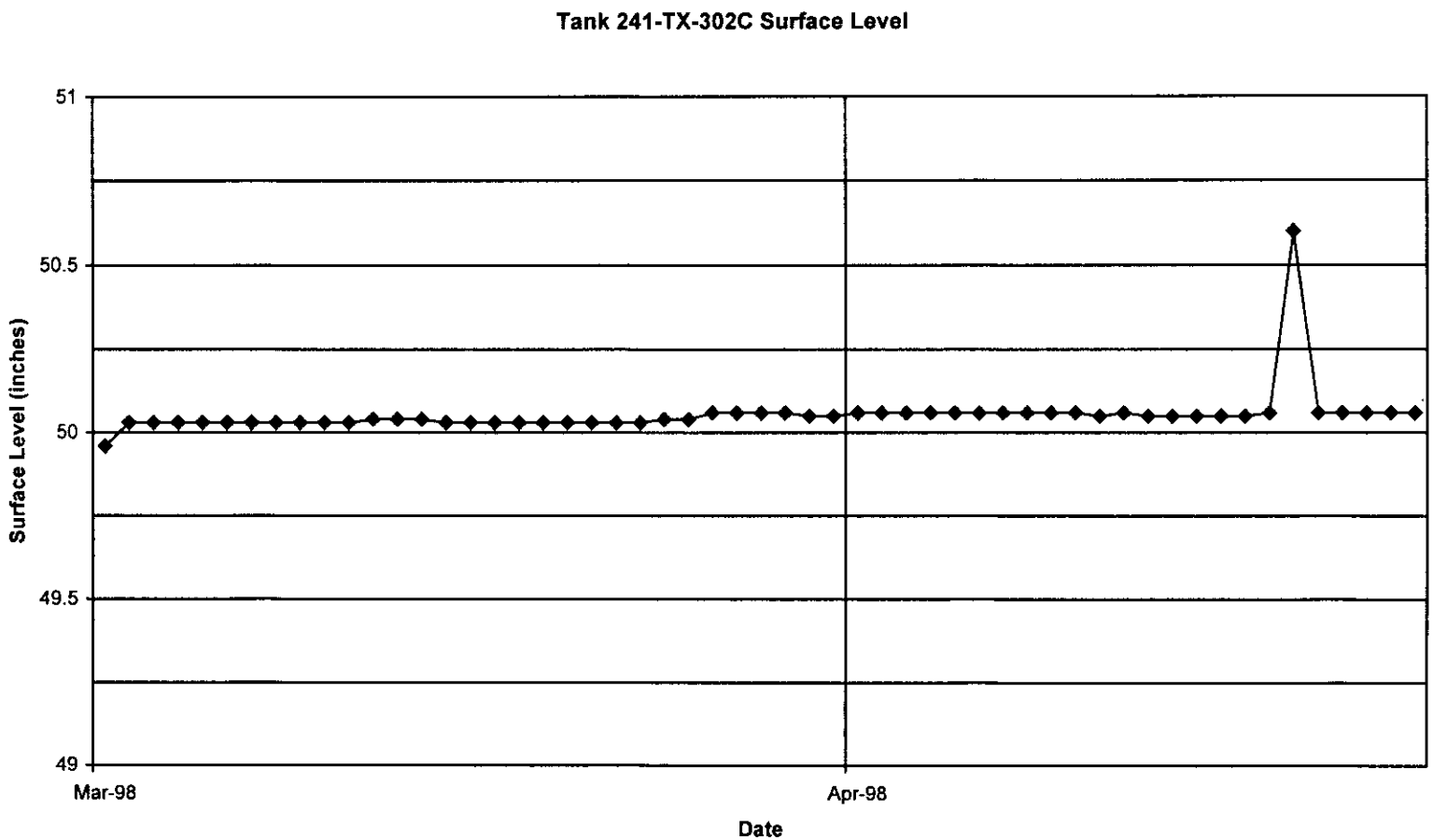

Figure D17
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APPENDIX E

244-BX DOUBLE CONTAINED RECEIVER TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing and Materials
CVI	Certified Vendor Information (file)
DCRT	double-contained receiver tank
DST	double-shell tank
FDS	functional design criteria
HDCS	Hanford Data Control System
HLAN	Hanford Local Area Network
HWS	Hanford Works Specification
LFL	lower flammability limit
M	Molar
NDE	non-destructive examination
RHA	Records Holding Area
RHO	Rockwell Hanford Operation
RMIS	Records Management Information System
SACS	Surveillance Analysis Computer System
SDC	Structural Design Criteria
SSE	safe shutdown earthquake (design)
SST	single-shell tank
TRU	transuranic
VITIS II	Video In-Tank Inspection System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

The 244-BX double-contained receiver tank (DCRT) facility is located in the 200 East Area of the Hanford Site (Figure E1). This DCRT was designed to provide short-term storage for supernatant liquid waste pumped from B, BX, and BY single-shell tank (SST) farm salt wells. The contents of 244-BX, after dilution with water, can be diverted through ER-151 and ER-153 diversion boxes, 244-A DCRT, A-A valve pit, AZ-02B sluice pit, and AN-B valve pit to the AN-101 double-shell tank (DST). The routing can be modified from the A-A valve pit to go to an alternate DST other than tank AN-101. The receiver tank also acts as a low collection point for line drainage during jumper changes or after the transfer lines are flushed.

The residual liquid contained in the primary carbon-steel receiver tank is the waste diluted with flush water, which is further mixed with intruded rainwater. The rainwater and snowmelt water enters through removable pump pit cover blocks and passes through the pit floor drain into the tank.

2.0 PURPOSE

The purpose of this design evaluation and examination is to determine the condition of the facility and determine if the 244-BX DCRT facility components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the 244-BX DCRT pump pit, tank vault and the receiver tank. The scope of the examinations includes a visual examination of the 244-BX DCRT receiver tank internal surface, pump pit, tank vault, and a leak test of the receiver tank.

4.0 DESCRIPTION

The 244-BX DCRT facility, constructed in about 1980, is an underground reinforced concrete structure consisting primarily of three main compartments that house different facility components. The receiver tank containment vault is on the bottom of the structure; the pump pit and filter pit both reside directly above the southern two-thirds of the vault (See Figure E2).

4.1 RECEIVER TANK CONTAINMENT VAULT

The receiver tank containment vault is a rectangular reinforced concrete structure, 44-ft in length by 16-ft in width x 16-ft in height inside dimensions with 2-ft-thick walls, 3-ft to 4-ft-thick bottom foundation slab, and an approximately 3-ft-thick top slab. The top of the vault is approximately 11 ft below ground level. The foundation slab slopes down towards a trench on the east side of the vault, which slopes to a sump to collect liquids. The 6-ft 7-in.-long y 2-ft-wide by 12-in.-deep sump houses a permanent leak detection device and a sump pump (when required). Lining the vault walls, floor and sump is a layer of protective coating material, Amercoat™ #33 for water tightness and ease of cleaning any spillage. Leak detection devices and a pump (when required) are housed in the sump. The vault houses the primary receiver, a carbon steel horizontally oriented tank.

4.2 RECEIVER TANK

The receiver tank is a 12-ft-diameter by 38-ft 6-in.-long-cylindrical shell with dished heads on each end of the shell. The cylindrical shell and the dished heads are built of 3/8-in. and 1/2-in.-thick carbon-steel plates, respectively. Nominal capacity of the tank is 31,000 gallons with a maximum operating capacity limited to 24,800 gallons.

4.3 PUMP PIT

The pump pit is 18-ft in length by 16-ft in width by 11-ft 6-in. in height with 24-in.-thick walls. Its approximate 3-ft-thick floor slab is supported on steel beams and 4 1/2-in. metal decking. Location of the pump pit is directly above the vault on its south end. Transfer lines enter the pump pit walls at different elevations. The pit has seven 2-ft-thick removable concrete cover block sections at ground level for access into the pump pit, the vault, and the receiver tank.

™ Manufactured by Protective Coating Division of Ameron, Brea, California

Limited access is provided to the tank annulus through riser 18 and riser 26. Similarly, limited access to the tank interior is provided through riser 16. These cover blocks also serve as shielding against radiation exposures. The pump pit floor has a drain with a p-trap and other nozzles rising from the receiver tank below. The floor drain directs any waste spillage, and rainwater and snowmelt infiltration through the cover blocks, into the receiver tank below. The pump pit houses the pumps, jumpers, and other ancillary equipment.

4.4 FILTER PIT

Adjoining the pump pit, also above the vault but on its north side, is the filter pit. It is a 13-ft-wide by 20-ft-long by 11-ft 6-in.-high concrete structure with 18-in.-thick walls. It has an approximately 3-ft-thick floor slab and 2-ft-thick removable cover blocks sections at ground level, for access into the pit. No examination is planned for the filter pit because it does not process any dangerous waste.

5.0 DESIGN EVALUATION

The design standards for the 244-BX DCRT facility and the vault, pump pit, and filter pit; the waste characteristics and compatibility; corrosion protection; and age of the tank system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of 244-BX DCRT facility. A thorough search was conducted to identify the available design requirements, and the design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base
- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Engineering personnel.

Project B-180 Functional Design Criteria (FDC) (Rockwell Hanford Operations [RHO] 1981), construction specification (B180 1979), and procurement specification (Hanford Works Specification [HWS] 1978) provide the design, material, fabrication, inspection, and testing requirements for the 244-BX DCRT facility, which was constructed in approximately 1980.

5.1.1 Receiver Tank Design Standards

The receiver tank was designed, fabricated, inspected, and tested in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Division 2 (ASME 1977). It was designed for an internal design pressure of 5 psig when the tank is 100-percent full and also designed for an external pressure of 6-in. of water, when full or empty. The design temperature was 200 degrees F. The receiver tank was successfully tested prior to service at a hydrostatic pressure of 8 psig. Overfilling of the tank is avoided by administrative liquid level limit control via operating procedures. Overpressurization is avoided during operations because the tank is vented to the atmosphere. In addition, the tank had cyclic design requirements. Specifically it was required to withstand: a) thermal cycles from 70 degrees F to 200 degrees F weekly for 10 years, and, b) concurrent with temperature cycling, pressure cycles by filling from empty to 80-percent full with working fluid plus internal pressure weekly for a period of 10 years. The design corrosion allowance for the receiver tank was 0.001 in. per year for each side for 10 years of minimum intended useful life or 0.02 in. total.

Project B-180 Procurement Specification HWS-10066 (HWS 1978) and Hanford Drawing H-2-73933 describe the design, configuration, and fabrication requirements for the receiver tank. The receiver tank cylindrical shell (3/8-in.-thick plate) and end flange and dish heads (1/2-in.-thick plate) were fabricated from the American Society of Testing and Materials (ASTM) A 537 Class 1 welded carbon steel plates (Welk Bros. Fabrication Drawing D 59142 Sheets 1 & 2). The tank's welds were 100-percent visually inspected and non-destructive examination (NDE) was performed on all welds (i.e., 100-percent radiographic examination) per ASME Section VIII, Div. 2 (ASME 1977). The exterior surfaces of the tank were prepared per SSPC-SP-6 requirement and painted with one coat of zinc chromate primer. The DCRT and components were designed to withstand 0.25g horizontal and 0.17g vertical acceleration seismic loads and sloshing forces generated by the contained liquid. These seismic accelerations are equivalent to the Safe Shutdown Earthquake (SSE) design requirements at the time of construction for Class I facilities at the Hanford Site (Structural Design Criteria [SDC] 1974). The receiver tank is appropriately anchored to floor slab with twenty 2-in.-diameter bolts to withstand the applicable design loads.

5.1.2 Vault, Pump Pit, and Filter Pit Design Standards

The below ground waste tank vault is a reinforced concrete structure. The Functional Design Criteria (RHO 1981), Construction Specification (B180 1979), and Hanford Drawing H-2-73784 established requirements for the material, design, and construction of the 244-BX DCRT facility according to applicable national codes and standards. The design requirements include a capacity to withstand dead loads, live loads, seismic loads, and lateral soil pressures.

Vault. The inside of the vault walls and the entire vault floor, including the sump bottom, are lined with a layer of protective coating material (Amercoat™ No. 33) for water leak tightness and ease of cleaning any spillage. Water stops are provided at wall construction joints to prevent groundwater intrusion through them. The vault floor slopes towards a 6-in.-wide by 5-in.-deep concrete trench which drains into a 6-ft 7-in.-long by 2-ft-wide by 12-in.-deep sump. A leak

detector located in the sump issues an alarm should the liquid waste or water leak into the sump.

The vault, which houses the receiver vessel, has more than adequate capacity to contain the maximum capacity of the receiver tank should it leak. The sump pump, P-244-BX-2, is provided (when required) through riser number 24 through the pump pit floor (Hanford Drawing H-2-73797) for transferring accumulated liquid in the sump to the receiver tank.

Pump and Filter Pits. The reinforced concrete pits are coated with protective paint, Amercoat™ No. 33, to mitigate seepage through their walls and floors. Each pit contains a 3-in. floor drain to route any liquid from its floor to the waste receiver tank below. The carbon steel butt-welded drain lines meet the Hanford Pipe Code M-24 per Hanford Drawing H-2-38217, and are equipped with p-traps to prevent communication of gas from the tank ullage to the pit environment. Specification B-180-C1 (B180 1979) establishes 5 psig at 200 degrees F as the maximum operating pressure and temperature for these 3-in. drain lines. The pits are closed with 24-in.-thick concrete cover block sections, which also serve as a shield against radiation.

The 244-BX DCRT facility's main structural (vault, pump pit, and filter pit) components, including cover blocks, walls, floor slab, and foundation slab, are designed to withstand design loads described in Functional Design Criteria (RHO 1981), Hanford Drawing H-2-73784, and Construction Specification (B180 1979) for the physical environment around them and for the intended purpose of collecting liquids from transfer lines to be pumped back into a waste tank. All structures were required to be designed to withstand seismic forces generated from an SSE of 0.25g horizontal and 0.17g vertical ground accelerations acting simultaneously.

A structural assessment of numerous facilities subjected to various loading conditions was performed recently (Westinghouse Hanford Company [WHC] 1996). This assessment determined that the 244-BX receiver tank could fail under internal vacuum of -8 psig and the vault roof collapsed under a 20-gallon gasoline ignition load. The review of this analysis indicates that the assumptions made for these load conditions are unrealistic, and therefore its conclusions are unrealistically conservative.

The 244-BX tank is open to the atmosphere through its filter pit. Further, operational controls preclude the loading conditions resulting from the ignition of 20 gallons of gasoline.

The DCRT structures and systems were adequately designed to withstand all applicable design loads to comply with all standards and codes requirements.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The 244-BX DCRT saltwell tank provides short-term storage for non-complex interstitial liquid wastes pumped from the B, BX, and BY tank farm saltwells. Waste transfers began in the early 1980s during saltwell pumping campaigns in B, BX, and BY tank farms.

To ensure that the tank does not exceed its design envelope of 5 psig and 200 degrees F temperature, tank waste characteristics that could lead to ignitable, reactive, and corrosive conditions are controlled. Prior to a waste transfer, a compatibility assessment is conducted. A description of a typical waste compatibility assessment can be found in (Blaak 1998). Here the assessment involves not only 244-BX DCRT, but also the downstream, waste-receiving DST 241-AP-106.

Basically the assessment involves compatibility requirements, waste categories, waste codes, and tank safety concerns that could potentially be created as a result of mixing the subject waste streams. Compatibility compliance centers on the requirements of five documents: Mulkey (1998), Cox (1997), Mulkey and Miller (1997), Fowler (1995), and HNF (1997). These requirements include: flammable gas (hydrogen, methane and ammonia), organic and energetic reaction, watch list tanks, corrosivity, chemical compatibility, tank waste type, transuranic (TRU) segregation, heat generation, complexant waste segregation, phosphate waste, and the wastes' Reynolds number. Flammable gas is particularly important in that for any saltwell transfer(s), the DCRT vapor space concentration must remain controlled. Specifically, the minimum time to reach 25-percent of the lower flammability limit (LFL) is required to be ≥ 7 days, assuming loss of primary tank ventilation.

Typically, 244-BX DCRT does not accept waste outside of the control limits. However, several limited exceptions exist. The first exception is given for single-shell tank waste that is outside the corrosion control limits. In those cases, the waste chemistry either is adjusted in the DCRT or is mixed with a specific amount of another saltwell waste. The mixing process changes the concentrations so that the corrosion control limits are satisfied. The second exception to the corrosion control limits is given for small quantities of wastewater from rain and snowmelt and for pipeline flushes.

One accidental exception to waste control limits occurred on September 14, 1990. On that date, a raw water line discharged water (to the ground) adjacent to the 244-BX DCRT pump pit (Caldwell 1990). The water then flowed into a flush pit that drains into the DCRT. Because of the discharge, the tank experienced a 1,500-gallon increase in content. Subsequent chemical analysis of the content showed that the hydroxide level was low (about 0.0004 Molar [M]) concentration versus the required ≥ 0.01 M concentration).

To determine the number of pressure and temperature cycles the facility was subjected to since the start of its operation in 1983, the 244-BX facility log book (RHO 1983) data from May 1983 to March 1995, and Surveillance Analysis Computer System (SACS) reports from April 1995 to June 2001 were reviewed. The total number of pressure-cycles noted over about 18 years, was 129. Based on the total operational time of about 18 years (May 1983 to June 2001) only about one pressure cycle occurred every 6 to 7 weeks, far less than the design limit of 1 cycle per week. Only during its first year of operation did the number of pressure cycles approach the design limit (48 in 52 weeks). The maximum waste level also remained within its prescribed limit.

No temperature data were found for the incoming wastes from SST tank farms B, BX, and BY to the 244-BX DCRT. However, a review of the *Maximum Surface Level and Temperature Histories for Hanford Waste Tanks* (WHC 1994) showed that the average temperature for the SST tank farms B, BX, and BY ranged from 80 degrees F to 110 degrees F. Based on the noted temperature levels, it is unlikely that the temperature level of 244-BX DCRT ever reached the design level of 200 degrees F. Furthermore, because only about 128 pressure-cycles occurred, by definition only about 129 temperature-cycles would have occurred too. Thus, during 244-BX DCRT's operation over about 18 years, it remained well within its pressure and temperature cycle limits.

As a result, the tank design is considered adequate to handle waste with the noted characteristics and the number of temperature- and pressure-cycles remains well below the design requirements.

An area where the design may be questioned is as follows: The design does not prevent the intrusion of liquid (rain, snow, etc.) into the tank. The liquid can pass through the cover blocks then through the pump pit floor drain into the tank. This water adds to the waste inventory and increases the potential for corrosion inside the tank and of the components in the pump pit.

In summary, waste ignitability, corrosivity, and reactivity are controlled by the application of certain tests, procedures, and controls on waste conditions, concentrations, and temperature before a transfer is made. Further, the number of operational pressure and temperature cycles remain well below design limits.

5.3 CORROSION PROTECTION

Corrosion protection in the 244-BX DCRT is provided primarily by the combination of good design and appropriate corrosion control. Proper design began with selection of a corrosion-resistant material (ASTM A 537 Class 1 steel) for the receiver tank. This was followed by ultrasonic testing before acceptance of the base metal followed by appropriate fabrication and welding requirements, a post-weld heat treatment, and post-fabrication non-destructive weld examination (HWS 1978). Ancillary piping systems are also constructed of corrosion-resistant carbon steel.

Corrosion protection in the DCRT systems is accomplished by controls on composition and concentration limits imposed at the waste generating facilities as well as at downstream tank farms. The primary corrosion control is provided through limits on hydroxide, nitrite, and nitrate (Kirch 1984). Although the waste contains a large number of other chemical species, these are all maintained at such low levels that corrosion behavior is not affected. The waste is kept essentially non-corrosive to the tank by addition of sodium hydroxide and sodium nitrite. Maintenance of these corrosion controls ensures that uniform corrosion rates are less than 0.001 in./year and that pitting corrosion, and stress-corrosion cracking are inhibited.

The 244-BX DCRT was designed for a maximum waste temperature of 200 degrees F, with a wall thickness of 0.375 in. Its corrosion allowance was 0.001-in./year, each side, for a total of 10

years or 0.02 in. total corrosion allowance. The working fluid was defined as a highly salted solution of 1.8 specific gravity with a concentration of up to 8.0 M caustic (HWS 1978).

The raw water discharge (noted in Section 5.2) resulted in the finding that the waste has been out of corrosion specification for as long as six months. Analysis of carbon steel waste tank corrosion data (Divine et al. 1985) indicated that the tank boundary had corroded an additional 0.00072 in. during that time (Carlos 1991). Because the tank has been in service for nearly 18 years, it is possible that the 0.010-in. corrosion allowance for the inside of the tank, has been exceeded even though the corrosion rate met (except for 6 months) the <0.001 in./year requirement. However because the tank is in a covered vault, and because it is partially ventilated, it is possible that no significant corrosion has occurred on the tank's outside wall. Thus the total corrosion allowance (0.02 in.) has probably not been exceeded.

Proper design controls, maintenance and operations, and visual examinations described in Section 6.0 indicate that the facility is in good condition without any noticeable significant corrosion.

5.4 AGE OF THE TANK SYSTEM

The age of the 244-BX DCRT facility is approximately 20-years old. The facility went into service in the early 1980s and since then has been used to transfer saltwell water from B, BX, and BY farms. No integrity assessment of this facility has been performed between construction and the present.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations were performed in 1999 and 2000 to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since completion of construction about 20 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the pump pit, tank vault (also termed annulus or annulus space) and the receiver tank interior. Dates of examination were June 29, 1999 for the pump pit, July 1, 1999 and July 23, 1999 for vault annulus, and March 15, 2000 for the receiver tank interior. Visual examination photographs present examples of the conditions noted during the three visual examinations. Data sheet tables present specific descriptions of the visual examination findings and the noted figures. The figures and tables appear at the end of this appendix.

The 27 individual 'still' photographs taken from the videotapes and presented below, show the satisfactory status of the facility.

6.1.1 Pump Pit Visual Examination

Access to the pit was obtained by entering a valve handle penetration in a reinforced concrete block. The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing all three facility components) was lowered through the approximately 4-in.-diameter, valve handle penetration. The camera has the capacity to both pan and tilt while viewing the pit internals. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or lesser-angle setting) used to view details of interest.

The color videotape showed that the condition of the pit walls, ceiling, and various ancillary equipment within the pump pit appeared very satisfactory. The water and dirt, on the floor made viewing of the coated concrete floor (including joints) difficult to see, but no gross anomalies were noted. Table E1 provides a general description of the pump pit along with details regarding the photographs. Figures E3 through Figure E11 show the condition of the pump pit.

Condition of the pit walls, ceiling (cover blocks), wall nozzles and instrument and power lead tray shown Figures E3, E4, E6, and E7 appeared very satisfactory. The generally satisfactory condition of piping elements, the large R-22 manway, the spider assembly, and floor equipment are shown in Figures E5, and E8 to E11.

6.1.2 Annulus Visual Examination

Access to the annulus, or tank vault region, was obtained through risers number 18 (24-in.-diameter pipe) and number 26 (4-in.-diameter pipe); see Hanford Drawing H-2-73865 for riser locations. Entrance of the camera through riser number 18, located in the northwest corner of the vault, provided a top-to-bottom view mainly of the north end of the tank, the adjacent floor, the west wall, and most of the vault ceiling. Table E2 contains the description of the video camera examination through riser number 18. Figures E12 through E15 show the condition of annulus components viewed through riser number 18. Riser number 26 projects down adjacent to the central, east side of the tank. It provided a similar top-to-bottom view, with visual access to more of the ceiling, the tank's east side and floor, and portions of the vault north wall and adjacent floor. Table E3 contains the description of the video camera examination through riser number 26. Figures E16 through E18 show the condition of annulus components viewed through riser number 26.

The color videotapes showed that all regions viewed, particularly the tank outer surface, supports, lifting straps, vault walls and floor, appeared very satisfactory

6.1.3 Receiver Tank Internal Visual Examination

Access to the receiver tank interior was provided through riser number 16 (4-in.-diameter pipe). This riser projects into the tank adjacent to its north dished-end and several feet north of the adjacent diptube assembly. The liquid level on the examination day was at 6 ft 2 in. Most of the tank interior could be seen except for a narrow region (approximately 5 to 8 degrees wide) along the top of the tank, south of riser number 16. This minor obstruction was caused by the proximal vertical three-pipe diptube assembly (see Figure E22). In addition, the tank walls could be viewed, through the clear liquid waste to the top of the bottom-lying sludge layer. The latter was visually estimated to be about 2- to 3-ft deep.

The color videotape showed that the tank interior surfaces are in very satisfactory condition. The one-fourth to one-third of the tank, for which no liquid waste has ever apparently touched, shows only spotty vapor phase corrosion, some minor pitting, and light blemishes. Nearly all of the tank wall surfaces, below its top waterline, are covered with a whitish deposit, estimated to be about 1/8-in. thick. In some areas the white deposit has spalled-off, leaving black-colored tank wall regions that appear insignificant. Based on these insignificant regions, the tank's general condition is judged to be satisfactory. These various regions are described in the attendant data sheet Table E4 are shown in Figures E19 through E29.

The generally satisfactory results of all the visual examinations indicate that additional examinations are not needed for the next 10 years.

6.2 LEAK TEST

On May 29, 1999, the 244-BX DCRT receiver tank was readied for a leak check test. Liquid waste that normally flowed into the tank was halted in order to ensure that the waste level did not increase during the course of the 40-hour long test. The waste level at the beginning of the test (0930 hours on 5/29/99) was 9-ft 1-in. and it remained at that level to the completion of the test (2330 hours on 5/30/99). This leak test level was slightly above the maximum allowable operating level limit of 80 percent (approximately 109 in.) capacity of the tank. Visual examination of the tank vault, several weeks later (see Table E2 and E3), also showed no signs of any prior leakage.

The satisfactory results of the leak test (see Table E5), coupled with the later visual examination of the annulus, confirmed that the tank is not leaking.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The combination of satisfactory results of the design evaluation and the successful visual examinations and leak test, presented in this report, indicate that the facility and its components are adequately designed and the receiver tank is not leaking.

2. The design does not prevent entry of water (from rain, snowmelt) intrusion into the pump pit and receiver tank, which adds to the waste inventory and increases the potential corrosion inside the tank and the components in the pump pit. This event should be mitigated by effectively sealing the cover block seams.

3. Because of operations' schedule constraints, the visual examination of the tank interior was conducted when it was partially full (6 ft 2 in.). The visible portions

of the tank interior were in good condition, however the bottom half of the tank could not be clearly inspected. Therefore, it is recommended that a visual examination of the empty tank be conducted within 5 years.

4. Since the overall condition of the facility is good, another leak test should be conducted within five years.

5. The structural assessment analysis (WHC 1996) should be revised with refined analysis methods using realistic assumptions and loading conditions to demonstrate and justify the operation of the facility.

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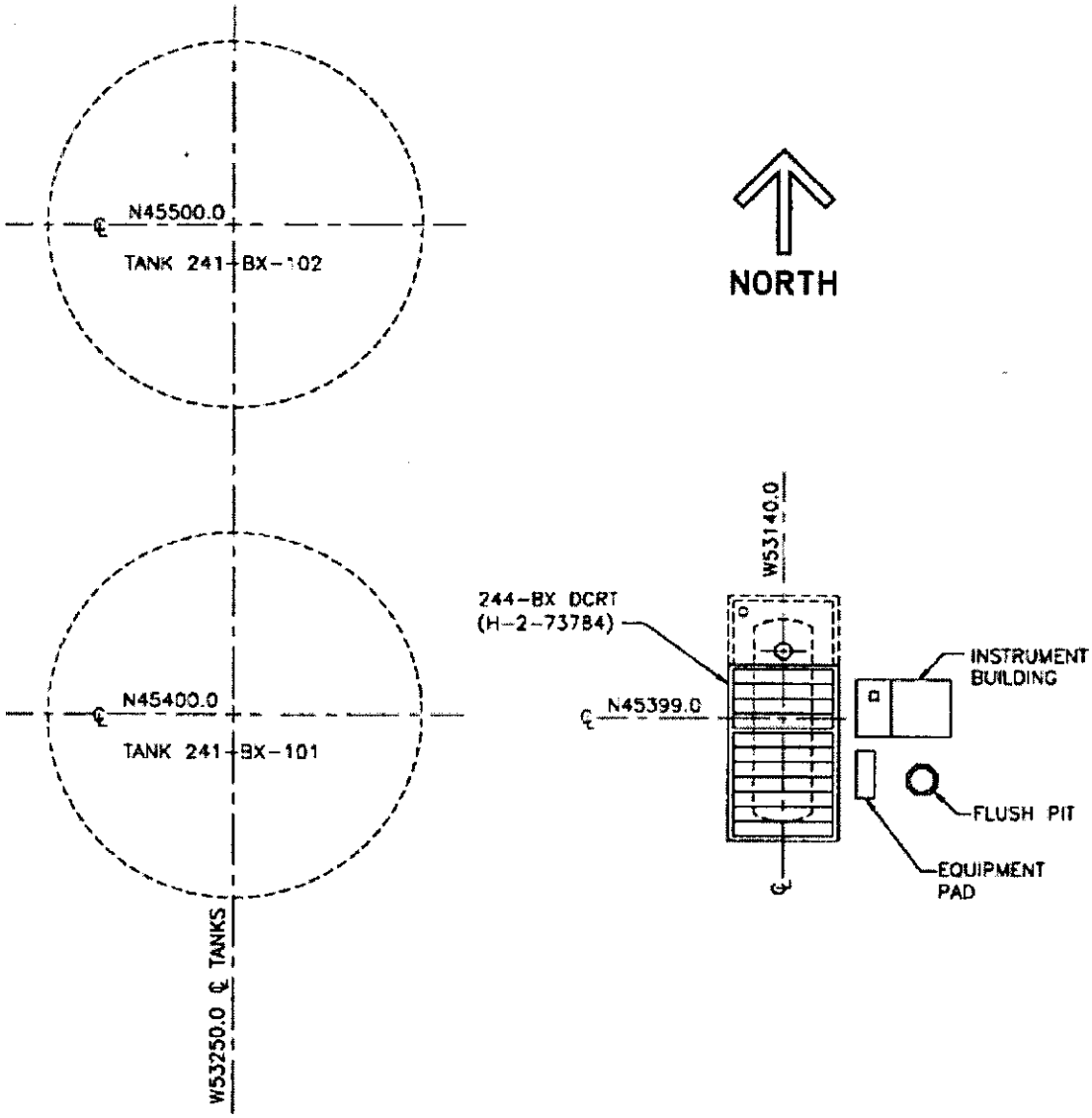
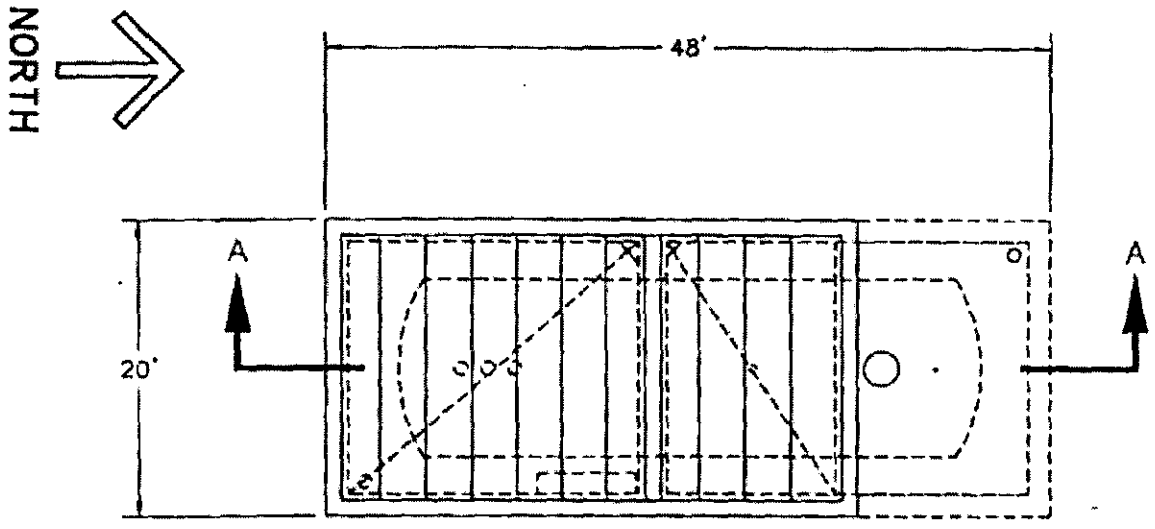
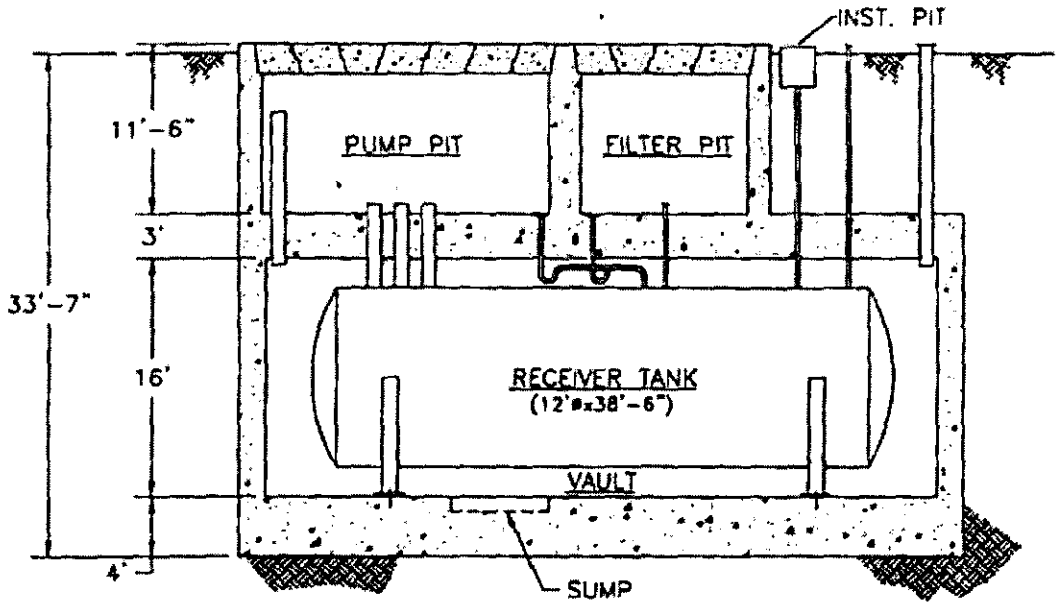


Figure E1
244-BX DCRT – Site Plan



PLAN



SECTION A–A

NOTE:
OTHER FACILITY DETAILS ARE
NOT SHOWN FOR CLARITY

Figure E2
244-BX DCRT

TABLE E1. VIDEO EXAMINATION DATA SHEET, 244-BX PUMP PIT

Examination Date: 6/29/99

Person In Charge: D. P. Niebuhr Camera Operator: B. D. Wright Video Examiner: D. P. Niebuhr

Riser: Valve Handle Penetration

Video Tape Reviewer: Earl B. Schwenk Date: 1/12/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					All items in the field of view of the camera were observed; essentially the entire pit region was scanned. Comments are made herein confirming the general conditions. Video-based still photographs are included that show some of the conditions. Pan & tilt refer to the angles of the viewing video camera either when a comment is made or when a "still" photograph was taken. The following information reveals that the pump pit is in satisfactory condition.
0629 PM	0651 PM	259	080		First, visual observations are made at the NW corner of the pit (region where south and east wall meet). Water is on the floor, probably 2-3-in. deep. Workers on top of cover blocks are moving a tethered drain plug up and down in an attempt to make the water drain out. This action was not immediately successful (but another one was later).
0636 PM		257	051		Figure E3 is a typical view of the pit corners at their intersection with the steel-edged cover blocks. Some minor rust markings occur most of the cover block steel edges. The entire east wall was scanned (257 to 314 pan angles) and back to the corner and also along the south wall (257 to about 015 pan). Some probable rainwater/snowmelt drip markings are seen on parts of the perimeter of the wall-cover block intersections. The Amercoat coating appears satisfactory.

Table E1 Video Examination Data Sheet, 244-BX Pump Pit (continued)					
0640 PM		230	046		Figure E4 presents a view of a post-construction penetration in a concrete cover block (near the NW corner). In-situ core-drilling was likely responsible for the chipped concrete around the edge of the penetration. Looks ok, however.
0650 PM		029	043		Figure E5 is a photo of the 24-in. diameter Annulus manway, noted as number 22 (entrance to tank area); also shows some minor rusting of the steel edges of the concrete cover blocks.
0649 PM		158	48		Channel tray along south wall is shown to be in good condition (Fig. E6).
0652 PM		15	118		Intersection of manways number 22 and number 23 (air inlet to catch tank region) with floor of pit was viewed. Both look good.
0654 PM		159	89		Scanned nozzles on wall (J, I, H, G, F, E, D, C, B and A). All appear in good condition. The wall around the nozzles was relatively clean, indicating that no significant waste leakage (past or present) had occurred. Figure E7 shows items G through A, including either vapor seals (red, flat-plate covers with a lifting bail) or actual nozzle connections.
0656 PM		226	73		Continuing past nozzle N and DOV. Old dip tube assy on floor. (No figure)
0657 PM	0659 PM	Var.	Var.		Looked at floor penetrations (with cover plates); one for leak detector and one for a sump pump. Metal plates covering these penetrations have been covered with water long enough to cause rusting. The area was also covered with a thin dirt layer. General condition looks good. Figure E8 shows the cover plates with guide pins (at 306 pan and 84 tilt at 0658 PM). Nozzles M and L appear satisfactory.
00700 PM		359	103		View of inlet air-flow pipe (number 23) as it enters the pit floor. Appears satisfactory (No figure)
0702 PM		311	084		Film covered rocks or paint-type bubbles at intersection of pipe number 23 with wall. They look insignificant, but it is not clear what they are. See Figure E9.
0703 PM		312	116		View of Riser number 22 and number 23 risers penetrating floor. They too, look satisfactory. (No figure)
0704 PM		198	122		Panned over transfer pump (floor); cover plates for leak detector, vapor seal, discharge connection, flow meter, blue DOV, spider drop (jumper) assemblies. (No figure)

Table E1 Video Examination Data Sheet, 244-BX Pump Pit (continued)					
0705 PM		199	131		View of large riser number 1 penetrating the pit floor. It includes a portion of the spider piping assemblies that connect with nozzles on the adjacent wall. The shininess (clear and oily looking condition), covering the various tank bottom equipment, is believed to result from fixants that had been sprayed on them to fix smearable contamination, prior to a human entry. Fixants apparently leave a shiny, but clear, lacquer-like finish that remains reflective. The cover plate is held in place by gravity and is restrained by guide pins. See Figure E10 for most of above the noted equipment.
0709-33 PM		Var.	Var.		Video panned entire bottom of pit at intersection of floor and walls. Looks ok. (No figure)
0733 PM		253	079		Video examination here is concentrated on the efforts of personnel to promote drainage of the surface water (in the NW corner of the pit). Personnel (on top of the pit cover blocks) manually raised and lowered a vertical leak detector pipe assembly. This action promoted draining of the excess water down into the tank vault. The leak detector opening is near the plugged floor drain that was previously referred to (see comments associated with Figure E3 above). See Figure E11 for evidence of the drain-water swirling around the annulus while draining downward. General darkness of the area precluded any significant lightening of the original videotape photo. The Amercoat coating appears intact.

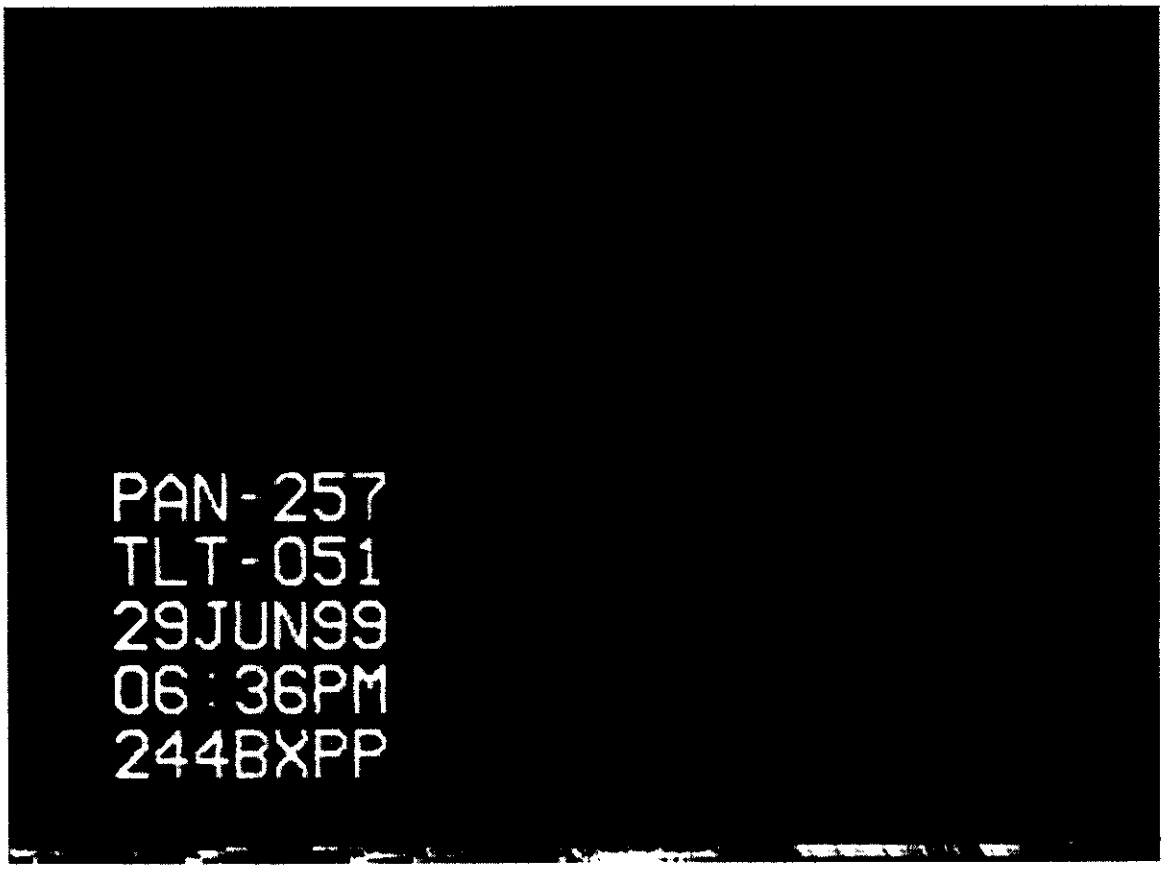


Figure E3
Typical View of Pump Pit Corner and Concrete Cover Blocks in North-West Corner (camera entered through valve handle penetration)

Figure E4
Penetration in Concrete Cover Block Near Northwest Corner (camera entered through valve handle penetration)

Figure E5
Side View of Riser number22 (24-in. diameter annulus manway to vault below pump pit; camera entered through valve handle penetration)

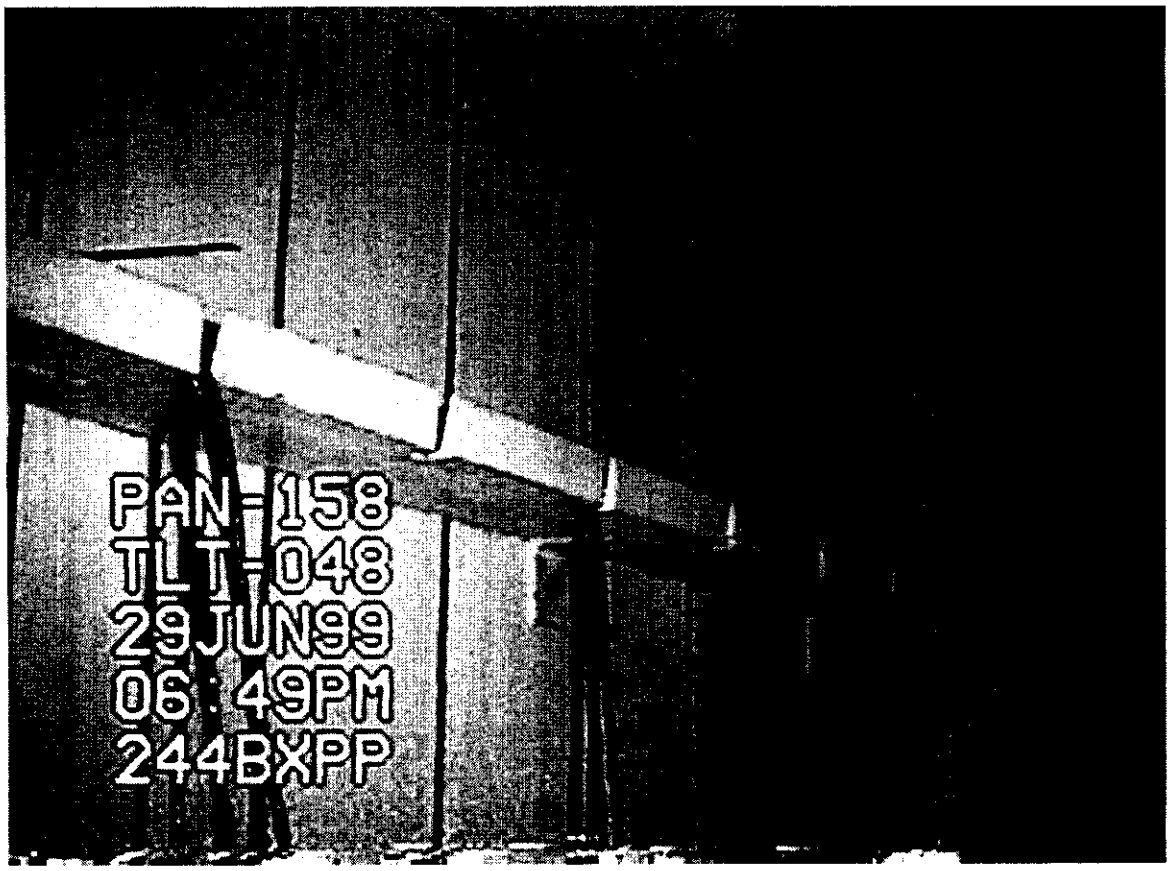


Figure E6
View of Channel Wiring Tray Along South Wall (camera entrance through valve handle penetration)

Figure E7
View of Wall Nozzle Openings (camera entered through valve handle penetration)

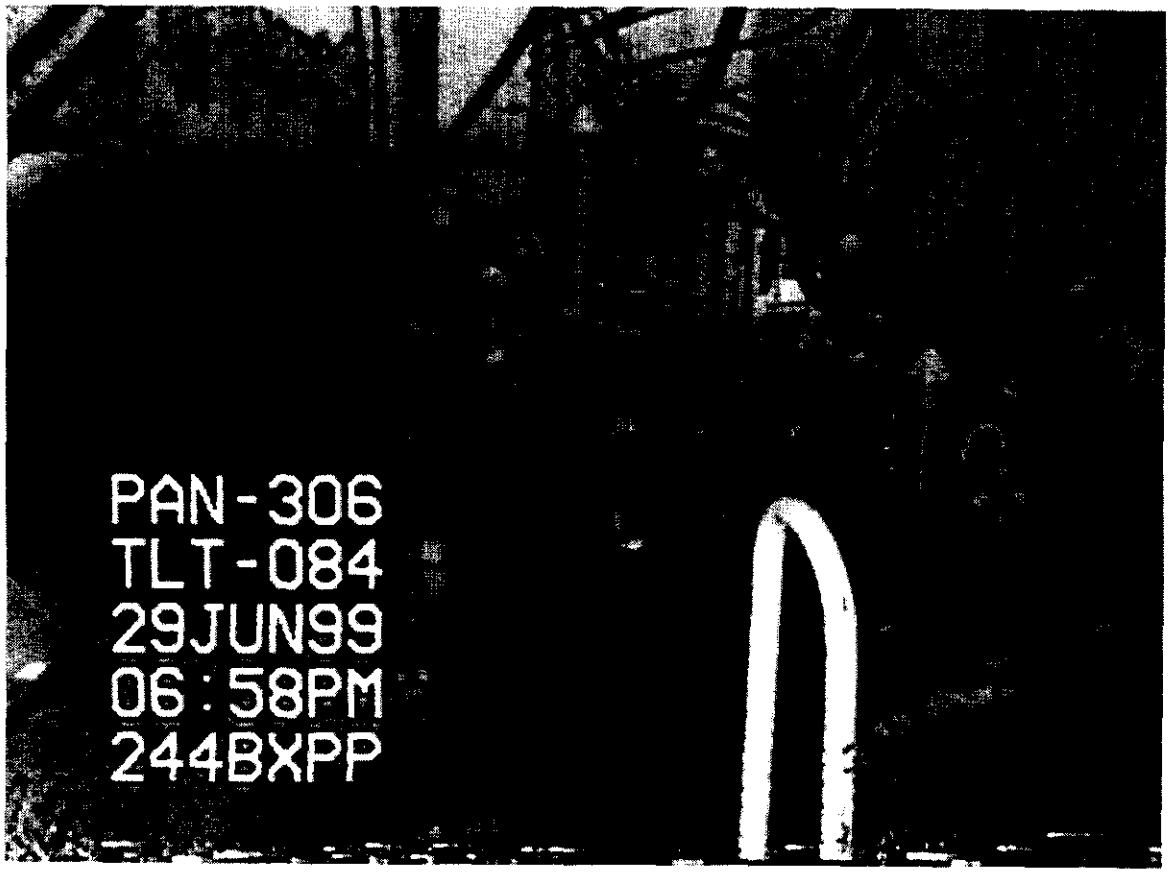


Figure E8
Nominal Rusting on Pit Floor Cover Plates (camera entered through valve handle penetration).

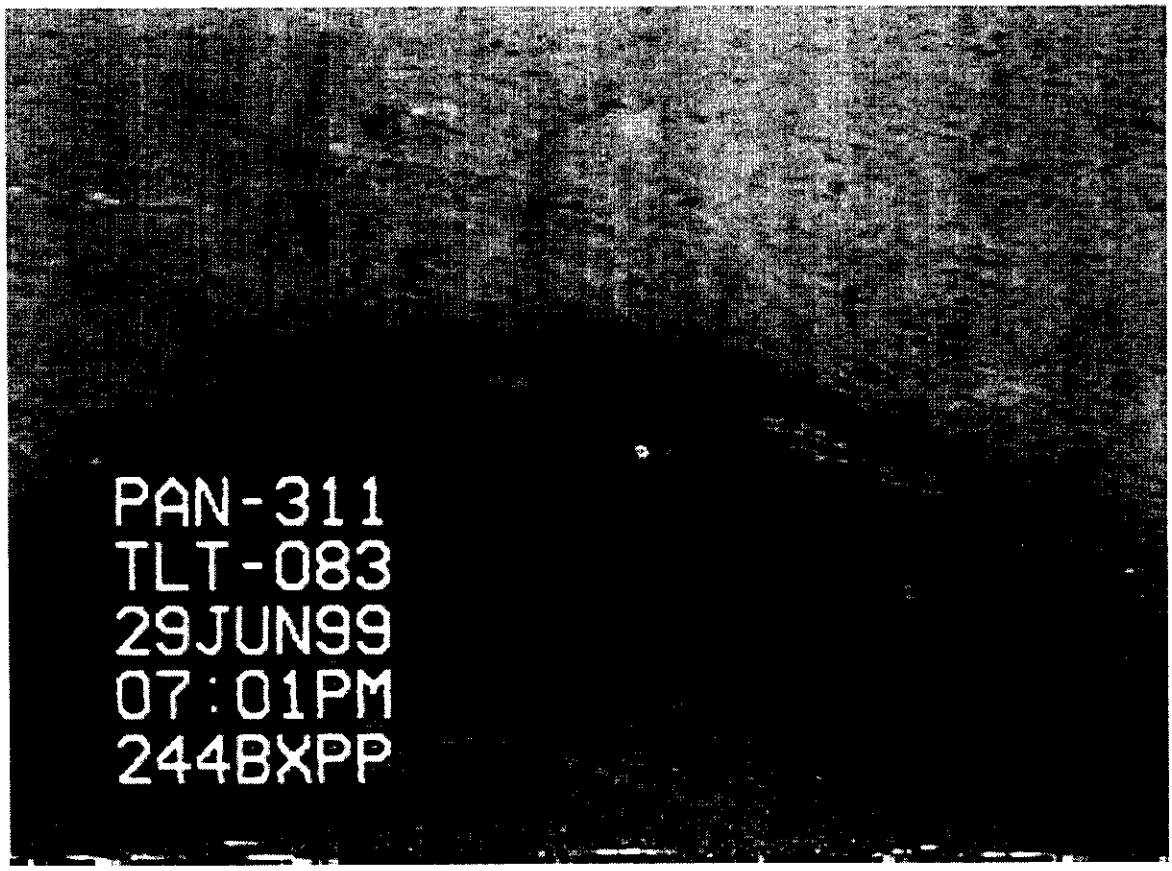


Figure E9
View of Possible Film-Covered Rocks or Bubbles in Paint at Intersection of Pipe number23 With Pit Wall (camera entered through valve handle penetration).

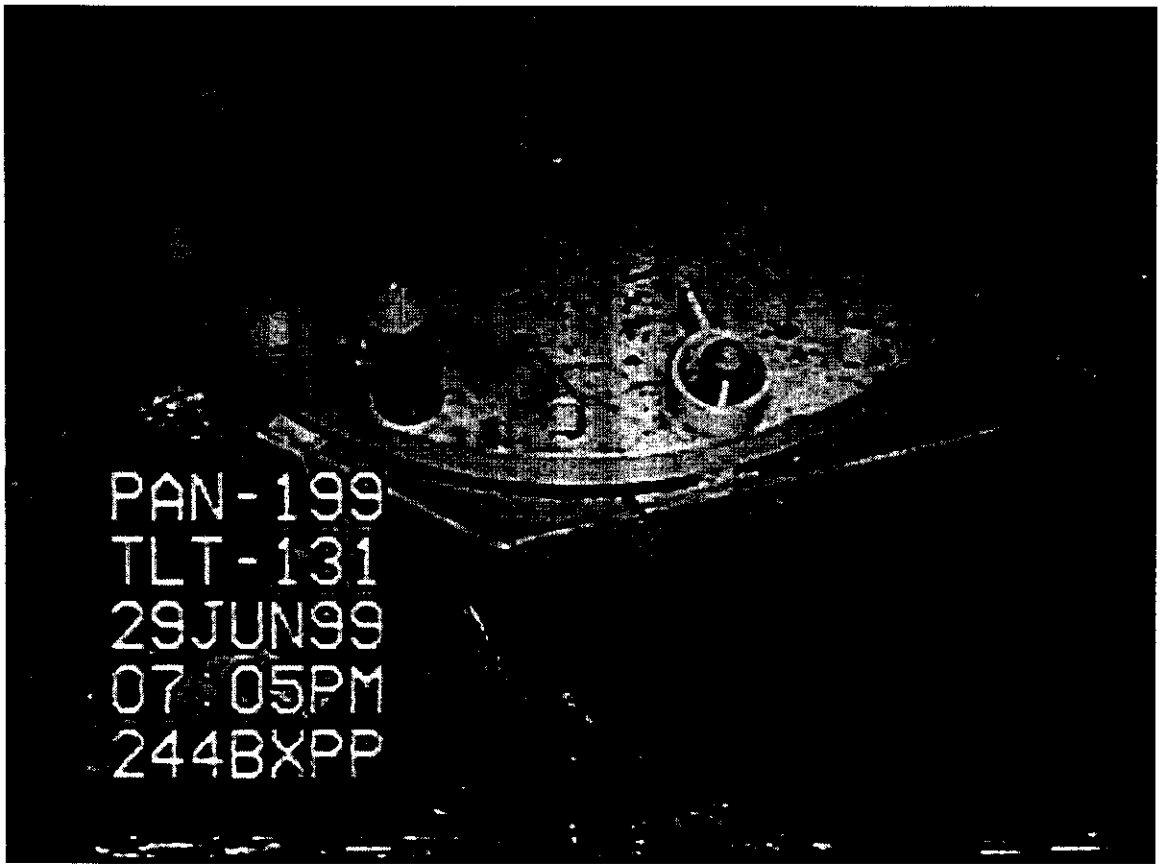


Figure E10
View of Riser number1 Cover Plate and a Portion of the Attached Piping Spider Assembly (camera entered through valve handle opening).

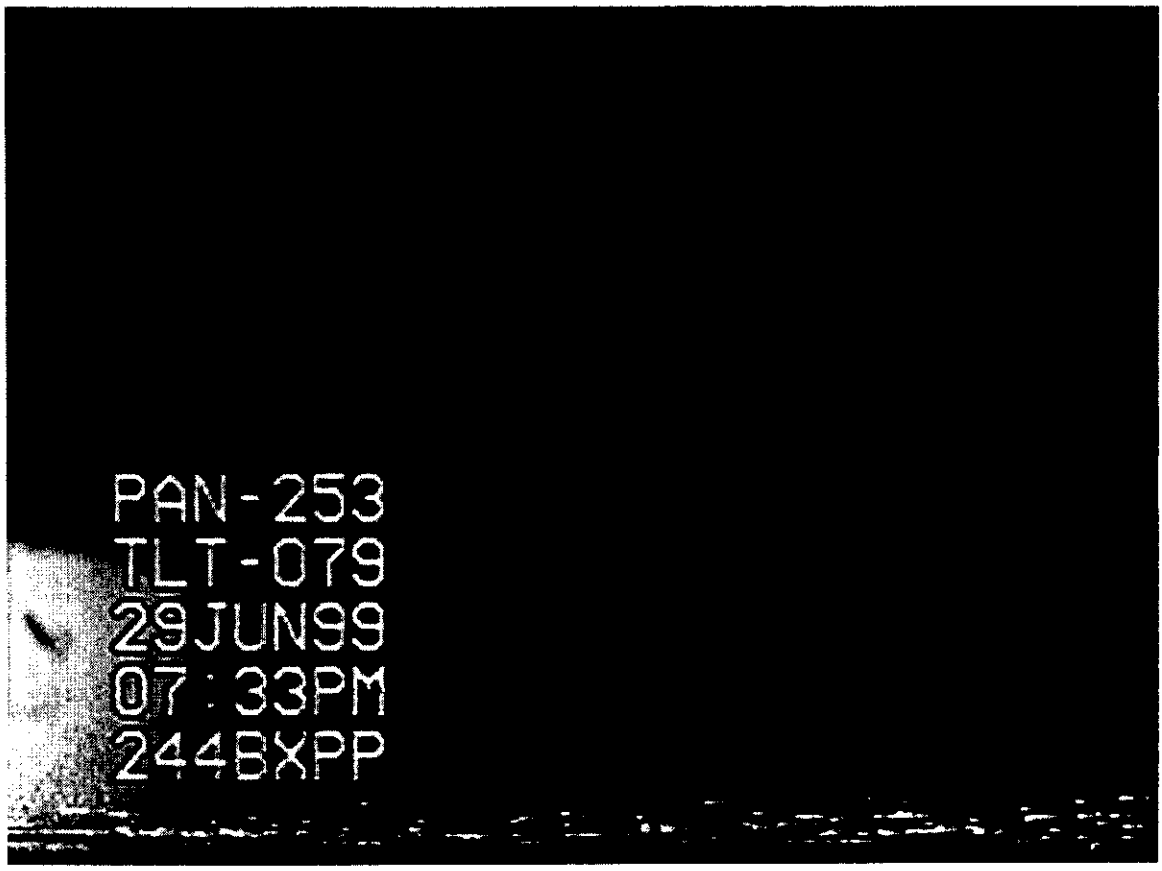


Figure E11
View of Water Emptying From Pump Pit Floor Around the Annulus of a Leak Detector Assembly (camera entered through valve handle opening).

TABLE E2 VIDEO EXAMINATION DATA SHEET, 244-BX DCRT ANNULUS AREA VIA RISER NUMBER 18

Examination Date: 7/23/1999

Person In Charge: D. P. Niebuhr Camera Operator: B. D. Wright Video Examiner: T.S. Hundal

Riser Number: 18

Video Tape Reviewer: E. B. Schwenk Date: 1/13/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following information reveals that the exterior walls and floor of the vault, as well as the outside surface of the tank, are in very satisfactory condition.
					Areas within the field of view of the camera were observed (walls, ceiling, tank exterior, visible tank welds, tank foundation, risers…). The camera was entered into the annulus of the DCRT vault through riser number 18 (24-in. diameter). The riser is located at the north end of the vault and is approximately in line with the west side of the tank.
					Comments are made herein at various locations confirming the general satisfactory conditions seen. Video/still photographs are included that show some of the noted conditions. Pan & tilt refer to the angles of the viewing video camera either when a comment is made or when a 'still' was taken. A similar write-up is made for entrance of the camera into riser number 26 (located about mid-tank but toward the east wall). Drawing H-2-73865 is helpful for orienting the camera with respect to a given riser entrance and compass directions.
0730 AM to	0733	-	-		Camera started down through riser number 18 but no sound was apparent. Rust/dirt speckles on floor, directly below the riser are likely due to the camera brushing up against inside of the lightly rusted riser inside dimension surface and gasket debris. Sound apparently not working. Camera pulled and restarted later. (No figure)

Table E2 Video Examination Data Sheet, 244-BX DCRT Annulus Area Via Riser Number 18 (continued)					
0830 to	0831	91	94		Camera is slightly above the tank looking toward the south wall with the west wall at the right side. The bright yellow ½ - ring in the foreground is one of two circumferential lifting ½ -rings. They look like a partial flange that was put on each top end of the tank near where the hemispherical heads join their cylindrical shell course. Each half ring is joined to the tank foundation support thereby securing the tank to the pit bottom structure. (No figure)
0834 AM		339	36		Figure E12 shows a view of a clean DCRT pit wall and ceiling at the NE corner of the pit.
0835		36	65		Figure E13 is a view of the top of the tank including bellowed risers that enter the tank. Looks very clean with no evidence of spills or leaks.
0837		71	66		Girth weld at north end of tank (top) looks very satisfactory (no figure).
0839		85	82		The west wall of DCRT vault and the west side of tank are clean and show little evidence (if any) of corrosion-type conditions as shown in Figure E14. Note that the color of the tank (dark yellow) appears darker, probably for several reasons. First, some of the light from the region of the camera is partially shaded by the lifting ring (bright yellow). Second, some slight color differences are seen in some of the paint. Perhaps the tank was, later, touch-up painted, or while the tank was being painted, the paint came from different cans each of a slightly different color.
0852		289	100		Only one circular stain mark seen on concrete floor, possibly from water in-leakage from the ceiling above. Some small markings also seen in NW corner (later around 0900 and 86/85 pan and tilt). (No figure)
0854 to	0855	≈ 260	≈ 36 to 110		This video range covered part of the of the north-facing tank hemispherical head where it sits upon the NW foundation of the tank. Both look very satisfactory. (No figure)
0859		144	80		Figure E15 shows a more direct in-line view of the bolts that secure the north tank support (and tank) to the floor. The dark, rectangular mark that appears stuck to the foundation ring plate, was purported to be a tag in a plastic container, that apparently contained tank delivery information. In addition, the head-to-cylindrical shell weld looks very satisfactory.
0922 AM	0924	155-190	82-28		Some small, flaky oxidation-type marking seen mainly on the lower side of the pit's west wall. They appear insignificant. (No figure)

TABLE E3 VIDEO EXAMINATION DATA SHEET, 244-BX DCRT ANNULUS AREA VIA RISER NUMBER 26

Examination Date: 7/1/99

Person In Charge: D.P. Niebuhr Camera Operator: T. N. Miller Video Examiner: T. S. Hundal

Riser Number: 26

Video Tape Reviewer: E.B. Schwenk Date: 1/14/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Like the visual exam thru riser number 18, the visual images seen through this riser (number 26) also show that the pit exterior walls, ceiling, floor, receiver tank, and receiver tank foundation are in very satisfactory condition. Hanford Drawing H-2-73865 is helpful for orienting the camera with respect to a given riser entrance and compass directions.
1059 AM		254	159		Camera entering through riser number 26. Note: the entrance shown at this point on the tape is not correct. The initial image seen is a carryover from a previous entrance into the 244-BX pump pit. In the 244-BX DCRT vault annulus, the sump is at the mid-span of the tank but along side the east wall. The camera, when lowered through riser number 26 also comes down near the middle of the tank but closer to the east side wall of the pit. (No figure)
1121 AM					Camera panning around top of tank. (No figure)
1125		220	46		Camera now looking at south wall of vault. Walls and ceiling look good. Some rust marking seen (briefly) around hole in ceiling. Will look back at later in the video scan. (No figure)

Table E3 Video Examination Data Sheet, 244-BX DCRT Annulus Area VIA RISER NUMBER 26 (continued)					
1126		243	027		Two large, but short risers are seen penetrating through the vault ceiling from the pump pit above. The largest is a 24-in. diameter manway. The smaller one has a number of rust-type 'stalactites' hanging from its bottom edge. They may have resulted from a buildup of condensate that subsequently ran down the inside surface of the riser pipe causing some rust-like deposits to hang from its perimeter. Or, possibly resulted from some rainwater or snowmelt in-leakage. In any case, they appear insignificant. Figure E16 shows the nature of the 'stalactites.'
1127		306	61		View of tank top and downcoming, bellowed risers shown here. Some minor stains on the tank top and side (east) possibly because of some fluid in-leakage such as rainwater or snowmelt. See Figure E17.
1132		141	55		Small differences in color of paint noted on top of tank that was also seen in the riser number 18 video exam. (No figure)
1132		213	55		Looking at north end of vault, including ceiling, walls and north end of tank. All look very satisfactory. (No figure)
1132-40					Main tank horizontal weld and girth weld look very satisfactory. (No figure)
1146		058	078		Some fluid in-leakage from the overhead pump riser appears to have occurred. Vertical stain-marks are seen on the outside of the riser. One long (about 2-in.), insignificant, 'snakelike' drip is residing near the top of the tank just below the riser (See Figure E18).
1150-1153		18	42		Sump appears satisfactory but contains some debris in it. The sump is stained indicating some prior in-leakage of some type. (No figure)
1154-55		182	77		Tank foundation (south end) also appears very satisfactory. The (south end) secure-down bolts cannot be seen here because they are on the backside of the support ring, when viewing the ring from near the tank outer-center region. Same comments hold for viewing the north end support structure; it too is satisfactory but the secure-down bolts are on the backside of the ring support structure. (No figure)

Figure E12
View of DCRT Vault Wall and Ceiling at Northeast Corner (fuzzy item in upper right corner is a shadow from the camera-mounted light system; camera entered through riser number18).

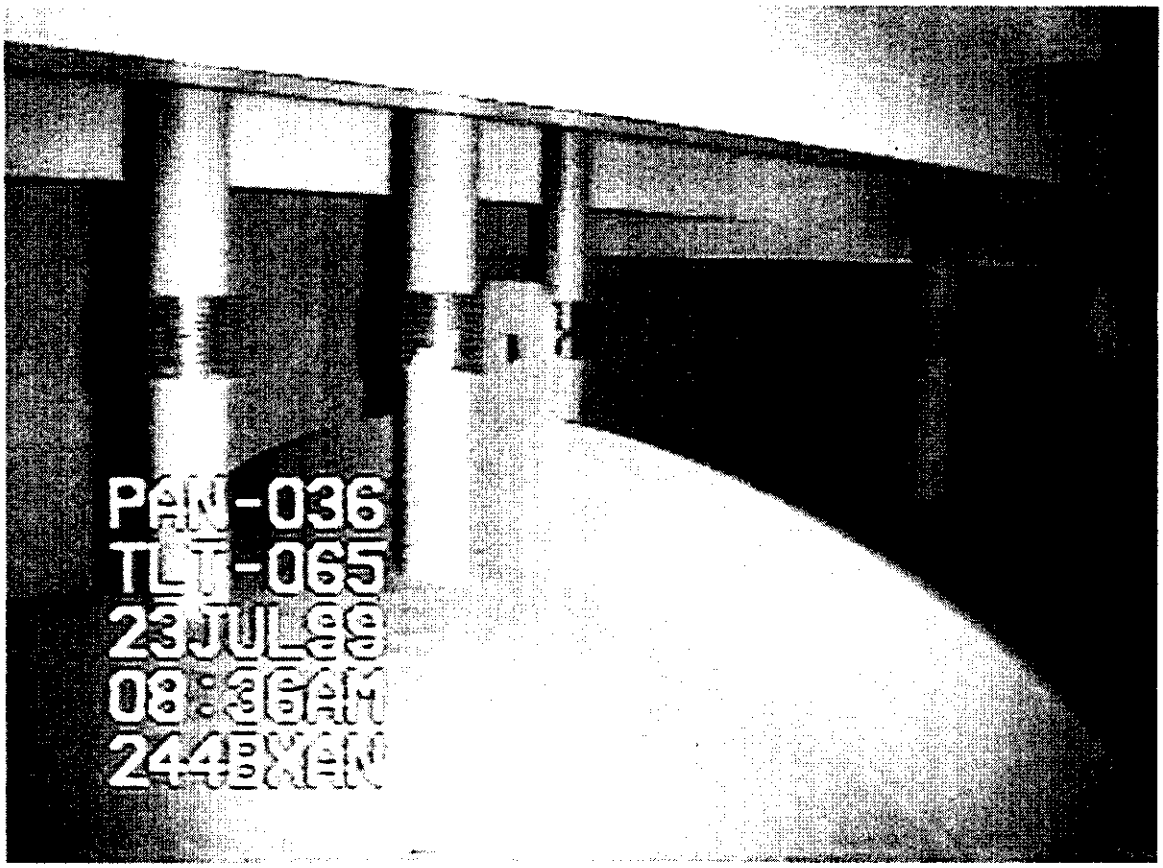


Figure E13
Top of 244-BX DCRT Tank and Bellowed Risers. Camera Viewing North end of Tank (camera entered through riser number18).

Figure E14
West Wall of Vault and West Side of 244-BX DCRT tank (camera entered through riser number18).

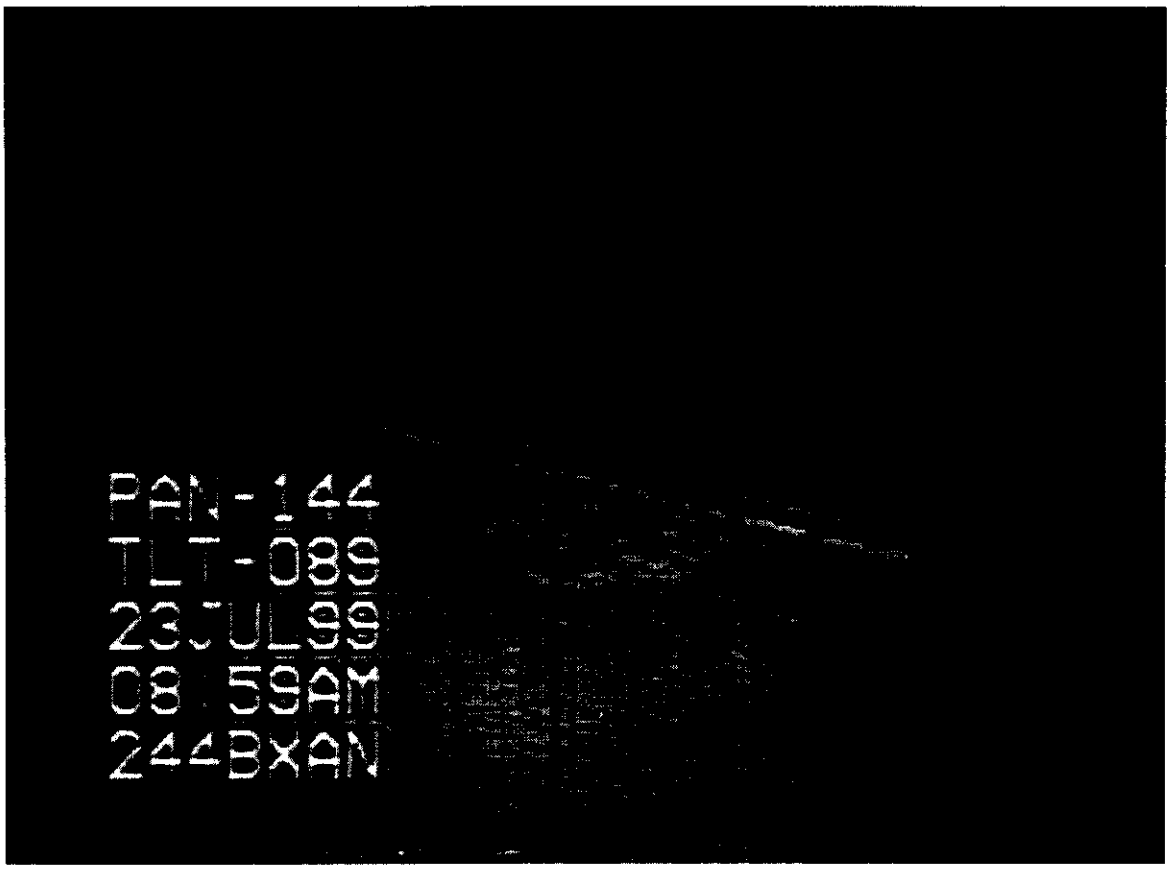


Figure E15
View of Tank Foundation Support, Bolts, and Concrete Foundation, Approx. NW corner of vault (camera entered through riser number18

Figure E16
Some Insignificant 'Rust-Type' Stalactites Hanging Down From an Inlet Riser. (camera entered through riser number26.)

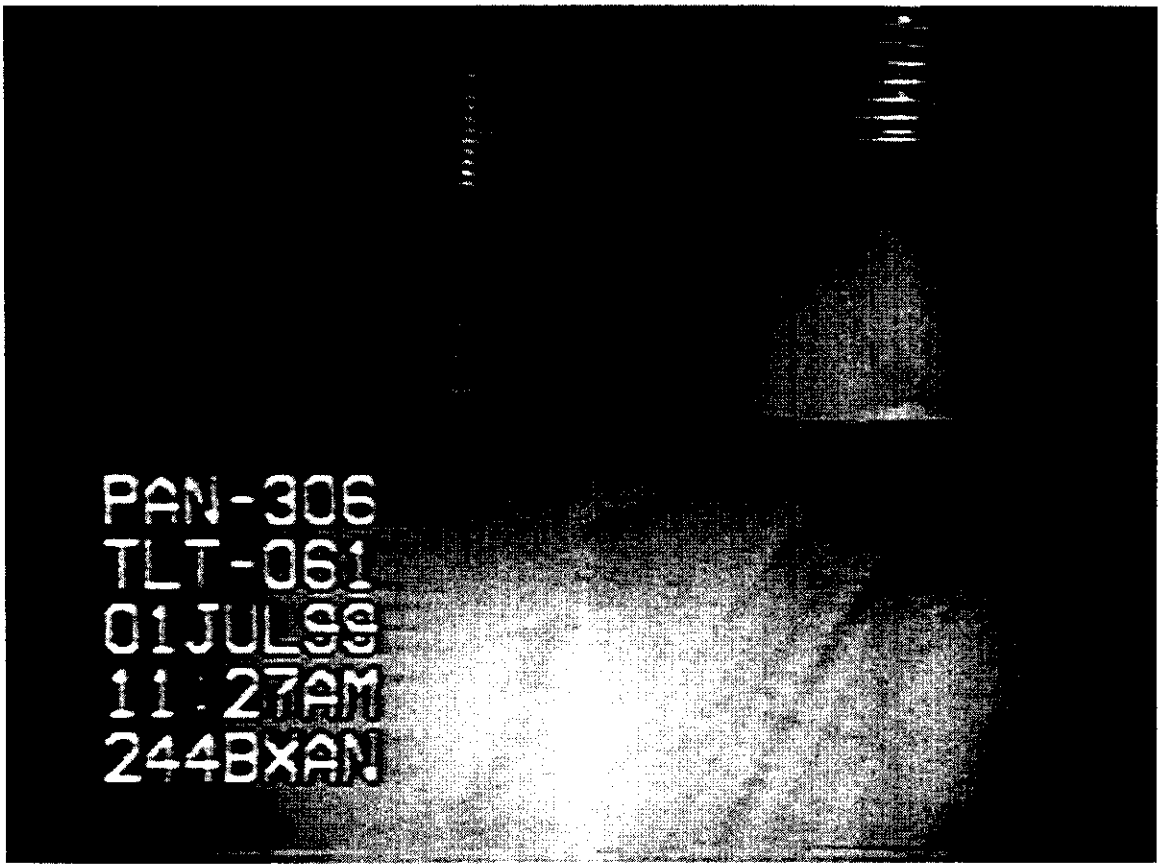


Figure E17
Minor Stains on top of Receiver Tank (probably from rainwater/snowmelt trailing down along the riser; camera entered through riser number26)

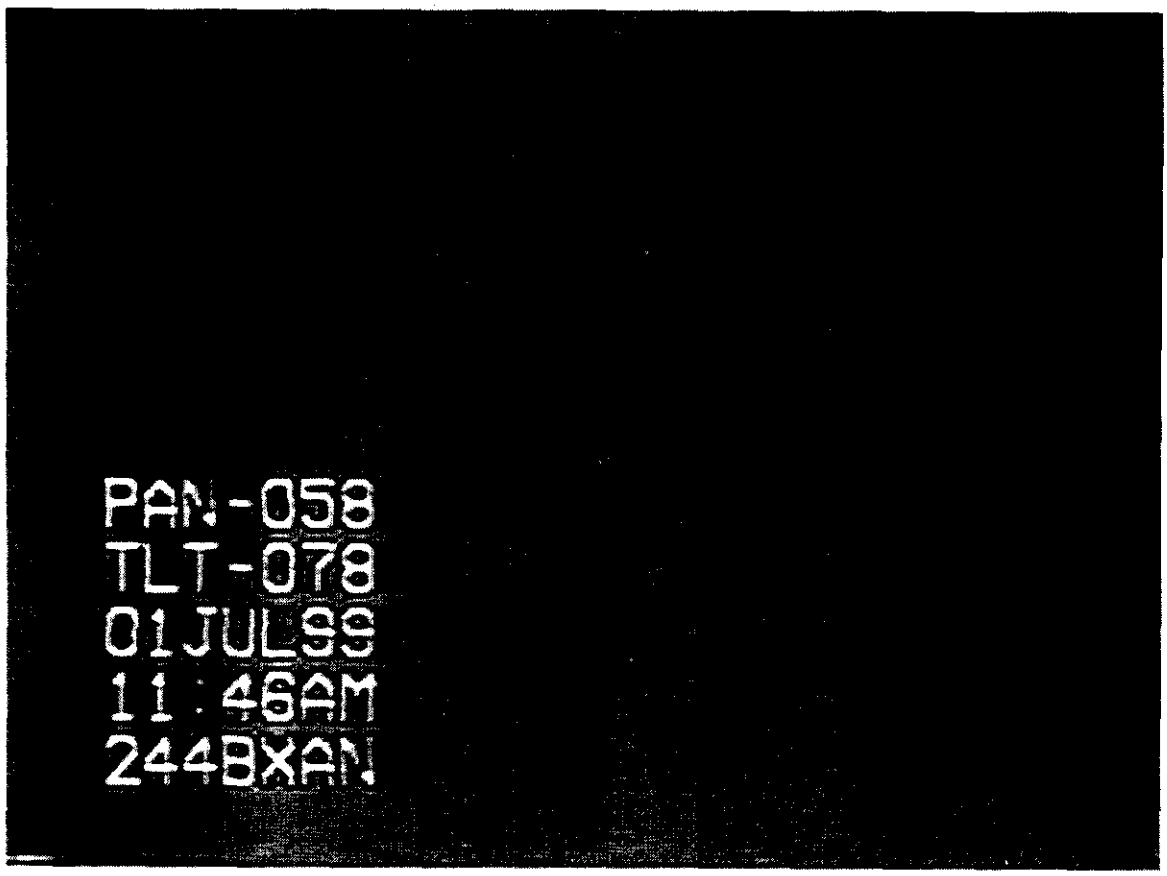


Figure E18
View of an Insignificant 'Snakelike' Drip Adhering Near the top of the Receiver Tank, Just Below a Riser (camera entered through riser number26).

TABLE E4 VIDEO EXAMINATION DATA SHEET, INTERIOR OF 244-BX DCRT

Examination Date: March 15, 2000

Person In Charge: Ken Baird | Camera Operator: Bruce Wyatt | Video Examiners: T. S. Hundal

Riser: Number 16, 4-in. diameter

Video Tape Reviewer: E. B. Schwenk Date: March 27-30, 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following narrative and photographs indicate that the approximately 20 year old 244-BX double-contained receiver tank is in very satisfactory condition. Most of the tank surface area could be viewed except for that below the sludge layer and for a narrow region (probably about 5°–8° wide) along the very top of the tank. Three vertical diptubes, penetrating into the tank through the proximal pipe riser (number 15) obscured the latter noted region. The waste fluid (about 5- ft deep) was very transparent. As a result, the tank sidewall could be viewed down to the top of the finely divided sludge layer (estimated to be 2-3 ft deep). Based on waterline marks, the tank apparently has never been filled with waste above two thirds to three fourths of its 12 ft height (diameter). Insignificant light and spotty corrosion, and some staining can be seen on the top one third to one fourth of the tank. Whitish deposits (with evidence of many different waterline markings) cover the majority of the tank below the top waterline. Some black-colored areas (also below the top waterline) appear to correlate mainly with external lifting straps/tiedowns or through-wall horizontal and girth weldments. For some reason, the white deposits do not completely adhere to these regions; however, these black regions do not appear detrimental to the integrity of the tank walls. Spotty black regions elsewhere in the tank (also all below the top fill line) appear to be holes in the white deposit that allow the unaffected, black-colored steel wall surface to show-through. Some waterline corrosion may have occurred in one vertical tube. Partial spalling of annular deposits, on one vertical tube in the tank, appear to be about 1/8-in. thick, implying that the tank wall deposits may be of similar thickness. With the possible exception of possible waterline corrosion in one vertical tube, no significant corrosion was seen in the areas accessible to the video camera. Stereo pair photographs were made in several areas to assist in evaluating possible waterline corrosion in the tank walls. No significant horizontal depressions were seen, suggesting that the tank corrosion allowance (0.010-in. per side) may not have been exceeded.

Table E4 Video Examination Data Sheet, Interior of 244-BX DCRT (continued)

					The terms pan and tilt refer to the angles of the viewing video camera (VITIS II) and attached light that had been lowered through 4-in. pipe riser number 16. Horizontal panning ranges from about 0 to 359°. Tilt angle ranges from 0 to about 180° (straight down).
0729 PM		010	151		The photo in Figure E19 shows typical air bubbles emanating from the bottom the two diptubes. Also seen is the clarity of the wastewater and pockmarked tube deposits. [A later photograph (Figure E29) shows how thick the deposit may be on the majority of the tubes and hence on the sidewall of the tank too].
0730 PM		010	126		A close-up view of the pockmarked deposits near bottom of the diptubes (at the extant waterline) is shown in Figure E20.
0733 PM		025	067		Scanning the top and side of the tank (in a southerly direction) showed no significant corrosion attack (Figure E21). A girth weld can be seen in the central region of the photograph. Further, no waste 'waterlines' can be seen in the top portion of the tank.
0735 PM		001	042		This view, shown in Figure E22, is of the three diptubes as they pass downward, into the tank, through riser number 15. As in Figure E21, the upper portion of the tank shows only limited, spotty corrosion. Some vapor phase corrosion, as well as blemish, deposits, appear to have occurred on the upper portion of the tubes. The minor, top-located whitish deposits may have occurred as a result of drying-out of periodic rainwater/snowmelt incursions.
0738 PM		016	082		A large number of horizontal waterline markings and some black blemishes are shown in Figure E23. The relatively wide circumferential black mark the left of the photo, correlates with the tank's southern lifting strap/support. Some of the horizontal black blemishes appear to correlate with tank weldments.
0741 PM		079	096		A higher magnification view of one brown-stained horizontal watermark is shown in Figure E24. A stereo pair photo (Figure E25, about 5° removed from Figure E24) was taken in an attempt to determine the 'depth' of the horizontal mark. The depth appeared to be less than the apparent thickness of the deposit, as shown in Figure E29, below.
0742 PM		103	105		A view of the northwest corner of the tank wall is shown in Figure E26. This photo shows a vertical, black blemish that is associated with a girth weldment at the end of the tank. As in Figure E23, a large number of horizontal waterline markings, both above and below the actual waterline, are shown.
0810 PM		000	076		An overall view of the nearly unattacked top of the tank relative to the lower, lightly black-marked, white-deposited areas, is shown in Figure E27.
0816 PM		000	096		The upper area of Figure E28 shows a combination of dissolution of the pipe's annular deposit along with some likely corrosion into the tube's base metal. This was the only area of possibly significant metal corrosion (in a non-fluid boundary surface) seen anywhere inside the tank.
0818 PM		018	115		Figure E29 shows a partial, scaling-off of the vertical tube's annular deposit. This photograph indicates that the tank's inner surface deposit may be of similar thickness.

Figure E19
View of Pockmarked Surface Deposits on Bottom two Diptubes, 244-BX DCRT

Figure E20
Close-up View of Deposits on Bottom two Diptubes, 244-BX DCRT

Figure E21
View near Top and Side of 244-BX Receiver Tank (southerly direction)

Figure E22
View of 244-BX DCRT Diptubes (passing through riser no.15) and top of Tank

Figure E23
View of 244-BX DCRT Sidewall Showing Waterline Markings, White Deposits and Black Surface Blemishes

Figure E24
View of Sidewall Watermark in 244-BX DCRT

Figure E25
View of Watermark on Sidewall of 244-BX DCRT (Stereo Pair with Figure E24)

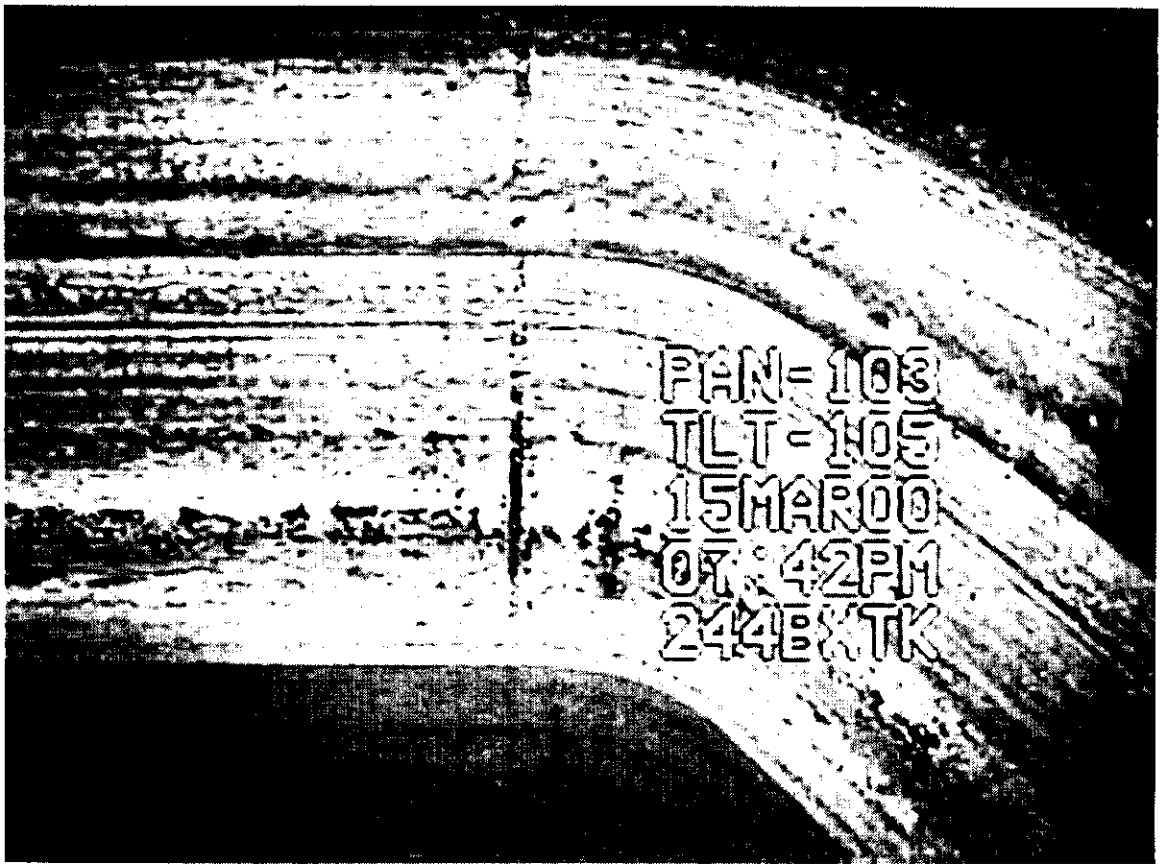


Figure E26
View of Northwest Corner of 244-BX DCRT and Darkened Vertical (Girth) Weld

Figure E27
Partial View of 244-BX DCRT Sidewall and Top Including Multiple Watermarks and Black Blemishes

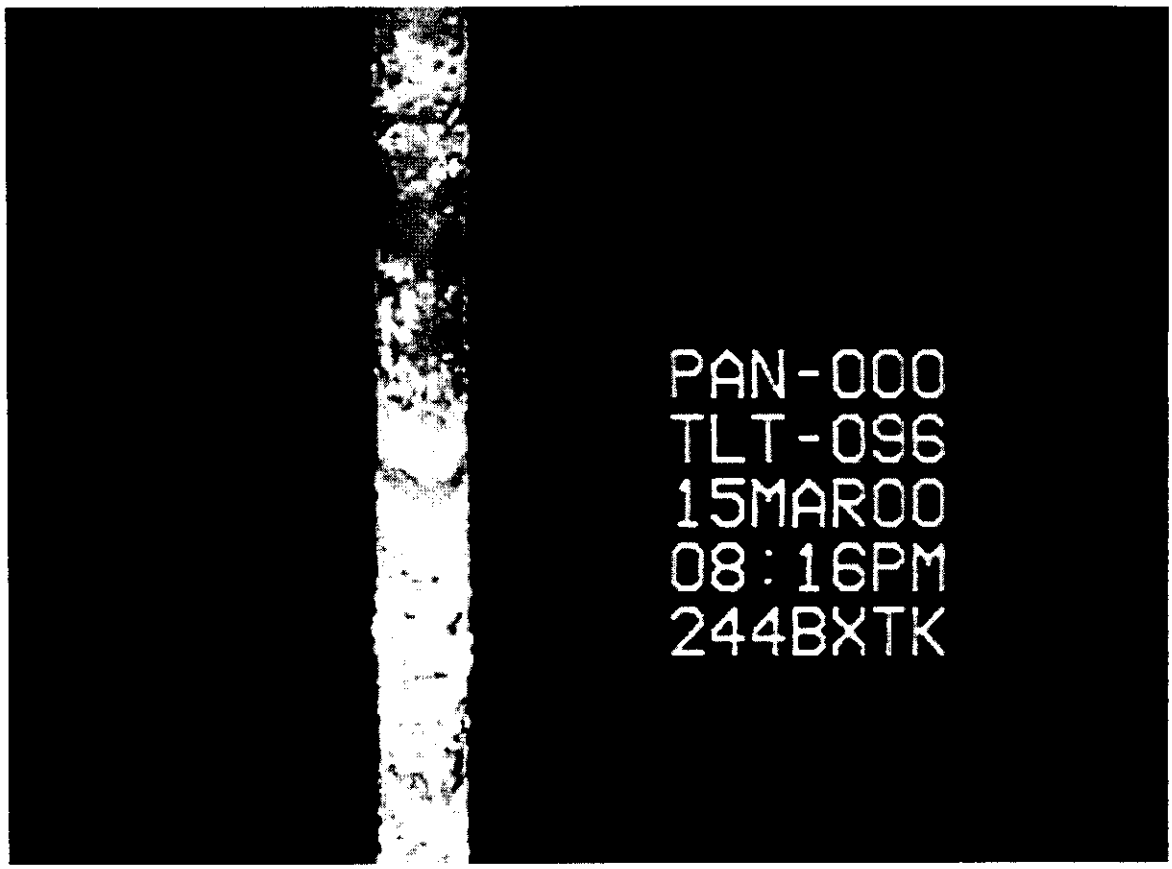


Figure E28
Waterline Corrosion Extending Through the Tube Deposit and Possibly into the Pipe Basemetal, 244 BX DCRT.

Figure E29
View of Surface Deposit Spalling Off of a Vertical Tube, 244-BX DCRT.

TABLE E5 LEAK TEST DATA

TEMPORARY ROUND SHEET

Starting Saturday morning, 5/29/99, record the 244-BX DCRT liquid level every 2 hours for 40 hours.

Shift Manager Approval: [signature] Signature 5-29-99 Date

Expiration Date: 6-10-99

244-BX DCRT LIQUID LEVEL READINGS								
Parameter			Normal Range			OSD Limit		
R08, 244-BX Receiver Tank Liquid Level (Ft. – In.)			≤ 9', 7"			12', 0"		
Date: 5-29-99								
TIME	LEVEL	OPER INITIALS	TIME	LEVEL	OPER INITIALS	TIME	LEVEL	OPER INITIALS
0930	9'1"	MJA	1530	9'1"	MJA	2130	9'1"	JM
1130	9'1"	MJA	1730	9'1"	SHA	2330	9'1"	JM
1330	9'1"	MJA	1930	9'1"	RB	0130	9'1"	JM

Shift Manager Review: [signature] Signature 5-30-99 Date

TABLE E5 LEAK TEST DATA

Starting Saturday morning, 5/29/99, record the 244-BX DCRT liquid level every 2 hours for 40 hours.

Shift Manager Approval: _____ Signature 5-29-99 Date

Expiration Date: 6-10-99

244-BX DCRT LIQUID LEVEL READINGS								
Parameter			Normal Range			OSD Limit		
R08; 244-BX Receiver Tank Liquid Level (Ft. – In.)			7'-9"			12'-0"		
Date: 5-30-99								
TIME	LEVEL	OPER INITIALS	TIME	LEVEL	OPER INITIALS	TIME	LEVEL	OPER INITIALS
0330	9'1"	JM	0930	~~9'11"~~ 9'1"	PS	1530	9'1"	PS
0530	9'1"	JM	1130	9'1"	PS	1730	9'1"	PS
0730	9'1"	PS	1330	9'1"	PS	1930	9'1"	TW

Shift Manager Review: _____ Signature 5/30/99 Date

Table E5 continued

TEMPORARY ROUND SHEET

Starting Saturday morning, 5/29/99, record the 244-BX DCRT liquid level every 2 hours for 40 hours.

Shift Manager Approval: [illegible] Signature 5-29-99 Date

Expiration Date: 6-10-99

244-BX DCRT LIQUID LEVEL READINGS								
Parameter			Normal Range			OSD Limit		
R08, 244-BX Receiver Tank Liquid Level (Ft. – In.)			≤9' 7"			12' 0"		
Date: 5-30-99								
TIME	LEVEL	OPER. INITIALS	TIME	LEVEL	OPER. INITIALS	TIME	LEVEL	OPER. INITIALS
2130	9' 1"	[illegible]	N/A					
2330	9' 1"	[illegible]	N/A					
N/A								

Shift Manager Review: [illegible] Signature 5/30/99 Date

APPENDIX F

241-AX-152 CATCH TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
CHG	CH2M HILL Hanford Group, Inc.
CR	Carbon Steel
CSR	Cesium Recovery Waste
CVI	certified vendor information
DCRT	double-contained receiver tank
DSSF	double-shell slurry feed
DST	double-shell tank
DW	decontamination waste
HDCS	Hanford Data Control System (database)
HLAN	Hanford Local Area Network
LFL	lower flammability limit
NCAW	neutralized current acid waste
NHW	(undefined designation of waste)
Non-GRE	non-gas release event
PCSACS	Personal Computer Surveillance Analysis Computer System
PRC	Plant Review Committee
RCRA	Resource Conservation and Recovery Act
PFP	Plutonium Finishing Plant
RHA	Records Holding Area
RMIS	Record Management Information System
SCC	stress-corrosion cracking
SRR	strontium recovery waste
SS	stainless steel
SST	single-shell tank
unk	unknown
VITIS	Video In Tank Inspection System
WTR	wastewater

1.0 INTRODUCTION

The 241-AX-152 Diverter Station (AX-152) is located in the 200 East Area of the Hanford Site (Figure F1). AX-152 is located between the 241-AY Tank Farm and 241-AX Tank Farm. A catch tank (located in AX-152) receives waste leakage and condensate from various facilities (Palit 1996).

It is noted to the reader that the following assessment of 241-AX-152 Diverter Station (and catch tank) presented in this appendix was conducted during FY 1999 and FY 2000. In FY 2001 Catch tank 241-AX-152 was formally declared to be leaking and action was taken by the CH2MHILL Hanford Group, Inc. (CHG) Plant Review Committee (PRC) on March 23, 2001 (PRC 2001) to preclude the tank from future use. Therefore, the data provided in the following sections is no longer needed to support an integrity assessment evaluation of this facility. The data is, however, being included in this document as a resource to support future decisions to disposition the facility and to support day-to-day tank farm operations.

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the AX-152 catch tank components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the AX-152 pump pit, diverter pit, and the catch tank. The scope of the examinations includes a visual examination of the AX-152 catch tank internal surface, its pump pit and diverter pit, and a leak test of the tank.

4.0 DESCRIPTION

The AX-152 Diverter Station structure is a rectangular two-tier reinforced concrete vault designed and built in 1962 and 1963. The upper tier has two compartments (Bovay 1962c), a pump pit, and a diverter pit that house Diverter Operators A and B (Bovay 1962a). The lower compartment designated as the catch tank vault, serves as the main reservoir for temporary waste storage. Exterior of the vault on the north side, a system of buttress type reinforced concrete walls and a beam supports a 24-in.-diameter vapor vent header. A sketch reflecting tank configuration and details is shown on Figure F2.

The bottom slab of the AX-152 diverter station is approximately 30-ft below grade. The overall dimensions are approximately 13-ft wide by 37-ft long by 30-ft deep (Bovay 1962c). For inside dimensions, geometric details, as well as the catch tank sump details, refer to Hanford drawing numbers H-2-44580 (Bovay 1962c) and H-2-44581 (Bovay 1962d). The upper cell floor slab is sloped towards a floor drain that empties into the catch tank below (HNF 1998). The diverter cell floor and up to 11 ft high of each wall are lined with 1/8-in. thick American Society for Testing and Materials (ASTM) A240-61T, Type 304L stainless steel plate (Palit 1996). The inside surfaces of the pump pit walls, floor slab and all cover block are coated with a protective coating (HNF 1998). There are a total of 53 pipe penetrations into the AX-152 Diverter Station (HNF 1999).

4.1 PUMP PIT

The pump pit (reinforced concrete about 7-ft 11-in. deep by 6-ft long, by 6-ft wide) houses the submersible pump, jumpers, and other ancillary equipment, and serves as secondary containment to the transfer lines and directs any leakage, such as transfer waste, rainwater, snowmelt, into the AX-152 catch tank. Both upper cells, the pump and diverter pits have a system of interlocking and removable concrete cover blocks for external access at ground level (Bovay 1962e).

4.2 DIVERTER PIT

The diverter cell (reinforced concrete about 8-ft deep by 6-ft wide by 13-ft long) contains two vessels (Operator A and Operator B). The vessels are 29-1/8-in. in diameter and are constructed of stainless steel. The vessels have a maximum capacity of 50 gallons and a movable spout is located on the bottom of the vessel, which can direct waste out of a vessel to one of several exit pipe nozzles. The spout is moved via a crank hoist mounted on top of the cover block (WHC 1985). The diverter cell provides only gravity flow from the vessels forward. Thus, waste flows in one direction only and is limited to a maximum flow rate of 75 gpm (WHC 1985).

4.3 CATCH TANK

The inside dimensions of the catch tank are 6-ft wide by 22-ft 2-in. long by 11-ft 5-in. deep. The catch tank inside surfaces (top, bottom and side) are lined with 1/8-in.-thick ASTM A240-61T, Type 304L stainless steel plate (Palit 1996). The catch tank end walls are 30-in. thick while the longer sidewalls are 18-in. thick. The bottom floor slab is 24-in. thick at the outer edges and tapers (slopes) to a thickness of 18 in. at the sump pit. A pipe riser extends from the pump pit

floor to the catch tank sump (Olander 1990). The catch tank has a maximum capacity of 11,000 gallons, and the maximum liquid storage limit administratively allowed (when the tank was in service) was 8,800 gallons (Jonas 1988).

5.0 DESIGN EVALUATION

The design standards for the 241-AX-152 Diverter Station, the pump pit, the diverter pit, and the catch tank vault; the waste characteristics and compatibility, corrosion protection; and the age of the tank system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of AX-152. A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- Drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base
- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- Interviews with the Tank Farm Engineering personnel.

The following sections 5.1.1 through 5.1.3 present a summary of available and applicable documents and information pertinent to this evaluation. Only those affecting the original structural design and the intended operational functions of the diverter station are included. The original design references and guidelines were used as basis to evaluate the structural integrity.

The design drawings generated for the 241-AX-152 Diverter Station facilities were dated for approval May 1962. These design drawings are the only documents that were found in the record archives that reflect and mandate design and construction conformance to Hanford Site design criteria and standards during the 1962 time frame. The following site-specific codes, and standards were reviewed as applicable for reference.

- ASME, American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code, Section VIII*, Division 2 (ASME 1961)

- Hanford Plant Standards, AC-2-6, Architectural-Civil Standard, Penetration Sleeves, Concrete Walls and Floors (DOE 1960)

- Hanford Plant Standards, AC-4-60, Architectural-Civil Standard, Steel Ladder Rung for Concrete Walls (DOE 1961)
- HWS-8237 *Hanford Works Specification*, PUREX 241-AX Tank Farm (GEH 1962)
- HW-4798-S *Hanford Standard Specification*, for Placing Reinforced Concrete (GEH 1961)
- HWS-7337 *Hanford Works Specification*, PUREX Waste Routing (GEH 1963)

For the overall diverter station concrete structure, the specification used for design basis was HWS-8237 (GEH 1962). This document covered items such as excavation, structural load-bearing fill and backfill materials, compaction, structural concrete, and welding. Structural concrete was to have a minimum compressive strength of 3,000 psi. Reinforcing steel was to conform to the requirements of HW-4798-S (GEH 1961).

To minimize force reaction build up at pipe penetration and nozzles, expansion joints were designed for expected high-temperature pipe systems. Engineering drawings also reflect piping thermal loops on long stretches of piping to accommodate in-line thermal expansion.

5.1.1 Catch Tank Vault

The stainless steel liners on the inside surfaces of the catch tank are provided with weld headed studs for anchorage (Bovay 1962f). Welds, including liner joints, were to conform to, be sealed, and inspected according to the Hanford Works Specification HWS-8237 (GEH 1962). Pipe penetrations into the catch tank are M-9 stainless steel (Bovay 1962) with end flanges and welded stud anchors (DOE 1961). Pipe systems associated with the catch tank were designed for a maximum operating pressure of 100 psig, an operating temperature of 160 degrees F, and a hydrostatic test pressure of 150 psig (GEH 1962).

5.1.2 Diverter Pit

Structural concrete for the removable cover blocks for the diverter pit were to be "Embeco" non-shrink concrete (trademark product of Master Builders) or approved equivalent (Bovay 1962e) with a minimum allowable compressive strength of 3,000 psi. Design of two vertical pressure vessels inside the diverter pit for Operators A and B was in accordance with applicable sections of the ASME Boiler and Pressure Vessel Code, Section VIII, Division 2 (ASME 1961). Fabrication, installation, hot working and cooling of the stainless steel vessels were performed according to HWS-8237 (GEH 1962). Welding was to be performed per Division IV of HWS-8237. Blend grinding was required to fix minor defects that did not reduce the wall thickness by more than 12.5 percent, otherwise repair by welding and grinding was required to fix defects such as gouges and cracks (GEH 1962).

Lines connected to penetrations into the diverter cell are process waste and water lines. They are M-9 stainless steel and M-35 carbon steel (CR) pipes respectively (Bovay 1962a). M-9 pipes were designed for a maximum operating pressure of 100 psig, an operating temperature of

160 degrees F, and a hydrostatic test pressure of 150 psig (GEH 1962). The M-35 pipes were designed for a maximum operating pressure of 120 psig, an operating temperature of 120 degrees F, and a hydrostatic test pressure of 150 psig (GEH 1962).

The M-9 pipe are stainless steel, ASTM A312, Grade TP304L and the M-35 pipes are carbon steel, ASTM A53 Type E or S Grade B, or ASTM A106 Grade B (Drawing H-2-31750), (Bovay 1962b).

5.1.3 Pump Pit

Inside surfaces of the reinforced concrete pump pit is coated with a protective sealant to mitigate seepage through its walls and floor. The pump pit contains a 24-in.-diameter pipe riser, which extends into the catch tank below (Bovay 1962f). It is provided with a shielded cover that contains a 4-in.-diameter plugged opening (Mendoza 1996). At ground level, the pump pit has a system of interlocking and removable concrete cover blocks for external access. Structural concrete for these covers are the same non-shrink "Embeco" concrete (Bovay 1962e) used for the diverter pit covers. They were designed to be leak-tight and resist weather element intrusion.

These records have undergone careful review and checking. Documents reflecting control and checking of design, procurement, and selection of construction products and materials ensured that the facility design and construction were based on good and acceptable engineering practice. Operational records were also reviewed and showed that control and monitoring of operating parameters ensured that design bases criteria were not exceeded.

Design drawings generated for the 241-AX-152 facility did not explicitly address industry type codes. Instead, for criteria and guidelines the project used Hanford Works Specifications that contain specific chapters and/or divisions that defined design criteria and selection of major structural materials. The concrete section of HWS-7337 (GEH 1963) for example reflected requirements equivalent to the American Concrete Institute code. Project specifications and design criteria in comparison to the applicable industry codes and standards were found essentially the same as the design basis in the key areas of design and construction. It is concluded therefore that the collapse, rupture, or failure from structural design, construction, or operational fault in the 241-AX-152 facility is not imminent and is not reasonably probable for the expected use and duration of this facility.

Structure design loads such as soil pressure, live load, seismic loads, and design load combinations from functional requirements are not available for reference at this time. However, maximum operating pressures and temperatures, and hydrostatic test pressures are reflected in the engineering drawings and were used in this evaluation. In addition, no structural analysis and calculations records were found or performed. In view of these limitations, no quantitative results are presented. However, the structure has favorably withstood approximately 38-years of continuous waste handling operation.

As a matter of record, the 241-AX-152 Diverter Station Facility underwent two functional design changes. The first modification was recorded on as-built drawings (KEH 1982) under Project B-220. The second was documented by ECN 708132 (KEH 1998) and was issued in September 1998. These recorded changes did not affect or alter the structural integrity of the structure.

The structural assessment report (WHC 1996) of numerous facilities subjected to various accident-loading conditions was performed for the safety analysis report. This assessment determined that AX-152 facility structural components could fail from: 1) seismic loads, and 2) internal transient pressure caused by hydrogen deflagration.

Review of this document (WHC 1996) indicates that the analysis methods used were crude and simple with very conservative assumptions and unrealistic loadings, which are also mitigated by design and administrative controls. The facility has been in operation for 38 years without any incident and recent internal examination (Section 6.0) reveals that the concrete pits are in good condition with hairline cracks in the walls. A recent refined analysis (Julyk 1999) of a similar concrete structure shows that it has adequate structural strength to withstand applicable design loads. A similar additional refined analysis also would be expected to show that the AX-152 structures have adequate strength for applicable design loads. Failure of the structure due to hydrogen deflagration is precluded by administrative controls.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The history of 241-AX-152, past waste transfers and projected waste transfers are discussed in this section.

5.2.1 Brief History of Changes to 241-AX-152

This diverter station played a principal role during operation of the Plutonium Uranium Extraction (PUREX) Plant and during later operation of B Plant. In addition, it can collect waste from a number of other sources. While these sources are difficult to fully clarify, their number has decreased significantly over the life of the station. Thus the amount of waste that is potentially deliverable to the station has decreased.

It has been said that the 241-AX-152 diverter station is the most complex catch tank of its type on the Hanford Site. For example, there are a total of 53 penetrations that enter into the station (Skelly 1998). Another indication of its complexity is the physical number of drawings associated with the structure; as many as 32 drawings were used in this report.

As noted above, the drainage sources that are closest to the catch tank come from its overhead pump pit and diverter pit; the remaining sources (of leaks or spills) have changed with time and should be anticipated to change further in the future. The diverter pit (with its two, 9-station, A- and B-diverter tanks), sits directly above the catch tank. Ostensibly there is no floor drain noted in the structural drawing (Hanford Drawing H-2-44583). However Detail "A" in Hanford Drawing H-2-44682, (Bovay 1962e) shows a small (unobtrusive) space between each of the nine piping penetrations (per each diverter tank A and B) that pass through the lined diverter pit floor. This space provides the drainage path for any leaks that collect in the approximately 11-in.-high diverter pit stainless steel pan. One 4-in. drain connects the pump pit with the catch tank. The remaining sources of spills or leaks that can enter the catch tank are large but they decrease significantly with time. Emphasis here is placed on changes that have lead to the reduced sources of drainage.

First, drawing Hanford Drawing H-2-64400 (Drawing 1992) shows a number of changes in potential sources of waste. Of the 53 penetrations into the station, nine process waste lines (to the 241-AX Tank Farm) have been plugged with concrete. Furthermore, drains and connections with the 241-AY-151 (Transfer Box Pump out pit) and 241-AX-153 (Isolation Jumper Pit) have both been weather-sealed and isolated. The 241-AY-501 (Condensate Valve Pit), the raw water flush valve pit, and the 241-AX-155 diversion box, and at least four other drains appear to remain connected (see Hanford Drawing H-2-64400).

In 1996, Palit 1996 indicates that the catch tank is used as a drainage receiver and holding tank for the 241-A Tank Farm complex. As noted above, Palit also indicates that it receives drainage from the A- and B-diverter tanks, as well as drainage from the AY-501 valve pit floor drain, the 241-AX-155 diversion box floor drain, and the 702-A seal pot overflow line. The latter is part of the 702-A mechanical ventilation system. Palit (1996) also indicates that after completion of the PUREX terminal cleanout and ventilation system upgrade under Project W-030, that the need for the catch tank will be dependent only on the use of the 241-AX-155 diversion box.

Mattichak (1997), indicates the same sources of drainage as Palit (1996) but adds the PUREX Transfer line V-714 encasement drain, the 110 seal loop drain (apparently related to the designation, 24-in. V-0110-W9 vapor header), and the K1-5-1 de-entrainers. Later, Blaak (1997) indicates that AX-152 catch tank receives condensate from the seal loop, the 702-A ventilation system and drainage from the overhead pump pit. Hanlon (1999) indicates that the 241-AX-152 facility, receives waste from the 241-AX-152 diversion box, indicating that it is its primary source of waste.

Recent conversations with tank farm engineering personnel indicated that further changes have been made in the surrounding waste systems, which will also affect the sources of drainage to the catch tank. First, the 702-A ventilation system has been replaced by the 702-AZ ventilation system and the 110 seal loop drain is no longer active. Engineering staff members did emphasize, however, that side-fill transfer lines may still be connected to the 241-AY and AZ Tank Farms, with the result that total isolation from these connections may not be complete. The number of drainage and leakage sources continues to decrease and the facility is anticipated to have no long-term use. Further delineation of potential drainage/leakage sources is of limited value.

5.2.2 Past Waste Transfers

According to Anderson (1990), the A, AX, AY and AZ Tank Farms were built to store PUREX and B Plant aging wastes. The 241-AX-152 diverter station, which was built after 1962, was likely associated with waste transfers for these four farms but over different time periods. The A and AX single-shell tank (SST) Farms began service from about 1955 and 1964 respectively, continued into the 1980s. The AY and AZ DST Farms began service between 1971 and 1976, and are expected to operate for several years. The AY and AZ DST Farms have been involved with double-shell slurry feed and various low-and high-level B Plant and PUREX wastes (Brevick 1997). The latter two categories also included cesium recovery waste, decontamination waste, strontium recovery waste, dilute noncomplexed waste, unknown wastes, and waste water.

According to Olander (1990), 241-AX-152 was used in the transport of mixed waste solutions from processing and decontamination operation. Olander further notes that the waste included B Plant complexed and non-complexed waste, neutralized current acid waste, and an undefined designation.

LaSalle and Karwoski (1991) indicated that in 1989 the 241-AX-152 catch tank was frequently used and that it was pumped out on a regular basis. It was pumped an average of about once a week between July and September 1989 and about 1,600 to 1,900 gallons were pumped each time. In the time period 1990 to 1991, its use was less frequent, and it was being pumped about once every three weeks.

In the Palit (1996) document, it was estimated that about 8,400 gallons of process drain and rain intrusion enter the tank annually. The exact amount of rain intrusion was not available.

Based on process history, Blaak (1997) estimated that approximately four transfers per year would be made from AX-152 to DSTs 241-AY 102, 241-AZ-101 and -102. The average volume per transfer was estimated to be approximately 5,000 gallons. According to the PCSACS (Personal Computer Surveillance Analysis Computer System), data on waste surface level is available from about July 1995 to the present. Since 1995 the tank has been pumped eight times from a height of 45 to 65 in. down to about 5 to 10 in. In November 1998, when the tank was identified as a suspect leaker (Barnes 1998), and was pumped down to approximately 1.5 in. The AX-152 catch tank has since been determined to be leaking, and by action of the CHG Plant Review Committee (PRC) on March 23, 2001 (PRC 2001), was preclude from future use.

AX-152 is one of the few catch tanks that contain a sump, thus the tank can be very nearly emptied entirely. Waste collected in AX-152 from 1995 onward, has been 702 de-entrainer flush water and some rainwater and snowmelt (see PCSACS comment report for AX-152). According to tank farm engineering personnel the tank was empty on June 1, 1999.

Prior to any waste transfer, a waste compatibility assessment must be conducted. According to tank farm engineering personnel, this requirement has been in effect since 1995. This analysis meets Washington State Department of Ecology (Ecology) requirements that the waste not be ignitable, reactive, or corrosive per WAC 173-303-090 (WAC 1998). More specifically the compatibility assessment covers requirements based on waste categories, waste codes, and process or safety concerns that could be created during transfer and during subsequent commingling of the waste in the final receiver tank.

Waste compatibility compliance centers on requirements noted in five documents: Fowler (1995), Mulkey (1998), Cox (1997), Mulkey (1997), and HNF (1997). These requirements include: flammable gas (hydrogen, methane, and ammonia); nuclear criticality; organic and energetic reaction; watch list tanks; corrosivity; chemical compatibility; tank waste type; transuranic (TRU) segregation, heat generation, complexant waste segregation, phosphate waste, radiological source control, toxic chemical source term controls, and the wastes' Reynolds numbers. Flammable gas is particularly important in that for any future saltwell transfer(s), the catch tank vapor space concentration must remain controlled. Specifically, the minimum time to

reach 25 percent of the lower flammability limit (LFL) is required to be greater or equal to seven days, assuming loss of primary tank ventilation.

A waste compatibility assessment for AX-152 was conducted in 1997 (Blaak 1997). The waste was in compliance with the above requirements.

5.2.3 Projected Waste Transfers

According to tank farm engineering personnel, condensate from AZ-151, which passes through diversion box AX-155, is the most likely source of waste. Some rainwater, snowmelt, and seal pot water, are also expected to accumulate.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided by the combination of good design, appropriate material selection, and corrosion control. The tank liner is made of welded type 304L stainless steel (SS). It is resistant to uniform corrosion, both from typical Hanford caustic wastes (primarily nitrite, nitrate, and hydroxide) as well as dilute solutions of water. The material, however, is susceptible to pitting corrosion and stress-corrosion cracking (SCC). Both of these corrosion mechanisms are affected primarily by chloride ions in the waste, particularly in a near-neutral (pH ~ 6 to 8) condition. Because flushing water and rainwater, and snowmelt, makeup a significant proportion of the collected waste in AX-152, a near-neutral condition is expected.

Incubation times for pitting corrosion and SCC often do not exceed one year. Because the tank has been in service for approximately 39 years, there has been ample time to initiate either of the two corrosion conditions. SCC has the appearance of a brittle fracture, yet it can occur in highly ductile materials (such as type 304L SS), frequently at stresses that are below design levels. Further, SCC is a term describing stressed alloy failures that occur by the propagation of cracks in a liquid environment that is not highly corrosive to the metal overall. SCC requires the simultaneous presence of a tensile stress, either applied or residual (as in the case of weldments) or a combination of both, and the presence of a specific corrodent (like near-neutral water with a very small amount of chloride). The cracks form and grow, in the neighborhood of the weldments, at right angles to the direction of the tensile stress. Because the catch tank has no apparent mechanical loading to contribute to the weld-induced residual stresses, growth of the stress-corrosion cracks will attenuate the driving-force stresses and they will eventually stop growing.

In non-welded austenitic stainless steel, the probability of chloride SCC decreases significantly below 130 degrees F (Smets and Bogaerts 1992). However, in welded austenitic stainless steel chloride SCC continues to occur even at room temperature (McIntyre 1990). While the probability of its occurrence is low, it is not eliminated as a source of leakage.

Pits can also penetrate the tank wall in areas remote from the weldments. Thus, both corrosion mechanisms can act as sources of leakage. Furthermore, pits tend to occur along water lines (the boundary between liquid and vapor phase).

Waste depth levels in AX-152 were reviewed and described earlier. During the July-August 1995 time period, the waste depth level was virtually constant. Later, in the April to November 1998 time period, a small decrease in level was noted implying that very slow leakage could be occurring. Because near-neutral flushing water and rainwater, and snowmelt have been the dominant fluid entering the tank since 1995, any leakage of this type will not likely breach the reinforced concrete.

Catch tank AX-152 is made of reinforced concrete and is lined with welded 1/8-in.-thick type 304L stainless steel sheet. No significant uniform corrosion is likely to have occurred over the lifetime of the tank. Chloride-induced pitting corrosion and SCC are possible wall-penetrating mechanisms, even though they are expected to be low risk phenomena.

5.4 AGE OF THE TANK SYSTEM

Design records found in the project file show the project date year as 1962. If operations started the same year, then the 241-AX-152 Diverter Station tank system has been in service approximately 39 years.

6.0 INTEGRITY EXAMINATIONS

Because of operations schedule, accessibility, and cost considerations, only visual examinations of the pump pit and diverter pit were performed. These visual integrity examinations were performed on June 14, 2000 and June 20, 2001 for the pump pit and diverter pit, respectively. The examinations were conducted to identify possible degradation of the two pits, and their ancillary equipment, and to determine the extent of that degradation.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the interior of both the pump pit and diverter pit. As noted earlier no examination was performed in the catch tank, because of access problems. The date of examination for these facilities was June 14, 2000 and June 20, 2000, respectively. Visual examination details and data sheet findings are included at the end of this Appendix.

The 26 individual 'still' (Figures F3 through F28) photographs, taken from the videotapes and presented below, show the satisfactory status of both pits.

6.1.1 Pump Pit Visual Examination

The VITIS II camera and associated lighting (used for viewing the facility components) was lowered into the pit through the inspection riser. The camera has the capacity to both pan and tilt while viewing the pit internals. Azimuthal movement of the camera is provided by manual manipulation of the camera's suspension pole. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or a narrower-angle setting) used to closely view details of interest.

The color videotape showed that the condition of the coated, reinforced concrete walls, floor, joints, and cover block ceiling, of the pump pit. There are numerous innocuous cracks in the walls, which appear not to be structurally threatening. In addition, these are a large number of vertical cracks-like markings, which, are innocuous rust-water stains on the concrete sidewalls. The overall condition of the pump pit was very satisfactory. Various pieces of ancillary equipment within the pump pit were also in good condition. Table F1 describes, and Figures F3 through F14 show, satisfactory condition of the AX-152 pump pit and its internals.

6.1.2 Diverter Pit Visual Examination

Entrance to the diverter pit interior was provided by opening a 4-in. riser at the north side of the central cover block. This allowed access for the VITIS II video camera which is less than 4.0 in. in diameter. Most of the diverter pit interior could be seen. However, because of the proximity of the diverter tanks to the single riser entrance (and hence the inserted camera), some portions of the walls were obscured. In addition, another factor caused most of the videotape to be recorded in an upside-down orientation. This was caused by a malfunction of the camera's pan and tilt mechanism. In order for the video tape reviewer to make satisfactory visual comparisons with the diverter pit structural drawings, most of the still photos were electronically inverted so that 'up' in the photo was also 'up' to the observer. As a result the photo's legends were also inverted. Those photos that were inverted are noted with the abbreviated term, "Inv."

The color videotape, covering the pit interior, showed that the concrete walls, cover blocks, A and B diverter assemblies, the 18 floor nozzles and floor liner, and the leak detector unit appeared structurally sound. In general, the color of the concrete walls and stainless steel equipment had a very similar reddish color. It has been suggested that waste spray, escaping from a given nozzle also tended to coat the walls and equipment thus, promoting the general reddish colors. As many as two innocuous, horizontal cracks appear in the walls of the diverter pit but at different levels. These cracks do not appear to be structurally threatening. The one closest to the top appears to be occurring near the same level as a change-in-cross section (slight stress concentration) of the upper concrete wall. The second is at a lower level and does not appear related to a given element of the reinforced concrete structure. Because of visual interference of the A and B diverter assemblies with respect to the camera, it could not be determined if both cracks totally encircled the pit. However, their tightness suggests that they likely occurred as a result of normal non-uniform contraction-curing of the relatively thick sections of concrete that make up the structure.

Table F2 describes, and Figures F15 through F28 show, the generally satisfactory conditions of the diverter pit.

6.2 LEAK TEST

In late 1998 the AX-152 tank experienced an unexplained loss in liquid level, which was documented via a discrepancy report (Barnes 1998). The tank was pumped down to a minimum level (approx. 1.5 in.) in order to minimize the possibility of leak to the environment. The rate of decline continued and the level reached zero in a very short time (6 weeks). The liquid loss was thought to be the result of a change in evaporation rate because of changed air inflow, sludge heat generation, or a leak. To resolve the above noted discrepancy of unexplained liquid loss, an

engineering evaluation, and a mini leak test (filling tank approximately with about 11 in. liquid) were initiated.

The tank was evaluated by CH2M HILL, Hanford Group, Inc. (CHG) as a potential leaking tank. Evaporation was considered as an alternate mechanism. Approximately 11 in. of water was added to the tank in late August 2000 to perform a leak test. At that time the tank had been empty for about 20 months. A loss-rate comparable to that seen in 1998 was expected, however, the surface remained almost constant for 45 days. After 45 days however the surface level began to decline. The level declined at about 1.5 gallons per day.

On February 28, 2001 the CHG Leak Assessment Panel met to consider all available data. Evaporation and elevated tank temperature level, were determined to not be viable explanations for the level decrease. As a result, the panel declared the tank a "leaker".

The CHG Plant Review Committee (PRC) voting members were polled March 23, 2001, and they voted unanimously to agree with the Leak Assessment Panel's conclusion that Catch Tank AX-152 was a leaker. Because it is not cost-effective to repair the tank, the PRC also precluded any future use of the tank (PRC 2001).

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. On March 23, 2001, tank 241-AX-152 was declared a leaker by the CHG Plant Review Committee. The tank is thereby precluded from further use at the Hanford Site.

2. The tank had been in service underground for about 39 years, which indicates that at the time of its construction adequate design controls were used to withstand applicable design loads.

3. The design does not prevent entry of water (rain, snow, etc.) into the tank. The water leaks through the cover blocks and drains. This water reduces the pH and adds to the waste inventory and increases the potential for corrosion inside the tank and of the components in the pump pit. Accordingly, since the tank has been formally declared to be leaking, it is recommended that it be isolated from all liquid intrusion sources.

4. The structural assessment analysis (WHC 1996) used inappropriate analysis methods and unrealistic assumptions and loading conditions. Subsequent analyses (Julyk 1999) of a similar concrete structure shows it has adequate strength to withstand appropriate design loads. Hence, a similar more refined analysis would be expected to show that the AX-152 structure also has adequate strength.

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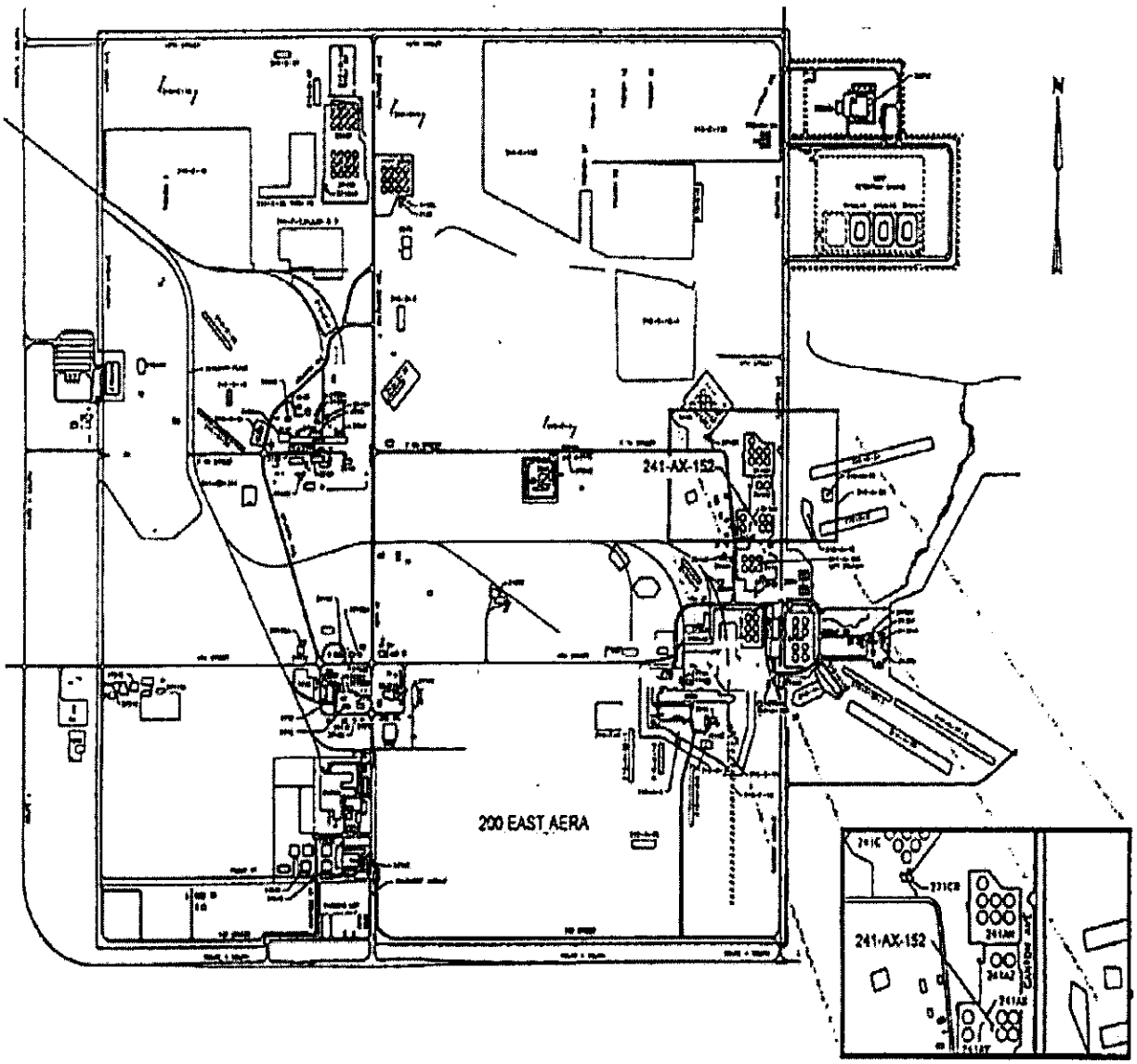

Figure F1 Location of 241-AX-152 on the Site Plan

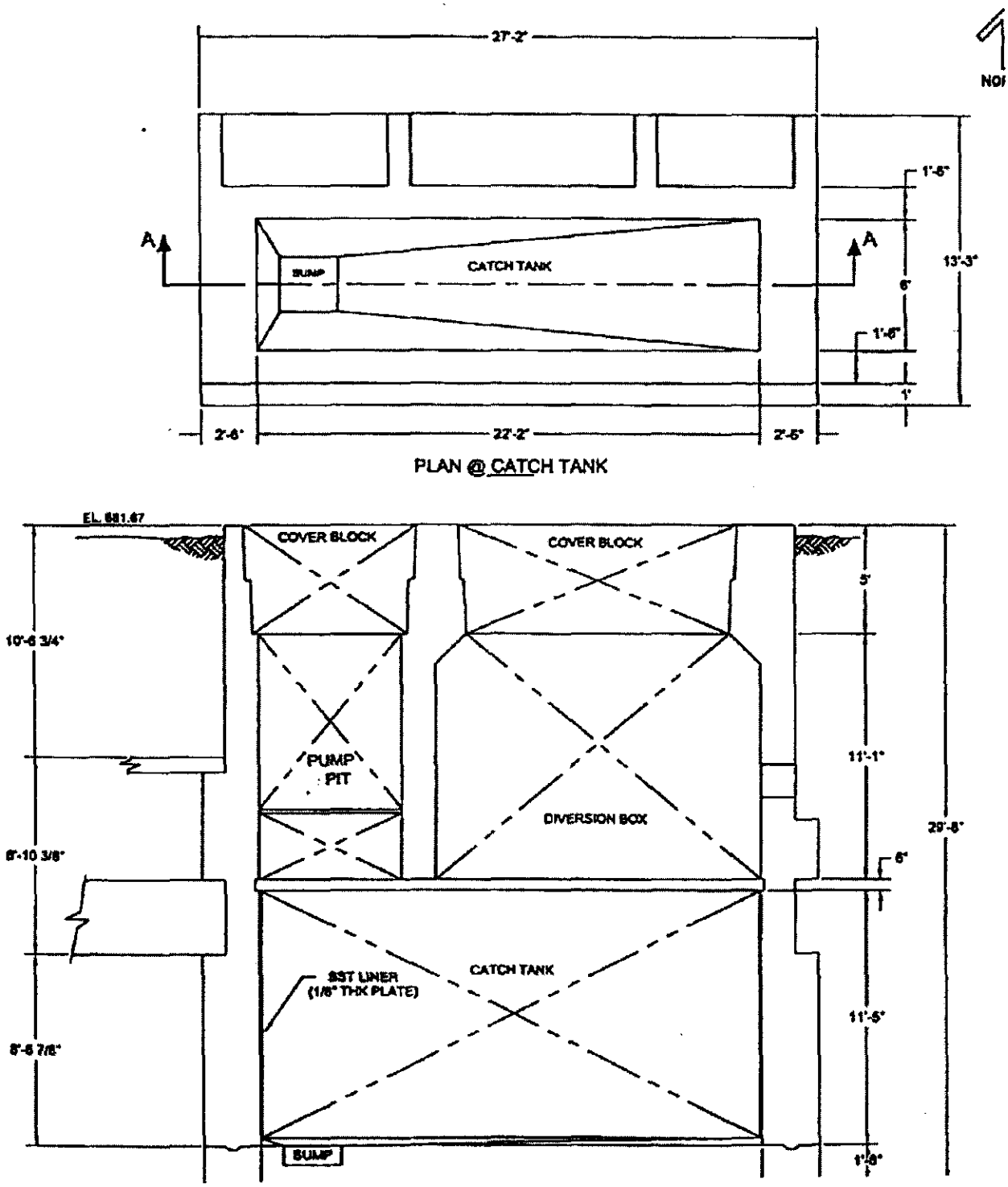

Figure F2 241-AX-152 Catch Tank

TABLE F1 VIDEO EXAMINATION DATA SHEET, 241-AX-152 CATCH TANK PUMP PIT

Examination Date: 6/14/2000

Person In Charge: D. P. Niebuhr Camera Operator: M. J. Busselman Video Examiner: T.S. Hundal

Riser # : Access Through 4-in. Shield Plug

Video Tape Reviewer: E. B. Schwenk Date: 7/ 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The interior of the 241-AX-152 Pump Pit was attained through removal of a shield plug, in an inspection riser in the central, reinforced concrete cover block (Bovay 1962a). The pit sits directly above the west end of the catch tank (Bovay 1962c). The pit is about 8 ft high and approximately 7 ft square and has nearly 6-ft thick cover blocks. Approximately 40 minutes of the nearly 70-minute long videotape was spent visually assessing the pit.
					All components in the pump pit appeared in very satisfactory condition. Structurally, the pit appeared sound. Some cracks in the concrete were evident at several levels, and were mainly horizontal. Water in-leakage around the cover blocks caused nominal rusting of the peripheral carbon-steel edge-angles of the reinforced concrete cover blocks. A minor amount of debris (dirt and rust flakes) was seen on the floor of the pit. The floor drain, and attendant leak detection device, were shaded (or masked) by the waste transfer pump and could not be seen. The following 12 photographs provide visual evidence of the pit's internal condition.
1022 AM		000	184		Figure F3 is a straight-down view of the centrally located waste transfer pump (at left), PUREX nozzles at the 'top' of the photo and a partial view of the connecting hardware.
1024 AM		196	161		Figure F4 shows a nozzle opening (center) and a stainless steel pipe with an attached PUREX nozzle.

Table F1 Video Examination Data Sheet, 241-AX-152 Catch Tank Pump Pit (continued)					
1025 AM		316	151		The next four photographs (Figures F5 through F8) show satisfactory condition of the pit floor, concentrating mainly in each of its four corners. At the northwest corner of the pit (Figure F5) the walls and floor joints appear sound. Some minor debris (dirt and rust flakes) can be seen on the floor along with a mechanical instrument jumper.
1025 AM		205	149		A view of the southwest corner of the pit can be seen in Figure F6; jumper P152AX is seen near the top of the figure.
1025 AM		119	149		The southeast corner of the pit including both a vapor seal and a PUREX nozzle on the east wall, are shown in Figure F7.
1025 AM		023	149		The northeast corner of the pit is shown in Figure F8. The brown stain mark at the top of the photo projects below an unseen electrical jumper hardware that is attached to the east wall (see Figure F9 below).
1031 AM		029	130		Shown in Figure F9 is the electrical jumper hardware. Water in-leakage, probably from rainwater and snowmelt, appears to have caused the wall-bolted, carbon-steel jumper fixture to rust and thereby stain the concrete wall. The vertical crack to the left of the hardware is really due to a rust stain from water in-leakage around the cover blocks.
1031 AM		064	130		Figures F10 and F11 are piecemeal photographs of the electrical jumper connection from the wall (Figure F9) to the waste transfer pump.
1033 AM		006	061		The intersection of the east wall (including its rusty carbon steel angle) and the contiguous carbon-steel-wrapped reinforced concrete cover blocks are shown in Figure F12. Periodic water in-leakage appears to have caused the steel portions of the structure to rust and to cause many, vertical rust stains which appears like cracks. This photograph is typical of the entire periphery of the pit.

Table F1 Video Examination Data Sheet, 241-AX-152 Catch Tank Pump Pi t (continued)					
					There are a number of cracks in the concrete walls of the pit, most of them horizontal. They do not appear structurally threatening. Because of visual obstructions and periodic malfunctioning of the videocamera zoom lens, it was not possible to clearly see the cracks around the entire periphery of the pit. One 'mainly horizontal' crack, appears to travel the entire periphery of the pit. Occasionally it meanders up-and-down as well as growing vertical in orientation in possibly as many as two corners. A second 'mainly horizontal' crack appears to traverse at least one-half to three-quarters of the pit, several feet above the first noted crack. (No figure)
1047 AM		008	081		Figure F13 is a view of the south pit wall, showing a major horizontal crack that bifurcates (splits) and continues to extend both horizontal and at an upward angle of about 45°. It then turns further upward to a vertical orientation in the southeast pit corner.
1048 AM		280	084		Figure F14 is a view of the east pit wall showing two 45° downcoming cracks that both turn horizontal. The downcoming crack at the far left, may also be continuing down (vertical) in the northeast corner. The main horizontal crack, shown in Figure F14, continues horizontally (out of the field-of-view) toward the southeast corner. It then bifurcates upward at 45°, and then turning vertical in the corner. Another horizontal crack appears above the primary horizontal crack, about 1-2 ft below the top of the pit. There could be additional minor vertical cracks because, many of the vertical, rusty-water stain marks look like cracks. However, the cracks are not structurally threatening.

Figure F3
Waste Transfer Pump (Left) And Nozzles (Top), 241-AX-152 Pump Pit.

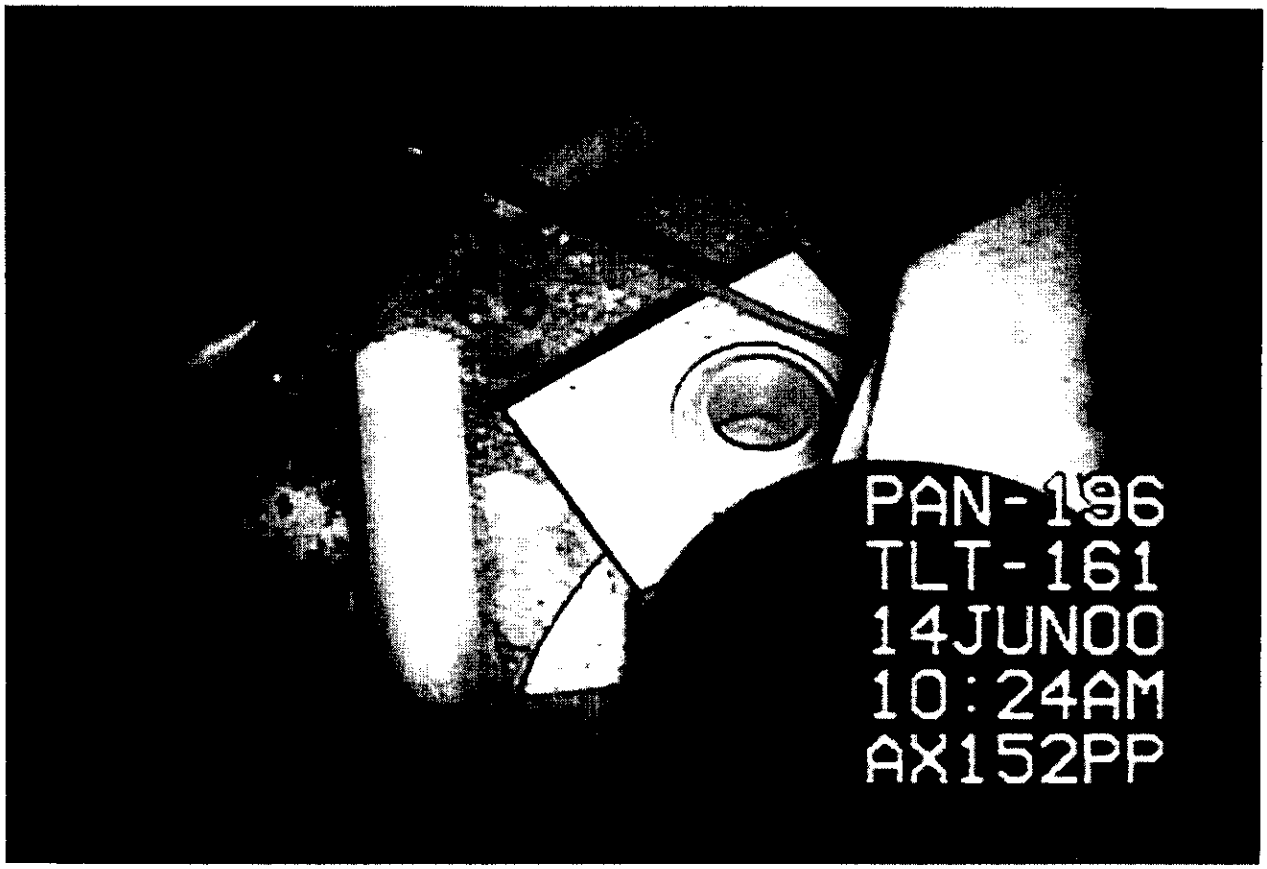

Figure F4
PUREX Nozzle And Stainless Steel Piping (Left), A Nozzle Opening (Center), And Waste Transfer Pump (Right) Hardware.

Figure F5
Northwest Corner of 241-AX-152 Pump Pit Floor Including An Instrument Jumper.

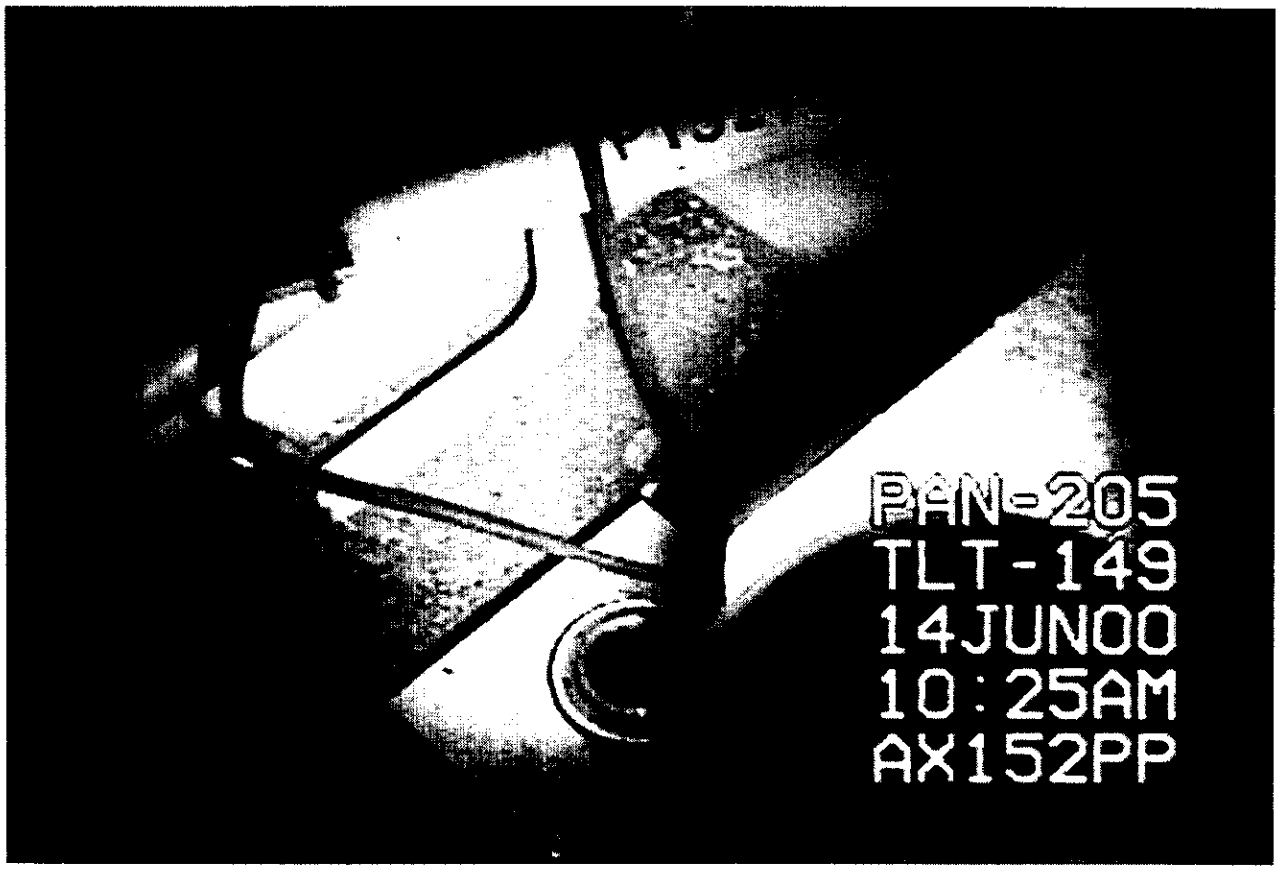

Figure F6
View of the Southwest Corner of 241-AX-152 Pump Pit.

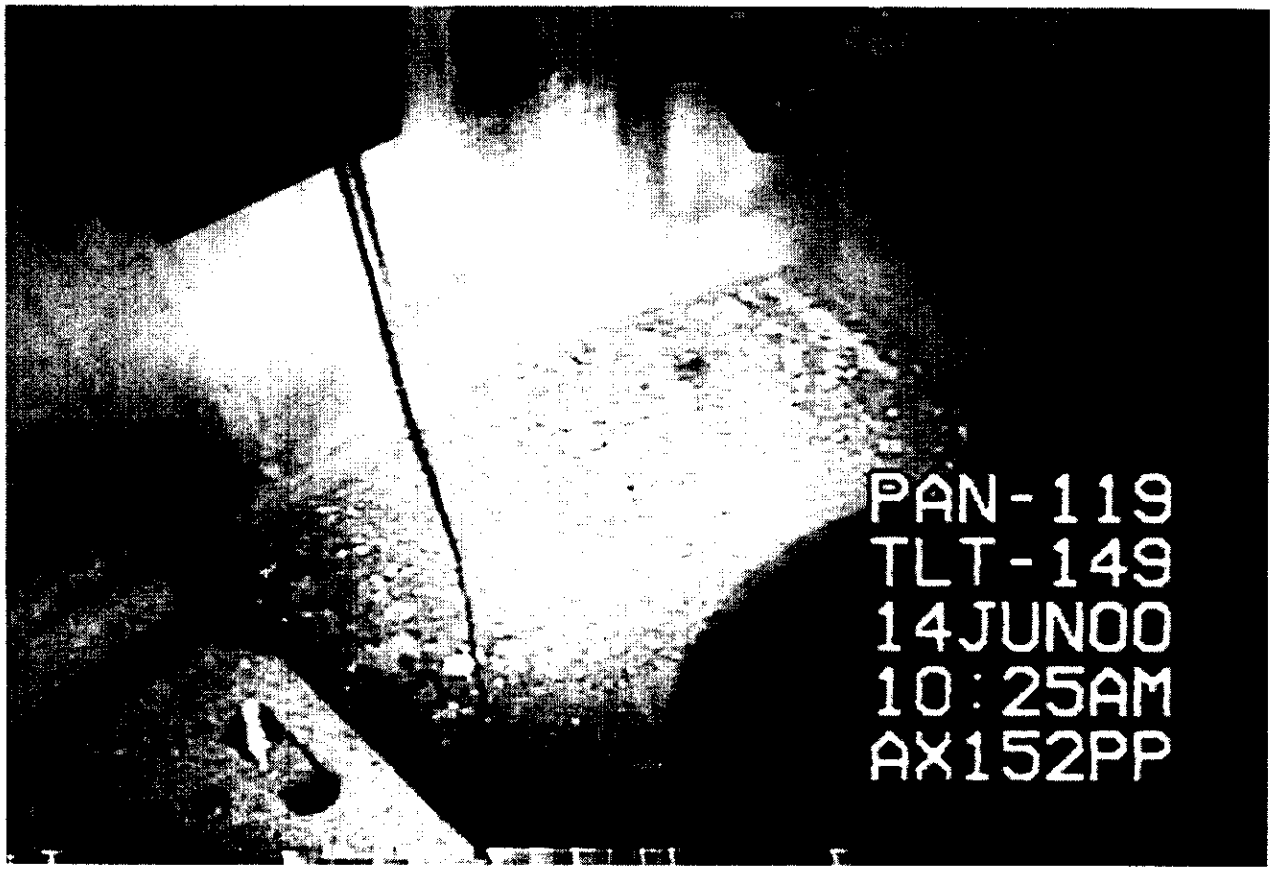

Figure F7
Southeast Corner Of 241-AX-152 Pump Pit Floor: Vapor Seal (Upper Left) And PUREX Nozzle (Upper Right)

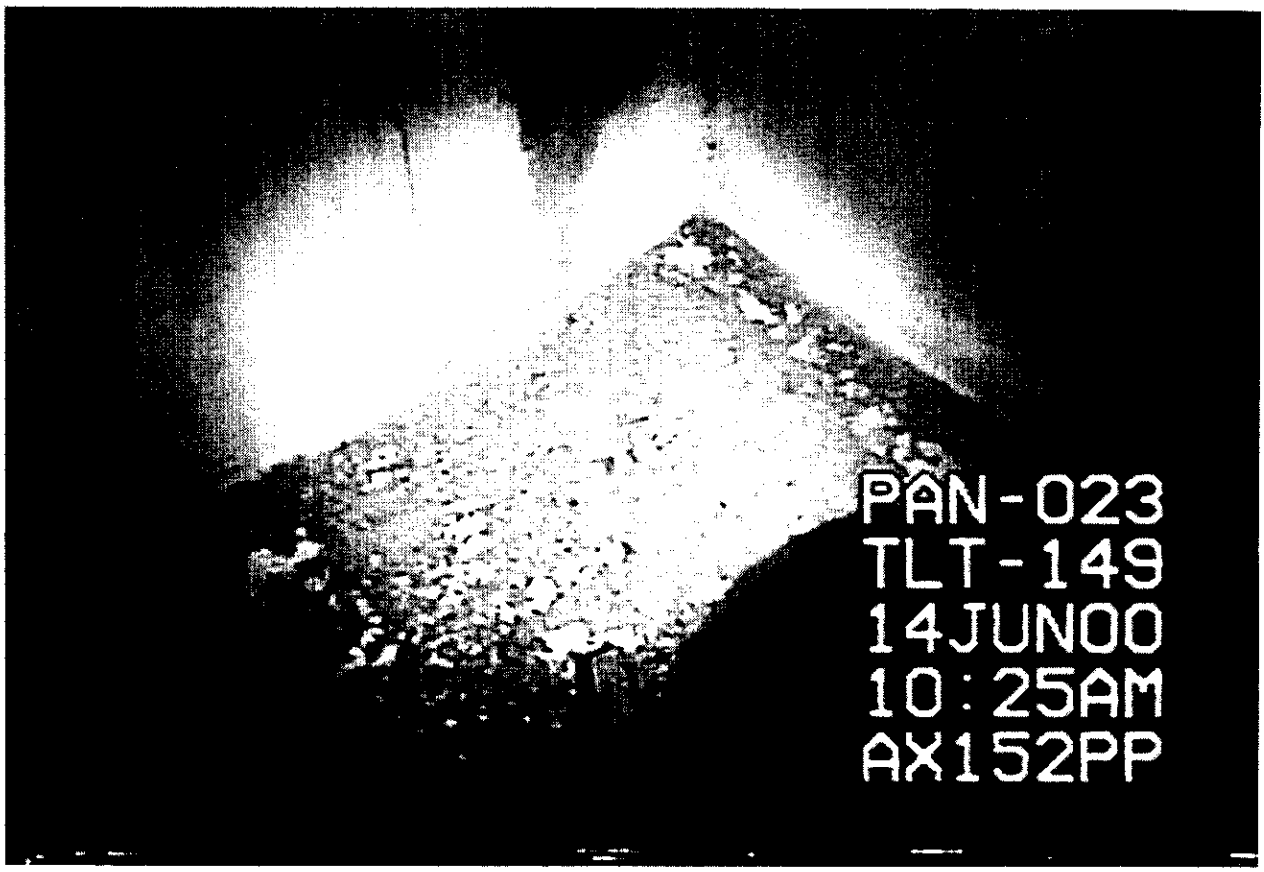

Figure F8
Northeast Corner 241-AX-152 Pump Pit And Floor.

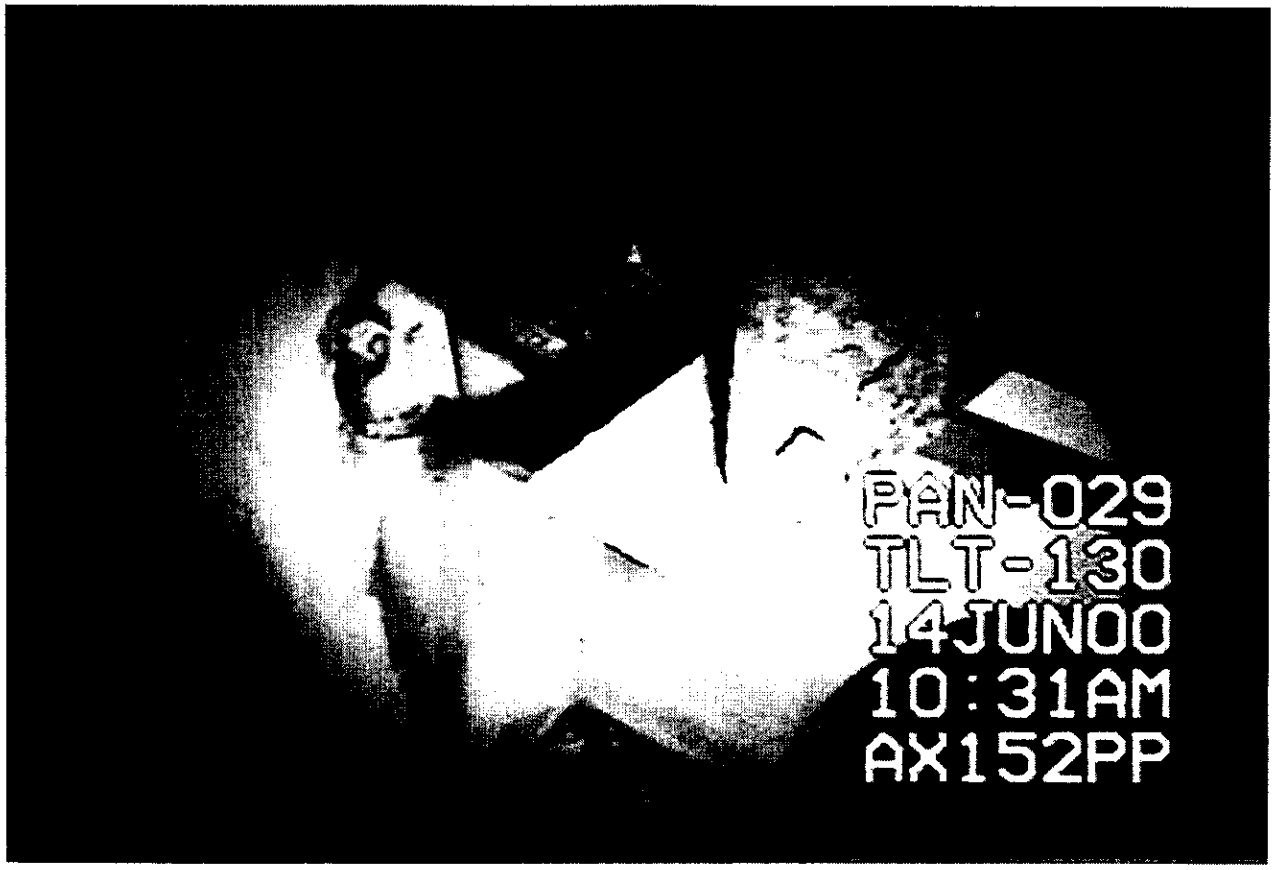

Figure F9
Electrical Jumper Hardware, Northeast Corner, East Wall. Probable Water In-Leakage Stains, From Cover Blocks (Left) And Through Electrical Jumper Fitting (Middle), 241-AX-52 Pump Pit.

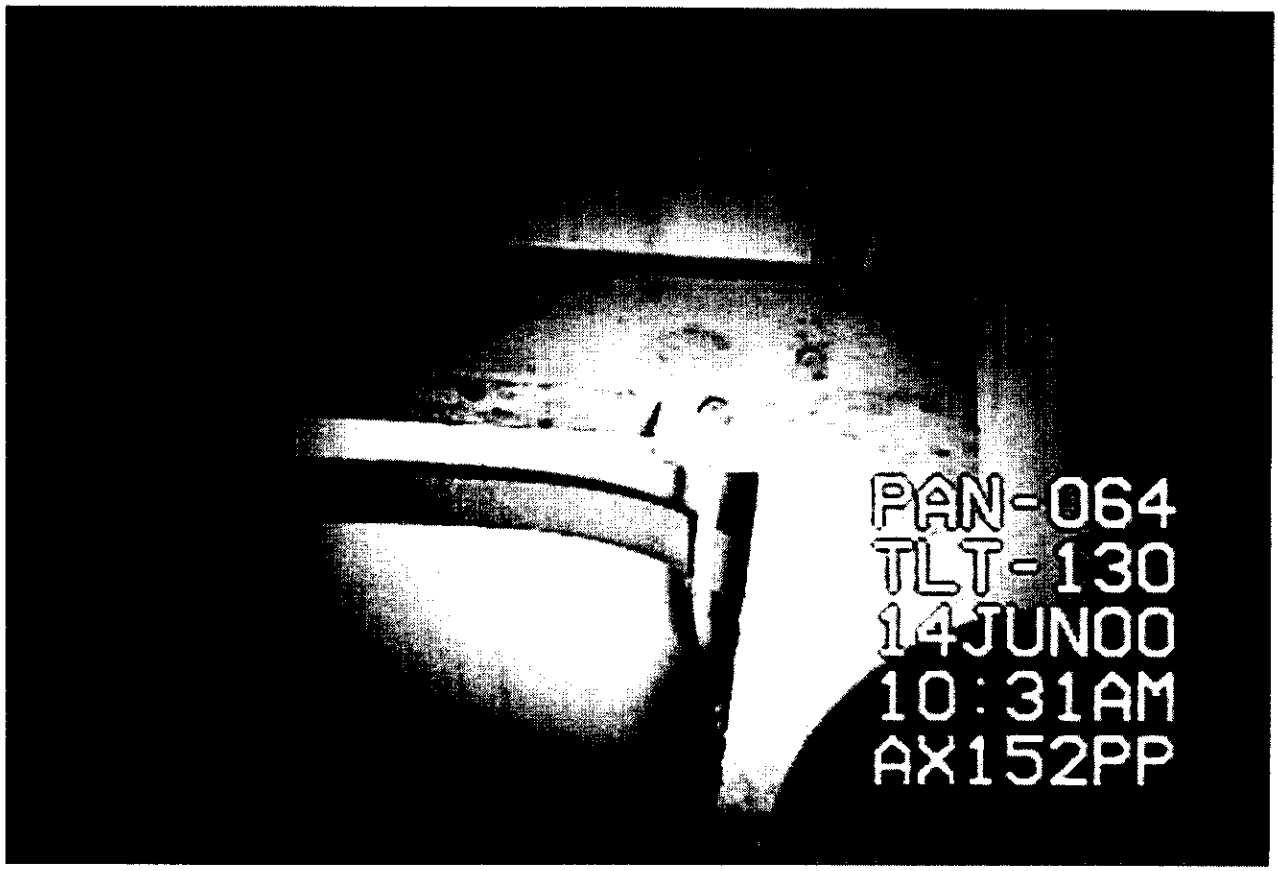

Figure F10
Continuation Of Electrical Jumper Equipment, East Wall 241-AX-152 Pump Pit.

Figure F11
Culmination Of Electrical Jumper Connection To Waste Transfer Pump; Floor Drain & Leak Detector Believed To Be Below Jumper Connection (Center), 241-AX-152 Pump Pit.

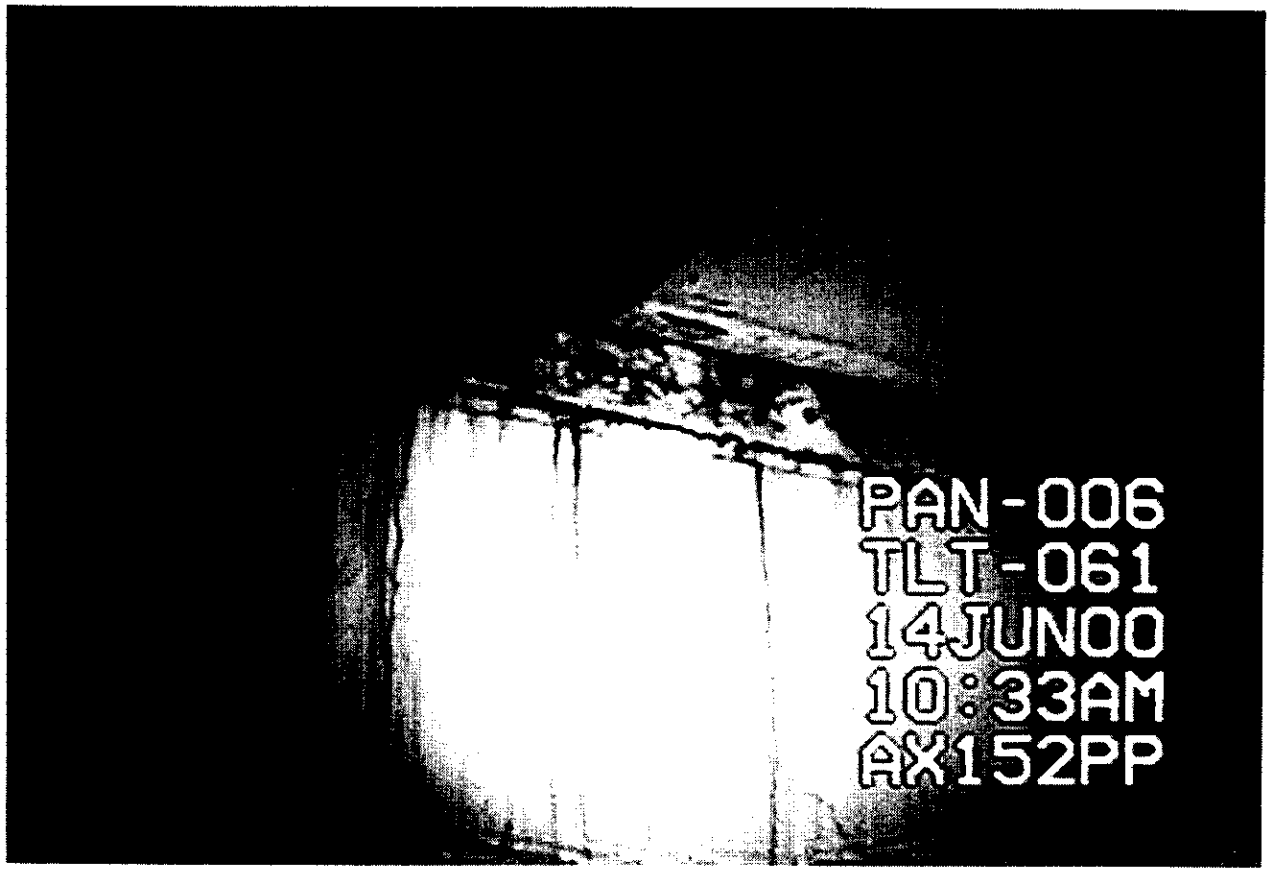

Figure F12
Intersection Of East Wall And Cover Blocks (Top); Typical Rusting Of the Steel Edge Angles (Including Vertical Rusty Water Stains On Concrete Walls), 241-AX-152 Pump Pit.

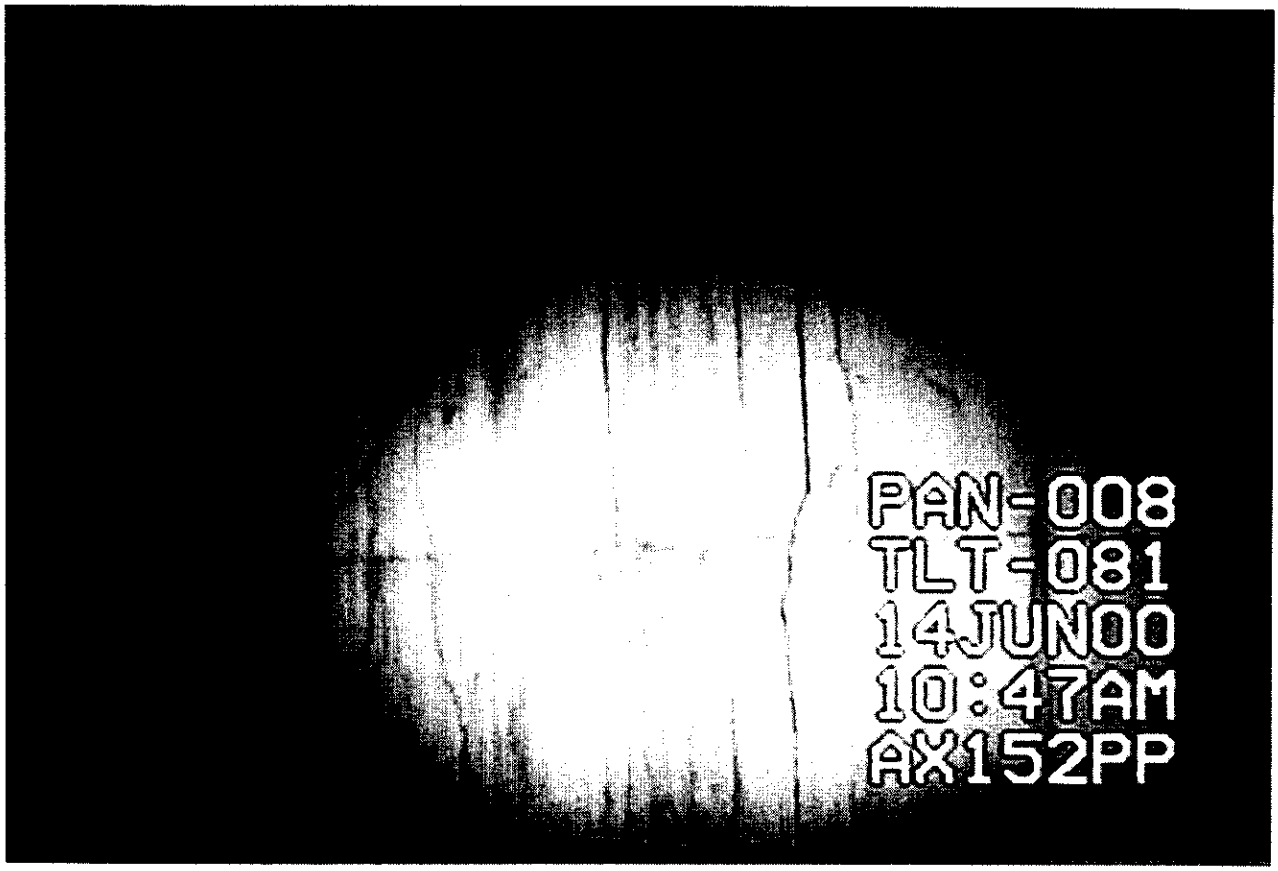

Figure F13
View Of Horizontal Crack (Left Side) Bifurcating Upward At 45 degrees (And Into A Vertical Orientation In The SE Corner) While Continuing To The Right, South Wall Of 241-AX-152 Pump Pit. Dominant Crack-Like vertical Stripes Appear To Be Rust Stains.

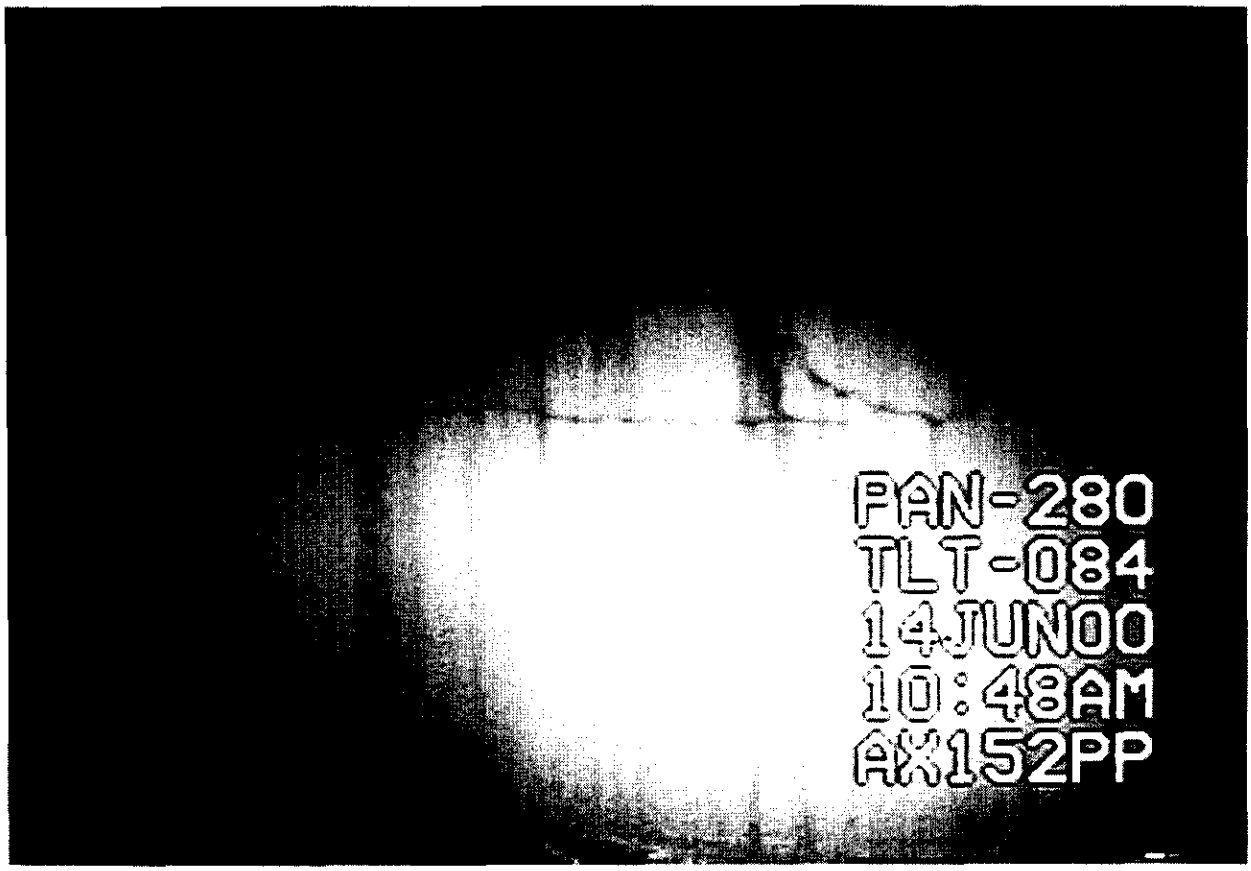

Figure F14
View Of Downcoming Crack Bifurcating Into One Vertical And One Horizontal With Second Downcoming Crack, East Wall Of 241-AX-152 Pump Pit. Horizontal Crack Is At Same Level (Tilt) As In Figure F13

TABLE F2. VIDEO EXAMINATION DATA SHEET, 241-AX-152 DIVERTER PIT

Examination Date: 6/20/2000

Person In Charge: D. P. Niebuhr Camera Operator: M. J. Busselman Video Examiner: T. S. Hundal

Riser: 4 in. Pump Pit Inspection Riser

Video Tape Reviewer: E.B. Schwenk Date: July 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs, and accompanying narrative, demonstrate that the approximately 38-year old pump pit is in very satisfactory condition and that it is fit for continued service.
					The interior of the 241-AX-152 Diverter Pit was entered through the north inspection riser in the center cover block. Dimensions of the pit are about 7 ft high by about 6 ft wide by nearly 15 ft long. The remaining 30-minutes of the 70-minute color videotape cover s the AX-152 Diverter Pit. No significant damage is seen in the entire pit. As many as two innocuous horizontal cracks appear in the walls of the pit at different levels. One may be occurring close to the same level as the change in cross-section (45-degree angle) of the wall as seen in Hanford Drawing H-2-44580 (Bovay 1962c). Because of the upside-down character of the videotape and the difficulty in seeing the cracks because of camera proximity and equipment interference, it was not possible to clearly determine if both cracks totally encircled the pit.
1129 AM		248	048		Figure F15 is a plan view of the floor of the diverter pit. Both diverter A and B are out of the field-of-view of the camera. Each of the rotational delivery spouts are shown along with a portion of each diverter's nine waste acceptance tubes. A leak detection unit, with attached electrical cables, is on the pit floor between the two sets of nozzles. The pit's east wall is in the foreground.

Table F2 Video Examination Data Sheet, 241-AX-152 Diverter Pit (continued)					
1058 AM		234	160		Because the entrance orientation of the camera, with respect to the pit, most of the subsequent photographs appeared upside down with respect to the viewer. As a result, the photographs were electronically inverted to a right-side-up state, using the 'Snappy' Video Photograph software. It should be noted that a simple inversion is not the same, from a symmetry point-of-view, as a 180° rotation. However, nothing is changed regarding the quality of the view. Figure F16 Inv. shows the pit walls at the southeast corner, including two of the top cover blocks. Some minor rusting is seen on the carbon-steel angles used as edging for the pit walls and its cover blocks. A round opening in the wall can be seen between two spray nozzles. In general the pit concrete walls and ceiling appeared satisfactory and may have been stained by spray from a given diverter nozzle.
1105 AM		059	097		A side view of the Diverter A tank and its nozzle spout vertical extension is shown in Figure F17 Inv. Note that the pit walls and pits equipment appear to have the same general color. It has been said that waste spray, from the nozzle-spout interface, could impinge on much of the pit internals.
1107 AM		103	129		A horizontal crack in the north wall of the concrete pit moves on into the west wall, as shown in Figure F18 Inv.
1110 AM		070	120		Possible intersecting horizontal and vertical cracks in the west concrete wall, just above diverter B, are shown in Figure F19 Inv.
1110 AM		081	112		Further vertical and horizontal cracking, above diverter B, are shown in Figure F20 Inv. The horizontal crack in the west wall and extends to right (into Figure F19 Inv.).
1111 AM		050	130		Additional cracking, further above Diverter B, is shown in Figure F21 Inv. The crack extends from the west wall (right) in to the north wall (left).
1113 AM		000	072		Four of each set of nine diverter nozzles (A and B, B-nozzle shown in Figure F22) had ID-inserted covers welded in-place. These were apparently welded before the pit was used (contaminated).
1116 AM		359	068		An overall view of the nine delivery nozzles (5-open, 4-closed) for Diverter A, is shown in Figure F23.
1117 AM		183	080		A continuation one of the main horizontal cracks, several feet down from the pit cover blocks are shown in Figure F24 Inv. The black lead at the left is an electrical cable for the leak detector in the AX-152 diverter pit.

Table F2 Video Examination Data Sheet, 241-AX-152 Diverter Pit (continued)					
1121 AM		024	085		Figure F25 Inv. provides a view of the stainless steel liner (about 11 in. high) at the bottom of the diverter pit. Drainage through the liner is provided by annular spaces around each of the eighteen nozzles.
1122 AM		299	096		An electrical connection, possibly for a temperature probe in Diverter A, is shown in Figure F26. The electrical insulation on the leads appears to have been degraded.
1123 AM		307	126		Further horizontal cracking in the east wall, moving toward the north wall, is shown in Figure F27 Inv.
1126 AM		164	069		Continuation of horizontal cracking from the east wall into the north wall is shown in Fig. F28 Inv.

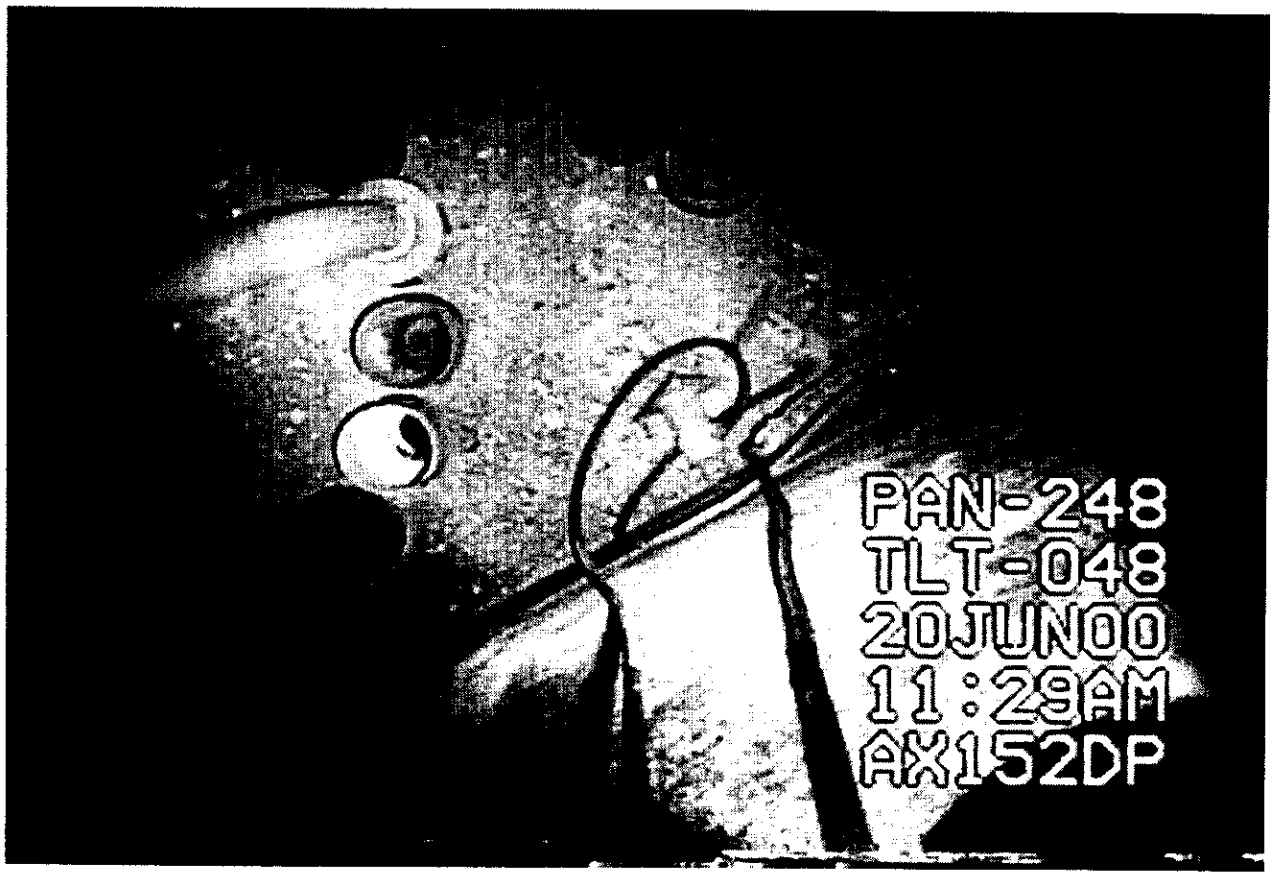

Figure F15
Looking Down At Diverter Pit Floor And Nine-Element Nozzles; Diverter B (Out-Of-Field) At Right; Piping (Left) Is Part Of Diverter A Rotational Spout/Nozzle.

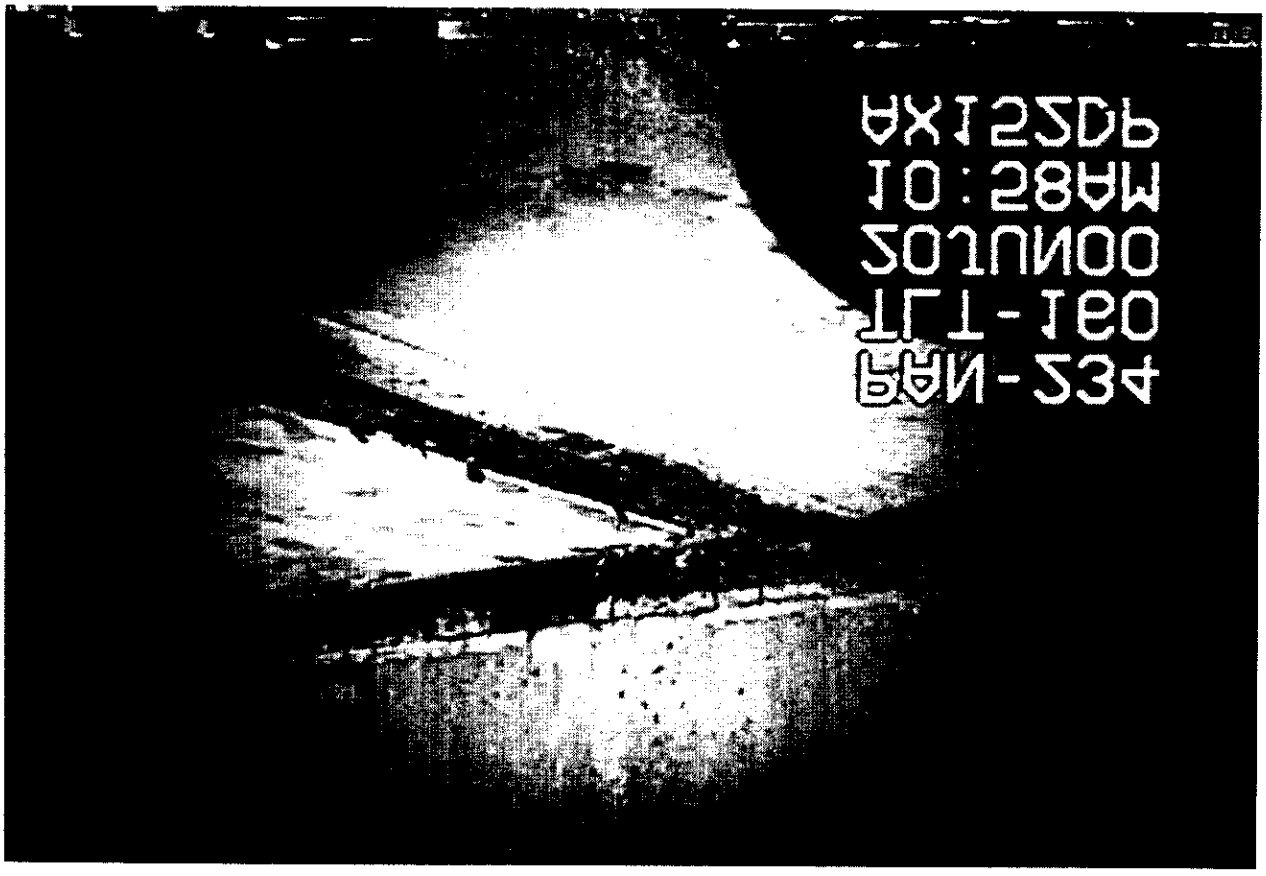

Figure F16 Inv.
South Wall, Top Cover Blocks, And SE Corner Of 241-AX-152 Diverter Pit (Typ); Spray Nozzles In Two Positions (Note: Photo has been inverted to facilitate reviewing).

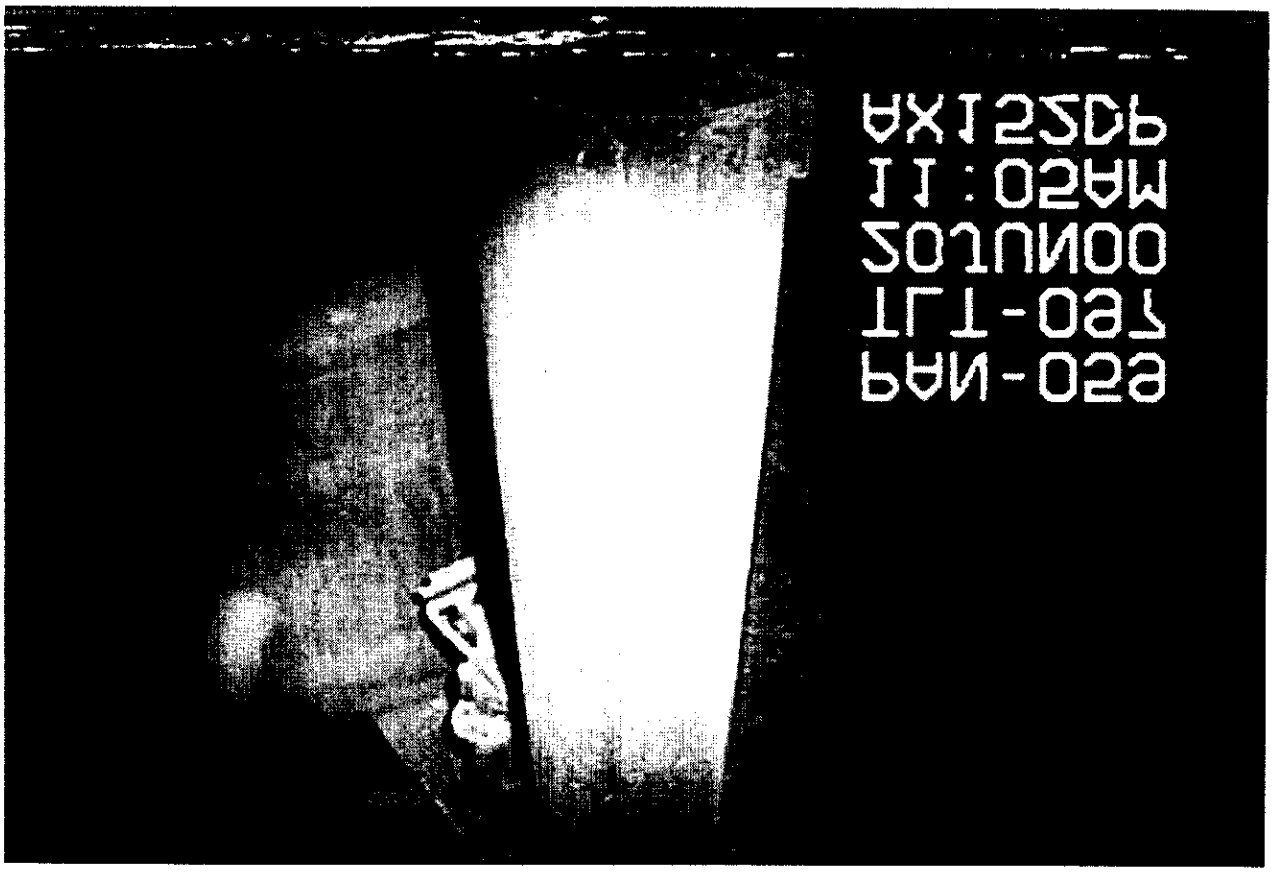

Figure F17 Inv.
Diverter A Tank At Left And Vertical Extension Of Diverter A Spout. South Wall At Right Side. 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

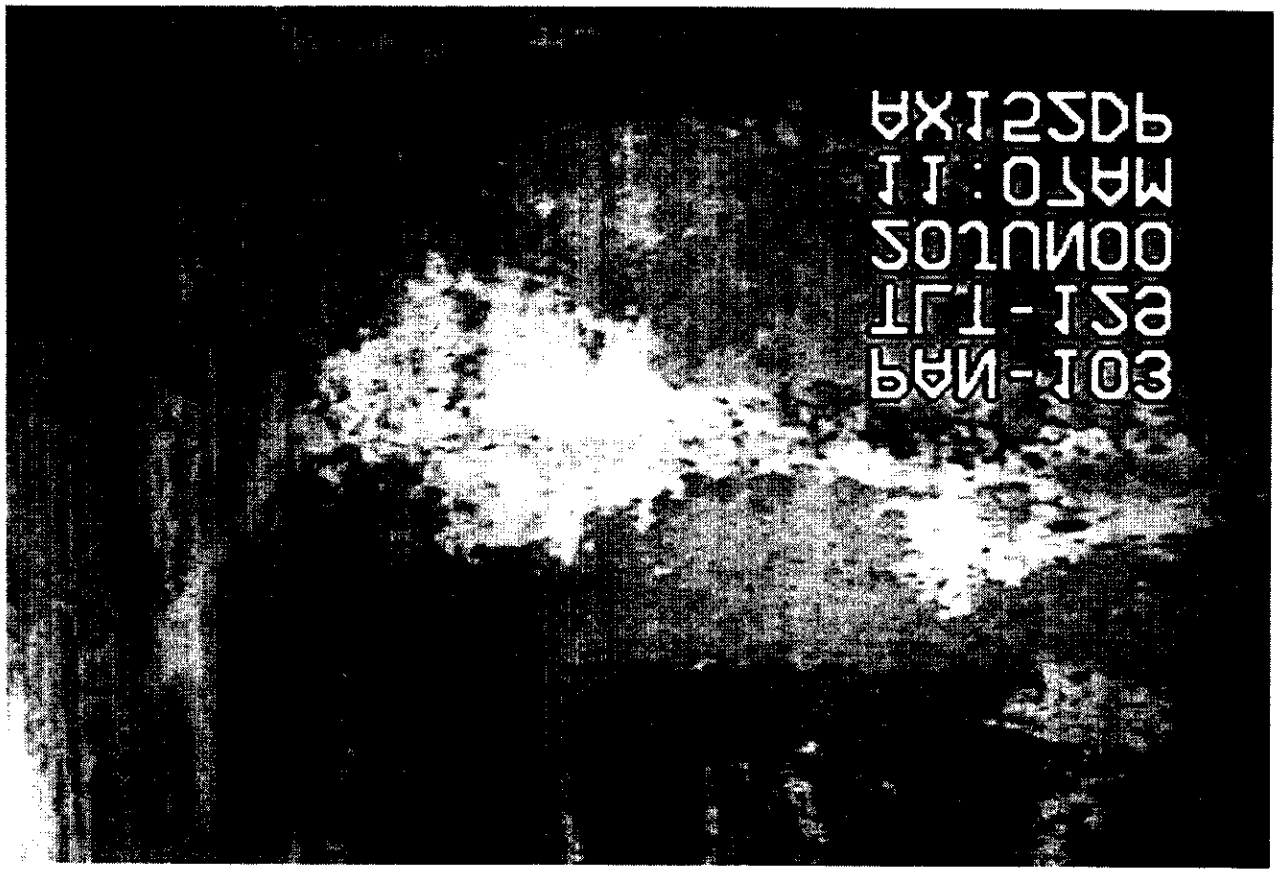

Figure F18 Inv.
Horizontal Crack In Concrete From North Wall (Left) Into West Wall (Right) and Out-Of-Field-Of-View, 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

Figure F19 Inv.
Intersecting Horizontal Cracks With Vertical Crack In West Concrete Wall Just Above Diverter B, 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

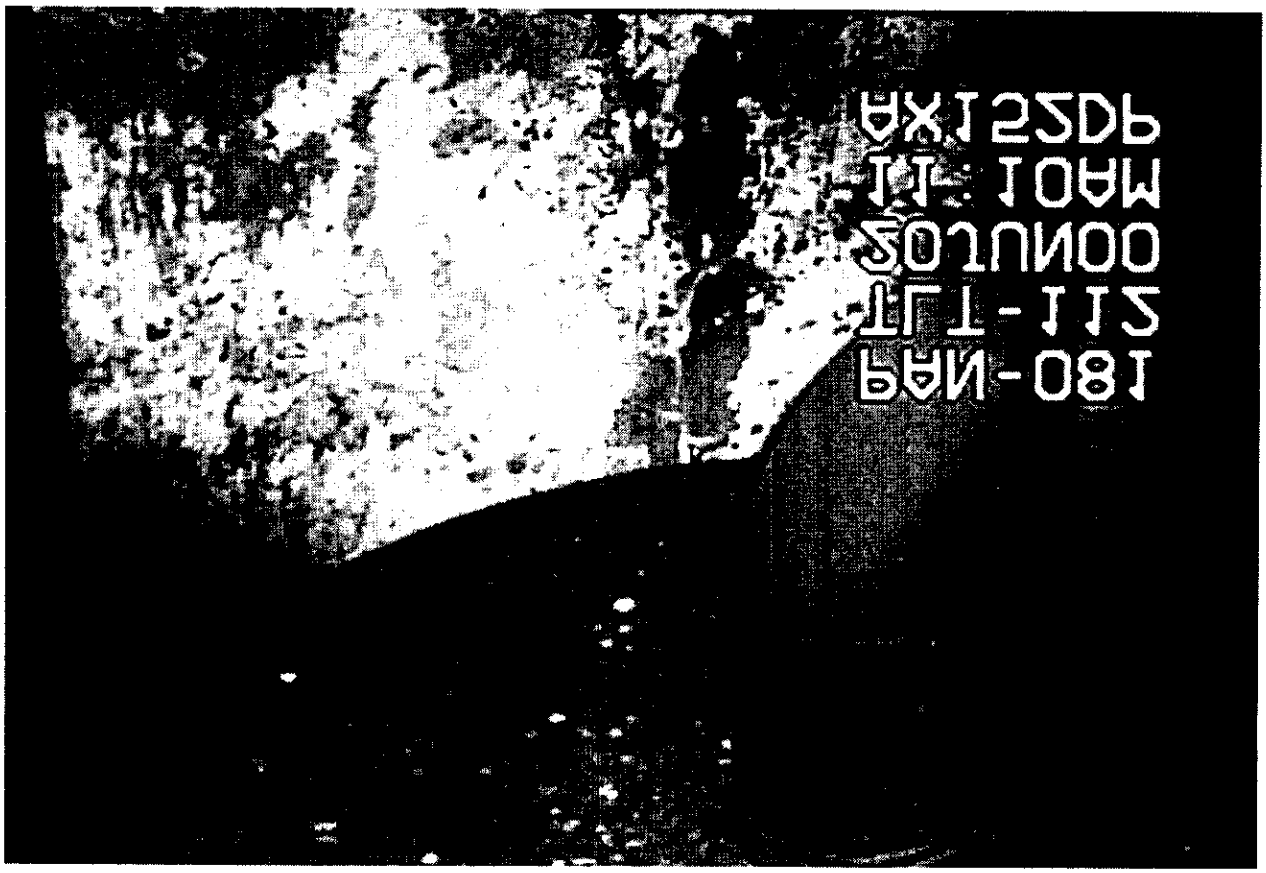

Figure F20 Inv.
Vertical And Two Horizontal Cracks Above Diverter B, West Wall; Horizontal Crack Extends To Right (Into Figure F2-17), 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

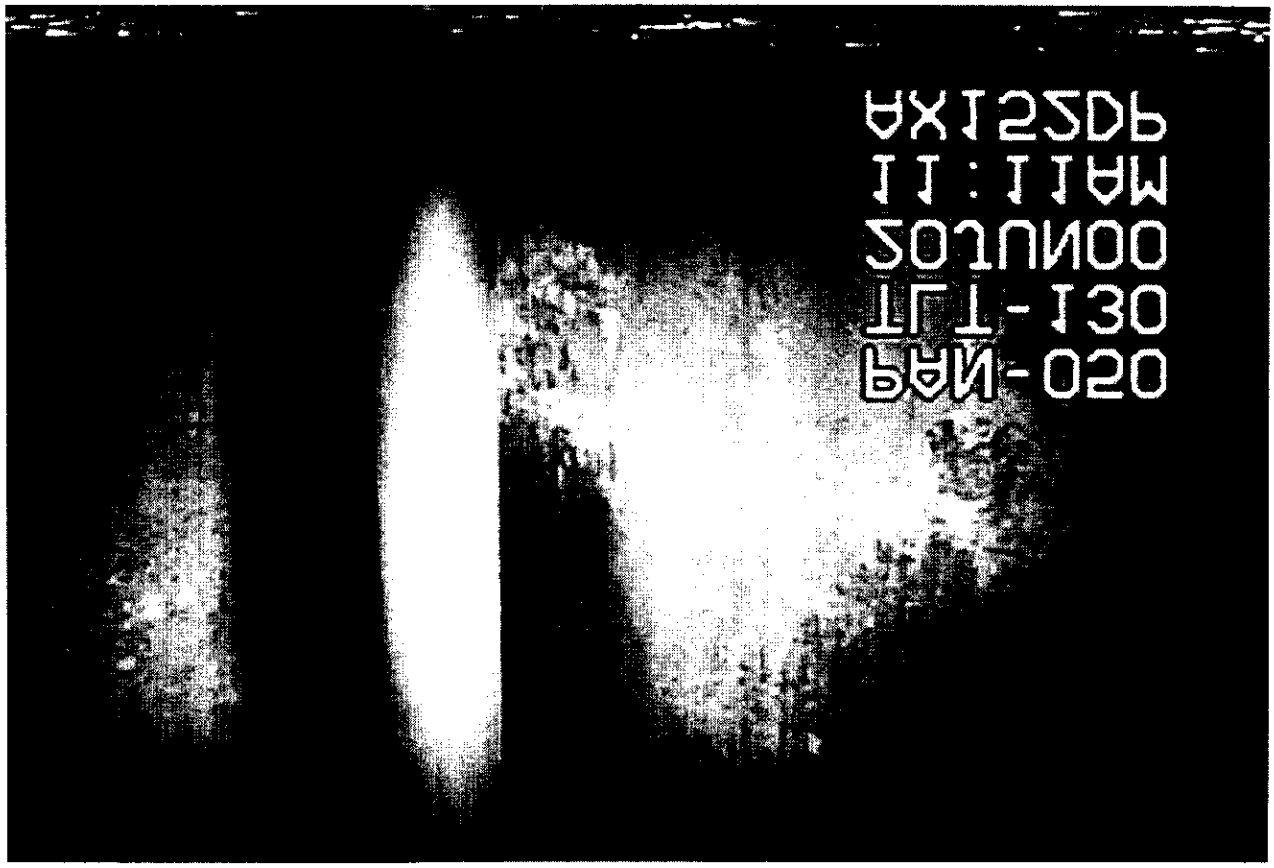

Figure F21 Inv.
Extension Of Higher Horizontal Crack (Right, West Wall) To North Wall (Left) In Figure F19. Diverter B Directly Below Central Pipe. 241-AX-152 Diveter Pit (Note: Photo has been inverted to facilitate reviewing).

Figure F22
Four Of Nine Diverter B Nozzles Apparently With Internally-Welded Covers, 241-AX-152 Diverter Pit.

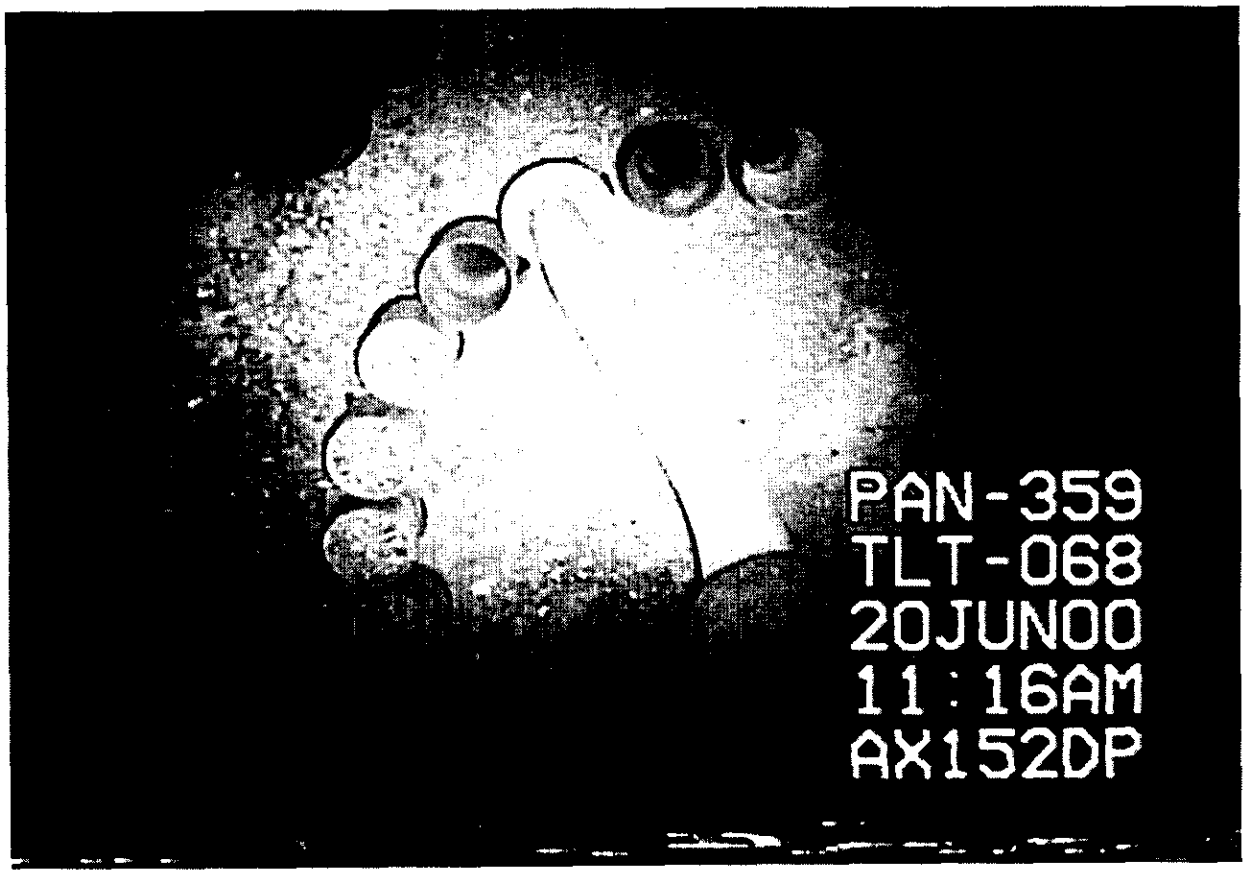

Figure F23
Diverter A Nozzle/Spout Assembly And Nine Delivery Nozzles; Four Covered, Five Open, 241-AX-152 Diversion Pit.

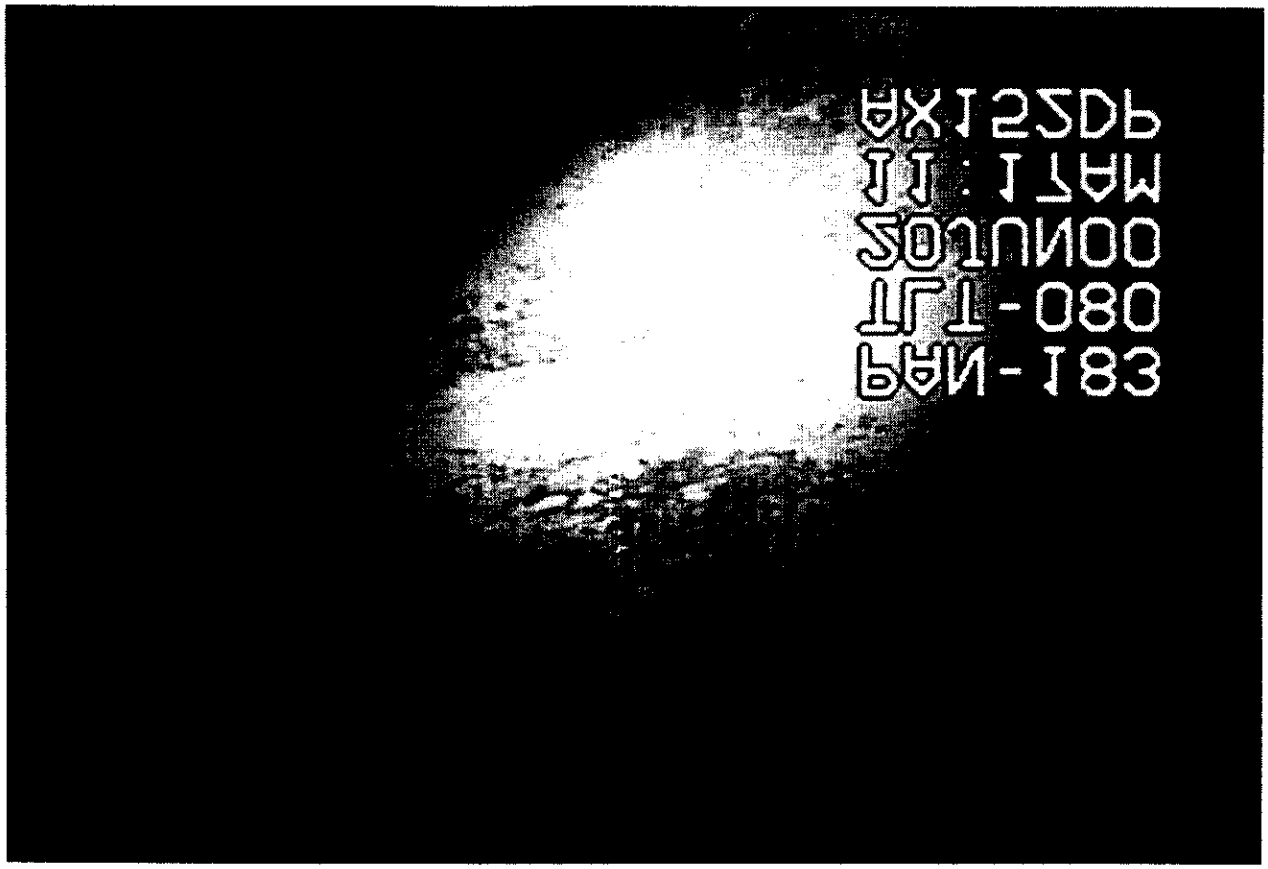

Figure F24 Inv.
Horizontal Crack In North Wall, Several Feet Down From Cover Blocks; Black Lead At Left Is Cable For Leak Detector. 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

Figure F25 Inv.
View Of Sidewall Of Stainless Steel Liner At Bottom Of Diverter Pit, South Wall, 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

Figure F26
Probable Electrical Connection Line, Diverter A, Near East Wall 241-AX-152 Diverter Pit.

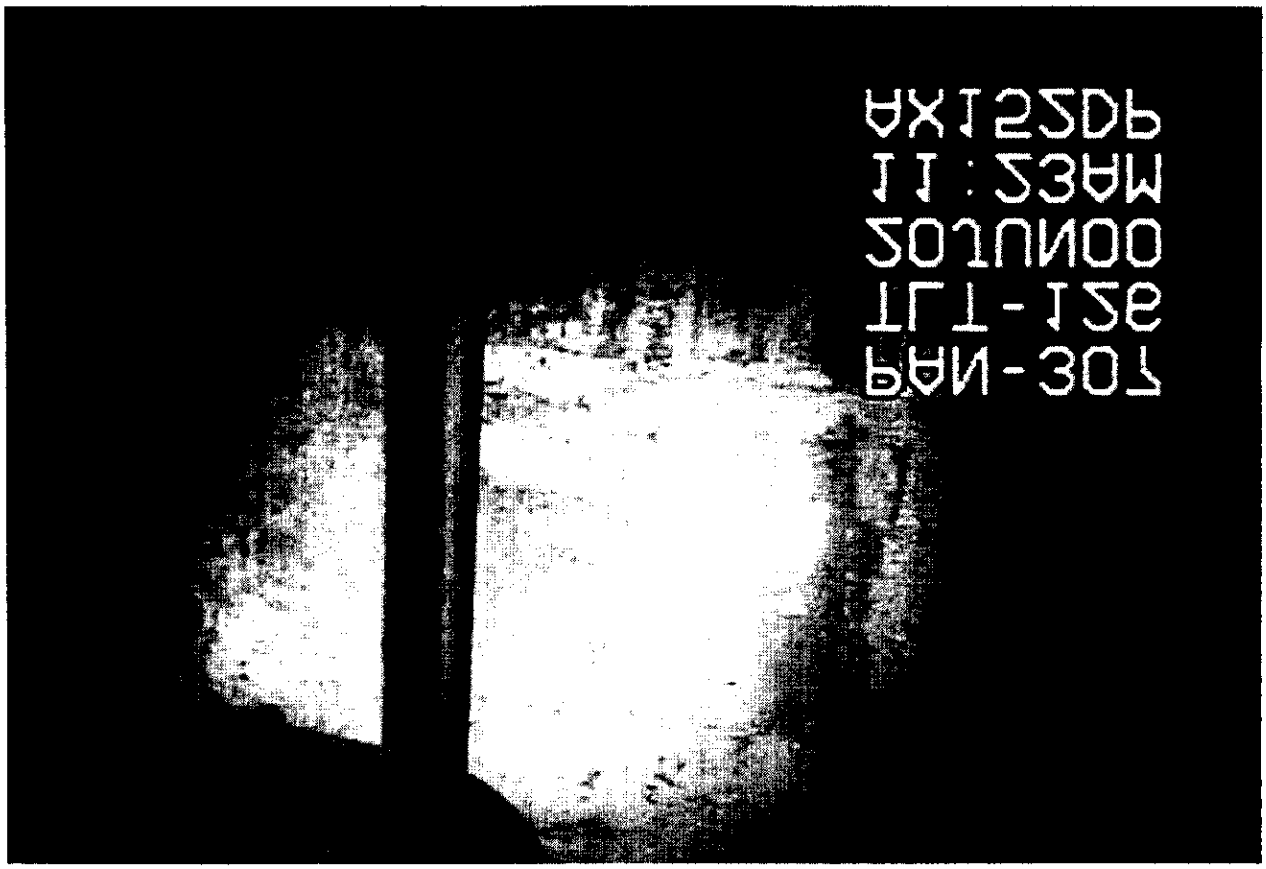

Figure F27 Inv.
Continuation Of Horizontal Cracks In East Wall Toward North Wall, 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

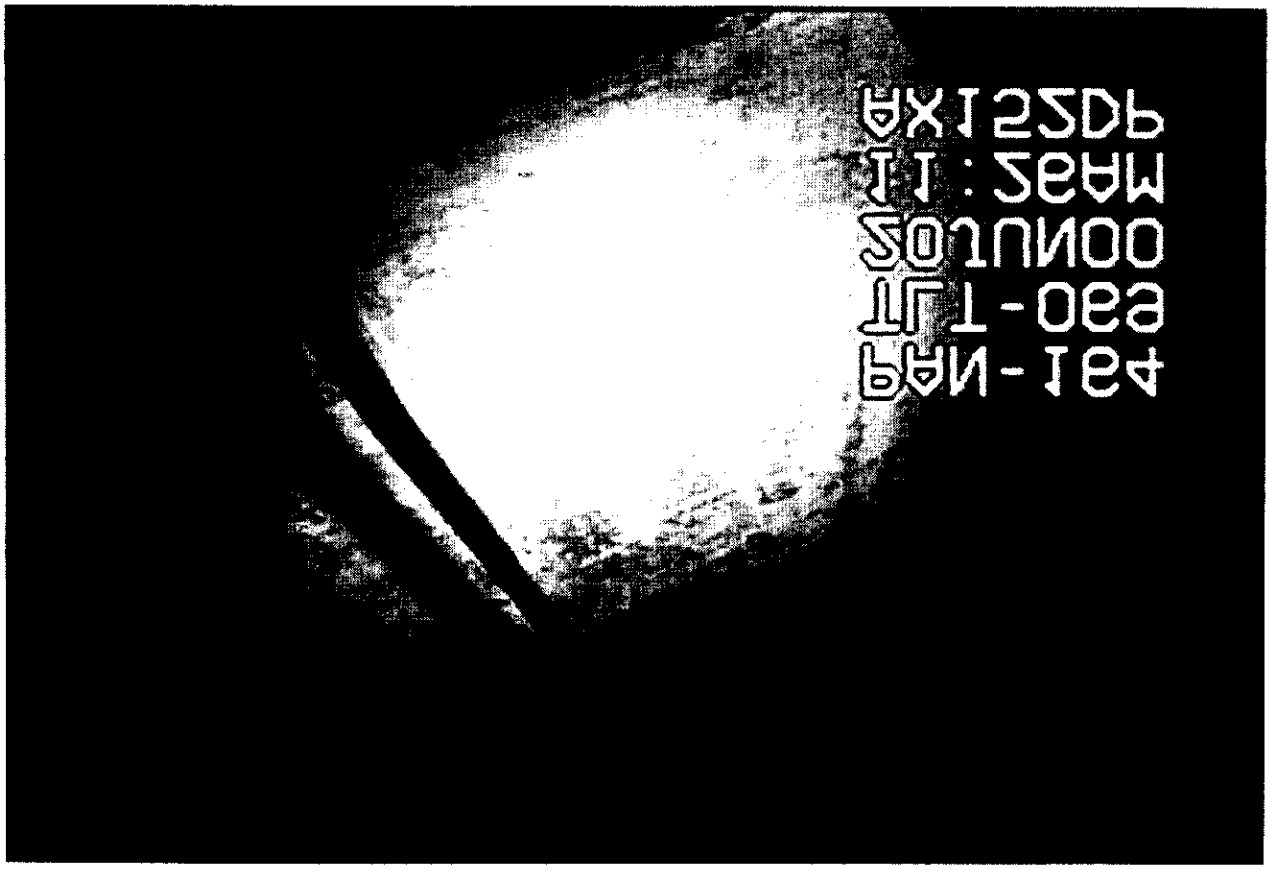

Figure F28 Inv.
Probable Horizontal Crack (Top) Continuing From East Wall Into North Wall (Right); Leak Detector Cable In Foreground. 241-AX-152 Diverter Pit (Note: Photo has been inverted to facilitate reviewing).

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LIST OF TERMS

ACI	American Concrete Institute
ASM	American Society of Metals
ASME	American Society of Mechanical Engineers
ASTM	American Society for Test and Materials
ATG	Advanced Technology servo tank Gauge
CHG	CH2M HILL Hanford Group, Inc.
CSR	Cesium Recovery Waste
CT	catch tank
CVI	certified vendor information
DCRT	double-contained receiver tank
DST	double-shell tank
Ecology	Washington Department of Ecology
ENRAF	Enraf-Nonius Series 854 ATG (liquid level gauge)
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System (database)
HLAN	Hanford Local Area Network
LFL	lower flammability limit
NDE	non-destructive examination
PCSACS	Personal Computer Surveillance Analysis Computer System
RCRA	Resource Conservation and Recovery Act
PFP	Plutonium Finishing Plant
PSP	Projection Scan Processor
RHA	Records Holding Area
RMIS	Record Management Information System
SACS	Surveillance Analysis Computer System
SCC	stress-corrosion cracking
SDC	Standard Design Guide
SP	stereo pair
SRR	strontium recovery waste

SS	stainless steel
SSE	safe shutdown earthquake
SST	single-shell tank
SWLIQ	dilute non-complexed waste
TBP	tributyl phosphate process
TRU	transuranic
TSD	Treatment Storage Disposal
TWRS	tank waste remedial system
unk	unknown
UT	ultrasonic testing
VITIS	Video In Tank Inspection System
WAC	Washington Administrative Code
WDOE	Washington State Department of Ecology
WESF	Waste Encapsulation and Storage Facility
WTR	waste water

1.0 INTRODUCTION

The 241-AZ-151 catch tank (AZ-151) is located in the 200 East Area of the Hanford Site (Figure G1), within the AZ tank farm, west of the 241-AZ-152 sluice transfer box. AZ-151 receives drainage from the 241-AZ-101 and 102 vent header seal loops, AZ tank farm leak detection pits, 241-AZ-801A instrumentation building floor drain, 241-AZ-702 ventilation system, and 241-AZ-152 sluicing transfer box floor drain, precipitation, and runoff (HNF 1998).

2. 0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the AZ-151 catch tank components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the AZ-151 pump pit and the catch tank. The scope of the examinations includes a visual examination of the AZ-151 catch tank internal surface, pump pit, and a leak test of the tank.

4.0 DESCRIPTION

The AZ-151 facility is an underground concrete structure, which consists of a pump pit on top of the steel lined concrete catch tank (Figure G2). The top of AZ-151 catch tank is located

approximately 17 feet below grade. The total height of AZ-151, from top of the pump pit to the bottom of the catch tank, is approximately 30 feet.

4.1 PUMP PIT

The pump pit is located on top of south end of the catch tank below. The inside dimensions of the pump pit are 6 feet long by 6 feet wide by 10 feet 9 in. deep. The pump pit is constructed of reinforced concrete and the walls are 1 ft thick. The pump pit is covered with a 30-in. removable concrete cover block. The inside surfaces of the pump pit walls, slab, and cover blocks are coated with a protective coating (HNF 1998). The pump pit houses the submersible pump, jumpers, and other ancillary equipment and serves as secondary containment to the transfer lines and directs any spilled liquid (i.e., transfer waste, rainwater or snowmelt) to the AZ-151 catch tank below.

4.2 CATCH TANK

The inside dimensions of the catch tank are 24 feet long by 6 feet wide by 11 feet deep. The catch tank is constructed of reinforced concrete and is lined with ASTM A569, 10-gauge sheets of carbon steel (HNF 1998). The catch tank walls and top slab are 1-ft thick. The catch tank floor is 1-ft 6-in.-thick and tapers towards a 10-in. deep sump located at one end. There is 8 in. of concrete below the sump (Olander 1990). The catch tank has a maximum capacity of 12,000 gallons though it is administratively controlled at 9,630 gallons. Monitoring instrumentation within AZ-151 consists of the following: one leak detection probe: LDE 151-1; one thermocouple box; one portable liquid level (Food Instrument Corporation [FIC]) that was replaced with an Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge) (ENRAF) between July 25, and July 31, 2000, and one weight factor interlock. (WFAS-151-1) (Olander 1990).

5.0 DESIGN EVALUATION

This section discusses the design requirements and other information used in assessing the integrity of the AZ-151 catch tank and pump pit.

5.1 DESIGN STANDARDS

A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base

- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Engineering personnel.

5.1.1 Catch Tank

The catch tank and the pump pit are underground reinforced concrete structures built under Project HAP-647 according to Hanford Works Specification HWS-8867 (Hanford Drawing H-2-68316). The walls and floor of the catch tank were constructed of Chem-Comp™ concrete (product of Kaiser Cement and Gypsum Corp.) with a minimal allowable compressive strength of 3000 psi at 28 days. The slump of concrete at the time of placement in the forms was specified at less than 4 inches or more than 6 inches for Chem-Comp™ concrete (Vitro 1972). The tank and the pump pit concrete structures were designed American Concrete Institute (ACI) 318-63 (ACI 1963) code requirements. The reinforcing bars are American Society for Testing and Materials (ASTM) A 615 Grade 60 or 40. No water stops are provided at the construction joints.

The 10-gauge carbon steel liner sheets, which line all the inside surfaces of the catch tank, were welded by a tungsten inert gas process and Hanford Works Specification HWS-8811. All welds joining the liner sheets were made and inspected per Hanford Works Specification HWS-8811 and HWS-8821. The 1-1/2-in.-or-less-diameter lines (i.e., temperature and portable liquid access wells) were constructed of Schedule 80 M-5 pipe while 2-in.-and-larger-diameter lines (i.e., drains, process waste lines) were constructed of Schedule 40 M-5 pipe, respectively (Vitro 1973). The M-5 pipe is required to comply with ASME B31.3 (Vitro 1973). Also, all catch tank pipe penetrations are welded to the 10-gauge liner (Olander 1990). The process waste pipe lines were designed for a maximum operating temperature of 220 degrees F and designed and tested for a maximum pressure of 275 psig (Vitro 1972). No documents or referenced records relating to structural design loads were found.

5.1.2 Pump Pit

The reinforced concrete pump pit was coated with a protective sealant (Vitro 1972) to mitigate seepage through its walls and floor. The pump pit contains a 4-in.-black steel pipe (M-5) that drains into the catch tank below. The 4-in. pipe is not encased nor is it listed on any pipe survey drawings (Olander 1990). The pump pit penetrations are welded to flanges located on the inside of the pump pit. The flanges used inside the pump pit are stainless steel Type 304L, per ASTM A240 (Olander 1990).

The pump pit is provided with a shielded cover, which contains a 2-in. access port with a 10-in.-long steel shield plug (Mendoza 1996). The pump pit cover is resistant to rainwater or snowmelt intrusion. Based on project records, the design and construction of the AZ-151 catch tank structure were in conformance with the 1972 and 1973 industry design codes and standards. Design codes and standards identified in Section 5.0 were reviewed and it was concluded that the AZ-151 catch tank structure was designed and constructed in accordance with acceptable and good engineering practices.

Structural design loads other than maximum design pressures and temperatures found in codes and standards are not available for reference at this time. However, the Hanford Plant Standards, Section SDC 4.1, Load Design for Facilities (SDC 1974) which was always enforced since the 1957 original issue could have been the minimum required structural design criteria. For new facilities, the SDC 4.1 has established design load criteria such as required live loads, soil pressure, and seismic loads to mention a few. No actual and complete analysis or calculations were found nor performed. However, the approximately 28 years of continuous waste handling operation reflect a good basis that the design and standards used were adequate.

No formal documents relating to the original functional criteria or procedures and how it interfaced with other facilities and systems were found for the AZ-151 facility. However, record drawings reflect pipe material specifications, hydrostatic testing requirements, and maximum operating pressures and temperatures. These design parameters and limits are still in effect and are consistent with current operational procedures and guidelines for this facility. It is concluded therefore that operational usage of the facility in handling, receiving, and transfer of liquid waste are still within the initial and original functional design requirements.

Structural assessment report (WHC 1996) of numerous facilities subjected to various accident-loading conditions was performed for the safety analysis report. This assessment determined that the AZ-151 facility structural components could fail because of: 1) seismic loads, 2) internal transient pressure caused by hydrogen deflagration.

Review of this document (WHC 1996) indicates that the analysis methods used were crude and simple with very conservative assumptions and unrealistic loadings. However, a recent refined structural evaluation of tank AZ-151 (RPP 2000) shows that the tank has adequate structural strength to withstand applicable seismic loads. The second concern of hydrogen deflagration is mitigated by the design and administrative controls.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

Drainage to 241-AZ-151 catch tank could come from as many as nine sources. Five improbable sources could involve high-level waste. A sixth source (undefined) appears to be disconnected. The remaining three sources are expected to be low-level waste.

The three low-level sources are precipitation and runoff (Ryan 1994), condensate from Project W-030 (now designated 241-AZ-702 Ventilation System, from aging waste system double-shell tanks [DSTs]); (HNF 1999) and drainage from 241-AZ-801A Instrument Building (Mattichak 1997, Ryan 1994).

The apparent disconnected source is associated with the 241-AZ-155 Storage Pit. Its jet-out line remains connected but the storage pit input line appears disconnected (DWG 1988). As long as the input line remains disconnected, AZ-155 is not a source of waste.

Three most improbable sources of high-level waste (from DST 241-AZ-101 and 102 Encasement Leak Detection Pits, [DWG 1972], and the Leak Detection Pit for AZ-102, [DWG 1975]), would require leakage through both the primary tanks and the secondary tanks associated with DSTs AZ-101 and 102. A fourth possible source of high level waste might come from the 241-AZ-152 Diversion box (also known as a Sluice Transfer Box, (DWG 1988), and (Ryan 1994)). The latter facility shows a pass-through connection (DWG 1980) to the 241-AY DST farm.

5.2.1 Past Waste Transfers

Records of catch tank fill level are available on the Personal Computer Surveillance Computer system (PCSACS) from 1981 to the present. Records prior to 1981 are reported to be in U.S. Department of Energy (DOE) warehouse storage in King County, Washington. PCSACS plots of surface level cover the time period from about 1984 to 1999, while comment information covers the period from 1981 to 1999. This same data (but only from 1981 to 1995) can be found in a record log book (RHO-CD-83-213-CT). Since 1995, all record data are stored in the PCSACS system.

In the PCSACS comment reports for AZ-151, rainwater or snowmelt inflows are only noted to have occurred in 1981, 1982, and 1984. From 1983 onward, fluid input was noted variously as vent header drain, condensate, drain from loop seals, etc. Waste transfers from AZ-151, generally were sent to AZ-102 (two are noted to AZ-101), from 1985 through 1999. The annual number of transfers ranged from four to 21, with an average of about 15 per year. All the transfers would have been near-neutral, dilute solutions of water containing some contamination. Even if rainwater and snowmelt incursions continued after 1984, their volume would be small in comparison to the thousands of gallons of condensate that are typically transferred annually.

Since 1995, waste compatibility analyses must be conducted before any waste can be transferred. These analyses meet Washington State Department of Ecology (Ecology) requirements that the waste not be ignitable, reactive, or corrosive WAC 173-303-090 (WAC 1998). More specifically the compatibility assessment covers requirements based on waste categories, waste codes, and process or safety concerns that could be created during transfer and during subsequent comingling of the waste in the final receiver tank.

Waste compatibility compliance requirements are noted in five documents: Fowler (1995), Mulkey (1998), Cox (1997), Mulkey and Miller (1997), and HNF (1997). These requirements include: flammable gas (hydrogen, methane and ammonia), nuclear criticality, organic and energetic reaction, watch list tanks, corrosivity, chemical compatibility, tank waste type, TRU segregation, heat generation, complexant waste segregation, phosphate waste, radiological source control, toxic chemical source term controls, and the wastes' Reynolds numbers. Flammable gas is particularly important in that for any future saltwell transfer(s), the catch tank vapor space concentration must remain controlled below the lower flammability level (LFL). Specifically, the minimum time to reach 25 percent of the LFL is required to be greater than or equal to 7 days, assuming no primary tank ventilation.

In November 1997, a waste compatibility assessment was conducted (Blaak 1997) which covered future transfer of condensate from catch tank 241-AZ-151 (including catch tanks

241-A-417, 241-AX-152) for possible transfer to DSTs AZ-101/102 and AY-102. Blaak (1997) estimated that, at the current condensate accumulation rate in AZ-151, approximately one to 12 transfers (at approximately 5,000 gallons each) per year would be necessary to receive the condensate without filling the tank above its operation limits.

5.2.2 Future Waste Transfers

When the time comes to remove sludge from the DST AY and AZ Farms, catch tank AZ-151 could receive non-dilute waste solutions along with the more dilute condensate solutions noted earlier. The non-dilute waste solutions could occur because of the method of future removal of the sludge through sluice pits that are located on the top of each of the AY and AZ DSTs. These pits provide a means of injecting a high-pressure liquid stream directly into the sludge so that the sludge may be broken up, removed and transferred to another tank (Leach and Stahl 1998). The central sluice transfer diversion box is 241-AZ-152, which has a drain connection directly to catch tank AZ-151.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided by the combination of good design, appropriate material selection, and corrosion control. Effective corrosion control, for nitrate-nitrite-hydroxide-based waste in DSTs, was introduced in 1984 (Kirch 1984). These corrosion control requirements are applied to DSTs, not to the catch tanks. Because almost all the wastes transferred from AZ-151 have been dilute, near neutral solutions of water, some uniform corrosion or pitting corrosion could be occurring.

All inside surfaces of the reinforced concrete catch tank AZ-151 are lined with ten gage (nominal thickness 0.135 in.) ASTM A569 carbon steel, a low-carbon, hot-rolled steel. These steel sheets were welded with a tungsten inert gas welding process according to Hanford Works Specification HWS-8811. No stress-relieving or post-weld heat treatment was conducted, therefore weld residual stresses remain high.

Corrosion controls, as described above, do not have to be applied, according to the procedures, to catch tanks as long as the designated projected final mixtures in the receiver DST have been evaluated to ensure that they will remain compliant. The pH of the contaminated condensate stored in catch tank AZ-151 will likely be less than eight (Blaak 1997). The requirement for pH to be greater than 8 applies only to transfers from non-Tank Farm facilities to Tank Farms (HNF 1997).

The corrosion of steel, in dilute solutions of water, is mainly affected by the solution pH value. Thus, pH control is the most effective means of inhibiting catch tank corrosion. However, it must be emphasized that corrosion also depends on gases and minerals dissolved in the water as well as the velocity of the water. The presence of relatively small amounts of some minerals can slow down (inhibit) corrosion processes while others can accelerate corrosion.

The corrosion of iron in soft, aerated water as a function of pH is described in the American Society of Metals (ASM) Handbook (ASM 1987). There the reported uniform corrosion rate,

between pH 4 and 10, is 10 mils/year. A grab sample of contaminated condensate, taken from AZ-151 was analyzed (Peters 1998) as 99.8-percent water with a pH of 7.95. This analysis indicates that the AZ-151 fluid is not significantly different from the soft water noted in the ASM Handbook (ASM 1987), with the exception of aeration. Thus it appears possible that uniform corrosion of several mils/year could have occurred in the liner since the tank went into service in 1973.

Even though the steel liner was not stress-relieved, the very low concentration of chemical species in the AZ-151 condensate reduces the likelihood of stress-corrosion cracking . No data were found regarding pitting corrosion in this steel, but it cannot be rejected as a possible damage mechanism.

5.4 AGE OF THE TANK SYSTEM

The tank was constructed in 1973 (Olander 1990). Thus, AZ-151 has been in service approximately 28 years.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations (visual and leak test) were performed in 2000. These examinations were done to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since completion of construction approximately 27 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the pump pit on June 27, 2000 and in the catch tank on two occasions, June 27 and May 2, 2001. The first catch tank examination (June 27) occurred when the waste depth was about 5 and 1/2-ft. An intervening UT wall thickness evaluation occurred about March 20, 2001, but the tank was essentially full and obviously was not re-examined at that time. Because the below-waste-surface wall thickness evaluation was not successful, a second entrance (May 2, 2001) was planned with the waste at a lower depth, approximately 3-ft. This was accompanied by a second UT-wall thickness evaluation, which is discussed later. Because the waste was now lower than on June 27, 2000, a second visual examination was conducted.

6.1.1 Pump Pit Visual Examination Details

Access to the pump pit was obtained by removing its cover block. A Video In-Tank Inspection System (VITIS II) video camera, with attached light, was used to view the pit interior and its ancillary equipment. The video camera has a zoom telephoto lens capable of wide-angle scanning and close-up or higher magnification viewing. Camera 'pan' and 'tilt' angles along with the pit designation (viz., AZ151PP) were omnipresent within the field of view of the camera. Time and date, which has been presented in almost all the other integrity examinations, were not available. Thus, the tape-location of a given photo is noted by its time-position in the figure titles, details of the examination can be found in Table G1.

Eight photographs of the pump pit interior region were taken, and are shown in Figures G-3 through G-10. In general, the pit interior surfaces, joints, and ancillary equipment appeared to be in very satisfactory condition.

6.1.2 Catch Tank Internal Visual Examination Details

Access to the catch tank was through a funnel-shaped floor drain in the pump pit, shown in Figures G3 and G4. Twenty-five photographs (Figures G11 through G31 – including some stereo pairs and pre- and post-washing comparison pairs) are presented. Because the camera entrance was restricted to the southeast corner of the tank, it was difficult to see both proximal regions (straight-on) and the more distant portions of the tank. Despite these limitations the 'still' photographs provide satisfactory evidence of the status of the tank.

The waste depth during the second entrance was about three feet. Thus, the vertical steel liner surfaces could be viewed down to the waterline. A slight murkiness in the water, along with a relatively thin bottom-lying sludge layer, prevented any viewing of the tank bottom.

Because the waste fluid is conducive to producing uniform corrosion of the carbon-steel tank wall (See Section 5.3), those surfaces available for viewing were closely scrutinized. No video still photographs for the first entrance (June 27, 2000) are presented, because of the significantly improved quality of the images obtained during the second entrance (May 2, 2001). Figures G11 to G14, G16, G19, G21, G25, G26, and G27, show a generally satisfactory appearance as to the corrosion behavior of the tank walls and internal components. Figures G15 & 15SP, G17, G18 & 18SP show some localized blemishes or marking that could be evidence of deeper local corrosion. There is no evidence, however, of any hole-through in those locations. Evidence of some possible patches of uniform corrosion near the tank waterline is shown in Figure G20. As before, no corrosion hole-through was evident.

Figures G22 through G24 (5-total, with before and after comparisons) show the effect of pressure washing, even in areas not in a direct line with the washing jet spray, for removing thin layers of lightly adherent rust. Figure G22 shows how non-straight-on viewing overemphasizes the nature and magnitude of the lightly adherent rust products. In the initial entrance (June 27, 2000) some possible wall-penetrating corrosion damage seemed to occur around the area where five downcoming pipes entered the tank. Figures G23 and 23a and G24 and 24a show that this was not so. The thin layer of metal (assumed) in Figure G23 appeared to be splitting away from the wall in the neighborhood of the pipes. After nearby pressure-washing (Figure G23a) the so-called strip of metal was almost entirely destroyed. This suggests that this may have initially been a thin piece of sheet metal (perhaps a template). Over a period of time it rusted to form mainly brittle iron oxides that were subsequently washed off. Only a very small amount of iron oxide remains as shown by comparing Figures G24 and 24a.

A vertical weldment in the southeast corner appears to contain a full-length crack (Figure G25). By rotating the camera (and attached light) [Figure G26], the so-called crack disappears. The 'crack' appears mainly to be a result of a shadow effect or perhaps a slight offset in the two pieces of metal, when in situ welding was performed. Again, a direct-on view of this weldment

was not possible due to the closeness of the walls and the relatively long-length of the camera/lighting system.

After the second internal visual examination, a spray washing device (Figure G30) was lowered into the tank through the 4-in. pump pit drain. A 3,000 psi pressure washing unit was used to spray two vertical strip areas in the southeast corner of the tank. The spraying action occurred about 9 to 12-in. from the wall, essentially the same distance of the drain from the corner walls of its pit. A pit-side crane provided vertical movement of the spray nozzle. The darker areas, shown in Figures G27 and 28 are overall and close-up views of the washed walls. In general the pressure washing removed the lightly adherent rust flakes and particles.

Figure G29 shows that the waste fluid (approximately three feet deep) in the tank is only partly murkey. The outline of a ladder lying on the floor can be seen. Further, it is likely that a thin layer of sludge prevented seeing the tank bottom.

Visual examination also continued during the UT-wall thickness evaluation. Figure G31 shows the ultrasonic test arm (actuated to a horizontal plane).

6.2 LEAK TEST

To satisfy the established detection of a volume change, a 24-hour leak test was conducted on July 15, 2000 through July 16, 2000. Prior to the start of the test, the waste level had accumulated to 114 in. Liquid waste that normally flowed to the tank was halted in order to ensure that the waste level did not increase during the course of the test period. Table G3 indicates the level remained constant at 114 in. during the 24-hour leak test period. Thus, the tank is not leaking.

Visual examination of the 241-AZ-151 catch tank, along with a 24-hour leak-test, indicates that the tank is not leaking. In addition, the tank's pump pit is in a very satisfactory condition.

6.3 ULTRASONIC INSPECTION OF TANK WALL

Attempts at ultrasonic wall-thickness evaluation of catch tank 241-AZ-151 were made twice, once on March 20, 2001 and on May 2, 2001.

6.3.1 UT Equipment and Approaches

Equipment used to conduct the UT examinations consisted of a 1/2-in.-diameter spring-loaded UT transducer (10 MHz) mounted on the articulating right-angle end of an approximately 40-ft-long, jointed 1-1/4-in. diameter aluminum pole. Water was the couplant used during both entrances: the actual tank, dilute liquid waste water was used during the first 'wet' entrance (June 27) and supplied (pumped) water, through a waterline that was secured to the pole, during the 'dry' entrance (May 2). Pressure washing was used during the 'dry' entrance in order to clean the tank surfaces of loosely adhering rust flakes and particles.

A Force Institute PSP-4 (Projection Scan Processor) digital system was used to condition and readout tank wall thickness values. Attachment 1, "Demonstration Test of the Tank AZ-151 UT-Thickness Measurement Tool," describes how the UT system was calibrated and evaluated for remote thickness measurements. A measurement sensitivity of ± 5% of the initial thickness of the tank wall (10-gage or 0.135-in.), or ± 0.007-in., was prescribed. Note that Attachment 1 also shows some photographs of the modified tool as used during the second, or 'dry' entrance.

The plan to measure tank wall thickness was to lower the pole-articulating transducer system (with a pit-side crane) into the ground-level pump pit, and then on through a 4-in. drain opening, leading into the catch tank. When inside the tank, an articulating arm would be activated to a position where the UT transducer was perpendicular to the tank wall. This was done by opening a nitrogen gas valve, which was connected to a small pneumatic cylinder near the end of the probe. The cylinder was an integral part of the probe (See Attachment 1 photos). UT-thickness measurements were planned using decremental steps, of about 4 to 6-inches, starting at the top of the tank's carbon-steel liner down to as close as possible to the tank's bottom. During the wet entrance, the depth of insertion of the probe was limited by a sludge depth, which was assumed to be about 2-ft. During the dry entrance, the probe was maintained between the top of the liner and above the fluid waterline.

Neither the 'wet' nor the 'dry' UT-thickness measurements were successful. During the wet approach, a relatively large amount of magnetite (rust) built up on the wall-adhering magnets that were used to help secure the UT-transducer to the wall. This was believed to be the primary reason that UT-thickness measurements were unable to be made, although the dry entrance presents an additional explanation. These magnets were backup to the UT-technician who also attempted to maintain the UT-transducer against the wall by applying a combined bending and translational force to the upper end of the pole.

During the 'dry' entrance, UT-transducer contact was made with the rusty wall, but no successful thickness measurements could be made. This was believed to be due mainly to the rusty-rough surface of the tank interior, which prevented adequate coupling with the wall, even though water couplant was continuously supplied to the transducer. Pressure-washing of the tank walls, proximal to the pump pit drain opening, was done to decrease the surface roughness and remove loosely connected rust. Attachment 2 describes how the pressure washing system was evaluated, so that it did not significantly damage the liner walls but still cleaned them of the noted rust material.

Figure G27, backed up by Figures G23, 23a, 24 and 24a, show that pressure washing did remove essentially all the loosely adherent rust flakes and particles. Visual monitoring of the UT-probe was done through a small camera attached to the rear of the articulating arm; see Figure G31. Small battery-fed lights (also attached to the articulating arm) allowed enough lighting to assure that probe was articulated and physically contacting the tank surface.

The NDE Ultrasonic Thickness Measurement Procedure and Test Report for AZ-151 is included in Attachment 3 of this Appendix.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings.conclusions, and recommendations are presented:

1. The tank has been in service underground for 28 years without any leaks reported, which proves that at the time of its construction adequate design controls were used to withstand applicable design loads. However, the expected corrosion rate of the carbon steel liner, the lack of water stops in the concrete design, and the long service period indicate the tank design, with respect to corrosion control is inadequate.

2. The design does not prevent entry of water (rainwater or snowmelt) into the tank. The water leaks through the cover block seams, then drains to the tank through the pump pit floor drain. This water adds to the waste inventory. This should be mitigated by effectively sealing the cover block seams.

3. Although the results of the catch tank interior visual examination and its leak-test were satisfactory, the slightly corrosive behavior of the waste requires that additional periodic visual examinations and leak-tests be conducted. While the potential 10-mil/yr corrosion rate has not been realized in the tank available for examination, a rate of about 3-5 mil/yr. could substantially reduce wall thickness to a level where leakage could result. The reinforced concrete backing structure, however, is normally resistant to dilute solutions of water that are near-neutral in pH level

4. Because of operations schedule constraints, the visual examination of the tank was done when it was almost three-quarters full (at 74 in.). The lower portion of the tank could not be seen. In order to assess the condition of the lower portion of the tank liner plate, a visual examination of the empty tank should be done in fiscal year 2001. From the results of this future examination, further findings, conclusions, and recommendations should be reported.

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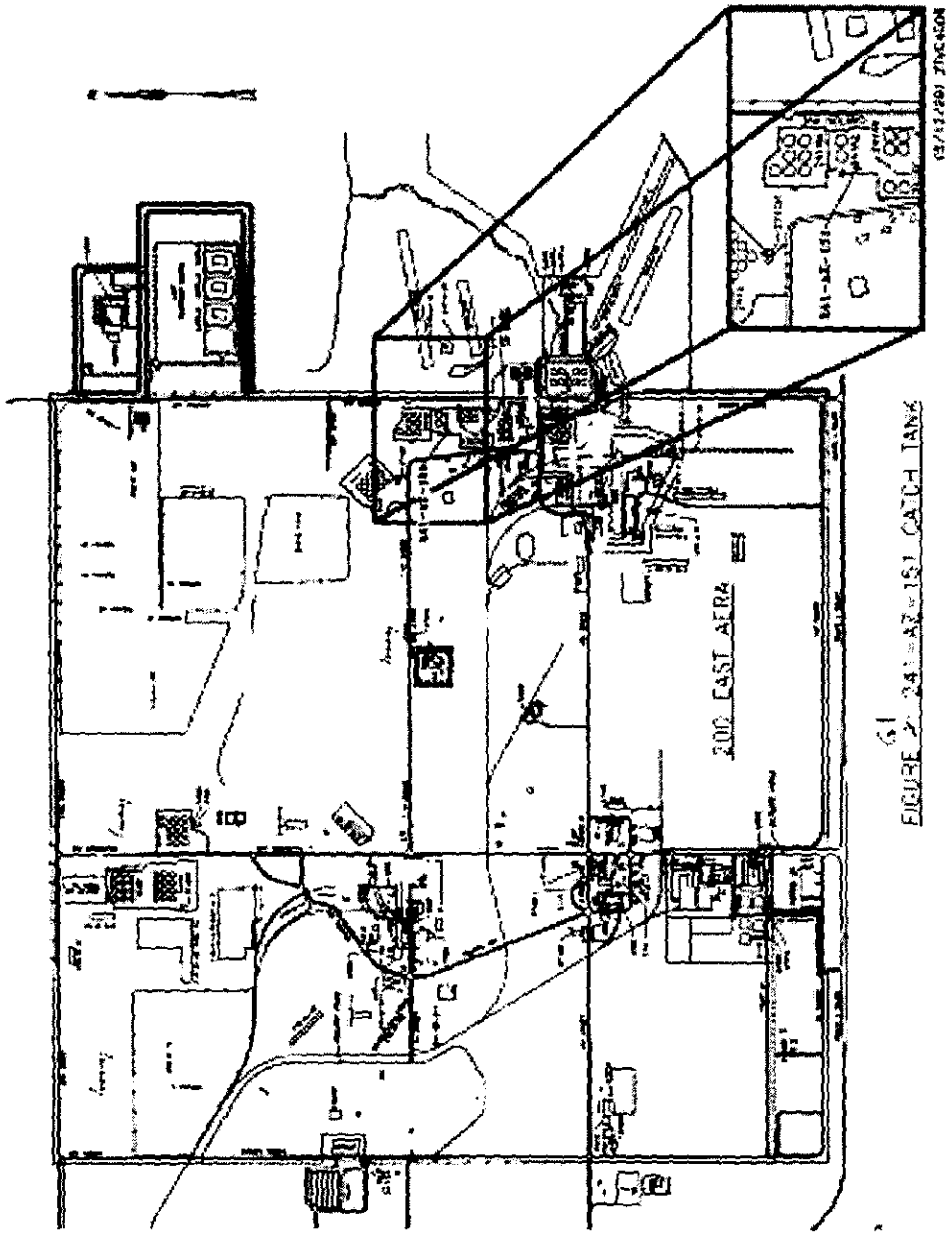


Figure G1 Location of 241-AZ-151 on the Site Plan

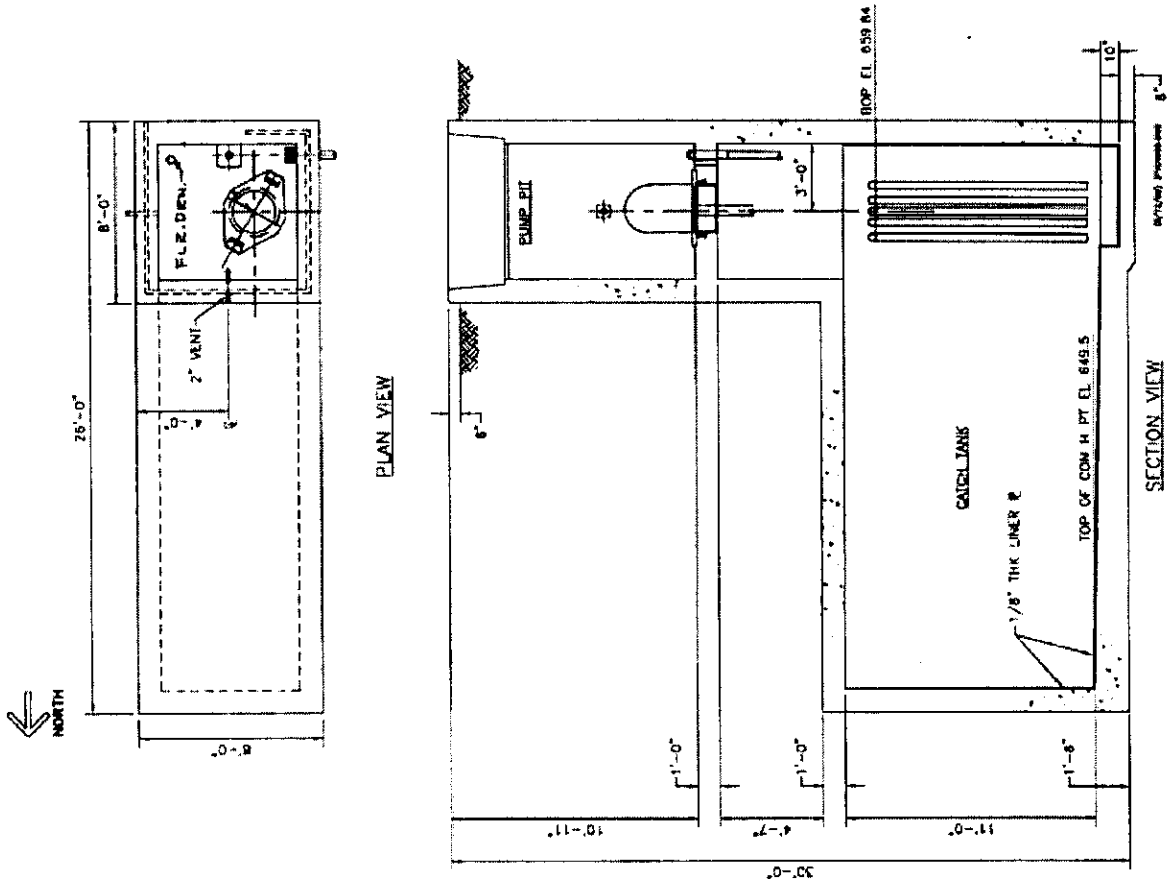


Figure G2 241-AZ-151 Catch Tank

TABLE G1 VIDEO EXAMINATION DATA SHEET, 241-AZ-151 PUMP PIT

Examination Date: 6/27/00

Person In Charge: D.P. Niebuhr/S. R. Chapman Camera Operator: C. W. Peake Video Examiners: T. S. Hundal

Riser: Cover Block Removed

Video Tape Reviewer: E. B. Schwenk Date: 9/00

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					241-AZ-151 pump pit was entered, with a VITIS II video camera by removing its cover block. The pit is about 6 ft square and about 7.5 ft deep, below the cover block.
					The following narrative and photographs show that this approximately 27-year old structure is in very satisfactory condition. Approximately 18 minutes of the 65 min.-long videotape was used in examining the pump pit. No time and date is shown on the videotape. As a result, actual tape-time is used to identify the position of a given picture on the tape.
	7.5 min	288	150		The pit appears sound. Figure G3 shows the southeast corner of the pit and the respective wall-pit joints. Drainage to the catch tank is provided by the funnel-shaped opening in the floor. Adjacent to the drain is a leak detector probe, on a vertical pipe-standoff. A Plutonium Uranium Extraction Facility (PUREX) connector fitting is seen at the left The coiled line, on the floor, appears to be a broken measurement tape. In addition, some common staining and minor amounts of dirt can be seen on parts of the floor.

Table G1 Video Examination Data Sheet, 241-AZ-151 Pump Pit (continued)					
	8.5-min.	358	167		A view of the south wall and adjacent floor (including the same floor drain in Figure G3) along with an instrument jumper and a portion of the waste transfer pump are shown in Figure G4.
	8.5 and 9.5 min.	272/149	194/164		Figures G5 and G6 show two different views of the waste transfer pump.
	10.5 min	102	155		A view of the west wall and floor joint, along with the transfer pump and a PUREX fitting can be seen in Figure G7.
	12-min.	174	143		The northwest corner, north wall and floor joint, shown in Figure G8, like the others, appears very satisfactory.
	14.5-min.	301	061		A typical view of the cover-block support area and the pump pit walls (south and east) are shown in Figure G9. The cover block had been removed to allow camera access to the pit (and catch tank). The upper concrete walls are the outer support structure (about 2.5 ft high) for the cover block.
	5.5-min.	200	106		A number of spray nozzles exist on the sidewalls of the pit. The north wall spray nozzle is shown in Figure G10. The brown stain below the nozzle probably results from rusty water that slowly leaked from the nozzle.

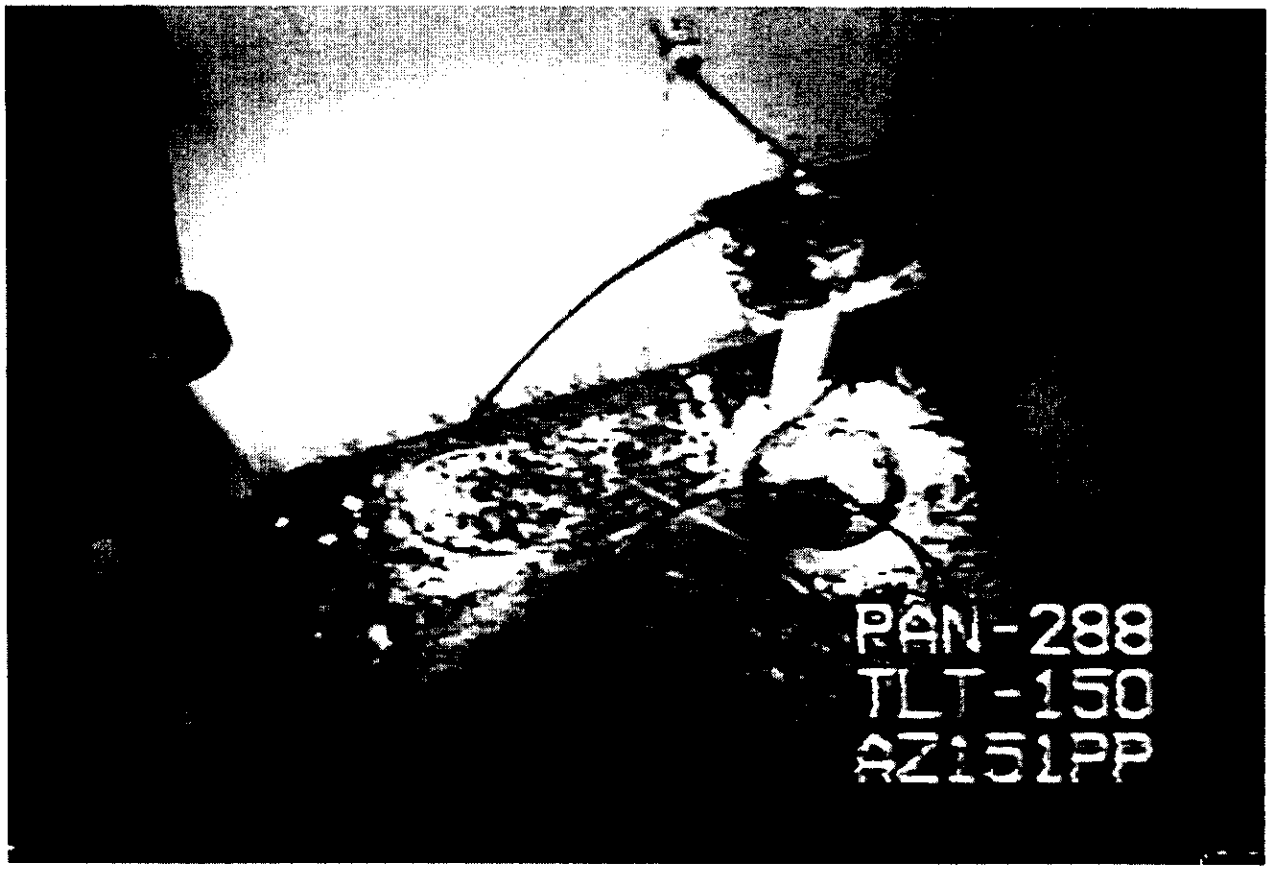


Figure G3
View of Southeast Corner of Pit Including PUREX Pipe Connector (left), Drain to Catch Tank and leak Detector Probe (both right). AZ-151 Pump Pit. Time: 7.5-Min.

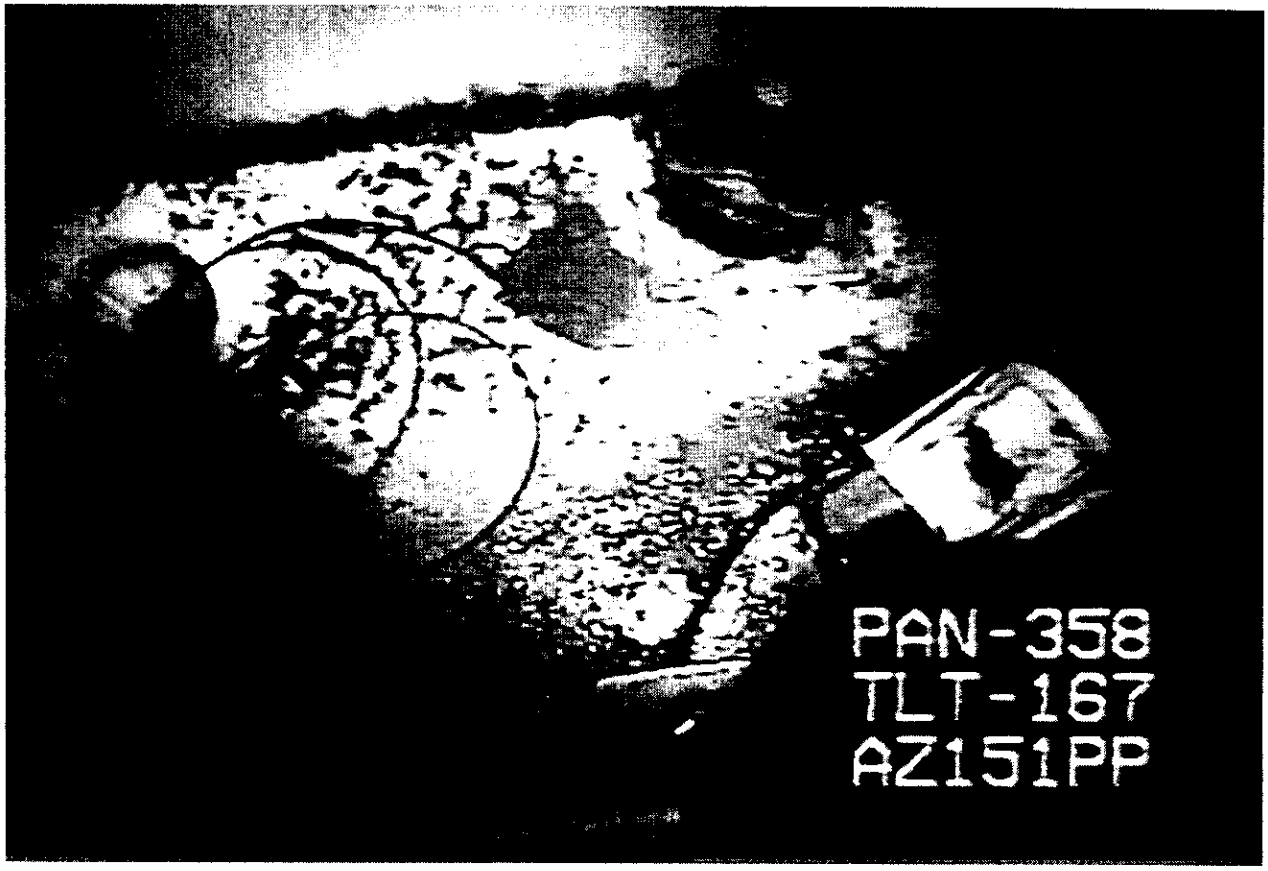


Figure G4
View of Bottom of Pit, South Wall (background), Drain to Catch Tank upper left), Instrument Jumper (upper right) Waste Transfer Pump (bottom right). 241-AZ-151 Pump Pit. Time: 8.5-Min.

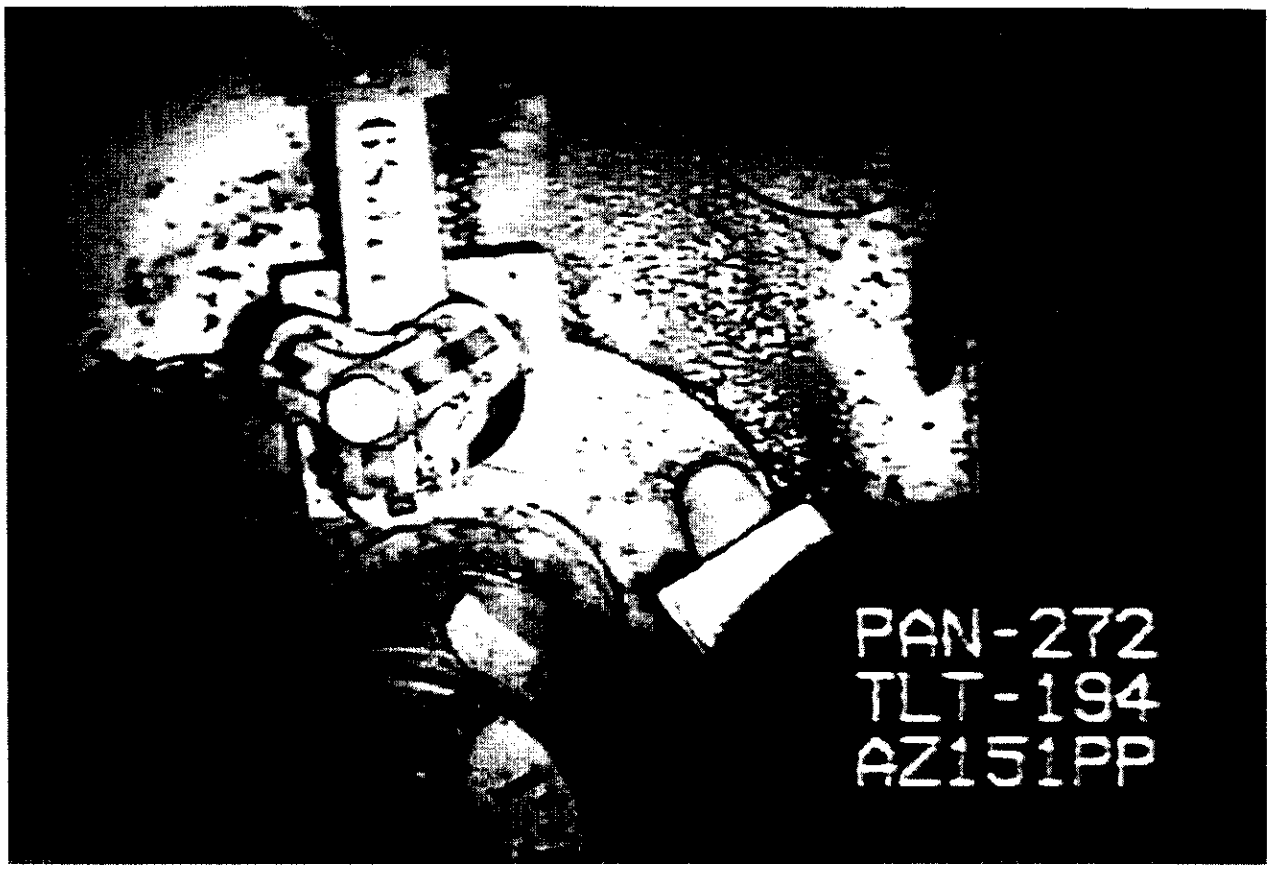


Figure G5
View of Bottom of AZ-151 Pump Pit with Waste Transfer Pump and Nozzle-Jumper Connection. Time: 8.5-min.

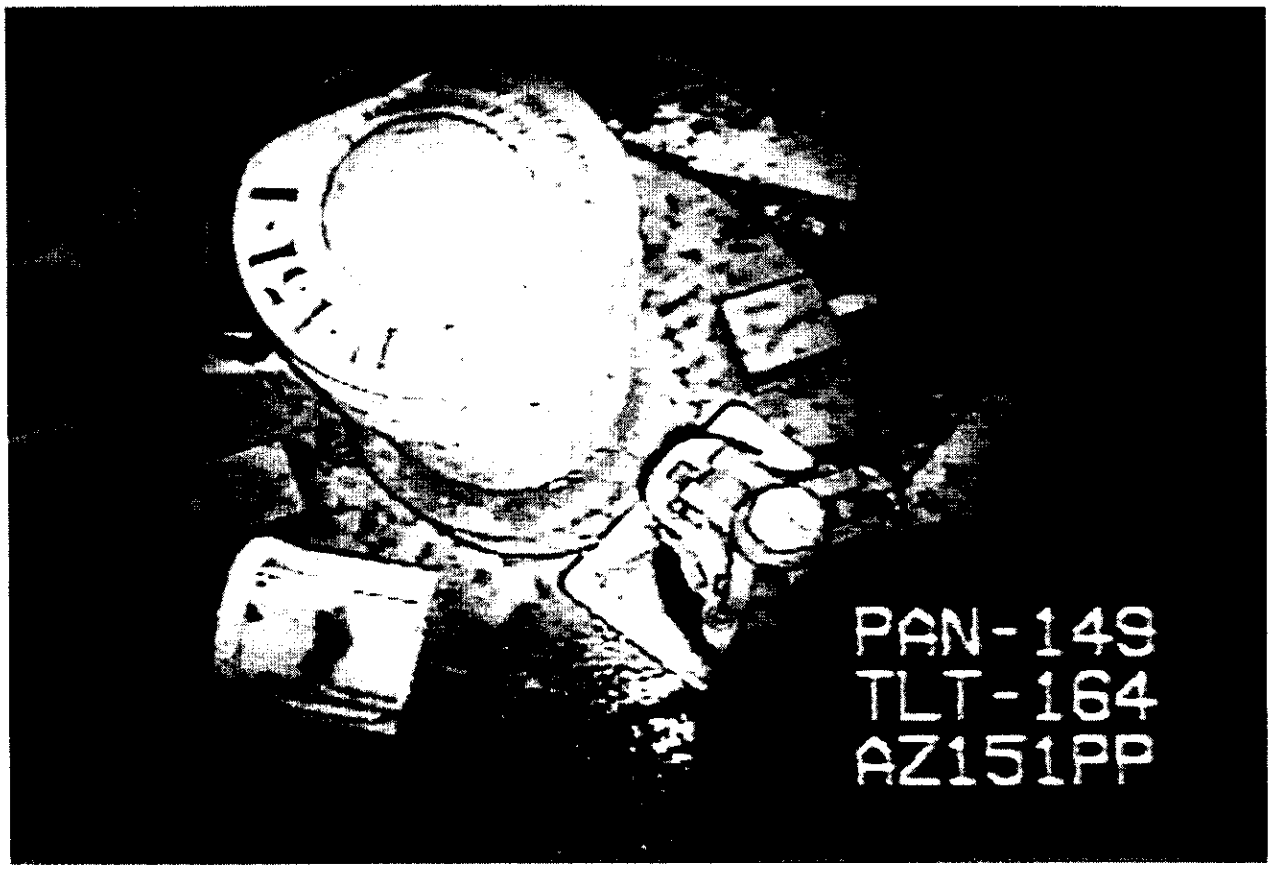


Figure G6
Overall View of Waste Transfer Pump, AZ-151 Pump Pit. Time: 9.5-Min.

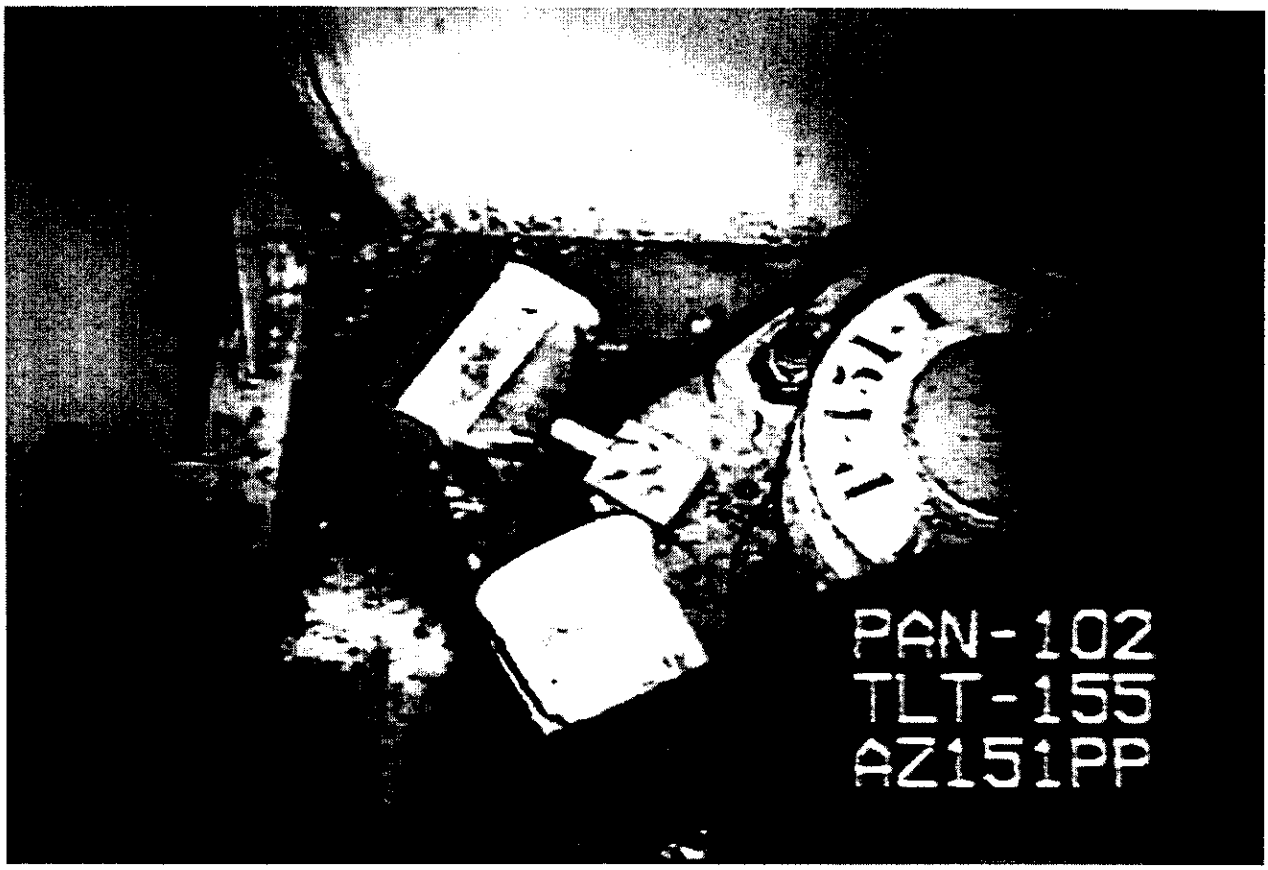


Figure G7
View of Waste Transfer Pump (right), West Wall (background), and Jumper Fitting (left).
Time: 10.5-min.

Figure G8
Northwest Corner and North Wall of AZ-151 Pump Pit. Time: 12-Min.

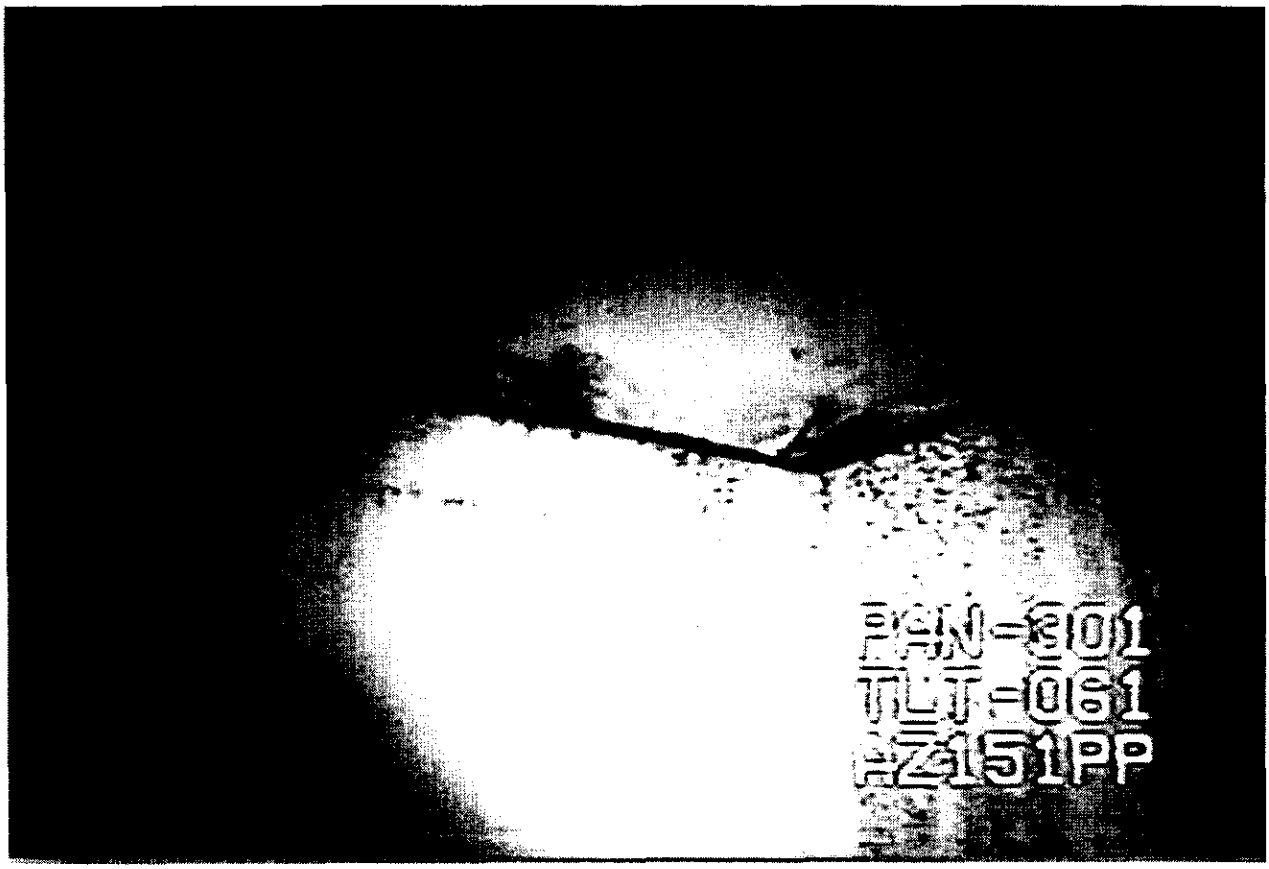


Figure G9
Typical View of Cover Block-Pit Wall Intersection, Southeast Corner of Pit, AZ-151 Pump Pit. Time: 14.5-Min

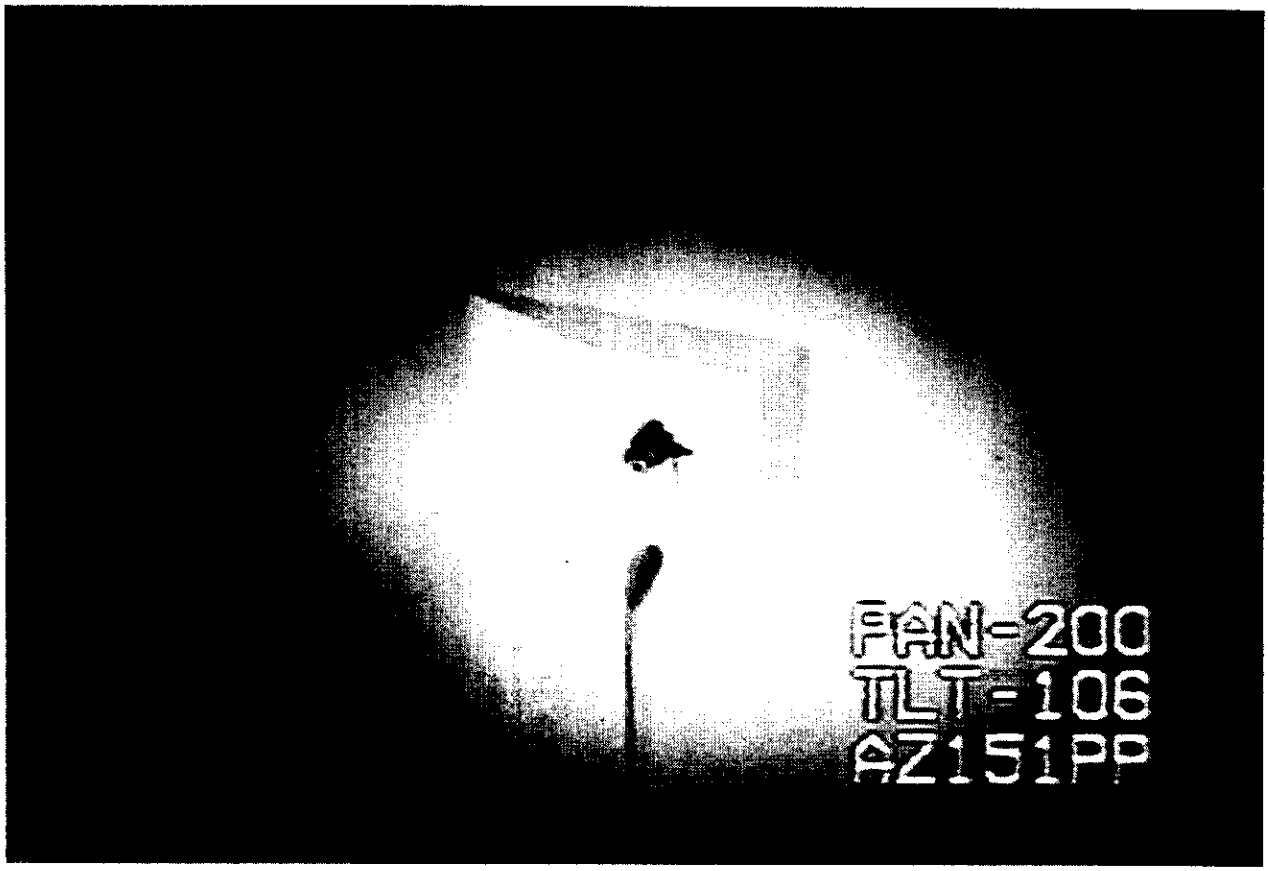


Figure G10
View of Typical Spray Nozzle, North Wall, AZ-151 Pump Pit. Time: 5.5-Min.

TABLE G-2. VIDEO EXAMINATION DATA SHEET, 241-AZ-151 CATCH TANK

Examination Date: 5/2/01

PIC: D.P. NIEBUHR/S.R. CHAPMAN CAMERA OPERATOR: BO PEAKE VIDEO EXAMINER: E. B. SCHWENK

RISER: CAMERA OPENING THROUGH PUMP PIT FLOOR DRAIN

Video Tape Reviewer: E. B. Schwenk Date: 5/23/01

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					After viewing the pump pit, the same camera (as used in Table G-1) was lowered through the southeast corner floor drain into the AZ-151 catch tank ullage. Date of the second entrance, described below was 5/2/01. An entire 2nd videotape was used to visually examine the tank ullage before and after pressure washing, and to view an attempt to measure tank wall thickness using an ultrasonic technique. The tank interior appeared satisfactory but contained some blemishes that could be indicative of areas of increased local corrosion. Considering that the typical waste fluid is conducive to uniform corrosion of the tank wall (see Section on Corrosion Protection in body of this report), the videotape of the tank interior was critically examined. The bottom 3-ft. of the tank sidewalls could not be seen clearly. A ladder could be seen lying on the tank bottom but a thin layer of sludge prevented any viewing of the bottom. In a prior examination (6/27/00), the waste was about 6-ft. deep and most of the tank walls (below the waste) and the bottom could not be seen. Further, because of the proximity of the camera only to the northeast corner of the tank, there was some difficulty in seeing to the distant, opposite end of the tank, as well as the proximal regions around the nearby northeast corner. Despite these limitations, no corrosion hole-through of the carbon-steel pit liner could be seen. The remaining liner wall thickness, could however, have been uniformly thinned by the slightly corrosive character of the waste and yet, not be obvious to the video camera. Several corrosion-type blemishes or markings might indicate some increased depth of corrosion. However, it was not possible to estimate if they were any more than superficial. In short, the exposed region of the tank liner, presently, appears satisfactory but bears further visual examinations in the future.

Table G-2. Video Examination Data Sheet, 241-AZ-151 Catch Tank (continued)

	2-min.	026	180		The camera was entered into the 4-in. drain. Figure G11 is a downward view of the northeast corner of the carbon steel tank liner. The liner begins a short distance below concrete wall seen at the left side of the photo. Diptube air bubbles can be seen on the top of the fluid, emanating from the pipe at the right. The pipe in the middle foreground is one of five vertical pipes that emanate from the north wall.
	2.+ min.	026	180		Fig. G12 is a view of the same area, closer to the waste fluid.
	3-min.	045	143		Further scanning to the right, Fig. G-13, shows the bubbling diptube (center) and pump shaft pipe (right).
	4-min.	076	106		A view of the east sidewall of the tank, with the diptube bubbler at the left and the pump shaft pipe at the right) is shown in Fig. G14. The pipes appear very satisfactory. If uniform corrosion has occurred it appears to have been a general attack over the entire area. The dark mark, near the bottom left, could be a region of increased local corrosion. No hole-through is apparent.
	4 +min.	063-067	112		These two figures (G15 and G15SP) are magnified views of the sidewall mark shown in Fig. G14. They were taken in an attempt to produce a stereo pair to determine if there is any significant depth to the mark.
	2:18 PM.	207	054		At this point in time, time and date were added to the field-of-view of the camera. This figure (G16) shows the intersection of the top of the carbon steel liner (which appears to be thicker on its top several inches) with the reinforced concrete roof above the tank.
	2:18 PM.	207	064		A closeup view of a another dark mark on the east sidewall is shown in Fig. G17. It is about directly below the intersection of the pump pit wall and horizontal concrete cover over the remainder of the tank.
	2:18 PM.	211, 214,	063, 071		Figures G18 and 18SP are reduced magnification views of the mark shown in Fig. G17. The magnification was reduced in an attempt to obtain a stereo pair, as in Figure G15/G15SP.
	2:19 PM	233	075		Fig. G19 shows a view of a possible corrosion waterline (insignificant corrosion) adjacent to a horizontal weld. Both appear satisfactory.
	2:19 PM	227	096		Some possible patches of uniform corrosion can be seen above the waterline (Fig. G20). No corrosion hole-through is evident.
	2:21 PM	247	067		A view of the remote corner of the tank under its concrete cover is shown in Fig. G21. The vertical corner weld appears very satisfactory. The waterline/horizontal weldment was also shown in Fig. G19.
	2:23 PM.	285	044		Fig. G22 is an upward glancing angle view of the underside of the downcoming pipes and tank sidewall. Thin flakes of slightly outward-jutting rust are size- and thickness-overemphasized by the angle-view.
	2:29 PM	243	125		Fig. G-23 is a downward looking view of the same pipes shown in Fig. G22. Note what appears to be a thin sheet of metal atop the first three pipes that enter the carbon-steel/concrete wall at right side of photo.

Table G-2. Video Examination Data Sheet, 241-AZ-151 Catch Tank (continued)

	6:40 PM	054	124		The same areas shown in Fig. G23, after pressure-washing, are shown in Fig. G23a. Even though the washing action was occurring up to 2-ft (and more) away from this area, almost the entire sheet is missing. It is speculated that the sheet was originally carbon-steel, possibly used for a template, which then converted mainly to brittle iron oxides (rust), and was washed away by rebound spray water from the nearby pressure-washing process. The white-colored strip-pieces at the bottom of the nearest complete pipe in the foreground of the photo, is a piece of tape. This tape may have been on the pipe for a number of years (See also Fig. G29 below).
	2:29 PM	260	111		Fig. G24 is a closeup of a thin sheet of rust, at an angle of about 45° to its contiguous pipe, that can also be seen in the upper portion of Fig. G23.
	6:40 PM	055	114		Following nearby pressure washing, the thin sheet appears to have fallen down to touch its contiguous pipe. Perhaps it retained enough metallic content to remain partially ductile, and hence not break away during washing.
	2:38 PM	020	161		Fig. G25 presents a downward view of the northeast corner of the tank liner. The vertical weldment appears to have an offset, or a shadow effect, overemphasized caused by the angular proximal lighting attached to the camera.
	2:38 PM	142	161		The crack-like image shown in Fig. G25, disappears substantially when the camera was rotated (Fig. G26) away from the corner. It is also possible that some mismatch occurred between the two sheets, during the in situ welding of the liner corner, which led to the possible shadow effect.
	6:29 PM	056	179		Pressure washing of two vertical strips, each about 1-ft. wide, occurred just prior to taking the still photo image shown in Fig. G27 (the camera was not in the tank during washing). Washing started at the top of the tank on the upper right, progressed downward then stopped just above the waterline. The pressure wand was rotated 90° to face the adjoining wall then slowly pulled upward. The darker vertical areas are the regions that were pressured washed. Remnant fog in the tank slightly masks the washed areas.
	6:32 PM	152	148		A closer view of the bottom of the two, dark pressure-washed areas is shown in Fig. G28.The washer device was apparently turned off for a short time during the rotation of the pressure wand to the other face (right side of photo).
	6:41 PM	000	138		Although not as clearly evident in Fig. G28, as it is in the moving videotape from which it was taken, what appears to be a ladder is lying on the bottom of the tank. Note also the pieces of partially peeling tape on the two vertical pipes at the right.
	6:48 PM	114	110		Fig. G30 shows an approximately 2-in. diameter pipe, with attached spray nozzle, being lowered into the 4-in. drain in the tank's pump pit. The pipe is partially masked by the legend in the upper left corner of the photo.

Table G-2. Video Examination Data Sheet, 241-AZ-151 Catch Tank (continued)

	---	---	---		The outward projecting arm of the UT thickness measuring device is shown in Fig. G31. The roughened tank surface is in the upper background. Three battery-source lights are attached to the arm to help the UT technicians see the surface that they are attempting to thickness-measure. The small TV camera is set within the arm, which is above, and outside the field of view of the photo. The brightest light on the tank surface is located just above the UT-transducer block.

Figure G-11
Downward View of Video Camera Entrance to AZ-151 Through 4-in. Drain (About 2-min. tape time).

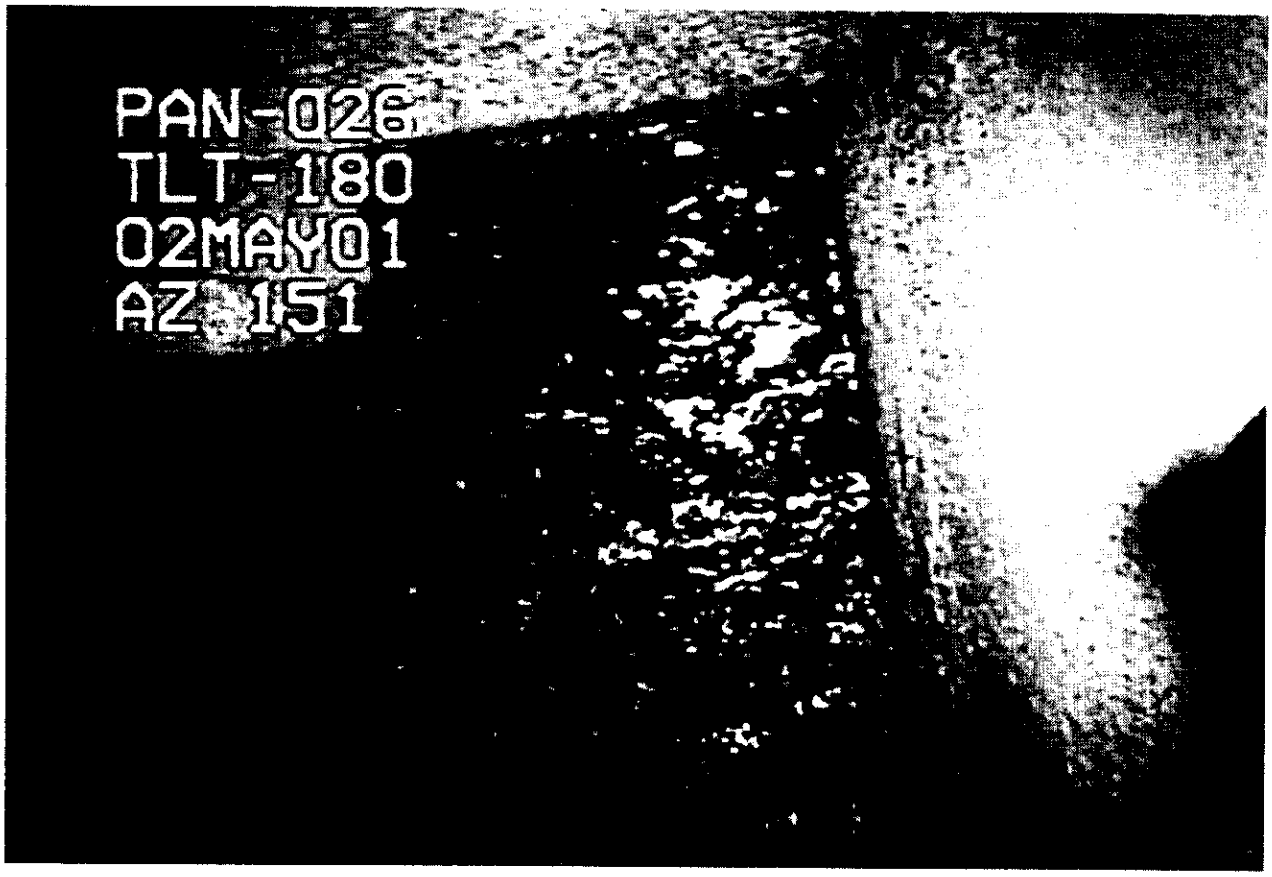


Figure G-12.
View of Southeast Corner of AZ-151. One of Five Downcoming Pipes (left); Water Surface Activity due to Bubbling Action of Diptube (Out-of-site below Picture). About 2-1/4 min. tape time.

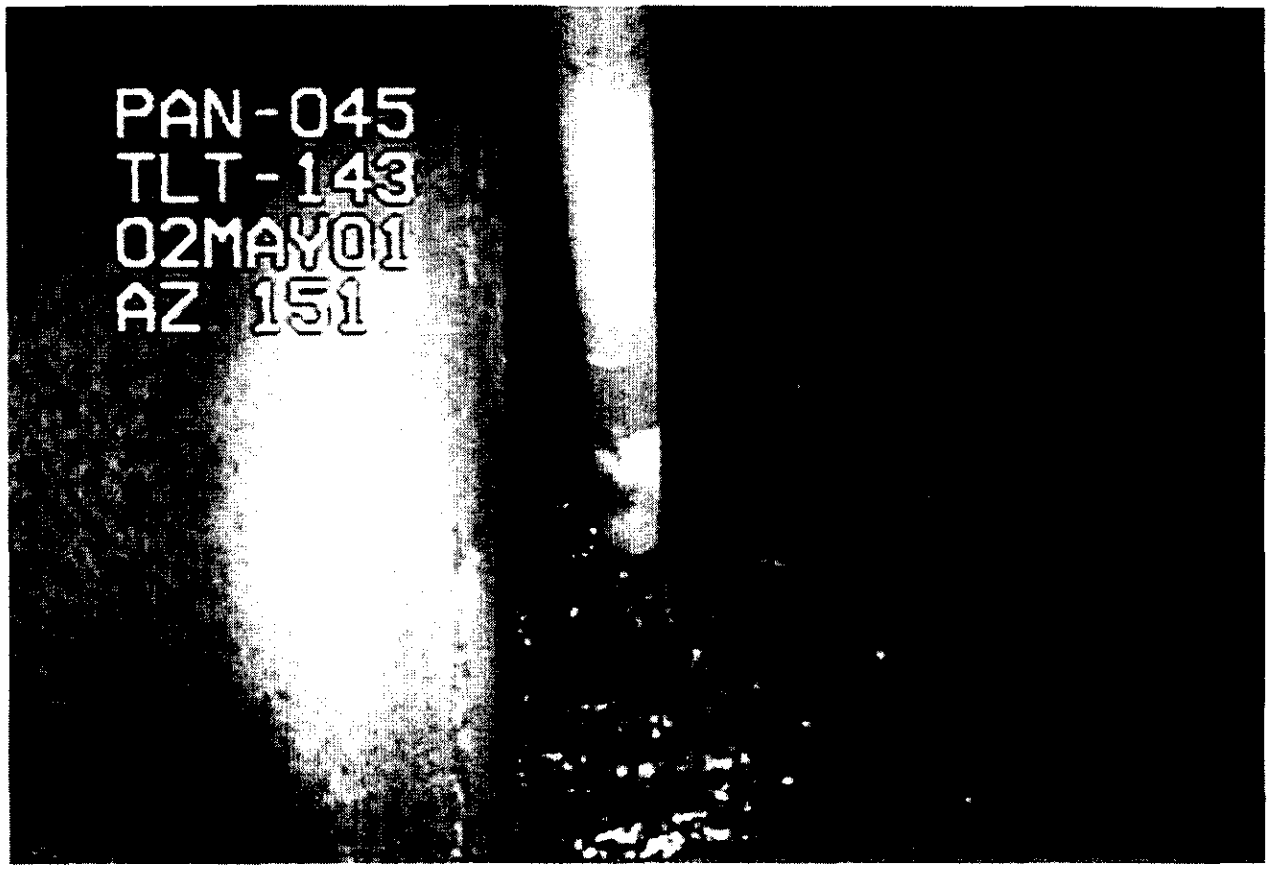


Figure G-13.
View of Diptube Bubbling Pipe (center) and Pump Shaft Pipe (right). 241-AZ-151 Catch Tank (About 3-min. tape time).

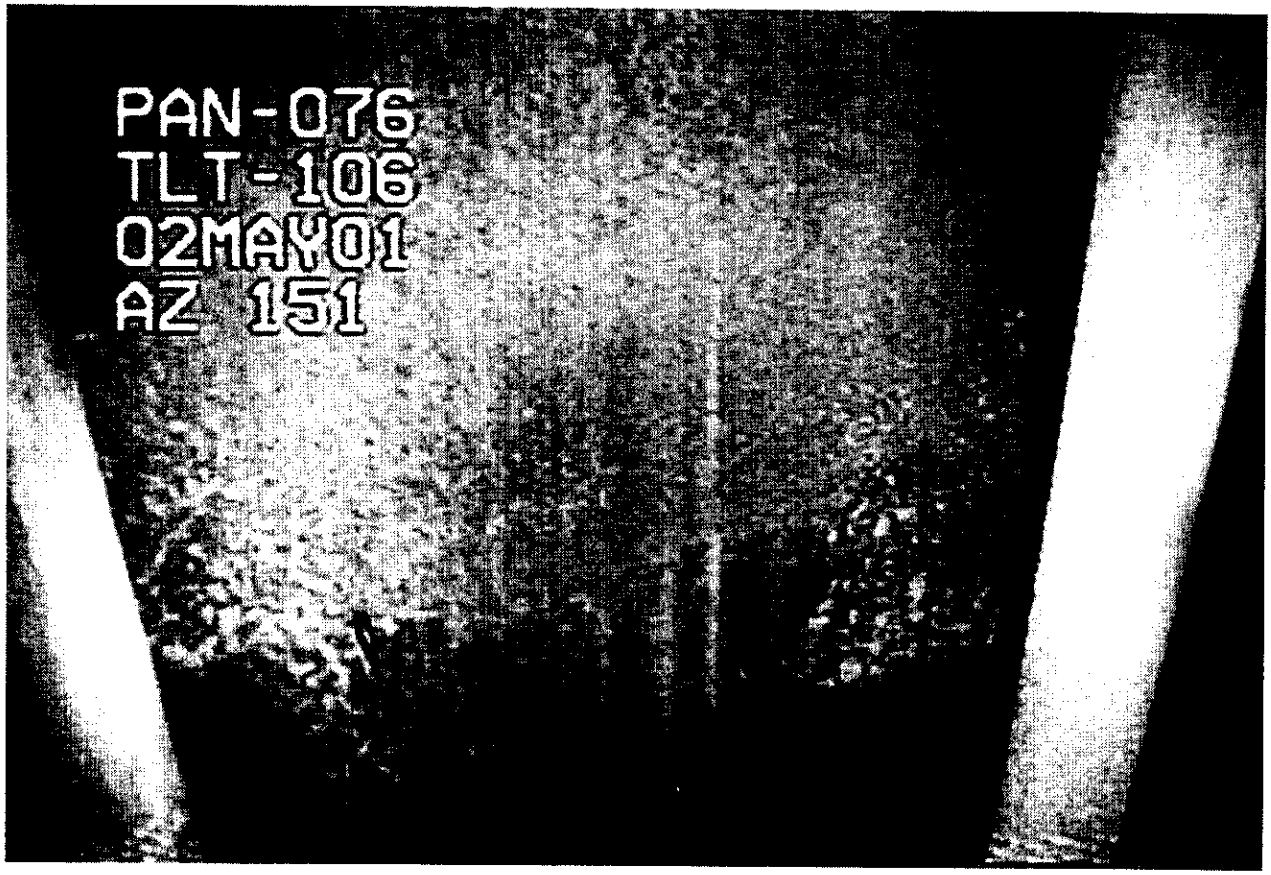


Figure G14.
View of West Sidewall Above Waterline (Diptube Bubbler at left and Pump Shaft Pipe at right) Including Mark in Sidewall. 241-AZ-151 Catch Tank (About 4-min. tape time).

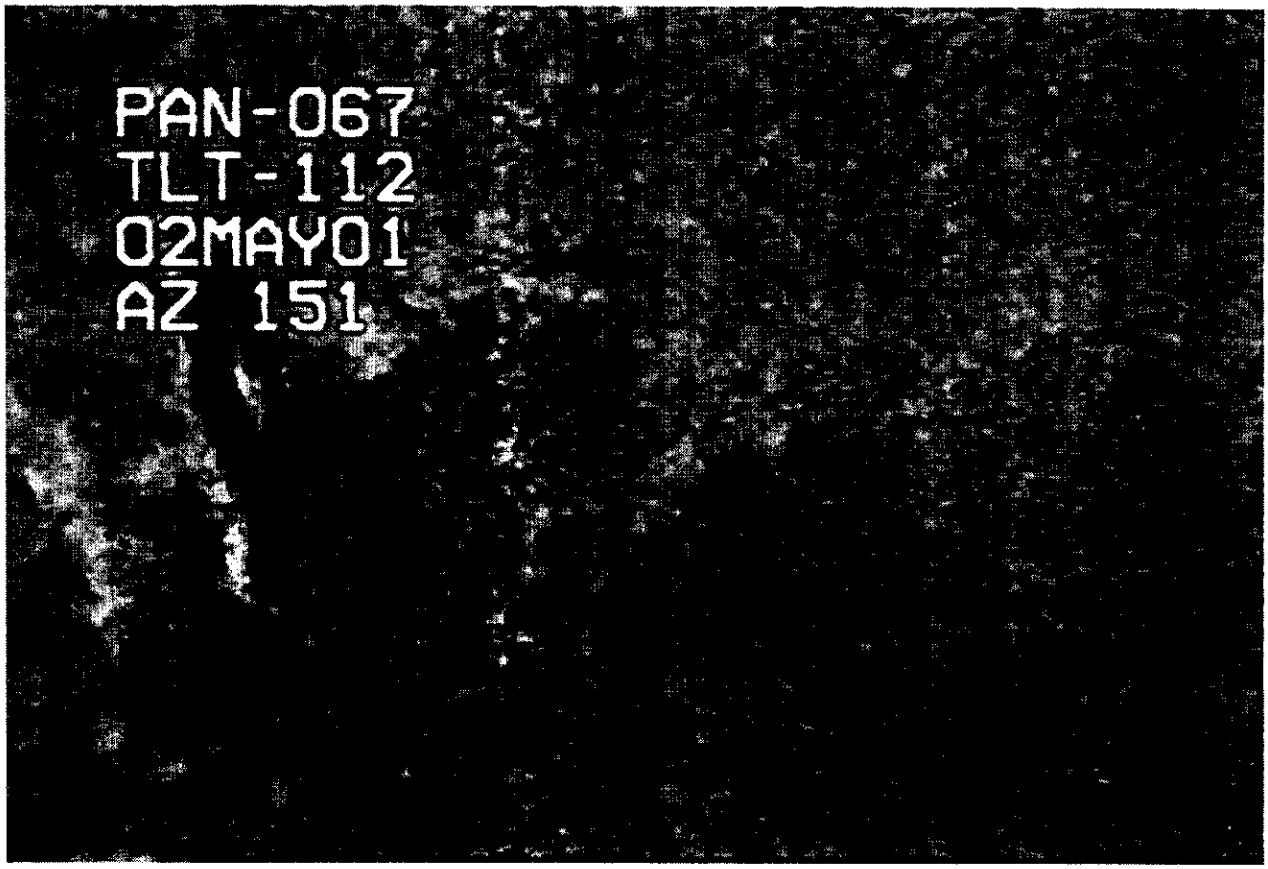


Figure G15.
Closeup View of Mark on West Sidewall of Catch Tank 241- AZ-151 (Tape time about 4-1/2 min.).

Figure G-15SP.
Stereo Pair View of West Sidewall Mark of 241-AZ-151 Catch Tank.

Figure G16.
View of West Sidewall of Catch Tank 241-AZ-151 at Intersection of Pump Pit Vertical Wall and Underside of Concrete Slab (right).

Figure G17.
View of Dark mark on West Sidewall Directly Below Intersection of Pump Pit Wall Extension and Horizontal Concrete Slab Over Catch Tank 241-AZ-151.

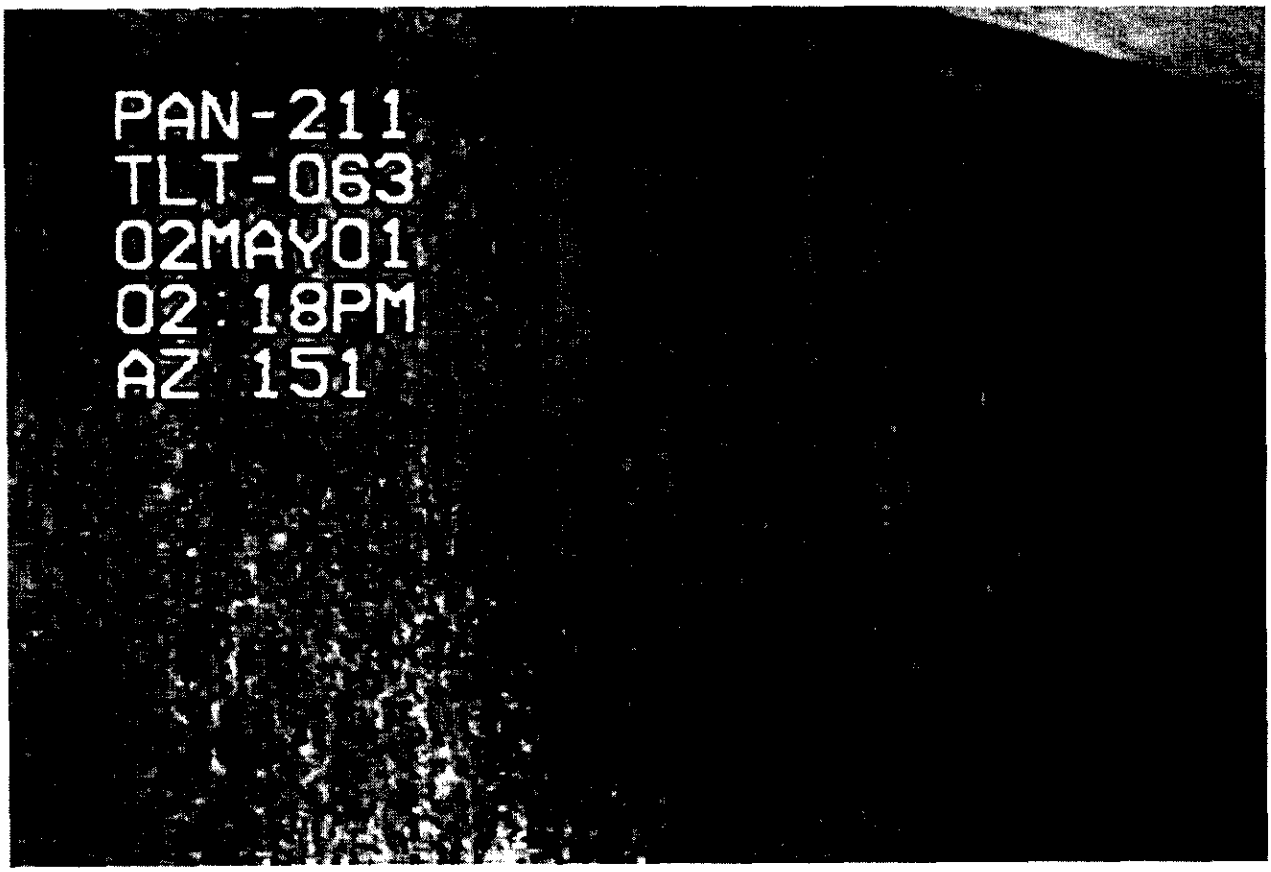


Figure G18.
View of Dark Rust Mark on 241-AZ-151 Catch Tank on West Wall. Catch Tank 241-AZ-151.

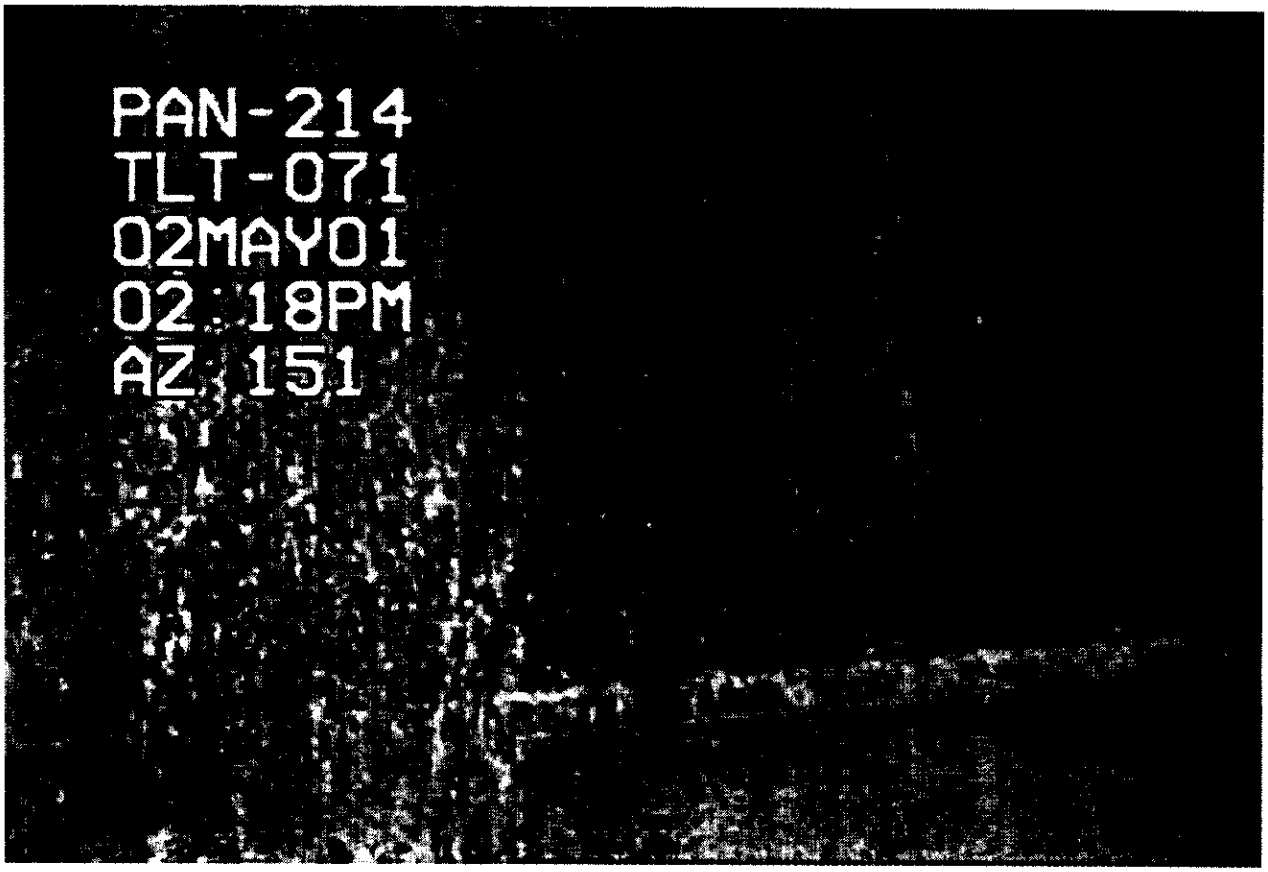


Figure G18SP.
Stereo Pair with Figure G18.

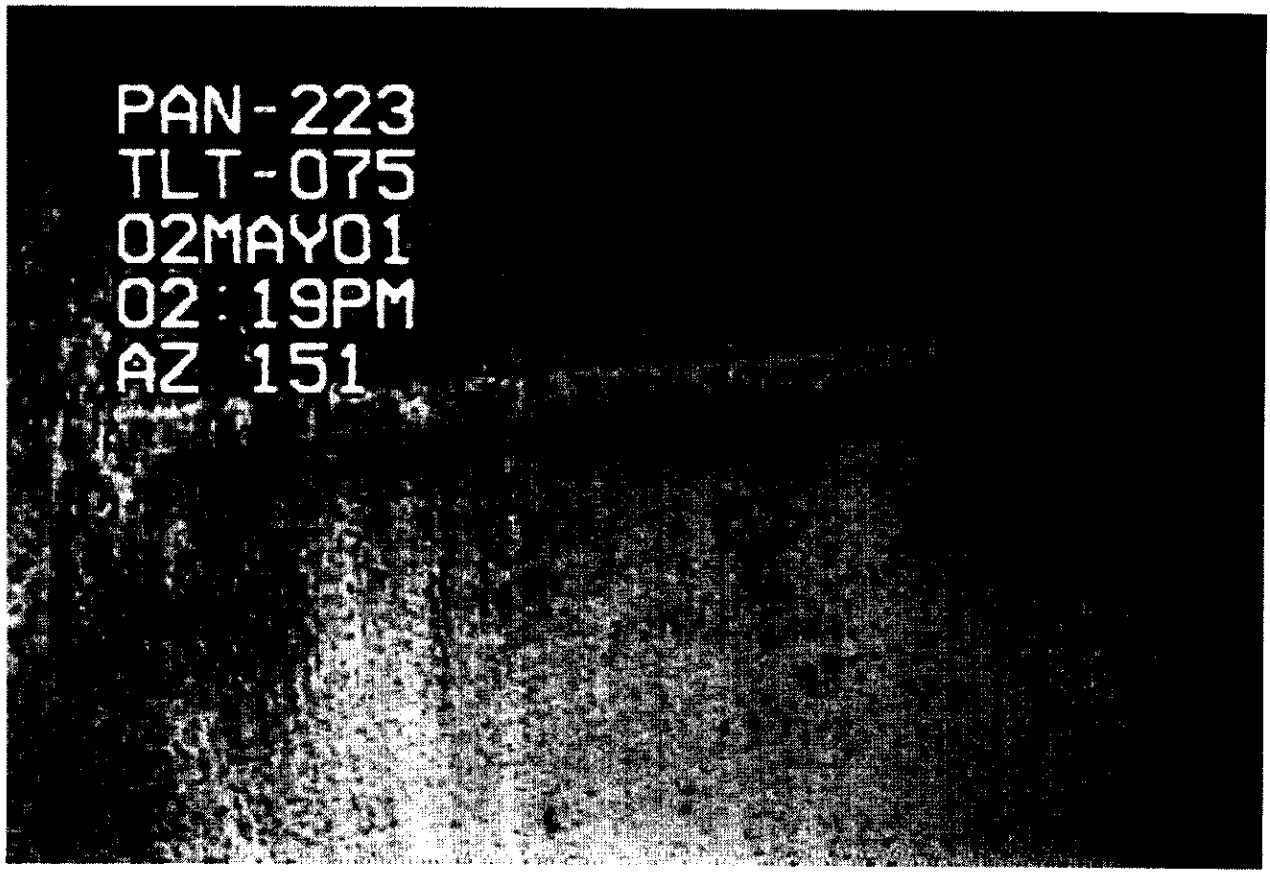


Figure G19.
View of Possible Waterline Corrosion Marks and/or Horizontal Weldment. 241-AZ-151 Catch Tank

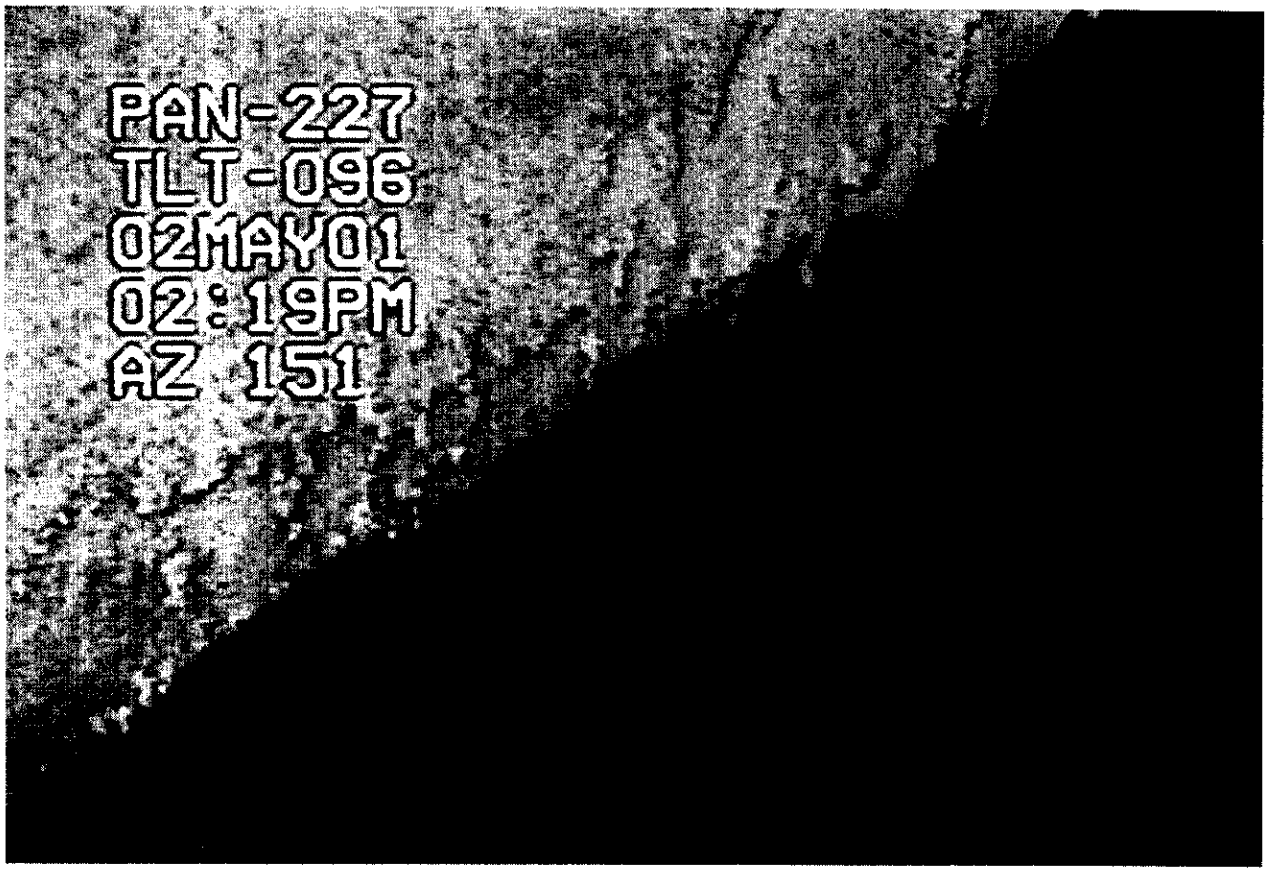


Figure G20.
View of Possible Patches of Uniform Corrosion Above Waterline, 241-AZ-151 Catch Tank.

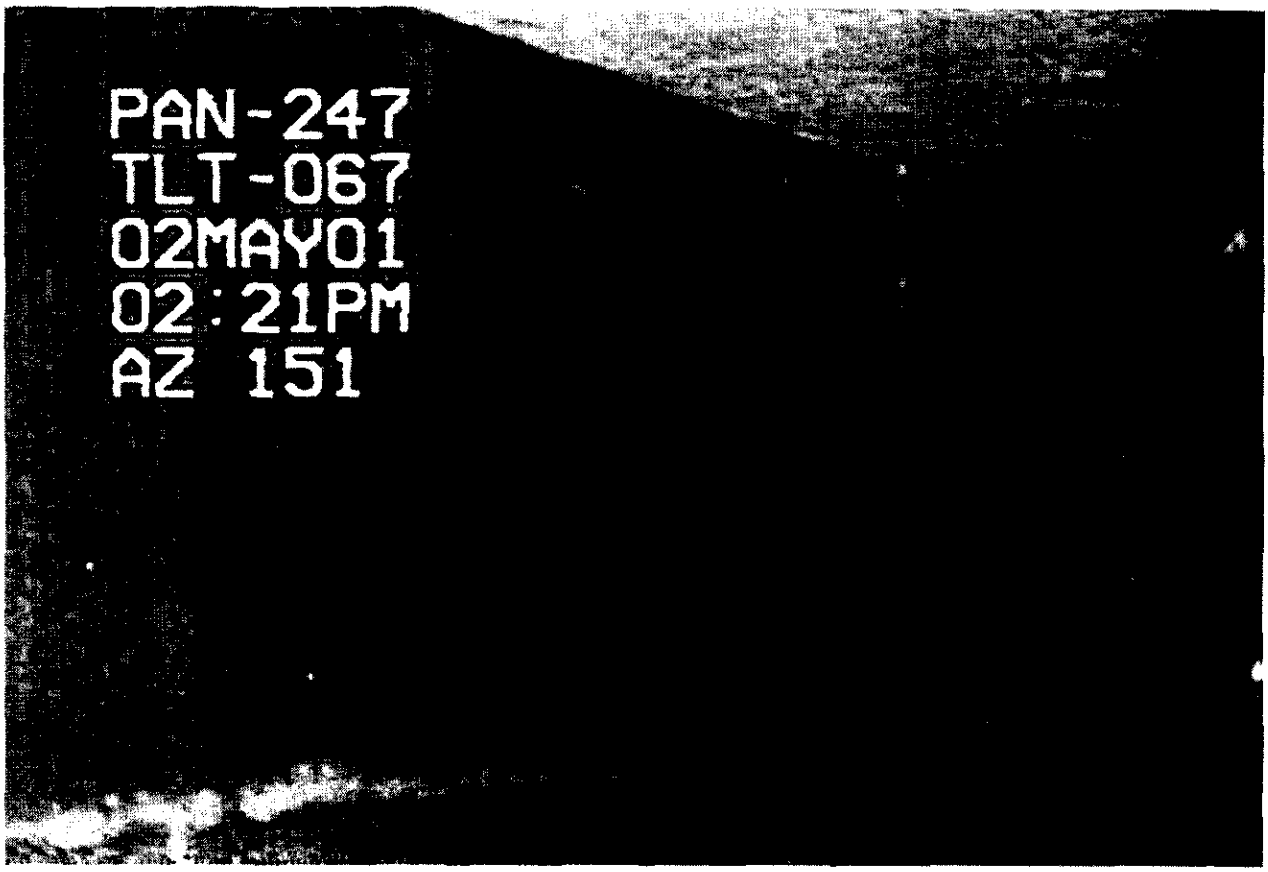


Figure G21.
View of Remote Corner of Tank Under Concrete Cover Showing Welded Corner Joint and Waterline Mark. 241-AZ-151 Catch Tank.

Figure G22.
View of Thin Rust Plates Beneath Piping Exit Through Upper Sidewall, Prior to Pressure Washing of Catch Tank 241-AZ-151.

Figure G23.
View of Thin Sheet of Rust Product on Face of Catch Tank 241-AZ-151, Prior to Pressure Washing.

Figure G23a.
View of G23 Area Post Pressure-Washing. Note That Washing Almost Completely Removed Thin Sheet of Rust. Catch Tank 241-AZ-151.

Figure G24.
Closeup View of Thin Rust Sheet in Catch Tank 241-AZ-151, Prior to Pressure Washing.

Figure G24a.
Closeup View of Figure G24 Area Showing Majority Removal of Thin Sheets of Rust by Pressure Washing. Catch Tank 241-AZ-151.

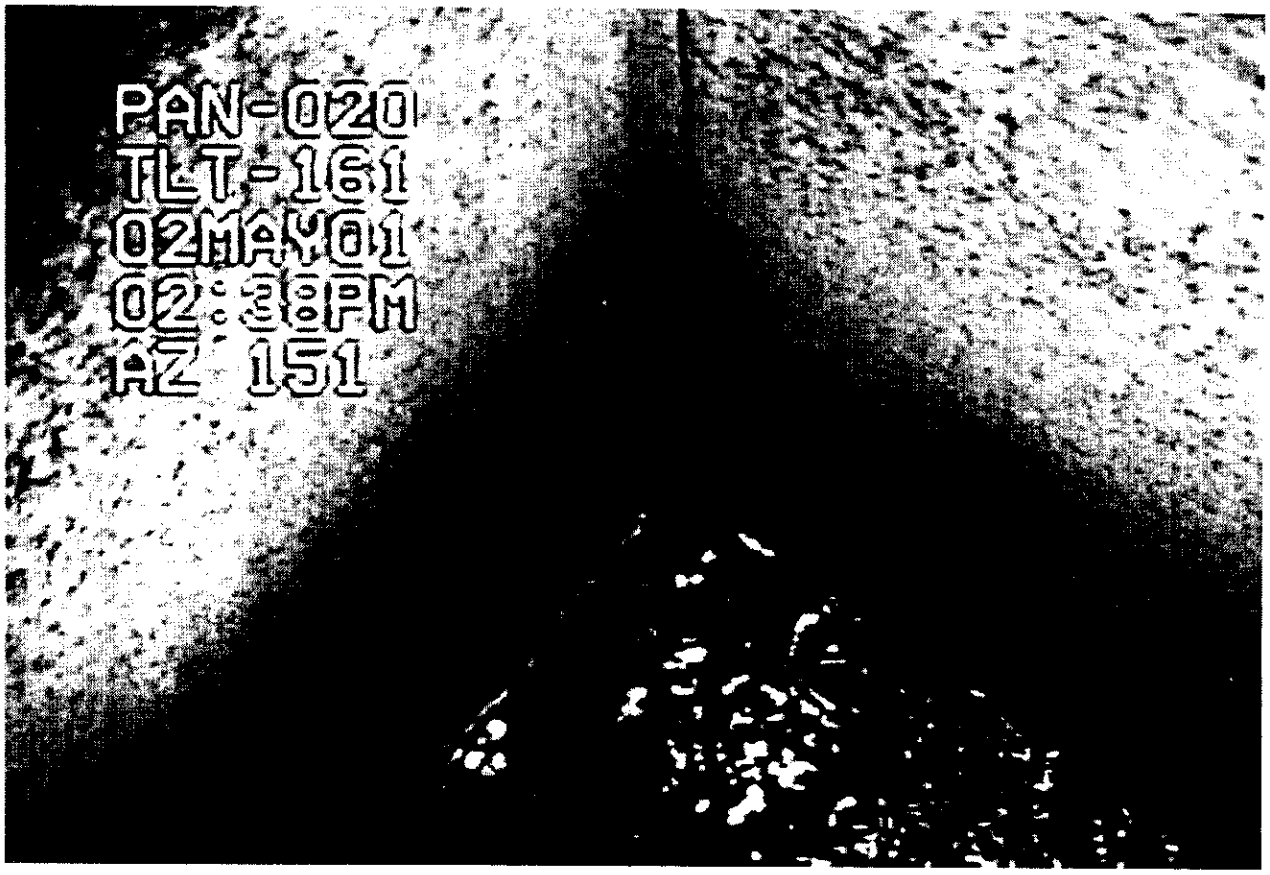


Figure G25.
View of SE Corner Weldment and Attendant Weldment Shadow Effect. 241-AZ-151 Catch Tank.

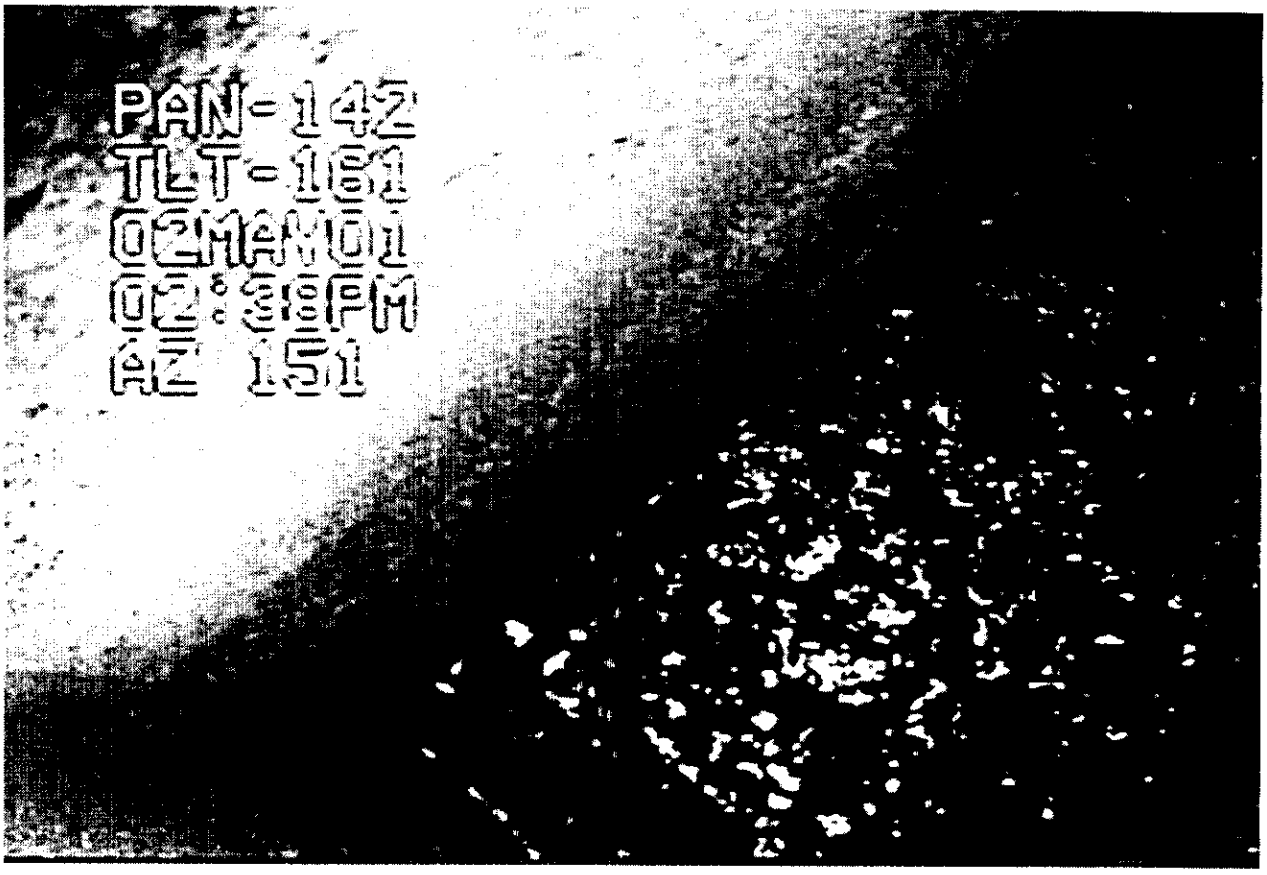


Figure G26.
View of Same Weldment (lower left) in Figure G25 With Significantly Reduced Weld Projection Shadow. Catch Tank 241-AZ-151.

Figure G27.
View of Southeast Corner of Catch Tank 241-AZ-151 After Pressure Washing Both Corner Face Strips. Remnant Fog in Photo due to Washing.

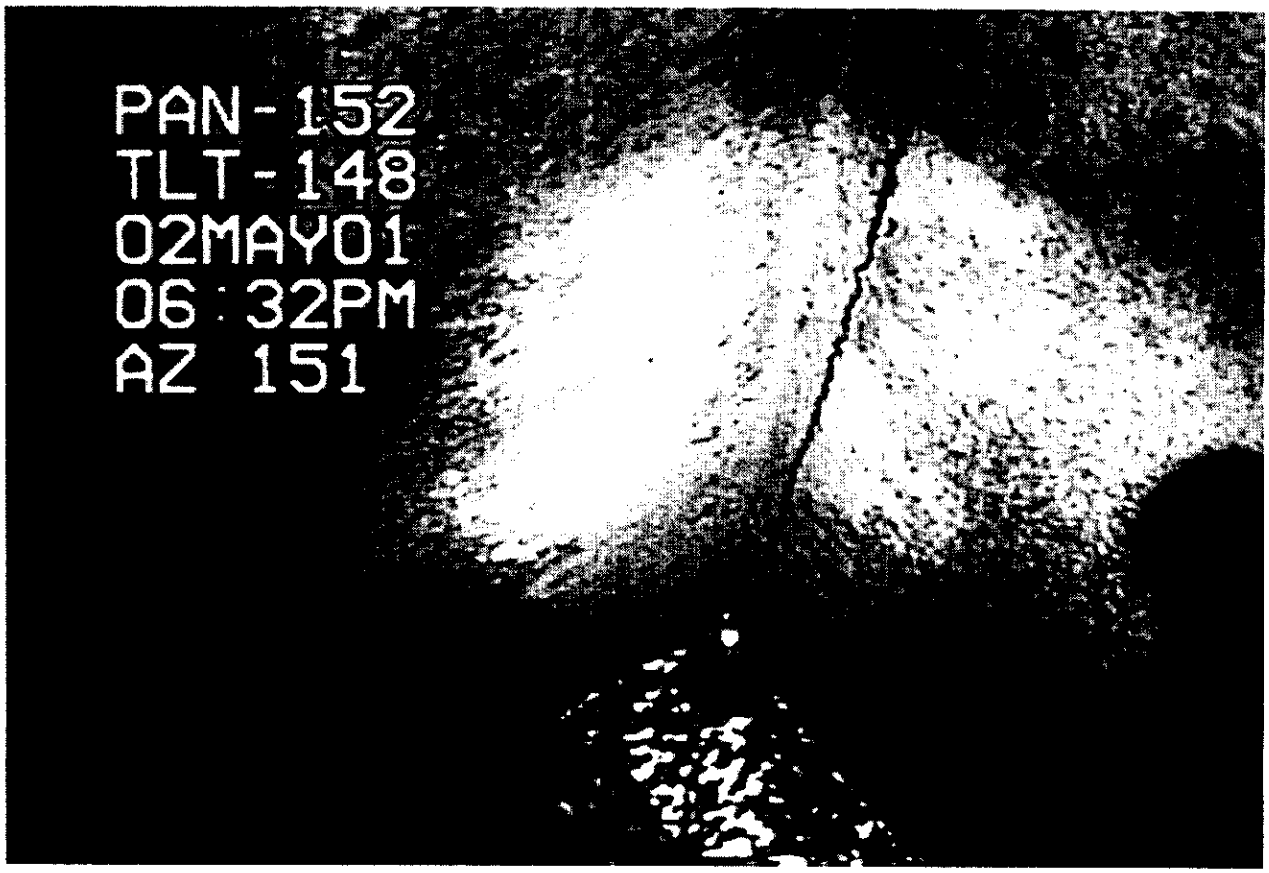


Figure G28.
Closer View of Dual Pressure-Washed Area Strips, SE Corner of Catch Tank 241-AZ-151.

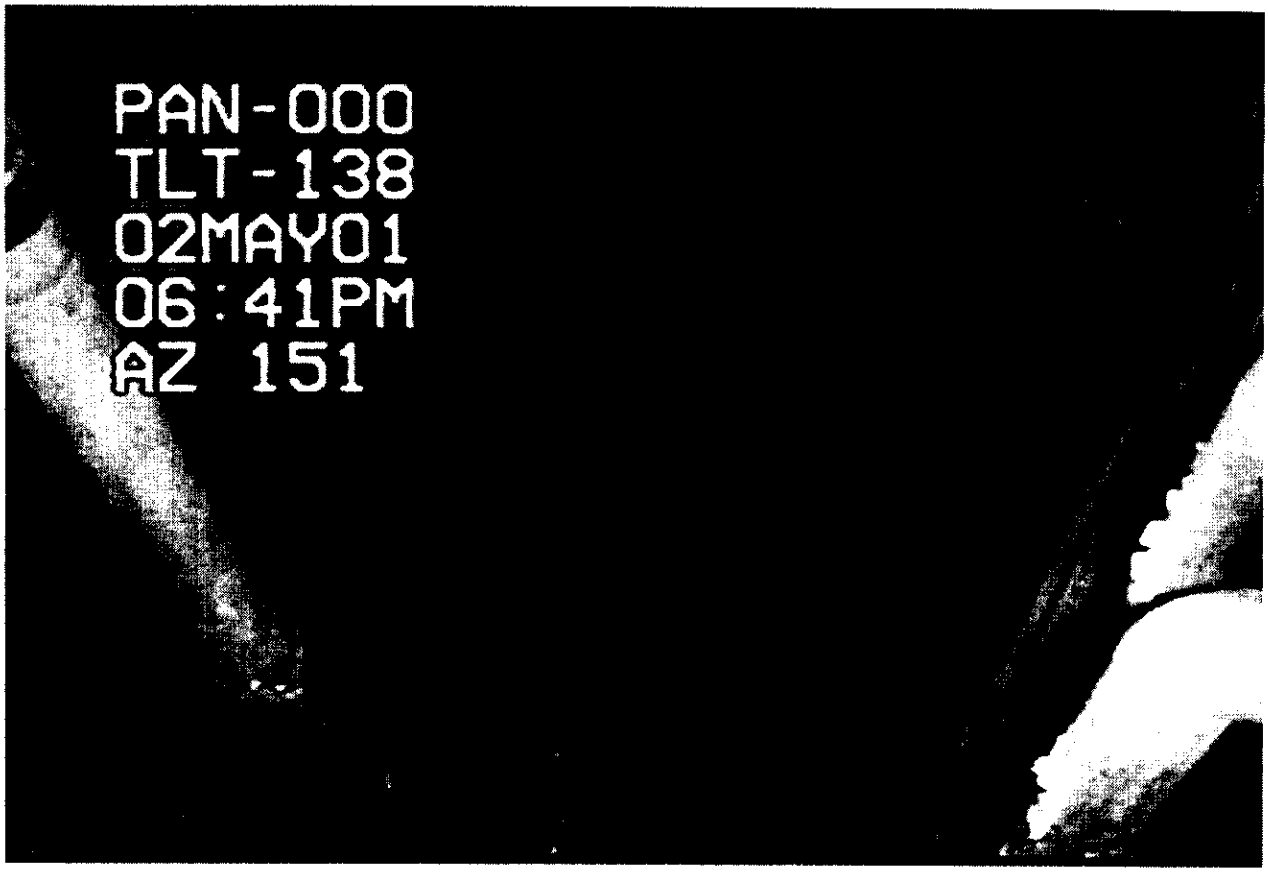


Figure G29.
View of Apparent Ladder Lying on Bottom of Catch Tank 241-AZ-151.

Figure G30.
Spray Washing Device Being Lowered Through 4-in. Drain into Catch Tank 241-AZ-151.

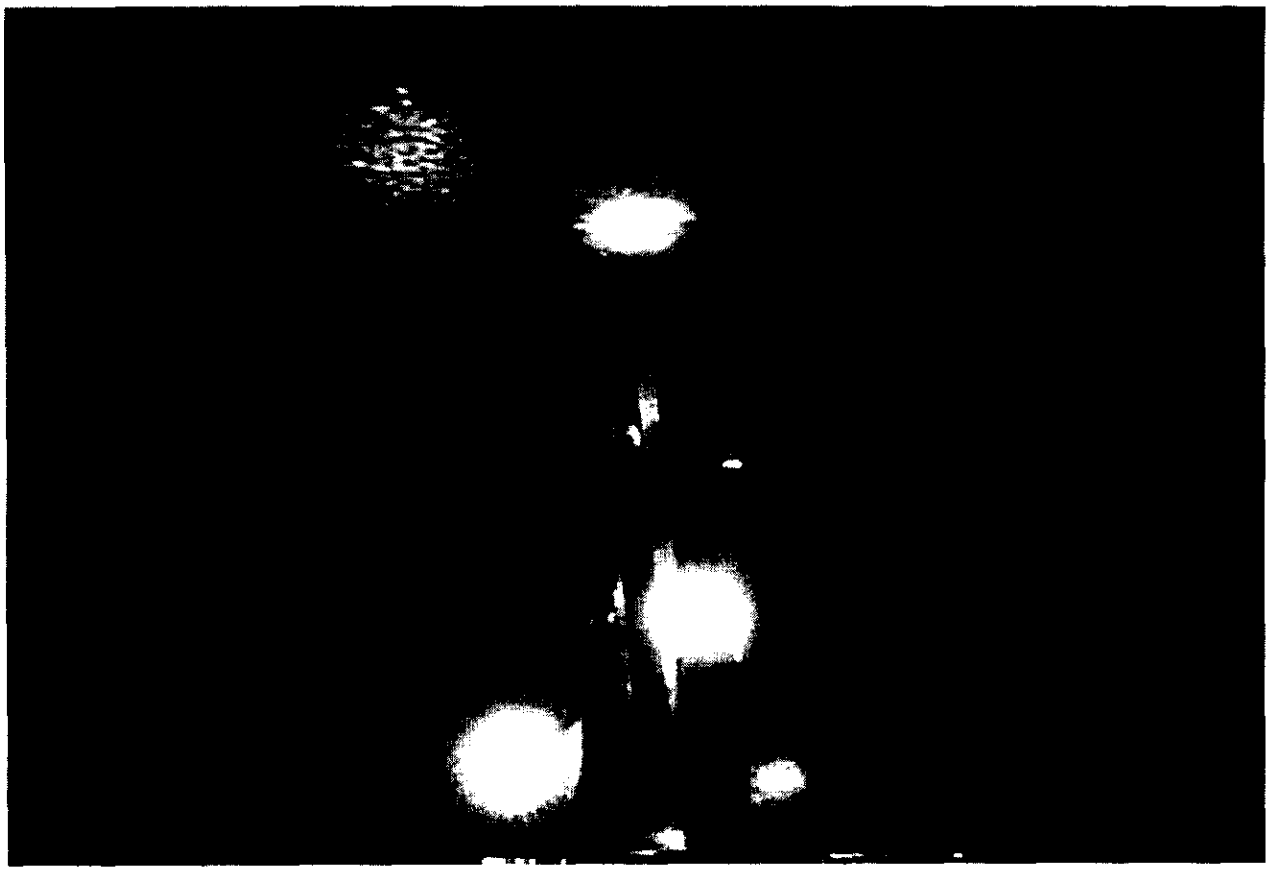


Figure G31.
Ultrasonic Test Arm and Transducer Placed Against East Wall of Catch Tank 241-AZ-151

TABLE G3 AZ-151 CATCH TANK LEAK TEST

241-AZ-151 CATCH TANK 24 – HOUR LEAK CHECK			
DATA SHEET – TANK LEVEL MEASUREMENT (Level Gauge)			
Data Recorded (2 hour intervals)[1]	Date/Time	Level Reading (Inches)[2]	Data Recorded by: Print Name/Initial
0	7/15/00 / 1700	114.00	L.E. Newquist / LN
2	7/15/00 / 1900	114.0	L.E. Newquist / LN
4	7/15/00 / 2100	114.0	L.E. Newquist / LN
6	7/15/00 / 2300	114.0	L.E. Newquist / LN
8	7/16/00 / 01:00	114.0	E.R. Hudspeth / [illegible]
10	7/16/00 / 03:00	114.0	E.R. Hudspeth / [illegible]
12	7/16/00 / 05:00	114.0	E.R. Hudspeth / [illegible]
14	7/16/00 / 07:00	114.0	E.R. Hudspeth / [illegible]
16	7/16/00 / 0900	114.0	L.E. Newquist / LN
18	7/16/00 / 1100	114.0	L.E. Newquist / LN
20	7/16/00 / 1300	114.0	L.E. Newquist / LN
22	7/16/00 / 1500	114.0	L.E. Newquist / LN
24	7/16/00 / 1700	114.0	G.L. Jackson / [illegible]

[1] Start readings when tank is filled and the liquid level instrument is returned to service and every two hours thereafter until test is complete.

[2] Record Liquid level to the nearest tenth of an inch (0.10).

ATTACHMENT 1

DEMONSTRATION TEST OF THE TANK AZ-151 UT THICKNESS MEASUREMENT TOOL

BACKGROUND

THE UT TOOL

A second tool was developed for delivery and manipulation of the Ultrasonic Test (UT) transducer to the inside wall of tank AZ-151. The new tool provides a much greater variation in reach along with a transducer support block face that is always vertical.

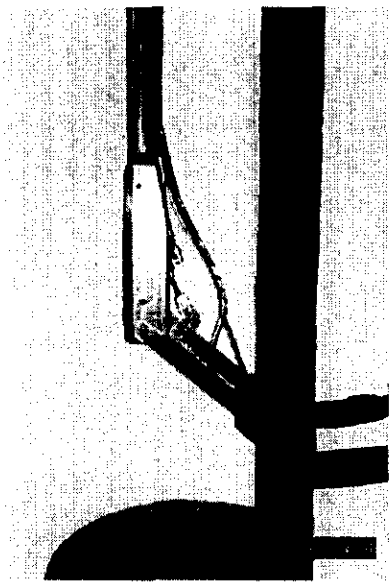


Photo 1

Photo 2

Photo 3

Photo 4

The UT tool consists of a 30 foot long pole, with lifting bail, and an air actuated mechanism to extend the UT transducer block up to 12 inches to the tank wall. The UT transducer block is fitted with two high strength permanent magnets to hold the block to the carbon steel wall. It is also fitted with an 1/8th inch tube which supplies couplant to the transducer in the center of the block.

DEMONSTRATION TEST

On April 12th, a demonstration test of the AZ-101 UT Thickness Measurement Tool was conducted at the 306E facility. Present for the demonstration test were: Dave Becker, Tom Delucchi, Wes Nelson, Bill Purdy, and Daron Tate.

The UT pole with the parallel extension arms was hung from a bridge crane, in preparation for the demonstration test, and lowered through a 3 ½in. pipe, simulating the tank access

penetration. A carbon steel sheet was mounted appropriately to simulate the tank wall, and a test plate was clamped to it for a UT measurement repeatability demonstration.

The electronic equipment used for the demonstration test was: 1) a Sigma 10 MHz single element transducer, 2) a Force Institute PSP-4 (Projection Scan Processor) digital system, and 3) a calibrated step-wedge (S/N 584-99-30-147) with thickness step increments of 0.050, 0.095, 0.150, & 0.201 inch.

The UT transducer extension mechanism was cycled several times to verify predictable operation, and parallel alignment of the transducer block face and the vertical simulated tank wall. The PSP-4 UT measurement tool using a Sigma 10 MHz single element transducer was then calibrated (pre-cal: see table 1).

TABLE 1. COMPARISON OF UT THICKNESS MEASUREMENTS WITH CALIBRATED STEP WEDGE

UT Measurement	Calibration Step Wedge # 584-99-30-147 -- Thickness (in.)			
	.201	**.150**	**.095**	**.050**
1	.201	.151	.095	.049
2	.201	.151	.095	.049
3	.201	.151	.096	.049
Avg.	.201	.151	.095	.049
Max. Var'n	0	.001	.001	.001

After turning on the water (transducer coupling agent), 3 sets of measurements were taken of each of the four stepped thickness regions of the test plate (see table 2). The UT transducer extension mechanism was repositioned for each reading. A post-calibration was conducted (see table 3).

Table 2. Test Plate UT Thickness Measurements Repeatability Check

UT Measurement	Remote Transducer Readings Using Parallel Extension UT Tool Thickness (in.)				
	.100	**.137**	**.075**	**.137**	**.050**
1	.099	.134	.074	.135	.051
2	.099	.134	.076	.134	.048
3	.099	.139	.077	.140	.049
Avg.	.099	.136	.076	.136	.049
Max. Var'n	.001	.003	.002	.003	.002

TABLE 3. COMPARISON OF UT THICKNESS MEASUREMENTS WITH CALIBRATED STEP WEDGE

UT Measurement	Calibration Step Wedge # 584-99-30-147 -- Thickness (in.)			
	.201	**.150**	**.095**	**.050**
1	.207	.156	.097	.050
2	.201	.152	.097	.049
3	.202	.152	.096	.049
Avg.	.203	.153	.097	.049
Max. Var'n	.006	.006	.001	.001

COMPARISON OF UT MEASUREMENT VARIABILITY LEVELS FOR THREEFOLD CALIBRATION

For the three calibrations presented above, the measurement variability is very satisfactory.

- For the step wedge bench pre-calibration, the UT measured thicknesses are within a maximum difference of .001 inch. This corresponds to an excellent variability of better than 1%.

- For the remote UT pole thickness measurements repeatability check, the maximum variability was 0.001, 0.003, 0.002, 0.003, 0.002 inch. This corresponds to a very good variability of 4% on the thinnest section (0.050 in.), 3% (at 0.075 in.), 1% (at 0.100 in.), and 2% (at 0.137 in.).

- For the step wedge bench post-calibration, the UT measured thicknesses are within a maximum difference of .006 inch. This corresponds to a maximum variability of 4%.

CAMERA ADDED

After completion of the demonstration test, a video camera module was fabricated and installed just above the parallel transducer extension tool (see photo 3 & 4). This element was tested on Thursday April 12th with Tom Delucchi, Daron Tate, and Frank Bolson present. It provides a very good view of the UT block and its contact with the wall.

SUMMARY

The results of the demonstration test of the 30 foot long remote UT tool with remotely variable extension and a video camera was very satisfactory. All calibrations show better than a ±5% precision for a metal catch tank wall thickness of as little as 1/16th inch.

ATTACHMENT 2

241-AZ-151 CATCH TANK UT PRESSURE WASHER DEMONSTRATION AT 306 E BUILDING

Demonstration attendees: Tom Delucchi, Steve Chapman, Bill Gibson, Tom Delucchi, & Daron Tate

A demonstration/test of the catch tank pressure washer tool was conducted at 306E on 4/9/01. The purpose of the test was to verify the capability, effectiveness, and safety of the in-tank pressure wash surface cleaning tool. All aspects of the test completed as anticipated.

The pressure washer tool consists of a 2 1/2-in. schedule 80 pipe 34 feet long (one piece), with the water jet recessed into the bottom. A 15-in. lifting bail at the top end provides for crane manipulation. The nozzle selected is a 15° spray width nozzle directed down at an angle of 60° from horizontal. Nozzle recoil is between 10 and 12 pounds, but the schedule 80 pipe limits deflection to imperceptible.

A 3000 psi Graco pressure washer with a Honda gasoline motor provides a 4 gallon per minute flow using a 150 feet of hose, to supply the pressure washer tool. Some measurements were made prior to the demonstration.

0 degree nozzle: Cleared a 1in.wide path at 9-in.-12-in.
Cut through .005-in. thick brass sheet rapidly at 1-in.
No perceptible damage at 6-in.
Removes light rust at 1-in.-2-in.
Removes dirt at 3-in.-12-in.
15° nozzle cleared a 3-in.-4-in. path @ 9-in.-12-in.
25° nozzle: Cleared a 4-in.-6-in. path @ 9-in.-12-in.
Cut .005 bras sheet at contact".
No damage at 2-in.-12-in.
Removes light rust at 1-in.
Removes dirt at 3-in.-12-in.
The wider-angle nozzles gave a softer spray pattern.

Thin metal failure test:

A test was performed to determine if the high-pressure (3000 lbs) water wash system was capable of tearing through thin (.002-in.-.005-in.) sheet metal. This test would establish a minimum tank wall thickness that the system could not damage. The test was performed using .002-in. and .005-in. brass shim stock. The use of brass adds a level of conservatism to the test, as its mechanical properties are lower than those of carbon steel. Two water jet nozzles were used for the test. The most aggressive is the 0° and the softer being 15°. The test pieces were anchored to a backing plate simulating the concrete tank wall.

Test 1) The 0° nozzle was placed on a 45° angle then pressure was added. At approximately twelve inches the water penetrated the .002-in. shim within seconds. The tearing became worse as the nozzle moved closer to the sample.

Test 2) Test 1 was repeated using .005-in. shim. The water jet quickly penetrated the sample, however, at a distance greater than 2-in. tearing would not occur.

Test 3) Test 1 was repeated with a 15° nozzle. Cutting of the .005-in. shim occurred at 1-in.. Cutting of the .005-in. sample only occurred at contact with the nozzle (0-in.).

Conclusion: We are assured that with as little as .005-in. solid wall material at the 9-in. reference spray distance, no damage to the wall will occur from water wash cleaning using the 15° nozzle.

ATTACHMENT 3

241-AZ-151 NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

COGEMA ENGINEERING CORP.

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

NONDESTRUCTIVE EXAMINATION
306E BLDG., 300 AREA - TEL. 376-5402

Job No. 01-41

Requester (client)	Company	MSIN	Bldg.	Area
DAVID BAKER	CHG	R1-04	2750 E	200E

Project/System/Work Package/Traveler No.: 151-AZ CATCH TANK

Acceptance Std. | Section | Para. | Date | NA

PART INFORMATION
Material: C/S
Wall Thickness: 1/8" | NA
Diameter | NA
Schedule | NA
Size | NA

Dwg. No. | NA | NCR | NA

PROCEDURE NO.
SVUT-PRC-007 Rev. 1
Appendix B Revision No. 1
Special Technique No. | NA

COVERAGE
☒ 100% of Area Requested
○ Other

INSTRUMENTATION
Mfg. FORCE Model PSR-4
S/N or Standards Lab No. S/N 209

CALIBRATION STANDARD(S)
Identification No. 584-99-30-147
Identification No.

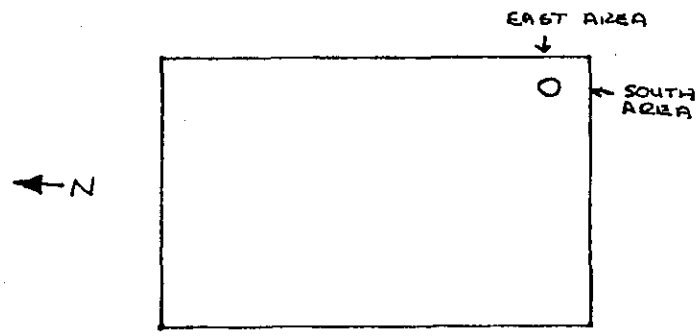
TRANSDUCER
Diameter 1/2"
Frequency 10 MHZ
Mfg. SEGMA
Serial No. 1115-01003
Stand Off 1/4"

Couplant WATER
Batch No. N/A

RESULTS

PRE CAL. .0497 .0956" .151" .199"
POST. CAL. .0497 .0956" .151" .199"

NO DATA COLLECTED DUE TO ROUGH ENTRY SURFACE.



Technician	UT Level	Interpreted by	UT Level	Reviewed by
Wesley D. Neb	III	Wesley D. Neb	III	John T. Fox
Date of examination: 5/2/01		Date of examination: 5/3/01		Date: 5-21-01

A-6000-507 (02/99)

APPENDIX H

244-A DOUBLE-CONTAINED RECEIVER TANK

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INITIALIZATIONS AND ABBREVIATIONS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CVI	Certified Vendor Information (file)
DCRT	double-contained receiver tank
DST	double-shell tank
ENRAF	Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge
HDCS	Hanford Data Control System
HEPA	high-efficiency particulate air filter
HLAN	Hanford Local Area Network
LFL	lower flammability limit
PCSACS	Personal Computer Surveillance Analysis Computer System
RHA	Records Holding Area
RMIS	Records Management Information System
SCC	stress-corrosion cracking
SSE	safe shutdown earthquake
SST	single-shell tank
TRU	transuranic
VITIS II	Video In-Tank Inspection System

1.0 INTRODUCTION

The 244-A Double-Contained Receiver Tank (DCRT) facility, located in the 200 East Area of the Hanford Site (Figure H1), was designed for transferring dangerous waste between the 241-BX and 241-A tank farms, and other dangerous-waste remediation facilities. Waste is transferred through this facility via appropriate jumpers but not into the receiver tank. The tank is not known to have stored a true concentrated waste from any facility and acts as a low collection point for line drainage during jumper change, normally after the transfer lines are flushed.

The liquid contained in the stainless steel primary receiver tank is a diluted flush waste that is further mixed with intruded rainwater. The rainwater and snowmelt enter through removable pump pit cover blocks and passes through the pit floor drain into the tank.

2.0 PURPOSE

The purpose of this design evaluation and examinations is to determine if the 244-A DCRT facility components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the 244-A DCRT pump pit, tank vault, and the receiver tank. The scope of the examinations includes a visual examination of the 244-A DCRT receiver tank internal surface, pump pit, vault, and a leak test of the receiver tank. The filter pit is excluded as it does not house any dangerous waste, equipment, or piping used to handle the waste.

4.0 DESCRIPTION

The 244-A DCRT facility is an underground reinforced concrete structure. Its three main compartments, the vault section, the pump pit, and the filter pit, each house different facility components. These three compartments are shown on Hanford Drawing H-2-38203 (Vitro 1974a) and are described below. The surface-level pump pit resides above the buried receiver tank containment vault; the filter pit is contiguous with, and at the same level as, the pump pit (Figure H2).

4.1 RECEIVER TANK CONTAINMENT VAULT

The vault section is a cylindrical structure, approximately 17-ft in diameter by 22-ft deep inside dimensions, with a 12-in.-thick wall lined with welded ¼-in.-thick carbon steel plate. The vault section was constructed with progressive excavation and lowering of 19-ft-diameter caisson sections built from three gage galvanized steel liner plates (Armco Drainage and Metal Products Company). The outside of the caisson liner sections were pressure-grouted to stabilize the soil around them. Its 18-in.-thick floor foundation slab slopes towards a sump to collect liquids and houses the leak detection devices and the sump pump. The vault contains the stainless steel primary receiver vertical tank.

4.2 RECEIVER TANK

The stainless steel receiver tank is a vertical 14-ft.-diameter-cylindrical shell tank with hemispherical ends and the shell has a nominal height of 14 ft. It is constructed of 5/16-in.-thick type 347, stainless steel plate. The tank is installed with its axis vertical and has an overall height of 21 ft 1 in., measured from the bottom of its skirt to the top of its riser flange, (Hanford Drawing H-2-40705). Apparently, around 1974 a modification was made to the top riser adding another 3 ft. to its height (Hanford Drawing. H-2-38229).

Initially, the tank was designated TK-387 for use in the 276-U Solvent Handling Facility (1950). It initially contained a bottom outlet and a bottom-residing tubing coil, of about three turns. It is not clear whether the coil was used for cooling (or heating) or in some connection with an agitator (see Hanford Drawing. H-2-38229), but the coil has been removed. The 276-U Facility was used for makeup and treatment of organic solutions used in the 221-U Building (U Plant operations). Further, it is not known if the tank was ever used in the 276-U facility. The Waste Identification Data System indicates that tanks at 276-U were cleaned out and isolated in 1957. As part of Project B-103, TK-387 was relocated and modified for service at 244-A around 1974 (refer to Hanford Drawing H-2-38229 for details regarding revised tank penetrations).

Nominal capacity of the tank is 17,800 gallons with a maximum operating capacity limited to 14,250 gallons (80 percent).

4.3 PUMP PIT

The pump pit section is a 15-ft. long by 13-ft. wide by 12-ft. 6-in. deep structure, with 12-in.-thick walls that are penetrated by transfer lines. It is directly over the vault and its 12-in.-thick floor slab is supported on steel beams and a 3/8-in.-thick plate. It has three 20-in.-thick removable and interlocking concrete cover block sections at ground level for access into the pit and the receiver tank. These cover blocks also serve as shielding against radiation exposure. The pump pit floor has a drain with a p-trap and other nozzles rising from the receiver tank below. It houses the pump, jumpers and other ancillary equipment and serves as secondary containment to the transfer lines, and directs any liquid to the receiver tank below through the floor drain.

4.4 FILTER PIT

Adjoining the pump pit is the third section, the filter pit. It is 11-ft. long by 11-ft. wide by 5-ft. 6-in. deep and is covered with a removable steel plate. It houses the high-efficiency particulate air (HEPA) filters for ventilation of the vault, receiver tank, pump pit and filter pit. It also has a floor drain with a p-trap, which directs condensate from the filters into the receiver tank in the vault. No design evaluations or examinations are planned for the filter pit.

5.0 DESIGN EVALUATION

The 244-A design standards, waste characteristics and compatibility for past and future transfers, and corrosion protection, and age of the system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of 244-A DCRT facility. A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information CVI Files
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software from the Hanford Local Area Network (HLAN)
- Hanford Data Control System data base (HDCS)
- all associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Engineering personnel.

The conceptual design document (ARH 1974a) and the functional design criteria (ARH 1974b) provided the design requirements and the project specification (Vitro 1975) provided the construction requirements for the 244-A DCRT facility, which was constructed in 1975. The receiver tank was fabricated, and procured earlier, around 1950, under project C-362.

5.1.1 Waste Receiver Tank Design Standards

The receiver tank was fabricated, inspected, and tested in accordance with the American Society of Mechanical Engineers (ASME) Code for Unfired Pressure Vessels, Class II (ASME 1949) and procured per Specification HW-4311 (GEH 1950a). It was designed for a pressure of 5 psi and tested at a hydrostatic pressure of 7.5 psi. Over-pressurization is avoided during service because the tank is vented to the atmosphere. Overfilling is avoided by liquid-level-indicating and -alarming instrumentation.

Hanford Drawing H-2-40705 (GEH 1950b) describes the configuration and fabrication requirements for the tank. The tank heads and shell are fabricated of welded 5/16-in.-nominal thickness, American Society for Testing and Materials (ASTM) A-167 Type 347 stainless steel material. The tank was modified and installed under project B-103 per specification B-103-C2 (Vitro 1975). It is assumed that a complete inspection of the tank was performed under Project B-103 prior to modification of the tank to verify compliance with the Project B-103 design criteria. The tank system was designed to withstand 0.25g horizontal and 0.17g vertical acceleration seismic loads. This is equivalent to a Safe Shutdown Earthquake (SSE) design requirements for Class I facilities at the Hanford Site (SDC 1974). The anchored supports (sixteen, 1-in.-diameter bolts) for the tank were designed to withstand the dynamic and static loading.

5.1.2 Vault, Pump Pit, and Filter Pit Design Standards

Vault: The Construction Specification B-103-02 (Vitro 1975), for Tank Farm Waste Transfer System, established requirements for the construction of the concrete vault per applicable national codes and standards. Hanford Drawing H-2-38203 (Vitro 1974a) reflects design requirements that include a capacity to withstand live loads, seismic loads and lateral soil pressures. Copies of the catch tank fabrication drawings for reinforcing bars (CBS 1975) and steel (Uhler 1975), and the original structural analysis and calculations (Vitro 1974b) for the facility, are currently stored in Hanford Project B-103 project files.

The inside of the cylindrical vault walls and the entire floor including the sump are lined with welded ¼-in.-thick carbon steel plate. The plate is supported and held in place by welded ½-in.-diameter by 5-in.-long anchors embedded in concrete. The vault floor slopes towards a sump, which is approximately 20 in. by 20 in. by 20 in. A liquid level alarm is located in the sump. The vault, which houses the receiver vessel, has more than adequate capacity to contain the maximum capacity of the receiver tank, should it leak. A sump pump (P-244-A-3) is provided through nozzle Q at the pump pit floor for transferring accumulated liquid in the sump to the receiver tank (Vitro 1974c).

Pump Pit and Filter Pit: The reinforced concrete pits are coated with protective paint, ™Amercoat No. 33 (as manufactured by Protective Coating Division of Ameron, Brea, California) to mitigate seepage through its walls and floor. Each pit contains a 3-in. floor drain to route any liquid from its floor to the waste receiver tank below. These carbon-steel butt-welded drain lines meet the Hanford Pipe Code M-24 (SDC 1974), and are equipped with p-traps to prevent communication of gas from the tank ullage to the pit environment. Specification B-103-C2 (Vitro 1975) establishes 20 psi pressure at 200 degrees F as the maximum allowable operating pressure and temperature for these 3-in. drain lines.

A structural assessment report (WHC 1996) of numerous facilities subjected to various accident-loading conditions was performed for the safety analysis report. This assessment determined that 244-A facilities could fail as follows; 1) vault could fail due to internal transient pressure caused by hydrogen deflagration, 2) pump pit walls could fail resulting from a seismic event, and 3) cover blocks could fail an impact load of 20,000 lbs.

Review of the Structural Assessment of Accident Loads (WHC 1996) indicates that the overly simple and crude analysis methods chosen for these load conditions are unrealistic and hence its conclusions are extremely conservative. A recent refined analysis was performed (Julyk 1999) to assess 244-A components for installation of new equipment. This analysis shows that the 244-A structure has sufficient strength to withstand seismic and drop loads. The hydrogen deflagration concern is mitigated by the design and administrative controls.

In summary, the 244-A DCRT system has been in service for approximately 25 years without any incident and based on the available documentation, it appears to have been adequately designed to withstand applicable design loads to comply with all design standards and codes requirements.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The terms double-contained receiver tank (DCRT), "lift station" and "catch station" have often been used synonymously at the Hanford Site (Sutherland 1991). This mix of terms, with respect to the 244-A Facility, is likely related to the number of functions served. Specifically, the 244-A DCRT-like others on site-- can act (but is not so used) as an in-line receiver tank during waste transfer operations between double-shell tank (DST) facilities. Further, it can function as a pumping or lift station, contributing hydraulic head ("lift" or line pressure) to facilitate liquid waste transfer. It can also act as a vent station to break suction after transfers and maintain atmospheric pressure in transfer lines and interconnected ancillary equipment during inactive periods. During waste transfer operations, the 244-A Facility functions as a pumping station and diversion box and is primarily used as a catch tank for collection and interim storage of liquid waste drainage from other DST ancillary equipment.

Typically, transfer lines are flushed after a waste transfer operation has been completed. Supply piping, providing steam and water for back flushing and decontamination of transfer lines to and from 244-A, is located in a nearby flush pit (refer to plot plan on Hanford Drawing H-2-38203). By design, the 244-A facility represents the low point in elevations of all interconnected piping.

™ Manufactured by Protective Coating Division of Ameron, Brea, California

Before any interconnected line is opened, the residual flush solution in the line is drained into the 244-A DCRT.

In addition, the 244-A DCRT collects drainage from the following sources:

- Pump pit and filter pit floor drains
- 241-ER-153 diversion box floor drain
- Drains from the flush pit and service pit associated with the 244-A DCRT.

A small percentage of the drainage is from liquid released into the pits during jumper changes, which is diluted and flushed to the DCRT via floor drains. However, most of the drainage originates from precipitation. The covers over the various pits are not completely waterproof. Small amounts of rainwater can enter through joints between cover blocks, at man-ways, and other penetrations.

5.2.1 Past Waste Transfers

Historically, the 244-A lift station has been used during waste transfers from various sources in 200 West Area, and from 241-B, -BX, -BY, and -C Tank Farms, and B Plant in the 200 East Area. Cross-site transfers were typically made once or twice a year. The west terminus of the old cross-site transfer line (V360) was at the 241-UX-154 diversion box. The east terminus was at the 241-ER-151 diversion box (located near the southwest corner of B Plant, see Hanford Drawing H-2-38200). Waste directed to 244-A went through an intermediate transfer point (241-ER-153 diversion box) which is adjacent to 244-A (see plot plan on Hanford Drawing H-2-38203). Waste involved in cross-site transfers could have originated from any facility in 200 West Area (i.e., REDOX, 222-S, T Plant, U Plant, Z Plant - see Figures 2-5, 4-2, and 4-98 in DOE-RL 1991 for routing details). A significant fraction of the waste volume involved in cross-site transfers originated from salt well pumping of single-shell tanks (SSTs) in West area 241 T, TX, TY, S, SX and U tank farms. This saltwell waste was collected in 241-SY-102 prior to cross-site transfer. Other sources of salt well waste routed through the 244-A Lift Station were from 241-B, -BX, and -BY Tank Farms and C Tank Farm.

Incoming process waste lines to 244-A from 241-ER-153 diversion box are SN-232 and SN-234. (Older Hanford Drawings identify SN-233 connecting to 244-A, rather than SN-234. SN-233 was replaced by SN-234, at the same nozzle - P4; date of modification is unknown.) Exiting process waste lines are SN 215 to 241-A-A Valve Pit, and SN-216 to 241-A-B Valve Pit. From these two valve pits, waste could be directed on to any DST in 200 East Area for interim storage or to the 242-A Evaporator. At the 242-A Evaporator, salt well waste was processed (i.e., concentrated) to reduce the storage volume required in DSTs. Salt well waste transfer lines and routings in use prior to construction of the new cross-site transfer line are as shown in Figures 4-76 and 4-77 of DOE-RL 1991.

Construction of new cross-site transfer lines (SNL-3150 and SLL-3160) was completed in 1998 under Project W-058. The new lines originate at the 241-SY-A and -B Valve Pits and terminate at new nozzle penetrations in the 244-A pump pit. To date, several transfers have been made through the new cross-site lines.

The 244-A DCRT receives and stores dilute solutions (e.g., flush solutions from transfer lines and pit drains) associated with waste transfers through the lift station and occasional jumper changes in either the 244-A pump pit or the 241-ER-153 diversion box. Some fraction of the liquid that accumulates in the catch tank between transfer operations originates as seepage from precipitation into the pump pit, filter pit, 241-ER-153 diversion box, and the flush pit and service pit associated with the 244-A lift station.

The waste solutions captured in the 244-A DCRT contain the same types of chemical and radiological constituents that are present in waste transfer solutions. However, they differ from waste transfer solutions to the extent that flush water and rainwater heavily dilute them.

Prior to any waste transfer, a waste compatibility assessment must be conducted. According to the cognizant engineer, this requirement has been in effect since 1995. This analysis meets WAC 173-303-090 (WAC 1998) requirements that the waste not be ignitable, reactive, or corrosive. More specifically, the compatibility assessment covers requirements based on: waste categories, waste codes, and process or safety concerns (criticality, tank bumps, flammable gas deflagrations, organic solvent fires, organic salt-nitrate reactions and moisture level after the transfer) that could be created during transfer and during subsequent comingling of the waste in the final receiver tank.

Waste compatibility compliance requirements are noted in five documents: Fowler (1995), Mulkey (1998), Cox (1997), Mulkey and Miller (1997), and HNF (1997). These include requirements for flammable gas (hydrogen, methane and ammonia), nuclear criticality, organic and energetic reaction, watch list tanks, corrosivity, chemical compatibility, tank waste type, transuranic (TRU) segregation, heat generation, complexant waste segregation, phosphate waste, radiological source control, toxic chemical source term controls, and the wastes' Reynolds numbers. Flammable gas is particularly important in that for any future saltwell transfer(s), the catch tank vapor space concentration must remain controlled. Specifically, the minimum time to reach 25-percent of the lower flammability limit (LFL) is required to be greater than or equal to seven days, assuming loss of primary tank ventilation.

Blaak (1999) conducted a waste compatibility assessment regarding the transfer of approximately 15,000 gallons of contaminated water and flush water, to be transferred from 244-A receiver tank to DST 241-AP-108. Concerns regarding the waste in 244-A and its subsequent mixture in the downstream tank showed that compatibility requirements, waste categories, waste codes and tank safety concerns were adequately addressed.

Based on the compatibility requirements for waste transfer, the 244-A DCRT design is adequate to handle the subject wastes.

5.2.2 Projected Waste Transfers

As noted earlier, construction of new cross-site transfer lines (SNL-3150 and SLL 3160) was completed in 1998 under project W-058. These lines connect into the 244-A pump pit. Providing no significant changes are made in the operation of 244-A DCRT, and that no significant changes are made in the characteristics of the waste that could leak or spill into it, the tank design will remain satisfactory.

5.3 CORROSION PROTECTION

Corrosion protection in a DCRT is provided by the combination of good design, appropriate material selection, and corrosion control. According to (Sutherland 1991), DCRT tank materials were physically and chemically certified, and ultrasonically inspected at the mill. During construction, the tank and welds were visually inspected and checked with liquid penetrant, magnetic particle (except for stainless steel), and radiographic examinations. A leak test was conducted prior to operation.

Effective corrosion control, for nitrate-nitrite-hydroxide based waste was introduced at the Hanford Site in 1984 (Kirch 1984). These controls were designed to minimize uniform corrosion, pitting corrosion, and stress-corrosion cracking (SCC) in waste tank carbon steels. The 244-A DCRT however, is unique among 200 Area DCRTs in that it is constructed of austenitic stainless steel material, ASTM A-167, Type 347. It is resistant to uniform corrosion both from typical Hanford caustic wastes (primarily nitrate, nitrite and hydroxide) as well as dilute, near-neutral solutions of water. However, because the latter solutions are the dominant waste in the 244-A DCRT, the tank material becomes susceptible to pitting corrosion and SCC. The latter corrosion mechanism is possible because residual stress levels in austenitic steel weldments remain at high levels and thermal stress relieving is generally not applied to welded stainless steel structures. Pitting and SCC can occur as a result of a low concentration of chloride ions, which is common to all Hanford wastes. Further, in non-welded austenitic stainless steels, the probability of chloride-SCC decreases significantly below 130 degrees F (Smets and Bogaerts 1992). However, in welded austeritic stainless steels, chloride-SCC continues to occur, even at room temperature (McIntyre 1990). While the probability of its occurrence is low, it cannot be eliminated as a mechanism for leakage.

Ordinarily, corrosivity of waste transfer solutions is minimized by the addition of sodium hydroxide and sodium nitrite to nitrate-caustic bearing wastes (typical of most wastes at the Hanford Site), at the source, before transfers are made. These controls (Kirch 1984) however, are not required for austenitic stainless steels, although they are not detrimental to such materials. In addition, the 244-A lift station is not configured for making chemical additions to solutions while they are retained in the 244-A DCRT. Finally, corrosion controls do not have to be applied to catch tanks as long as the projected final mixture in the receiver DST has been evaluated to ensure that it will remain corrosively compliant.

Corrosion protection is also applied to other portions of the 244-A facility. According to information summarized in DOE-RL 1991 from the Project B-103 construction specification, protective coatings were painted onto the exterior surface of the catch tank and exposed surfaces of the carbon steel vault liner at the time of construction. Process waste lines to and from the

244-A lift station are direct-buried, pipe-in-pipe lines. Cathodic protection, consisting of a grid loop of anodes, was provided to protect these lines from corrosion (refer to Hanford Drawing H-2-91043). The junction box for the local cathodic protection loop is located adjacent to 241-ER-153 Diversion Box. No specific measures were taken to provide corrosion protection for drain lines to the tank or the DCRT itself.

Notes in the Personal Computer Surveillance Computer System (PCSACS) indicate that liquid volumes may be retained in the 244-A DCRT for periods of a few weeks up to several months. During these periods, the liquid level in the tank may vary by only a few inches. The tank is pumped out as necessary to support ongoing operations (i.e., within a few weeks prior to waste transfers, or within a few weeks after jumper changes, pit flushes or line flushes). Levels around the tank wall where a static liquid-air interface has been maintained for a prolonged period could be sites for localized pitting corrosion and SCC. Furthermore, some residual liquid remains in the tank after it has been pumped down to the maximum extent. Because the bottom of the tank is hemispherical, the volume of residual liquid is small. The portion of the tank below the pump pickup is a region where pitting corrosion and SCC could be concentrated.

Because waterline effects promote pitting and SCC, it could be advantageous to maintain relatively large amounts of waste in the tank rather than small amounts. A future pitting/crack-type leak near the top of the tank could be temporarily managed by lowering the waste level to regions that are less pitted or cracked. This could allow time to design, build, and replace the old tank. A leak at, or near, the bottom of the old tank could prematurely shut down the facility.

Incubation times for pitting corrosion and SCC, in austenitic stainless steels, often do not exceed one year. Because the tank has been in service for about 25 years, there has been ample time to initiate either of the two wall penetrating corrosion conditions. Furthermore, a cursory visual examination of the tank interior made in 1996 indicated the presence of some relatively large corrosion pits. Visual examination of the annulus (dry side) did not reveal the presence of any through-wall leaks, indicating that corrosion pits or stress-corrosion cracks have not yet grown deep enough to penetrate the tank wall.

Records from March 1984 to present are available for inspection in the PCSACS regarding liquid levels in the 244-A DCRT sump. There have been no significant inflows into the vault in this time frame. However, the records indicate that a small amount (¼ to ½ in.) of standing liquid is nearly always present in the sump. Moreover, Tank Farm Engineering staff members are unaware of any occasion when sufficient liquid has ever accumulated in the vault sump to require it to be pumped out. Based on this evidence, it is considered likely that the protective coating that was applied to the carbon steel liner in 1975 has been compromised in the vicinity of the sump, and the sump may be an area where significant amounts of uniform corrosion or pitting corrosion could have occurred. Stress-corrosion cracking in the sump-liner weldments is possible because the liner was not stress-relieved and because the concentration of SCC-producing species, such as nitrate ions, will concentrate during evaporation. Uniform corrosion rates approaching 10 mils/year are possible in iron, produced by soft water, for pH levels between 4 and 10 (ASM 1987). Blaak (1999) stated that 244-A DCRT waste is mainly contaminated water. Thus it is likely that it could behave corrosively, as soft water. Should

penetration have occurred in the carbon steel sump liner, escape of any fluid to the environment is unlikely because concrete is highly resistant to degradation by dilute aqueous solutions.

The above corrosion design evaluation, coupled with the visual examinations, operation and maintenance practice, and leak check of the tank (Section 6.2) indicate that appropriate corrosion protection is provided and the tank is adequately designed and is not leaking.

5.4 AGE OF THE TANK SYSTEM

The age of the 244-A DCRT facility is approximately 25 years. The waste receiver tank (TK-387) was built in about 1950 for Project C-362 according to Specification HW-4311 (GEH 1950a), then modified according to Specification B-103-C2 (Vitro 1975), and moved and installed in 244-A DCRT in about 1975.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations were performed in 2000 and a prior video examination of the receiver tank vault was conducted in 1996. These examinations were done to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since completion of construction about 25 years ago.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the pump pit, tank vault (also termed annulus or annulus space) and the receiver tank interior. Dates of examination were June 2, 2000 for the receiver vault and June 6, 2000 for the visual examination of the interiors of the pump pit and the receiver tank. The previous cursory visual examination of the facility performed in 1996 was also reviewed.

Visual examination details and data sheet findings are included in 34 individual "still" photographs and three video examination data sheet tables. The photographs, taken from the videotapes show the satisfactory status of the facility.

6.1.1 Pump Pit Visual Examination

Access to the pump pit was accomplished by removing two of the reinforced concrete cover blocks. The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing all three facility components) was manually lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or lesser-angle setting) used to view details of interest.

The color videotape of the pump pit showed that the condition of the walls, nozzles, unremoved cover blocks, floor, and various ancillary equipment appeared very satisfactory. Some normal dust and dirt on parts of the floor prevented the reviewer from seeing the entire coated concrete floor and joints. However, where visible, all surfaces and equipment appeared to be in satisfactory condition.

Details of the visual examination are presented in video examination data sheets in Table H1. Satisfactory conditions of the pit walls, ceiling (unremoved cover blocks), walls, nozzles, and pit floor are shown in Figures H3 through H8, below. Figures H9 through H11 show the waste transfer pump, floor drain and leak detection equipment, and other ancillary equipment.

A prior inspection of the pump pit and tank interior was made in August and September 1996. Video tapes from 1996 and 2000 were reviewed. Concerning the pump pit condition, no significant differences were noted between the September 9, 1996 tape and the most recent June 2, 2000 tape. Based on these recordings the condition of the pump pit is judged to be satisfactory.

6.1.2 Annulus Visual Examination

Access to the annulus, or tank vault region, was obtained through the west and east inspection risers, both 6-in. in diameter, see Hanford Drawing H-2-38203. Note that there are no specific number-letter denotations on the drawing other than being noted as inspection risers. Further, there is a third riser in the southeasterly direction, which was not identified. Color videotaping occurred on June 2, 2000 with about 100 minutes dedicated to the examination of the annulus through the two risers. Details of the visual examination are presented in Table H2. Sixteen photographs of the vault/tank exterior region are presented in Figures H12 through H27.

In general, the vault and the tank exterior surface appeared to be in very satisfactory condition. Leak detection in the sump appears to be compromised by rust-through of one of its diptubes. Some apparent minor water leaks in spray ring piping and at least one pronounced spherical indent, in the side of the tank that bear some further integrity consideration. Neither condition, however, appears to be structurally threatening.

Possible Water Leakage. Visual analysis of rust stains on the top and side of the tank, indications of fluid collecting in the sump, and apparent rusting-through of one of the sump diptubes, suggest that periodic water accumulation had occurred in the annulus. The frequency and number of 'leakings' could not be determined. Most of the evidence is subjective although rational. Figures H12 through H22 present visual evidence of possible periodic water 'leaking.'

Initially, it is proposed that laitance flows, that occurred during construction, resulted in partial white 'staining' of much of the tank top and side, and the bottom of the annulus. This evidence still remains. Some time later water appears to have periodically outwardly leaked (sprayed) from one or more the carbon-steel spray rings that are welded to three of the main top risers on the tank. Heavier rusting, on parts of the carbon-steel annulus wall, also suggests that the initial leakage occurred as a wide-covering spray. After the spray abated, it appears that some rusty water then leaked on to the top of the stainless steel tank, as indicated by the rust stains on its top (and part of its side). Generally, stainless steel does not rust as does carbon-steel, but it can be

stained by rusty water. Further, an elbow in one of the carbon steel spray rings appears to contain a hole, in an area that (rusty) water could drip down and stain the tank (Figure H21).

Concurrent with the periodic water spray leakage, it is proposed that the annulus filled to a depth of several inches. In doing this a number of times, it is proposed that the initial annulus-residing laitance was loosened by periodic rusting of the bottom, with subsequent redistribution of that laitance to the more rust-intensive, approximate 2-in.-high region of the circumferential sidewall of the vault. While there may be other scenarios for explaining the above noted rusting and staining, the one presented appears to best fit the visual evidence.

Hemispherical Indent. A relatively large hemispherical indent (possibly about 1 in. in diameter) appears on the sidewall of the stainless steel tank an estimated 2 to 4 feet above the central girth weldment (Figure H23). Based on viewing the tank internal videotape, it is possible that an antipodally oriented indent may also exist, see Section 6.1.3. The action of indenting would be expected to thin the wall at the indent below its initial 5/16-in. thickness. During plastic deformation of metals, their volume (and density) remains essentially unchanged. Thus, while the area of the hemispherical indent has increased (compared to its pre-deformed area), its wall thickness will correspondingly decrease. Further, it may take only a small amount of future corrosion to cause the indent to breakthrough as a hole, thereby resulting in a leak, if the waste level were ever to be that high within the tank.

The approximate 100-minute long videotape showed that all other regions viewed, appeared very satisfactory. These included the tank outer surface, weldments, and risers, and the carbon-steel plates of the sidewall and annulus bottom.

6.1.3 Receiver Tank Internal Visual Examination

Access to the tank interior region was accomplished by lifting riser cover "E" (Figure H11) at the pump pit floor and lowering the camera through its 12-in.-diameter opening. Because the overhead pump pit had to be opened to the atmosphere, and because it was highly contaminated, total videotaping time (in the pit and the tank) was limited for fear of airborne spread of contaminants.

Approximately 35 minutes of the hour-long videotape, taken on June 6, 2000, was spent inside the receiver tank. A total of ten photographs of the tank interior were taken and are shown in Figures H28 through H37. There is evidence of minor amounts of corrosion pitting and waterline corrosion, the latter being mainly near the tank bottom. Furthermore, there appears to be evidence of interior markings that may correlate with the spherical indent noted in the above discussion on the vault annulus and tank exterior.

Because of operations' schedule constraints, the visual examination of the tank interior was conducted when it was partially full, at 25.6-in. Thus, the bottom portion of the tank could not be clearly inspected because of the murkiness of the residual liquid waste.

In general, however, the tank appears to be in satisfactory condition and is fit for future use with several conditions. These are discussed in Section 7.0.

6.2 LEAK TEST

Analysis of tank level records indicates that an accurate leak check cannot be made from the data alone. The entire 21-year period of recorded surface level data (from PCSACS) was reviewed including the most recent time period (1999-2001). Consistent, slow meandering changes in surface level, probably resulting from evaporation, some periodic minor waste inflows, and the less-sensitive diptube measurement system, preclude the use of diptube measurement data for conducting an effective leak check. However, visual examination of the 244-A facility indicates that the tank has not leaked and it is in satisfactory condition.

The vault sump leak detection system appears to be compromised by rust-through of one of its diptubes.

Water from the spray rings may be periodically spraying/leaking onto the tank and into the annulus.

As many as two manufacturing-type spherical-indent defects exist about 2 to 4 feet above the tank's central girth weldment. Further, mainly near the tank bottom, some minor amounts of corrosion pitting and waterline corrosion exist.

PCSACS surface level data and comment reports were reviewed, unsuccessfully, as a basis for the leak test. Data were studied for the last 21 years (1980 to 2001). For the first ten years, the tank was actively receiving and pumping-out waste. For the next six years no data was apparently taken. More recent data (1996 to present) involved mainly input/output of dilute solutions such as flushings, decontaminations, snowmelt, rain, and drain checks. None of the surface level data, by themselves, are consistent enough to make the claim that no leakage is occurring.

For example, Figure H38 shows the general overall surface-level activity between 1980 and 2001. A recent time-period (September 1998 to May 2001) was selected for the leak check, shown in Figure H39. Figures H40 and H41 are expanded-time views of Figure H39 in the May-October 1999 and April-August 2000 time periods, respectively. Within the expected data sensitivity, for a diptube measurement system, the data in Figures H40 and H41 suggest that the daily change in surface level obfuscates any indication of a leak.

The leak data by themselves are not consistent enough to claim that no leakage is occurring. However, the annulus visual examination data and photographs, described in Section 6.1.2, indicate that no leakage from the tank has occurred.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings conclusions, and recommendations are presented:

1. The combination of satisfactory results of the design evaluation and the successful visual examinations indicate that the facility and its components are adequately designed and the receiver tank has not leaked.

2. The design does not prevent entry of water (rain, snowmelt) intrusion into the pump pit and receiver tank, which adds to the waste inventory and increases the potential corrosion inside the tank and the components in the pump pit. This should be mitigated by effectively sealing the cover block seams.

3. Because of operations' schedule constraints, the visual examination of the tank interior was conducted when it was partially full, at 25.6-in. The visible portions of the tank interior were in good condition, however the bottom portion of the tank could not be clearly inspected. Therefore it is recommended that a visual examination of the tank be conducted at the next opportunity when it is empty.

4. Waste height should be limited to some point below the tank wall spherical indent. The indent appears to be about 2 to 4 feet above the central girth weldment in the 14-ft. high cylindrical section. During the next inspection of the tank interior, an attempt should be made to view the interior of the spherical indent(s) that are in the tank wall.

5. An Enraf Nonius Series 854 ATG (Advanced Technology Servo Gauge) (ENRAF) system is recommended for future surface level monitoring. Its level sensitivity of ± 0.004 in., is adequate for future leak checks.

6. A visual examination of the vault annulus should be made, in conjunction with operation of the spray rings to see if they truly are spraying or leaking during service. An attempt should be made to visually determine the status of the bottom of the hemispherical indent(s).

7. Visual examination of the vault annulus sump leak detection system indicates that it has deteriorated. It should be tested to verify its operation.

8. The interior of the tank, particularly near its bottom, should be visually examined at the next pit entry to ensure that no significant changes in waterline corrosion are occurring in the tank's wall.

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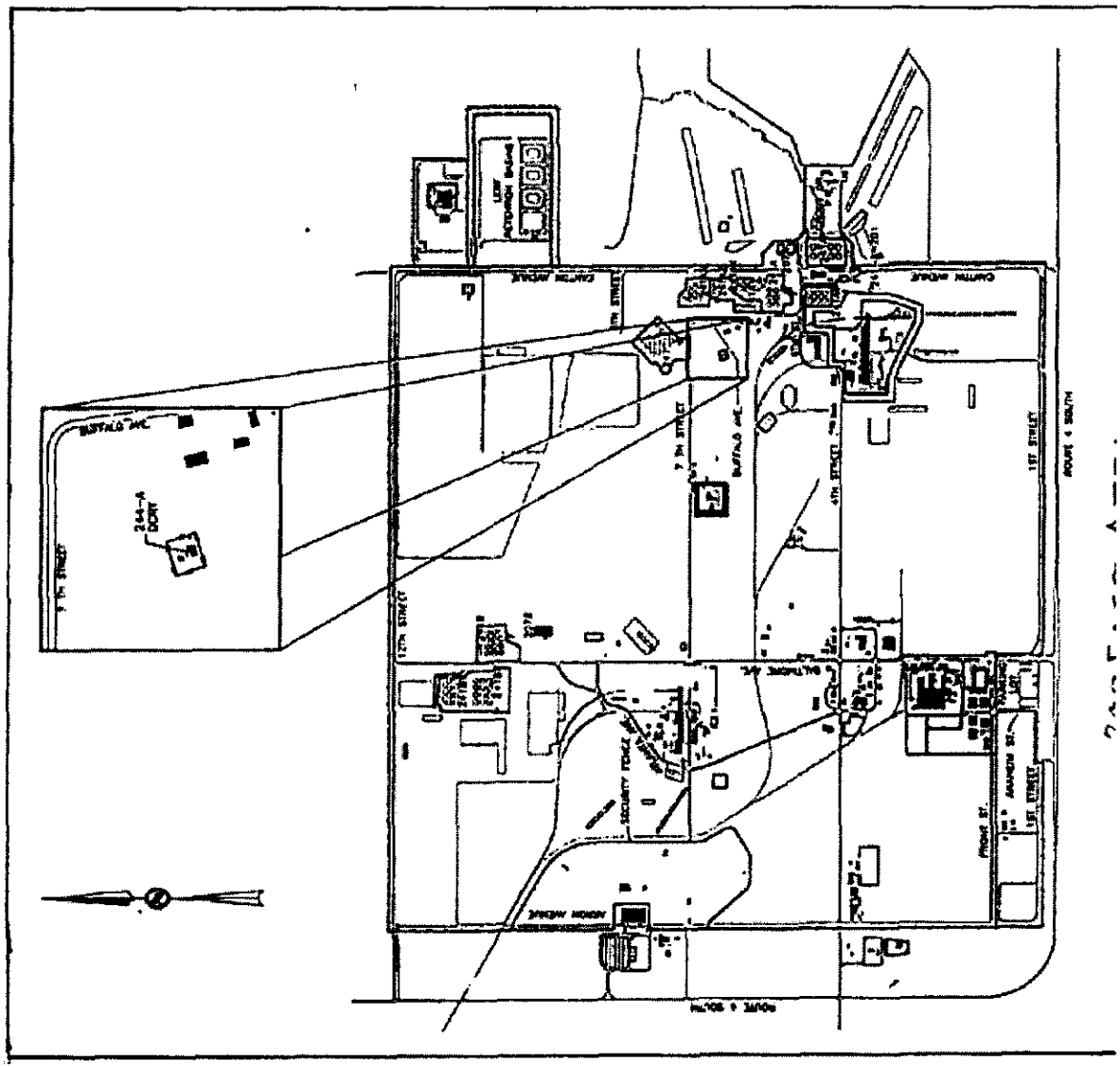


Figure H1. Location of 244-A DCRT on the Site Plan

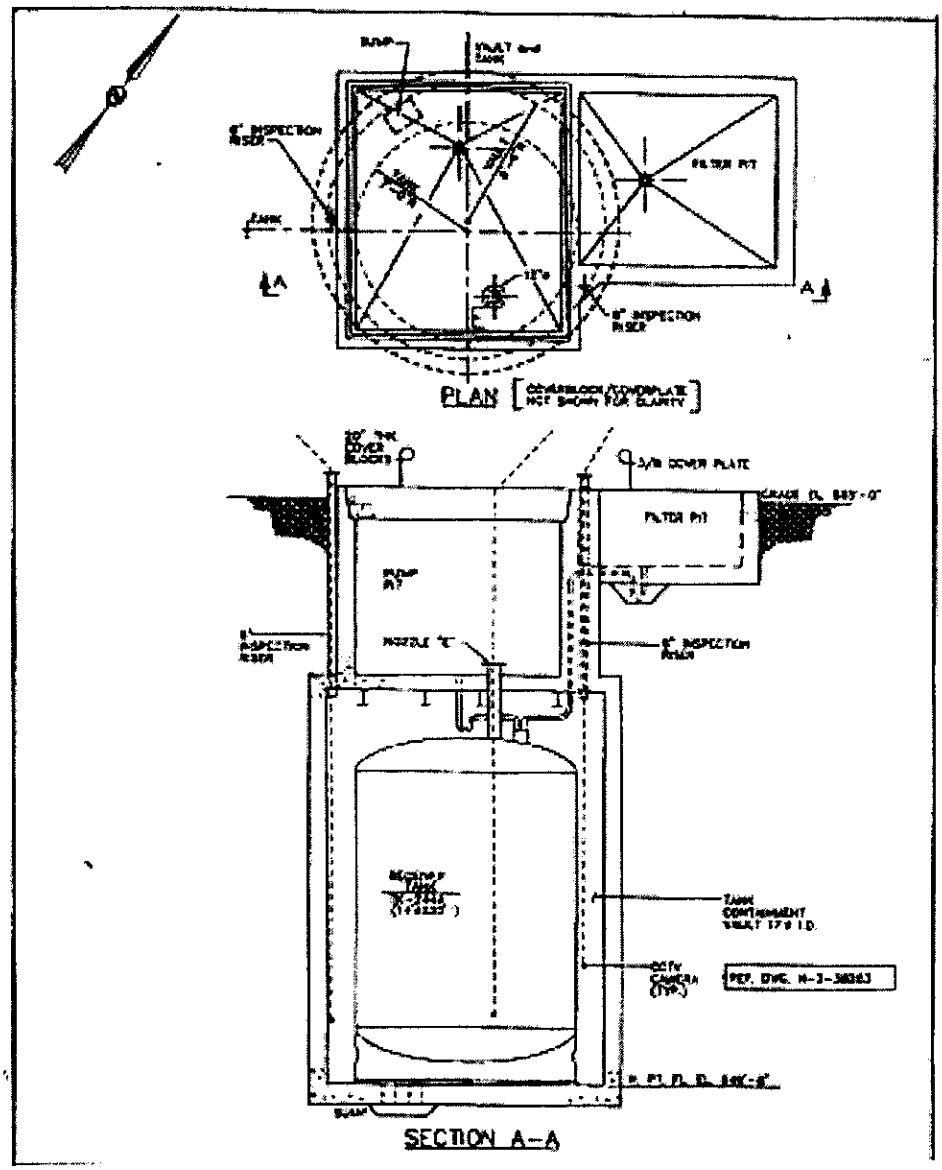


Figure H2. 244-A DCRT Lift Station

Table H1. Video Examination Data Sheet, 244-A DCRT Pump Pit

Examination Date: 6/6/00

Person In Charge: D. P. Niebuhr / S. C. Sutton Camera Operator: M. J. Busselman Video Examiners: T. S. Hundal

Riser –N/A (Cover Blocks Removed)

Video Tape Reviewer: E. B. Schwenk Date: June 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Ingress to the interior of the 244-A DCRT pump pit was achieved by removal of two of its reinforced concrete cover blocks. Its interior is a 15-ft. square and is about 10.5-ft. high. The following photographs and narrative show, structurally and materially, that the 25 year old pump pit facility is in very satisfactory condition. Because the facility contains a relatively high level of radioactive contamination, a liquid fixant was periodically sprayed on the floor and the floor-based equipment of the pit, while the wind-limited (and time-restricted) video examination was taking place.
0919 AM		000	071		Figure H3 is a view of the pump pit looking toward its southeast corner. All piping and nozzles appear very satisfactory. Inconsequential rainwater/snowmelt staining of the pit sidewalls is evident.
0920		046	069		Panning farther to the right (of Figure H3) additional nozzles, piping, and wall staining are evident in Figure H4. All appear in satisfactory condition.
0920 AM		081	068		Figure H5 is a farther right view (of the southwest corner of the pit) showing the continued satisfactory conditi0on of more nozzles and some minor wall staining.
0920 AM		159	059		Continued panning to the right (Figure H6) shows the adequacy of the northwest corner of the pit, including one of its remaining-in-place cover blocks.

Table H1. Video Examination Data Sheet, 244-A DCRT Pump Pit (continued)					
0925 AM		265	110		The bottom of the southwest corner of the pit (Figure H7), including two nozzle connections (P3 and 4), a nozzle connector, ancillary piping, and floor joint all appear in good condition.
0925 AM		228	123		Figure H8 provides a clearer picture of the joint completeness between the floor and the wall as well as two more nozzle-covered pipe openings.
0927 AM		048	120		Additional scanning of the pit floor (Figure H9) shows the favorable appearance of the waste transfer pump and related ancillary equipment.
0929 AM		267	148		The floor drain (to the receiver tank below), including its coaxial leak detector unit are clear of debris and appear undamaged (Figure H10).
0940 AM		009	123		The Riser E opening into the receiver tank, for the video camera entrance, is shown in Figure H11.

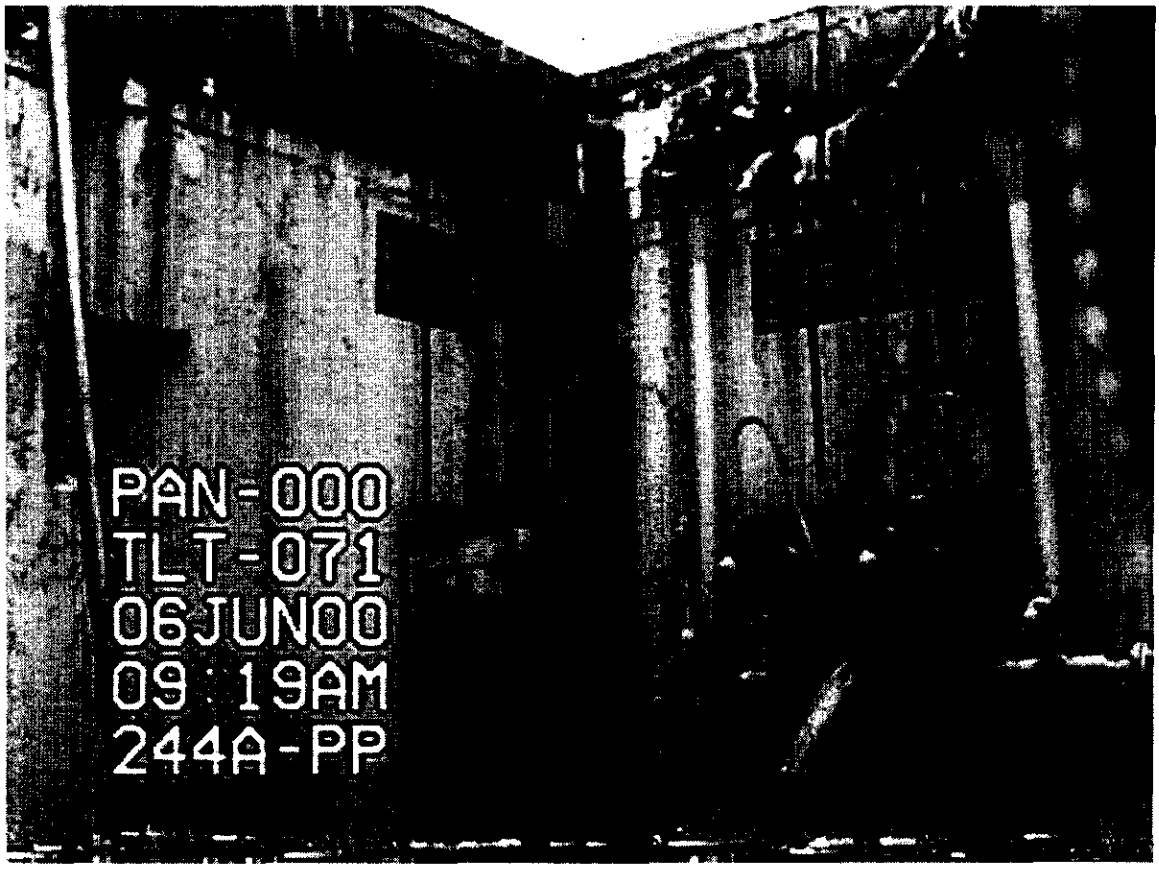


Figure H3.
View of Southeast Corner of 244-A Pump Pit Walls and Nozzles

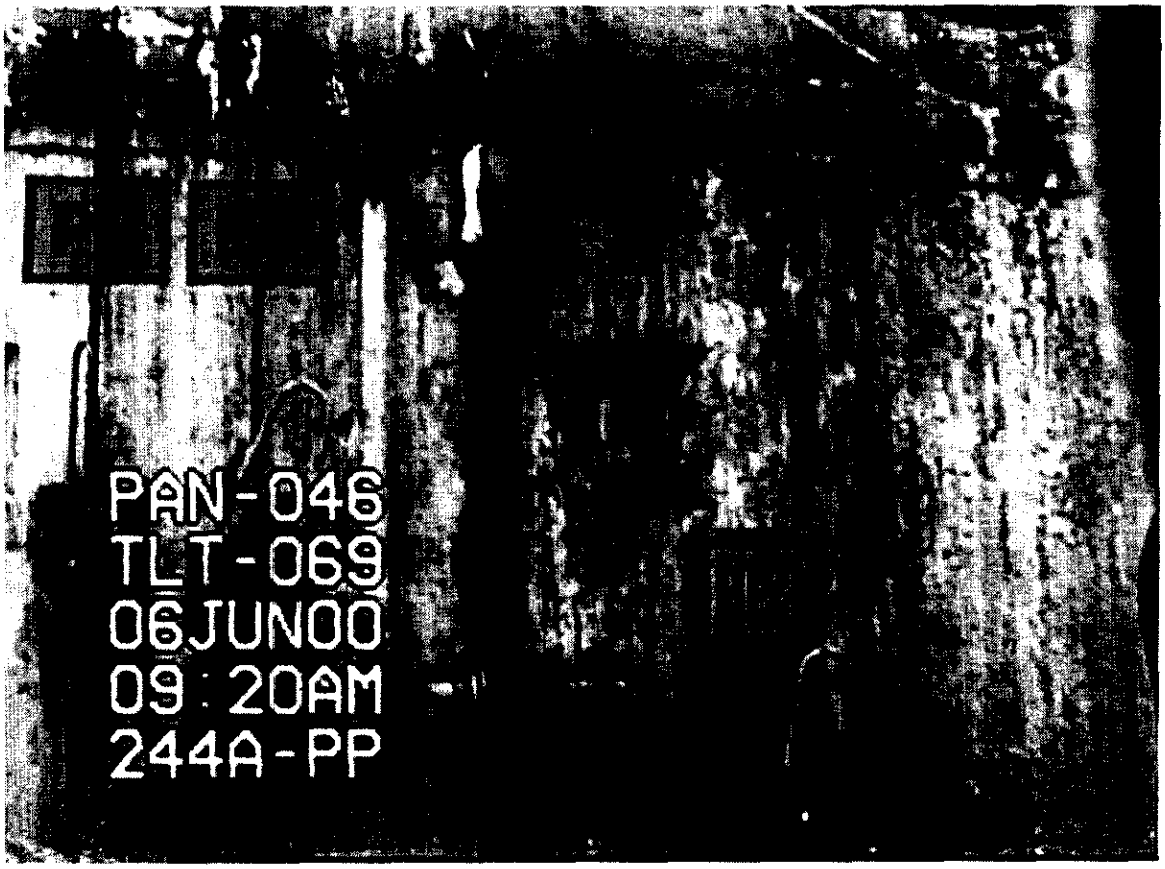


Figure H4.
Additional Nozzles along South Wall of 244-A Pump Pit, Adjacent to Walls and Nozzles shown in Figure H3

Figure H5.
Additional Nozzles, Southwest Corner of 244-A Pump Pit

Figure H6.
View of Northwest Corner of 244-A Pump Pit, Including Cover Block

Figure H7.
Bottom and Sidewalls of 244-A Pump Pit Northeast Corner

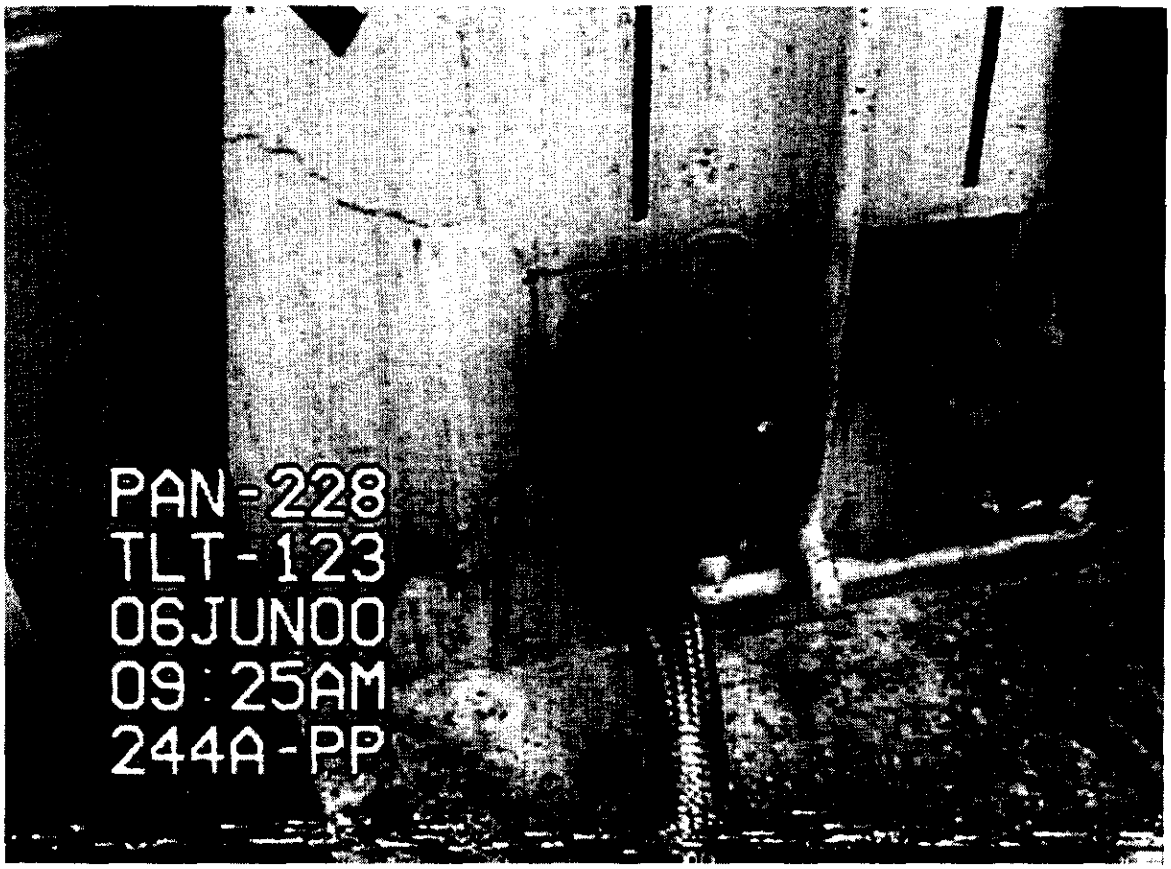


Figure H8.
View of 244-A Pump Pit Wall, Floor, and Nozzles, Adjacent to Figure H7

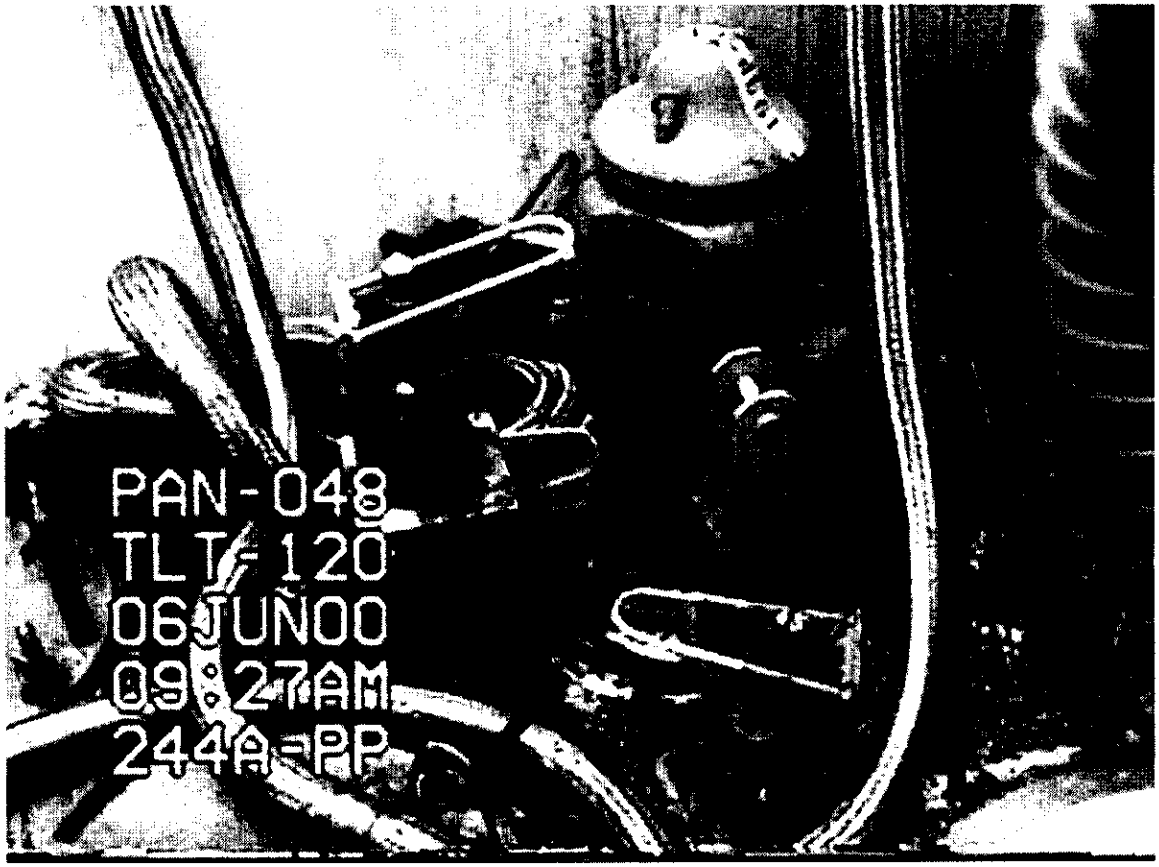


Figure H9.
View of 244-A DCRT Waste Transfer Pump and Ancillary Equipment, Southwest Corner, 244-A Pump Pit.

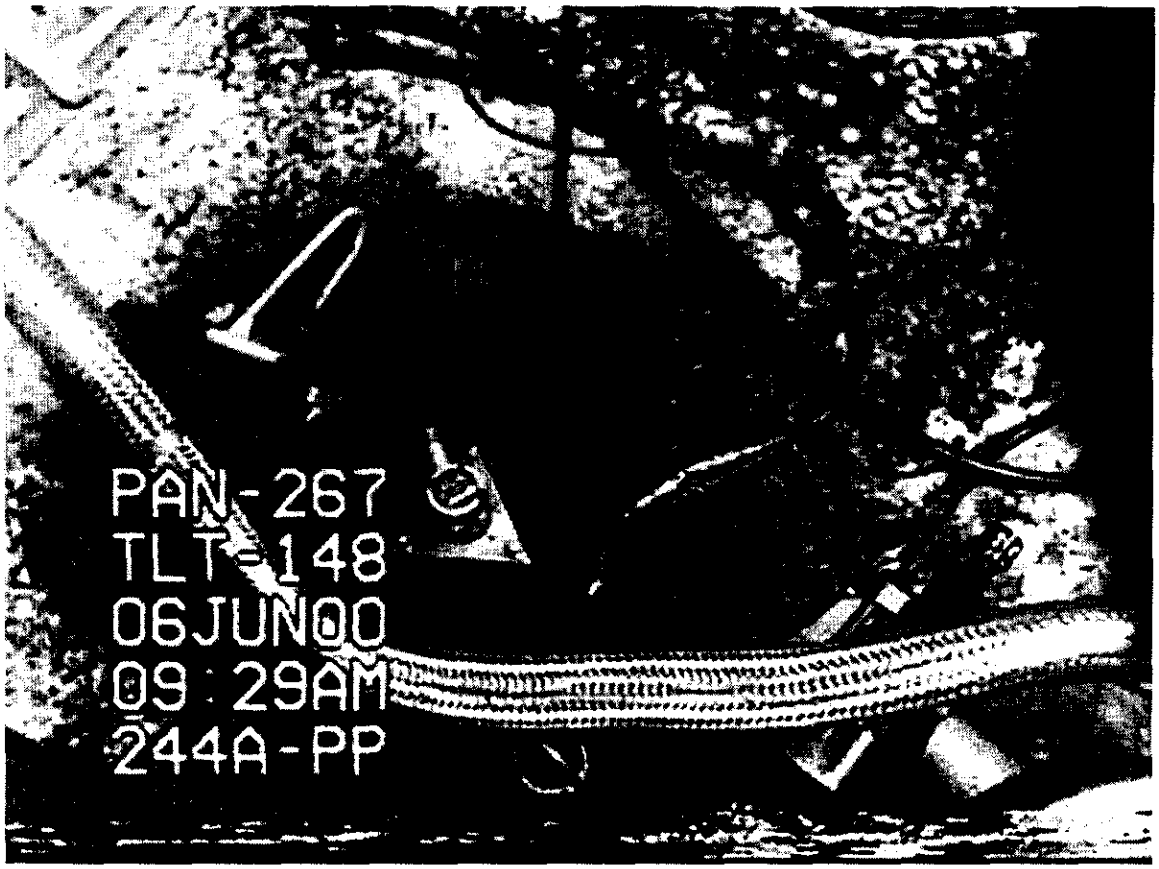


Figure H10.
Floor Drain (to Receiver Tank) and Combined Leak Detector Unit, 244-A Pump Pit. [Note Fixant Spray Fluid (Impact Circles In Liquid) Being Applied to Floor to Reduce Possible Aeolian Spread of Radioactive Contamination.]

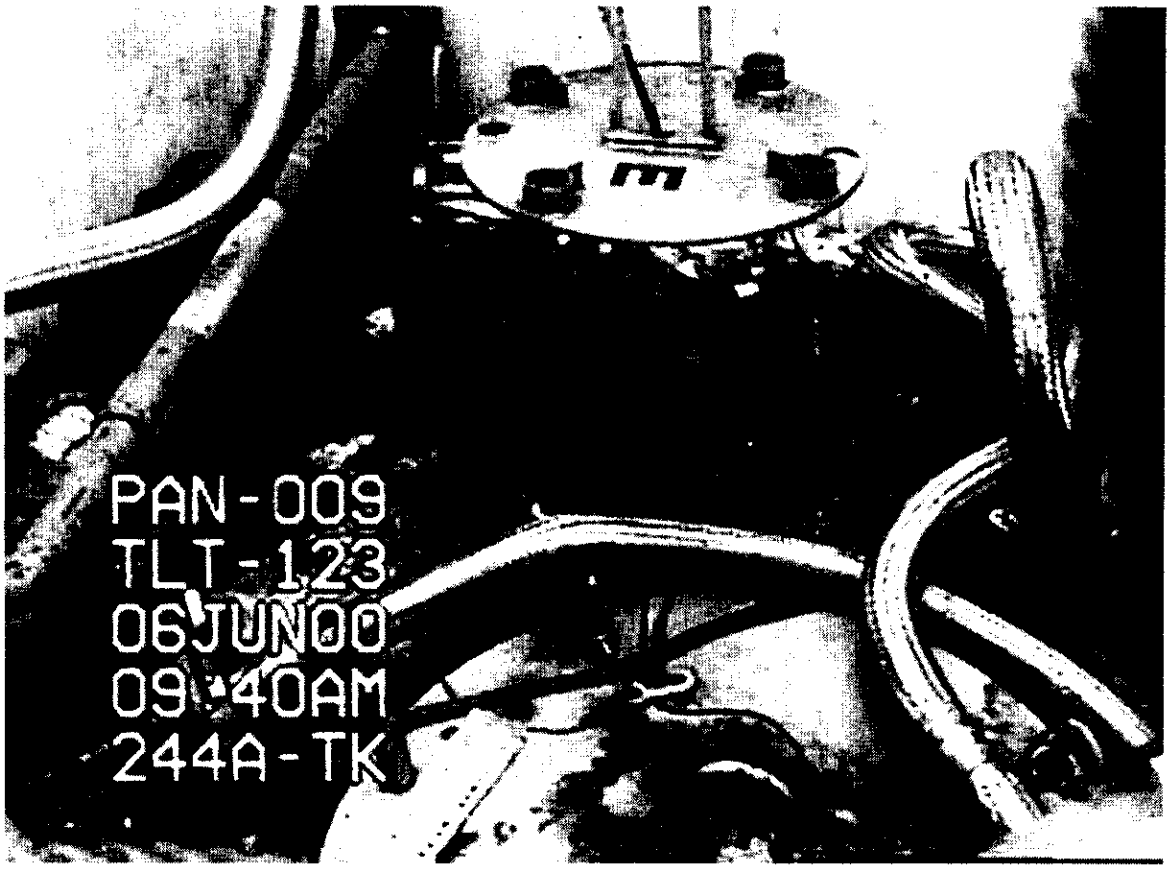


Figure H11.
View of Riser E Opening For Camera Insertion Into Receiver Tank, 244-A DCRT

Table H2. Video Examination Data Sheet, 244-A-DCRT Annulus

Examination Date: 6/2/00

Person In Charge: D. P. Niebuhr / S. R. Chapman Camera Operator: D. F. Heidelberg Video Examiner: T. S. Hundal

Riser: 6-in. Dia. West and East Inspection Risers

Video Tape Reviewer: E. B. Schwenk Date: June 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs and narrative demonstrate that the approximately 25-year old vault and catch and receiver tank exterior are in satisfactory condition and are fit for continued service. Some minor water leaks, into the vault, have apparently occurred in the past, and may still be periodically recurring. These innocuous leaks imply that a prior waste leak could have occurred, although it is highly unlikely. The rationale for determining that no waste leaks had likely occurred, required the videotape reviewer to conduct an extended review of the videotapes and to present a relatively large number of photographs. This approach provided for the development of a scenario that clarified the nature of the minor problem and its relationship to both the continued safe operation and satisfactory condition of the vault. In addition, there is a non-structurally threatening, spherical-shaped, internally bulging geometric discontinuity in the tank's outer surface about 2-3 ft above the tank's central girth weldment. This spherically shaped indent, about 1 in. in diameter, appears as an inward-projecting dimple. It does not appear to violate the tank's fluid boundary. In the future, it is recommended that the tank's maximum fluid height be limited to some point below the dimple. It is possible that the tank's wall thickness (at the dimple), is thinner than the surrounding wall. Thus, a small amount of corrosion could lead to a future leak if the waste were to wet the dimple.

Table H2. Video Examination Data Sheet, 244-A-DCRT Annulus (continued)

					Entrance to the annulus, with the video camera, was through two risers: the west and east inspection risers (both 6-in. in diameter). The first west entrance was at 11:25 AM with removal at 12:08 PM, after examining the structure for about 40 minutes. During this time the sound track was not working. The camera was put back in the same riser, at 12:09 PM, after attempting, unsuccessfully, to fix the sound track. The camera was removed at about 12:18 PM. Later, about 1:17 PM, the camera was put into the east inspection riser. Removal occurred about 40 minutes later (1:58 PM). The video camera sound track functioned during the latter insertion. In the following discussion of the photographs, 'W 'and 'E' following each figure number are used to note that a specific photograph was taken from either the 'west' or 'east' riser, respectively.
1136 AM		093	113		Evidence of prior, relatively high fluid levels in the annulus sump is shown in Figure H12W, by the presence of the white staining and waterline markings. In addition, the leftmost vertical sump diptube, appears to have been corroded through-wall. A 1996 videotape of the same annulus region showed the same diptube appearance, implying that the apparent corroded state of the tube has existed for at least four years, probably much longer.
1131 AM		125	151		Figure H13W, taken through a rounded-end access port (near bottom of tank skirt), shows some white staining amidst a region of rust-like stains on the slightly elevated pad, upon which the carbon-steel tank skirt is bolted. The white stain appears to have occurred during a construction concrete laitance flow. The adjacent rust-colored stain may result from periodic, prior water leakage from circumferential spray piping above the tank.
1138 AM		033	150		Further evidence of some white stains on the carbon steel annulus floor, as well as edge-on white stains on the annulus wall and tank pad, are shown in Figure H14W.
1142 AM		085 092	095 093		Additional white stains were also seen when the video camera was later entered into the annulus through the east inspection riser. Figure H15W shows a 'waterline'-type accumulation of a white substance rising several inches up the annulus carbon-steel wall. The white substance (believed to be concrete laitance) typically appears to accumulate in a more intensely rusted, sidewall band, as shown in Figure H16W. This white band probably occurs all around the annulus circumference.

Table H2. Video Examination Data Sheet, 244-A-DCRT Annulus (continued)

133 PM		147	059		Figure H17E, is a typical view of the primary tank sidewall taken from the southeast riser region. Much of the tank sidewall in this area has been stained (white) with concrete laitance. The small brown-colored vertical 'drip' in the center of the photo is most likely a rust-bearing drop that fell from a 'rust stalactite' that was originally located on some overhead carbon steel structure associated with the pump pit floor. This same effect has been seen on some catch tanks. Although there is significant evidence of large-scale amounts of laitance covering the tank sidewalls, there is only a small amount that sits on the annulus bottom. It is suggested that repeated, short-term wetting of the annulus floor resulted in normal rusting of the carbon steel floor, that subsequently broke the laitance loose, only to re-deposit it as white bands along the edges of the annulus bottom when the thin pool of water, periodically evaporated.
1217 PM		356	089		Evidence of prior laitance flow down the 12-in and 36-in. central risers, as well as prior flow of some rusty water on the top of the tank can be seen in Figure H18W (camera suspended through west riser). Additional in-flow or vent-type piping can be seen at the left. The rust stain on top of the tank water is believed to have come from rusty water in the spray ring piping (see Figure H21E) below.
148 PM		021	066		A view of the central 36-in. riser, taken from the east riser entrance, can be seen in Figure H19E. Laitance stains (on the riser) as well as rust stains, on the tank top can also be seen. While it appears that the rust-laitance boundary on the tank top lines up with the overhead carbon-steel beam, it is suggested that condensate drips from the beam are not likely to represent any significant flow of rusty water. Further, the perpendicular beam shows drip marks on its underside, but no apparent rust-staining directly below on the tank top.
156 PM		052	063		Figure H20E was taken slightly to the left of the image in Figure H21E, but still through the east riser entrance. Here the rust staining of the tank top is more apparent along with vertical laitance stains. The other 12-in. diameter entrance riser is shown at the left, along with intersecting, carbon-steel spray-ring piping.
150 PM		023	062		A possible water-leakage opening in a spray ring elbow is shown in Figure H21E. This image is directly to the left of the image shown in Figure H20E that shows a 12-in riser opening just to the left of the central 36-in. riser opening. It is believed that additional defects of the same type exist elsewhere in the same piping.
156 PM		005	078		The rust-stains on top of the tank, shown in Figure H22E, are located directly below, and to the left of, the possible leakage opening shown in Figure H21E.
154 PM		107	106		Additional rust staining on top of the stainless steel tank (Figure H26E) can be seen to the right of the images shown in Figures H21E and H22E.

Table H2. Video Examination Data Sheet, 244-A-DCRT Annulus (continued)					
1150 AM		224 226 234	092 091 091		Figure H23W is a glancing angle view of an spherically indented dimple in the tank wall that was briefly discussed above. Because the west riser entrance location was laterally displaced from the dimple, a straight-on photo was not possible. That the defect is inward projecting is shown by the presence of a shadow inside the dimple. Higher magnification views were not possible because of the narrowness of the annulus and normal limits of the camera optic's depth-of-field. Figures H24W and H25.WSP were used by the reviewer to make a stereo pair (SP or 3-D) observation of the dimple, further confirming its inward projection.
127 PM		168	121		Figure H27E is a view of one vertical weldment in the tank's carbon-steel support skirt, showing possible weld-root cracking (estimated to be about 1-ft. long). This is not considered significant because there are only a few vertical welds while the remainder of the skirt is 360° girth-welded at its top (to the tank) while the bottom is securely bolted to the floor.

Figure H12W.
View of Sump, Diptubes, and Sump Pump (Right), in 244-A DCRT Annulus

Note: The letters 'W' and 'E' at the end of a given figure number designate that the camera was entered through either the 'West' or 'East' inspection risers.

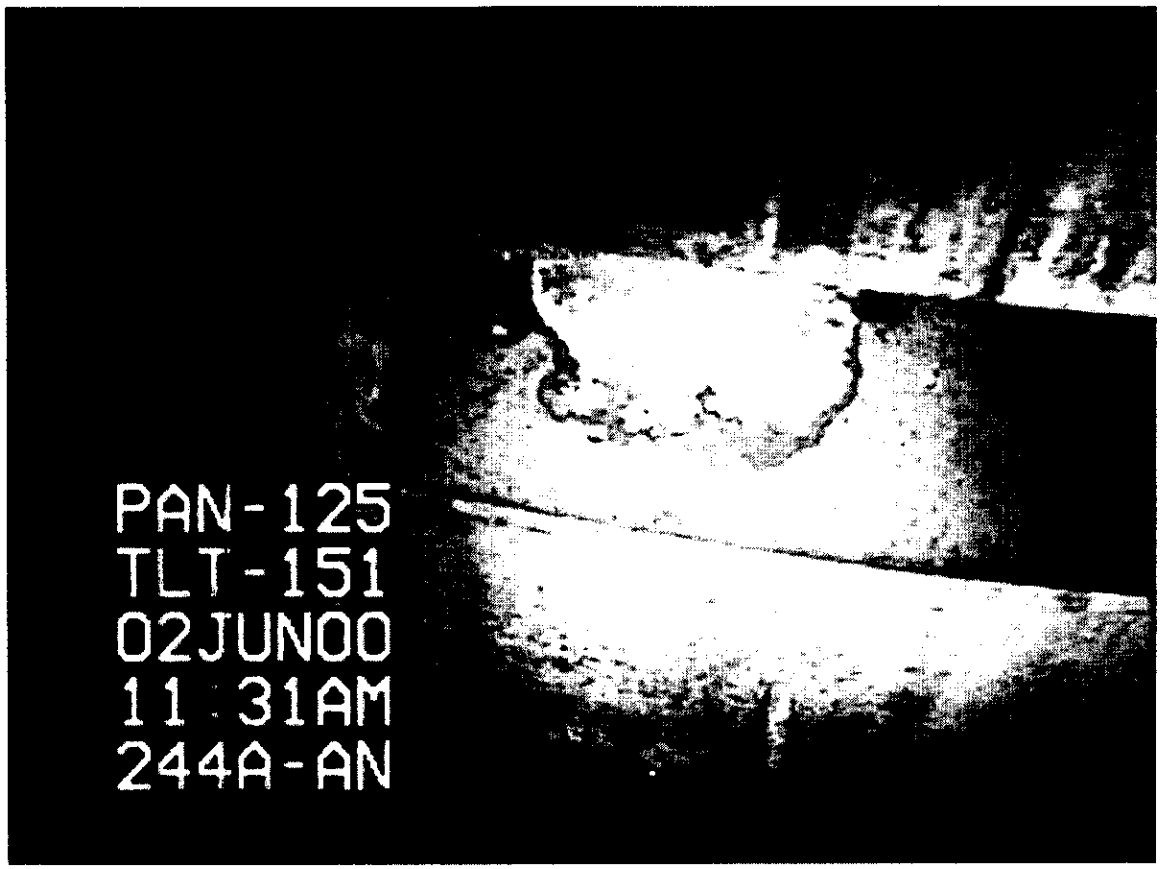


Figure H13W.
White and Rust-Colored Stains on Pad Underneath 244-A DCRT (photo taken through opening in tank skirt).

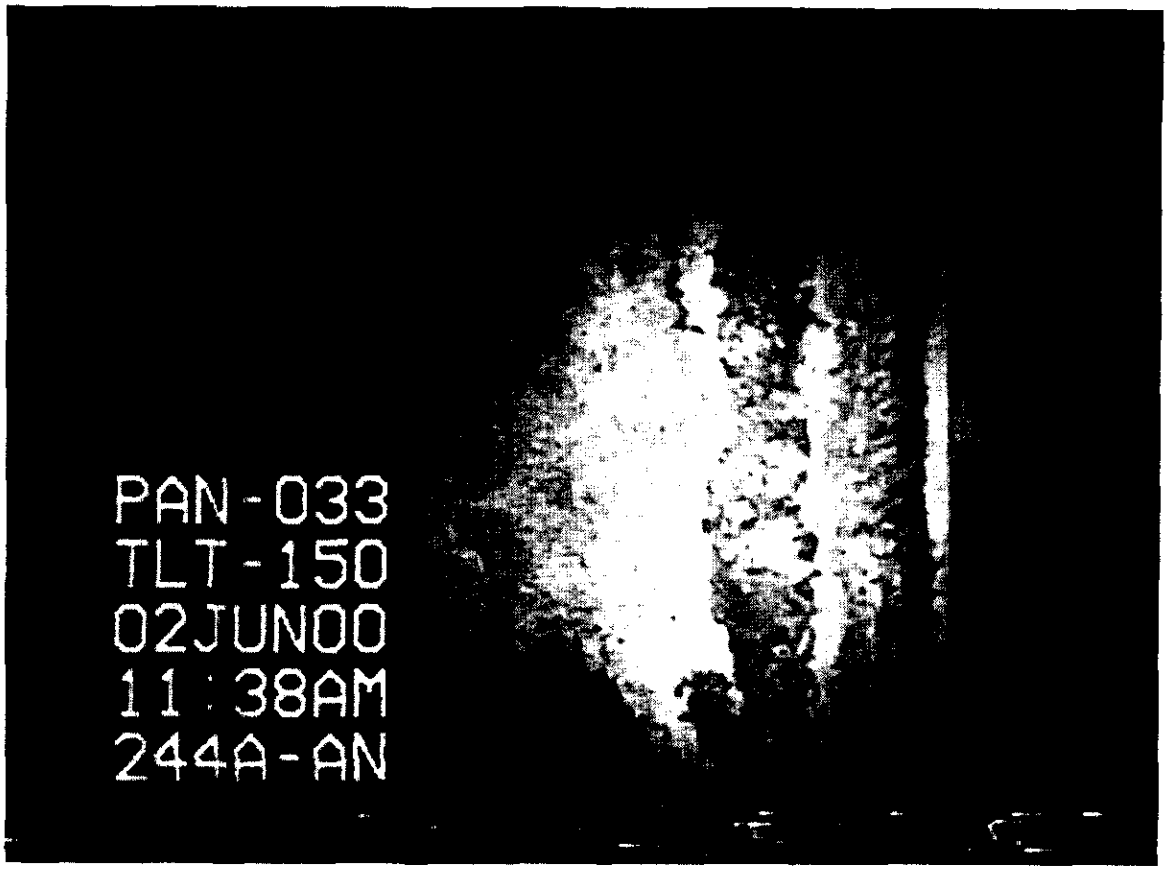


Figure H14W.
White Stains on 244-A DCRT Carbon Steel Annulus Floor and Along Edge of Wall and Tank Pad (Right)

Figure H15W.
Apparent Evidence of Long-Term "Waterline" Laitance Reaccumulation on Side of Annulus at Bottom, 244-A DCRT

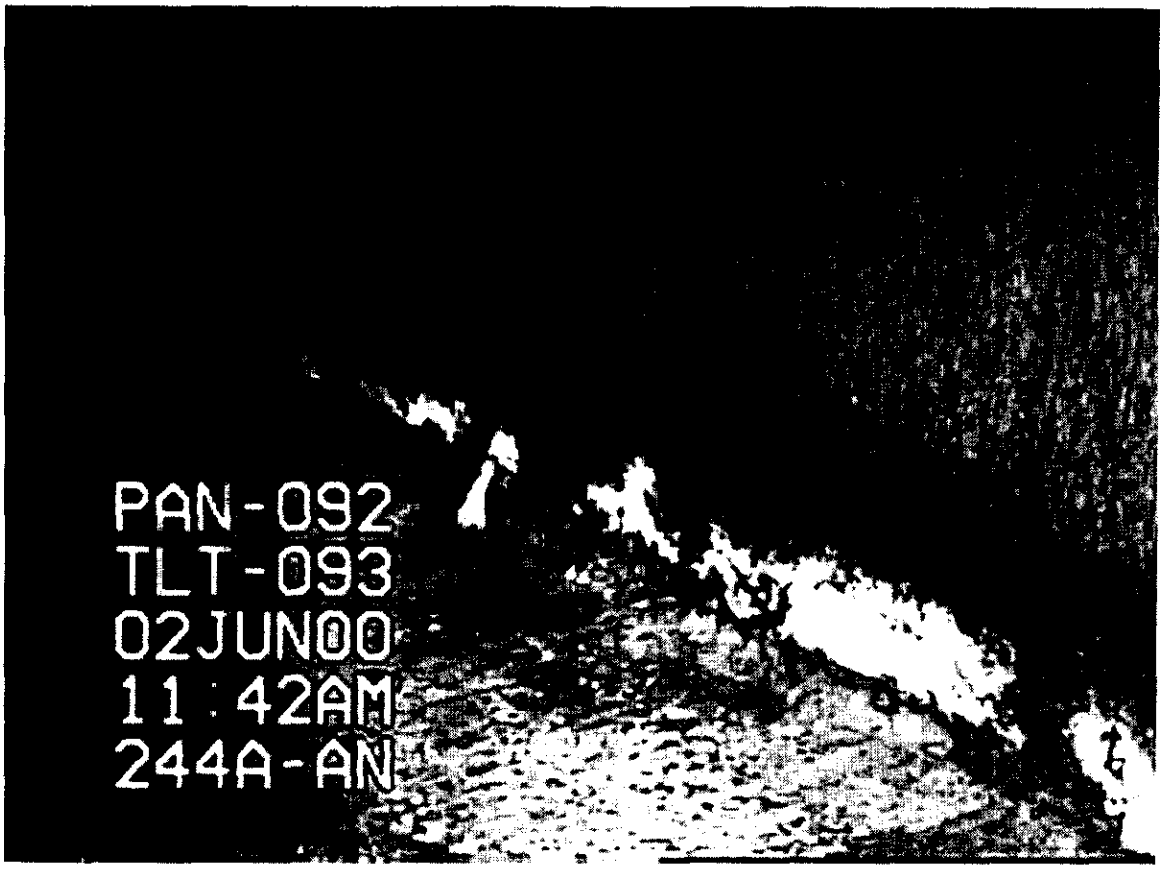


Figure H16W.
Close-up of "Waterline" Laitance Waste Re-Accumulation in Annulus Bottom, 244-A DCRT

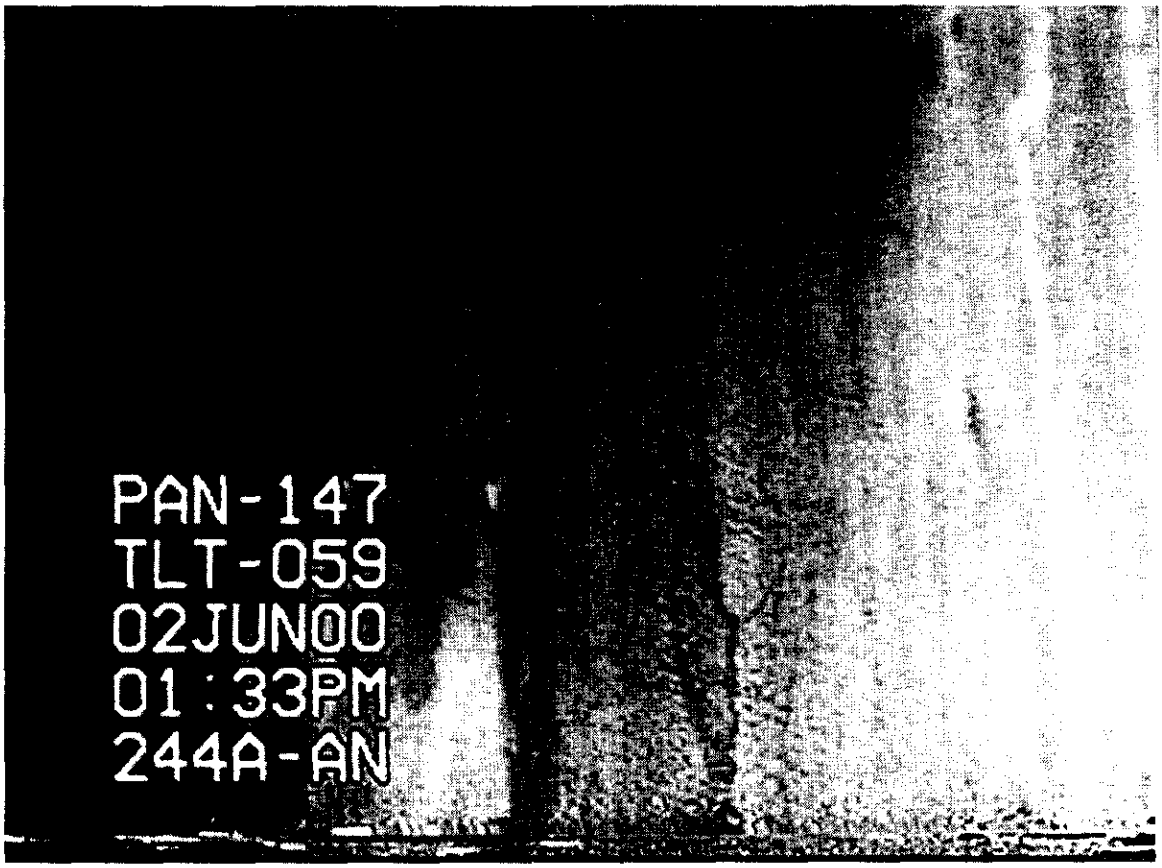


Figure H17E.
Rust Mark or Dropping on Laitance-Covered Side of Stainless Steel Receiver Tank, 244-A DCRT.

Figure H18W.
12-in. and 36-in. Risers and Spray Ring, Including Laitance and Rust Stains, Top of Receiver Tank, 244-A DCRT

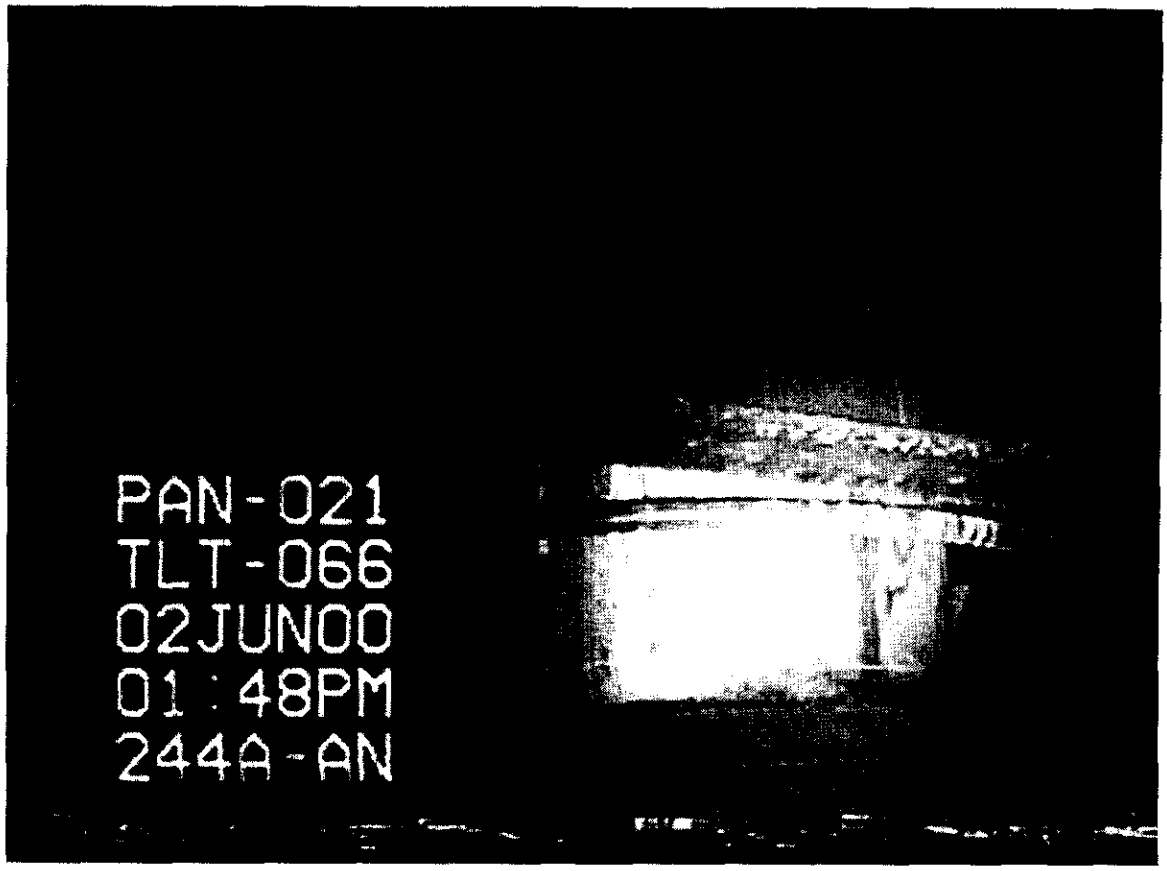


Figure H19E.
Probable Laitance "Leakage" Around Main Central Riser, 244-A DCRT

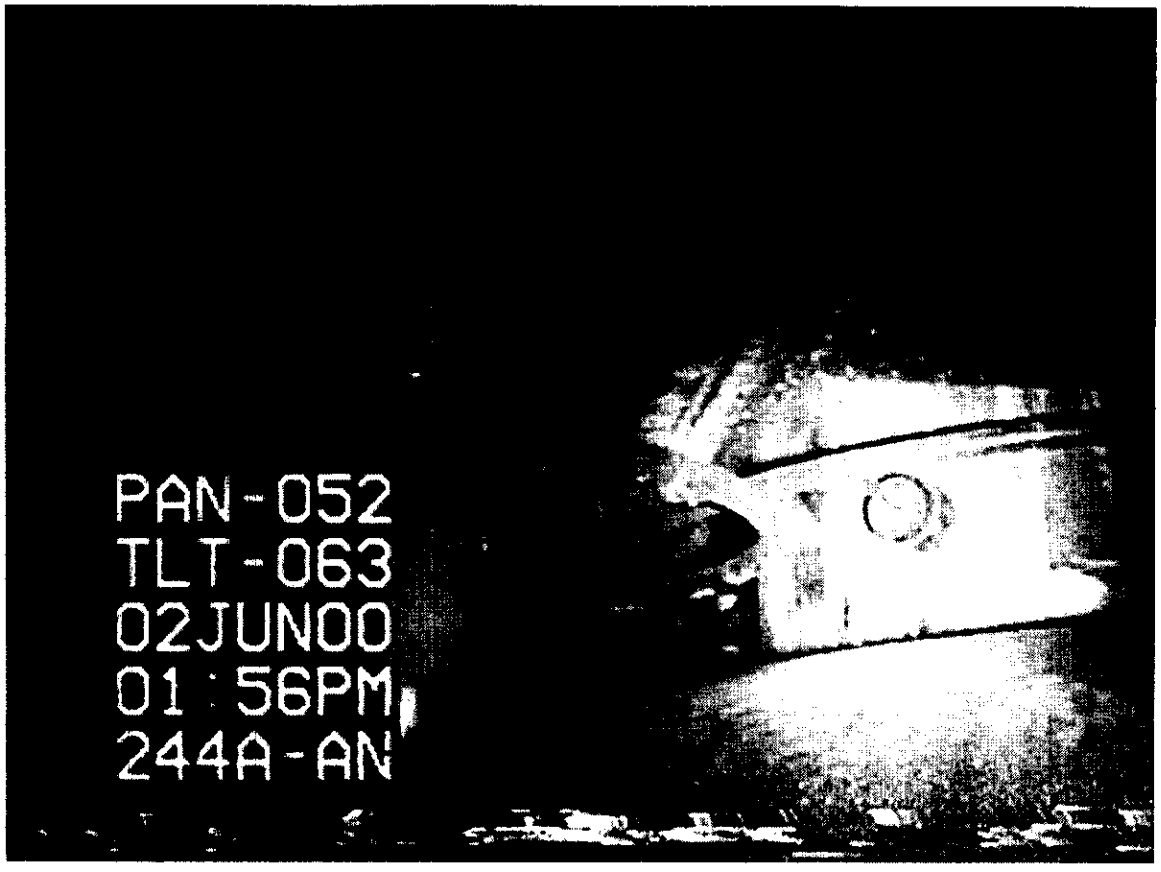


Figure H20E.
Probable Laitance Stains on Central Riser and Rust Staining on Top of Receiver Tank, 244-A DCRT

Figure H21E.
Possible Spray Ring Water Leakage Opening in Pipe Elbow, 244-A DCRT

Figure H22E.
Rust Stain Marking on Stainless Steel Receiver Tank Below Possible Leak Hole in Carbon-Steel Spray Ring Elbow, 244-A DCRT

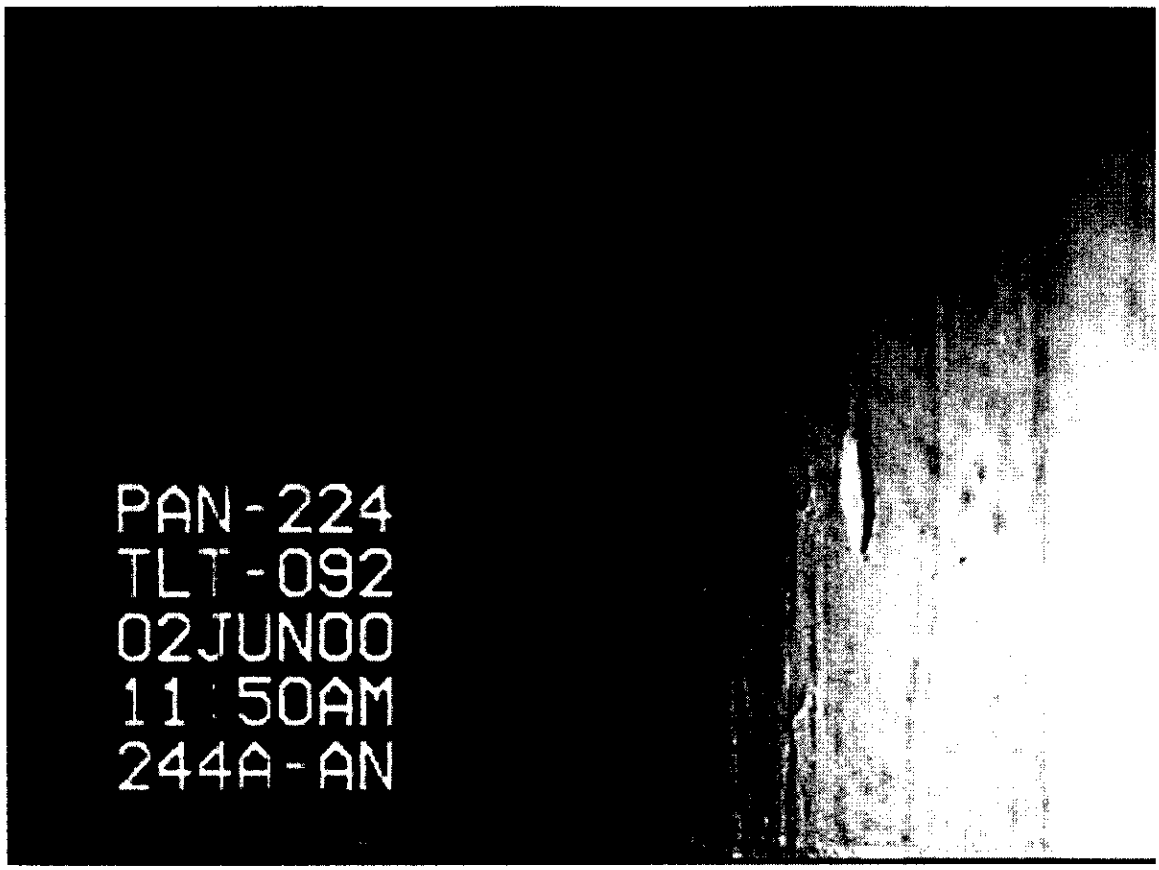


Figure H23W.
Prominent, Inward-Projecting Dimple or Pit on Exterior of Primary Tank, 244-A DCRT
Estimated to be 1-in. diameter

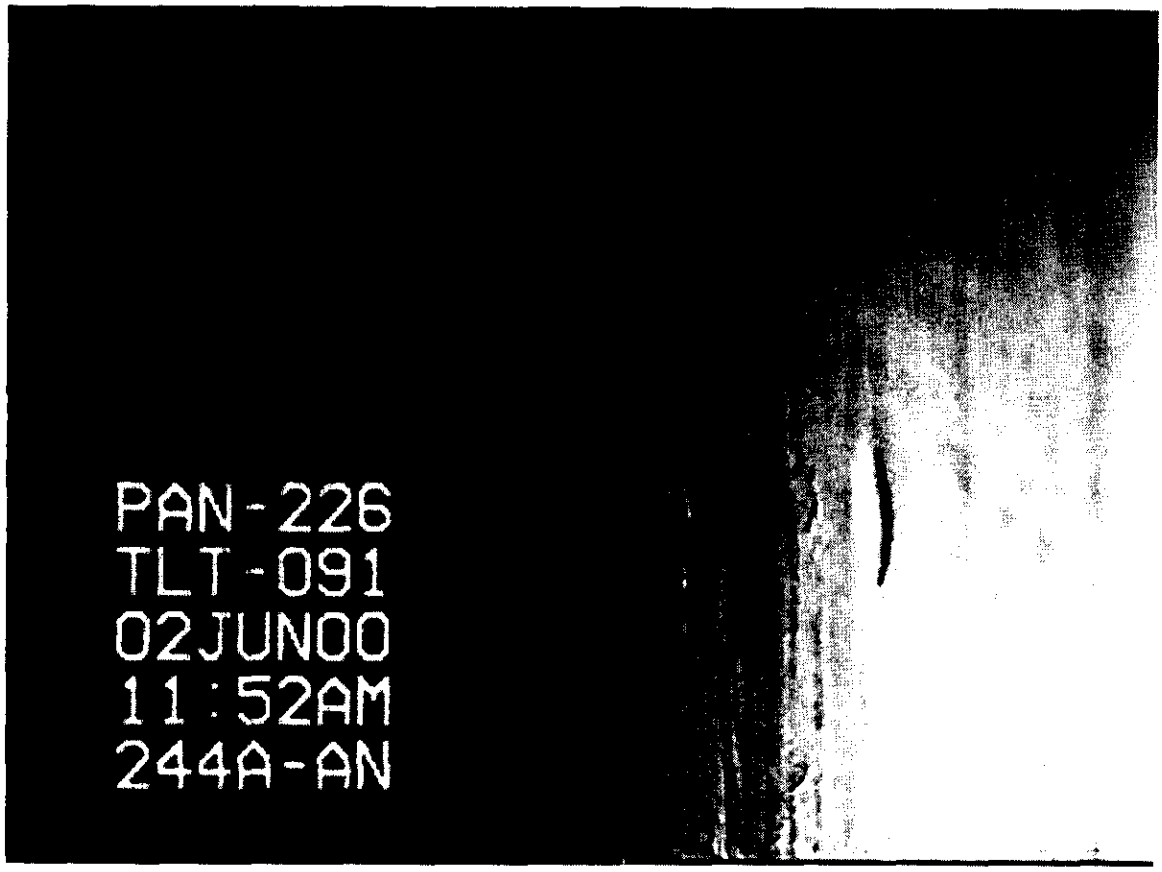


Figure H24W.
Half of a Stereo Pair to Figure H25WSP this Figure Confirms that the Dimple was Inward-projecting.

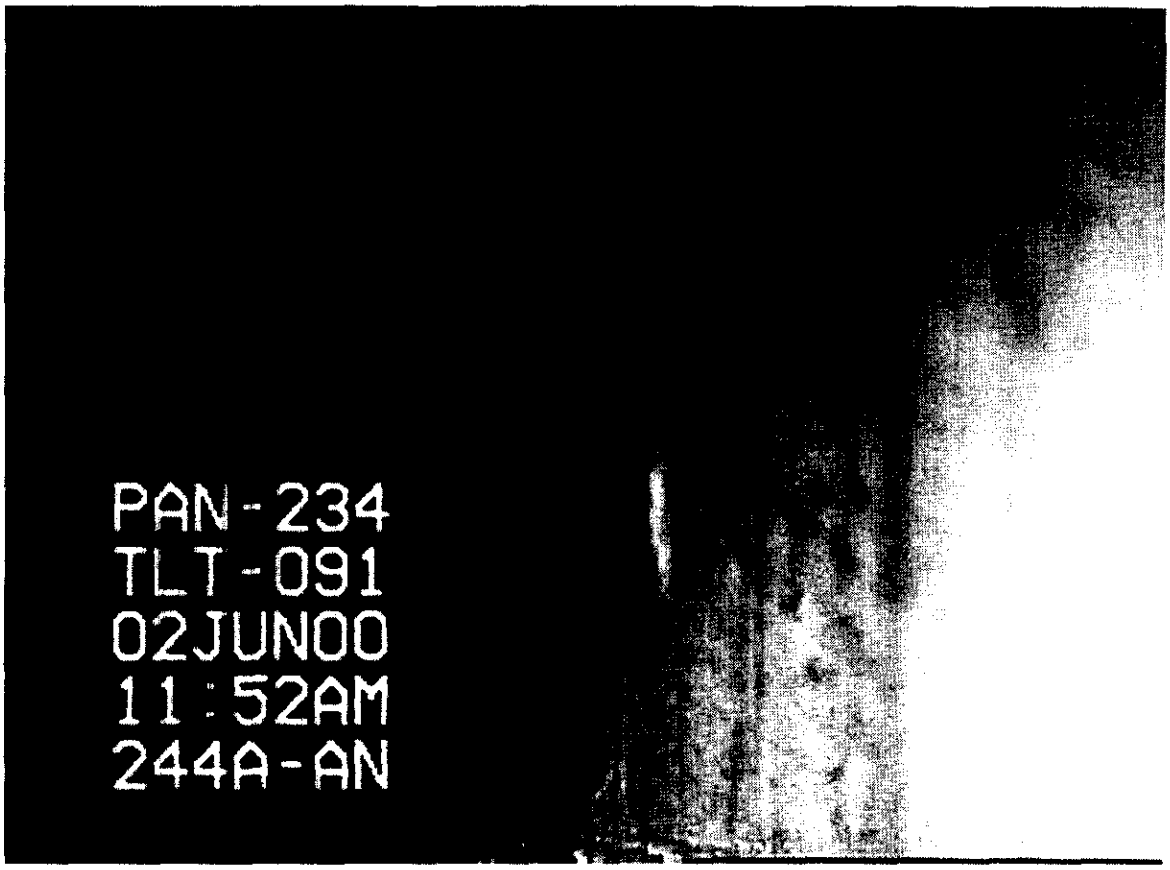


Figure H25W.
Half of a Stereo Pair to Figure H24W, this figure confirms that the Dimple was Inward-projecting.

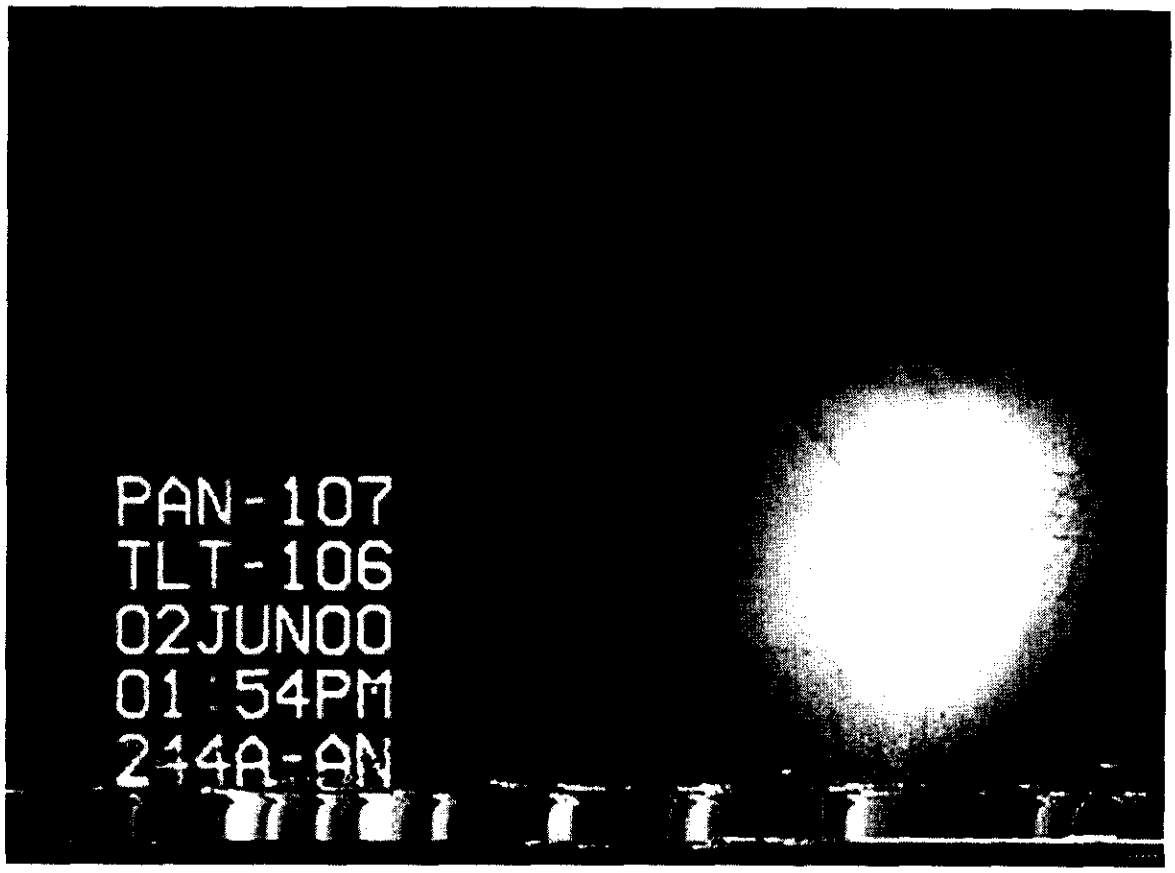


Figure H26E.
View of Rusty Water Staining on Top and Radiused Edge of Tank, 244-A DCRT

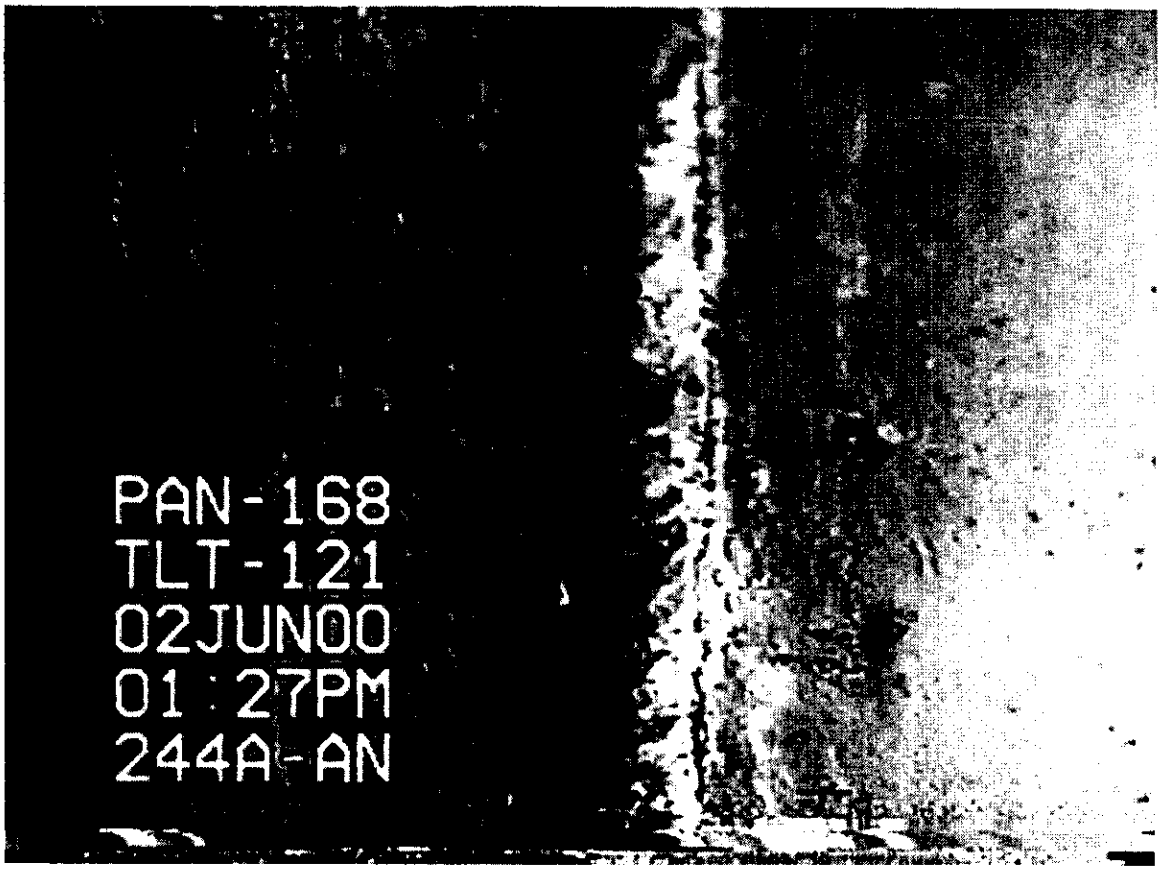


Figure H27E.
Possible Cracking at Interface between Base Metal and Weld Metal, in Carbon Steel Support Skirt for Receiver Tank, 244-A DCRT

Table H3. Video Examination Data Sheet, 244-A Receiver Tank

Examination Date: 6/6/00

PIC: D. P. Niebuhr / S. C. Sutton Camera Operator: M. J. Busselman Video Examiner: T. S. Hundal

Riser # E at Pump Pit Floor

Video Tape Reviewer: E. B. Schwenk Date: June 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs and narrative demonstrate that the approximately 25-year old stainless steel receiver tank (fabricated in 1953, and apparently used in the 276-U Solvent Handling Facility before transferred to the 244-A Project about 1975) is in satisfactory condition and appears fit for continued service. An upper limit on waste depth should be established so that no future waste fluid comes into direct contact with a spherical indent (possibly more than one) that exists about 2-3 ft above the tank's central girth weldment. A limit is recommended because the tank wall thickness, in the region of the spherical indent(s), is unknown and a small amount of corrosion might lead to future leakage at that spot. (see Table H2 data sheet for further description of the spherical indent as seen from the 244-A annulus.) There is evidence of minor amounts of corrosion pitting and waterline corrosion (particularly near the tank bottom). Because their depth of penetration into the wall could not be readily evaluated, periodic visual examinations should be conducted to see if they are increasing in severity.

Table H3. Video Examination Data Sheet, 244-A Receiver Tank (continued)					
					Video camera panning and tilting allows much of the tank interior to be examined. It should be noted, that when the tilt angle is high (approaching 180°, or nearly straight down), the panning angle appears to become distorted with respect what it becomes when the tilt angle is reduced (to say, 60 to 120°). Because of this, approximate compass directions are noted on some of the figures to reduce orientation confusion.
0947 AM		009	181		A view of the tank interior from just below riser opening E, is shown in Figure H28. The vertical plate in the background is one of four tank baffle plates. Waste depth is low (around 26-ft in. deep). The tank bottom cannot be seen due to the black, oily sludge. The relatively large white area near the photo center is a reflection of the camera's attached light.
0953 AM		353	143		The next five photographs Figures H29-H33 are characteristic of the tank wall near its bottom. Figure H29 shows some minor corrosion attack, above the waste. What appears to be a waterline corrosion mark is simply an actual waterline. Clear water, about 1-2 in. deep, resides on top of the oily sludge.
0953 AM		332	142		An actual, tan-colored waterline corrosion mark (Figure H30) can be seen near the top of the figure. Some small stains or blemishes and minor corrosion pits are also apparent. It should be noted, that because the camera is projecting down at a steep angle of about 140°, the pits and waterline corrosion show a greater degree of contrast (and apparent depth) than they would if the camera was more nearly perpendicular to them.
0953 AM		319	141		Figure H31 shows a horizontal baffle plate stiffener, some adjacent waterline corrosion markings, and some precipitated salts (on the stiffener).
0955 AM		167	111		A more direct-on view of the waterline corrosion effect is seen in Figure H32. Depth of penetration cannot be accurately assessed. This view suggests that that it could be in the order of 10 % of the wall thickness ($t_{nom.}$ = 5/16 in.).
0955 AM		150	112		Another view of the tank bottom (Figure H33) shows the ubiquitous waterline corrosion effect, some debris stuck on the wall, and what appears to be, a slightly more intense local corrosion area on the right side of the photo.

Table H3. Video Examination Data Sheet, 244-A Receiver Tank (continued)					
1019 AM		000	159		An overall view of the sidewall of the tank, from the waste surface level up to the central girth weldment is shown in Figure H34. Additional waterline corrosion markings and dark marks (possible corrosion pits) are also shown.
1011 AM --- 1011 AM		283 --- 137	049 --- 048		The next three photographs Figures H35-H37 suggest that there may be more than one spherical indent, as noted above. To be more confident of this claim, additional video camera entrances should be made into the tank at different locations in an attempt to get closer to these possible internal defects. Figure H35 presents a view of the southeast baffle plate (upper right) and a suspicious round, dark mark about 2-in. to the left at the dark/light border. This same defect can be seen in Figure H36 (To compare location similarities between Figures H35 and H36, the reader must review the videotape at 10:17 AM, 294 Pan and 048 tilt.; this tape location shows the same tank-interior markings as shown in Figure H36). The latter photo was taken during a tank entrance in 1996 and more clearly shows the same round, dark mark to be about 2-4 ft below the dome-cylinder weld intersection along with the same southeast baffle plate, at the right. Figure H37, taken nearly 150° to 180° away, at the same tilt angle, shows the presence of a possible spherical mark in the same region about 2-4 ft down from the weldment. Here, the spherical mark is about 1-in. to the right of the vertical, temperature element pipe and directly below the light black mark, about 1 in. up from the bottom of the photo. While these photos do not prove the existence of antipodal spherical indents in the tank sidewall, they do argue for future, more detailed periodic visual examinations to better determine their leak-integrity at the noted positions.

Figure H28.
View of 244-A Receiver Tank Interior from Riser Opening E, in Top of Tank, 244-A DCRT. (Southeast Direction)

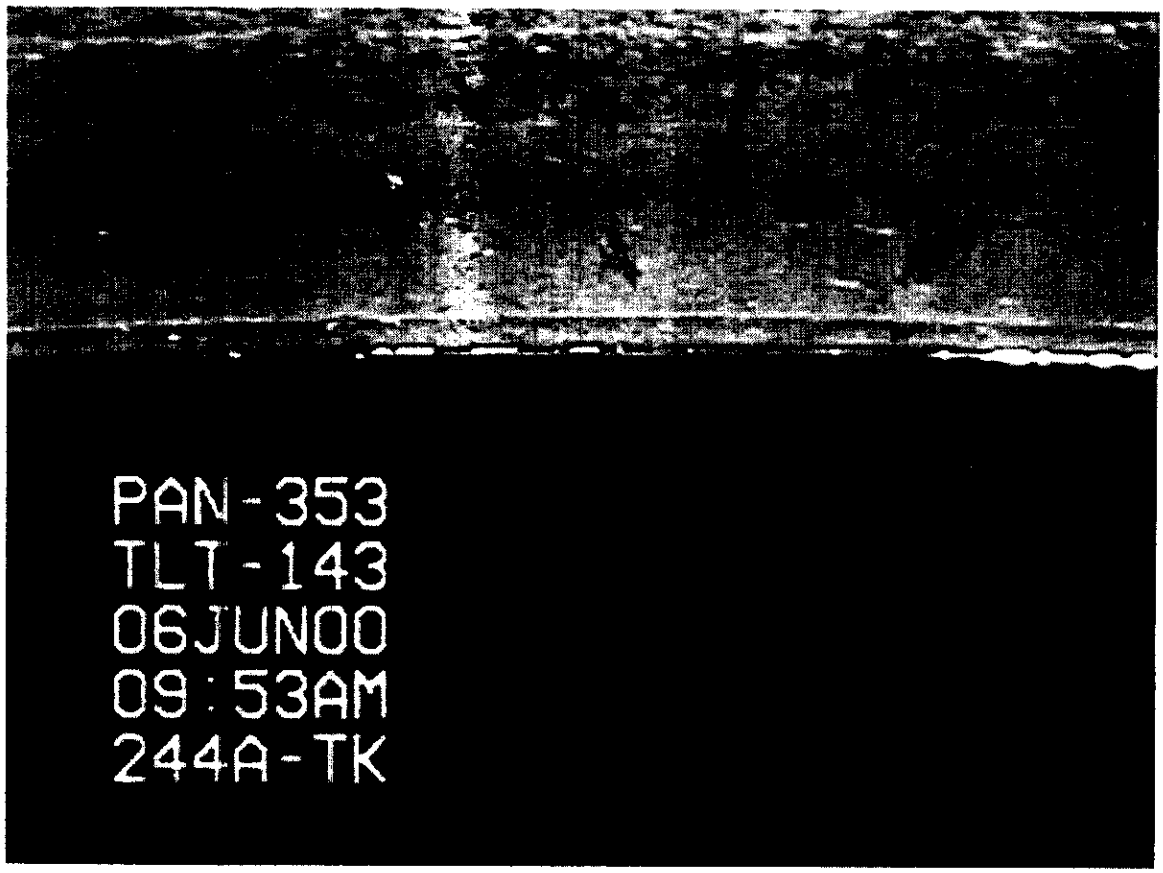


Figure H29.
Approximately 1- to 2-in. Thick Layer of Water on Top of Oily Appearing Sludge, 244-A DCRT

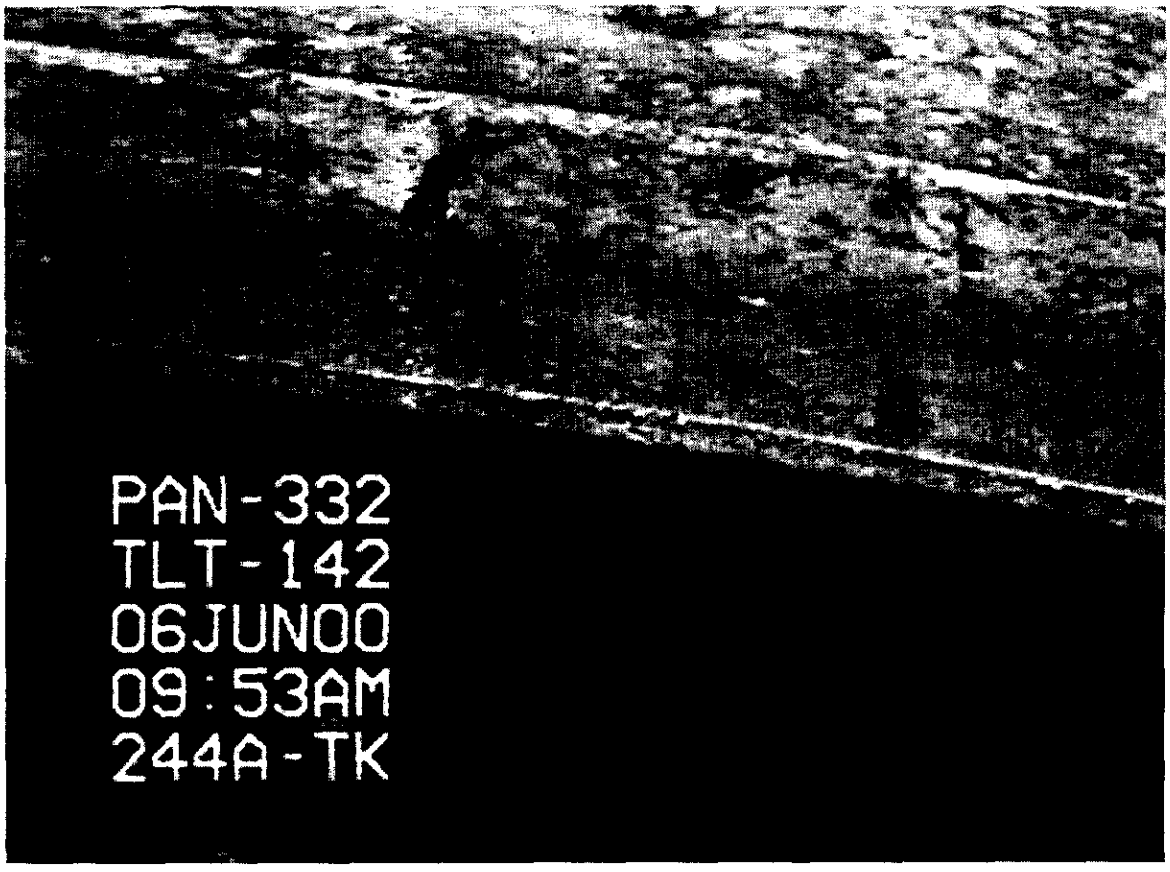


Figure H30.
Probable Waterline and Light Pitting Corrosion Attack in Tank Sidewall Near Bottom, 244-A DCRT

Figure H31.
Solid Waste Precipitated on Baffle Plate Stiffener Plus Waterline Corrosion Effects, near Bottom, 244-A DCRT

Figure H32.
Further Evidence of Waterline Corrosion Attack and Some Minor Pitting Corrosion near Bottom, 244-A DCRT

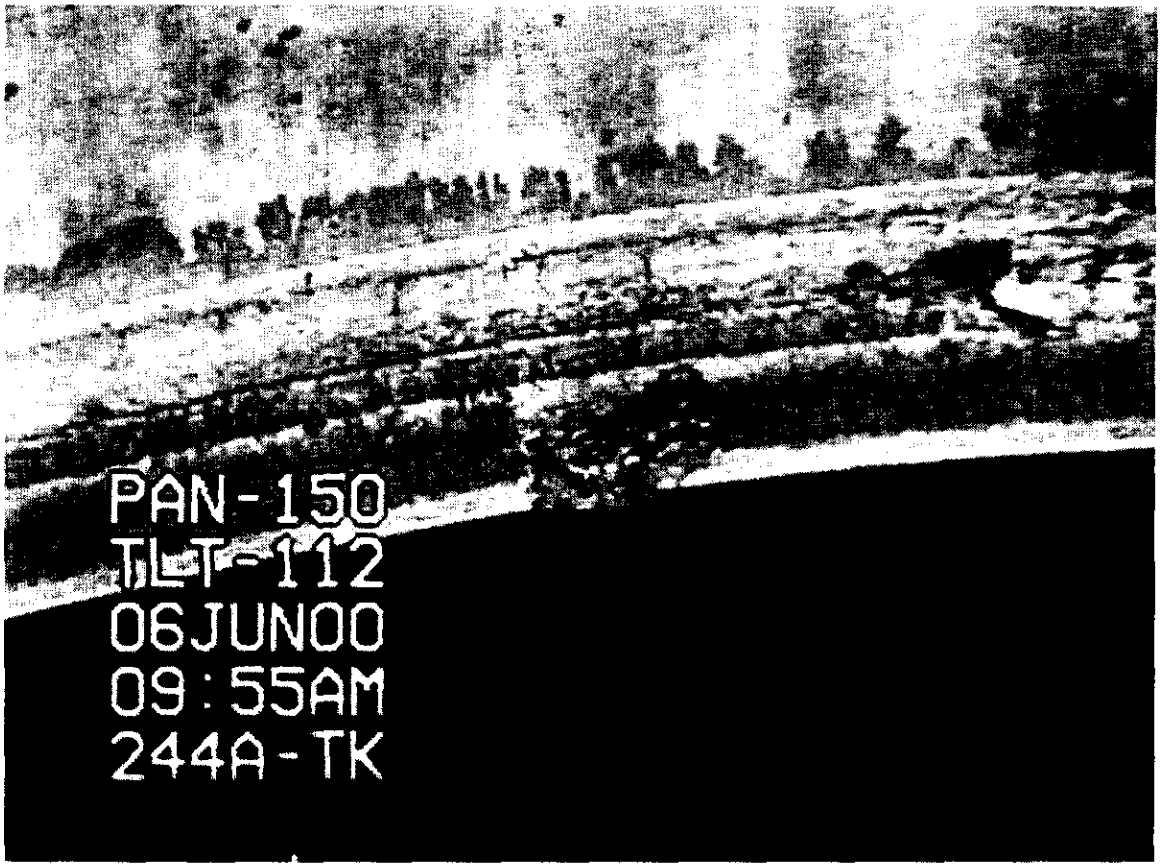


Figure H33.
Waterline Corrosion, more Intense Wall Corrosion, Upper Right, Debris Stuck on Wall, Center and Upper Right, 244-A DCRT

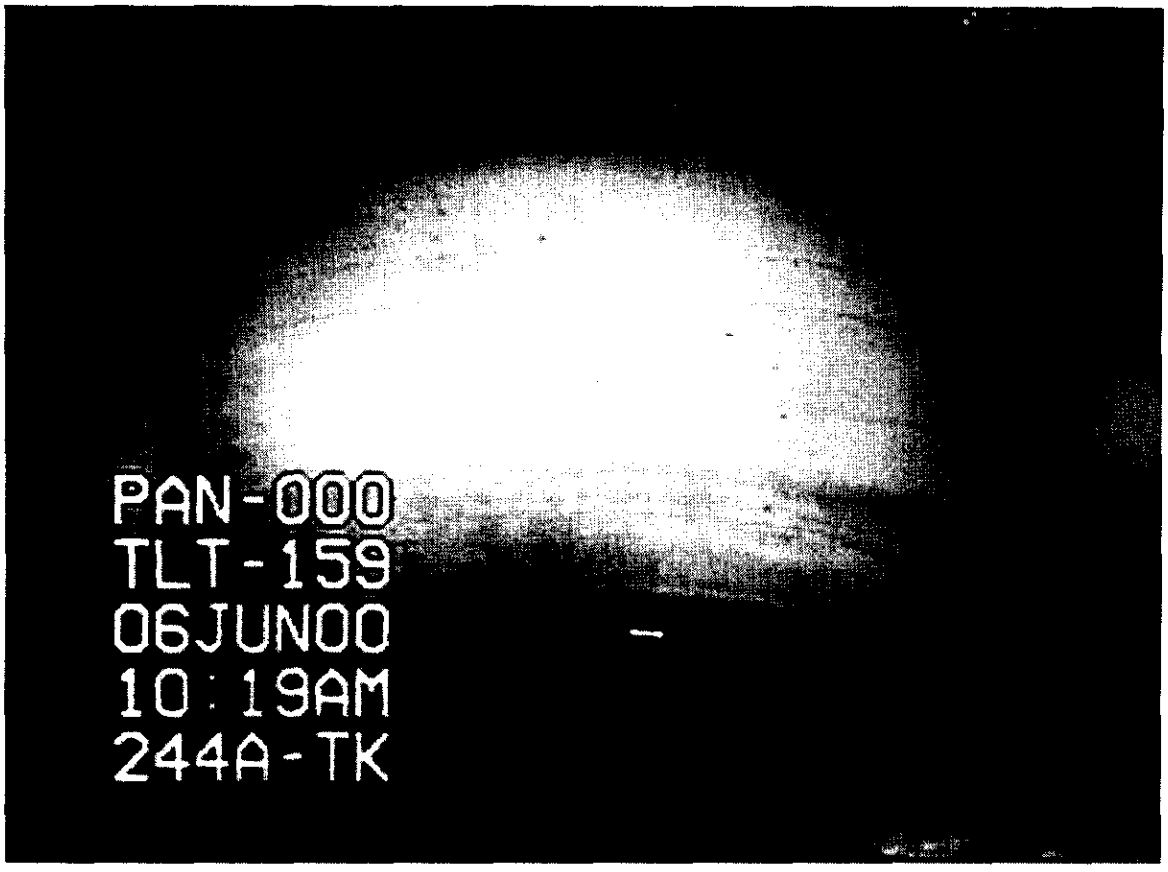


Figure H34.
Dark Marks (Possible Corrosion Pits) and Waterline Corrosion Marks on Receiver Tank Sidewall, 244-A DCRT (Westerly Direction). Top Band is a Central Girth Weldment

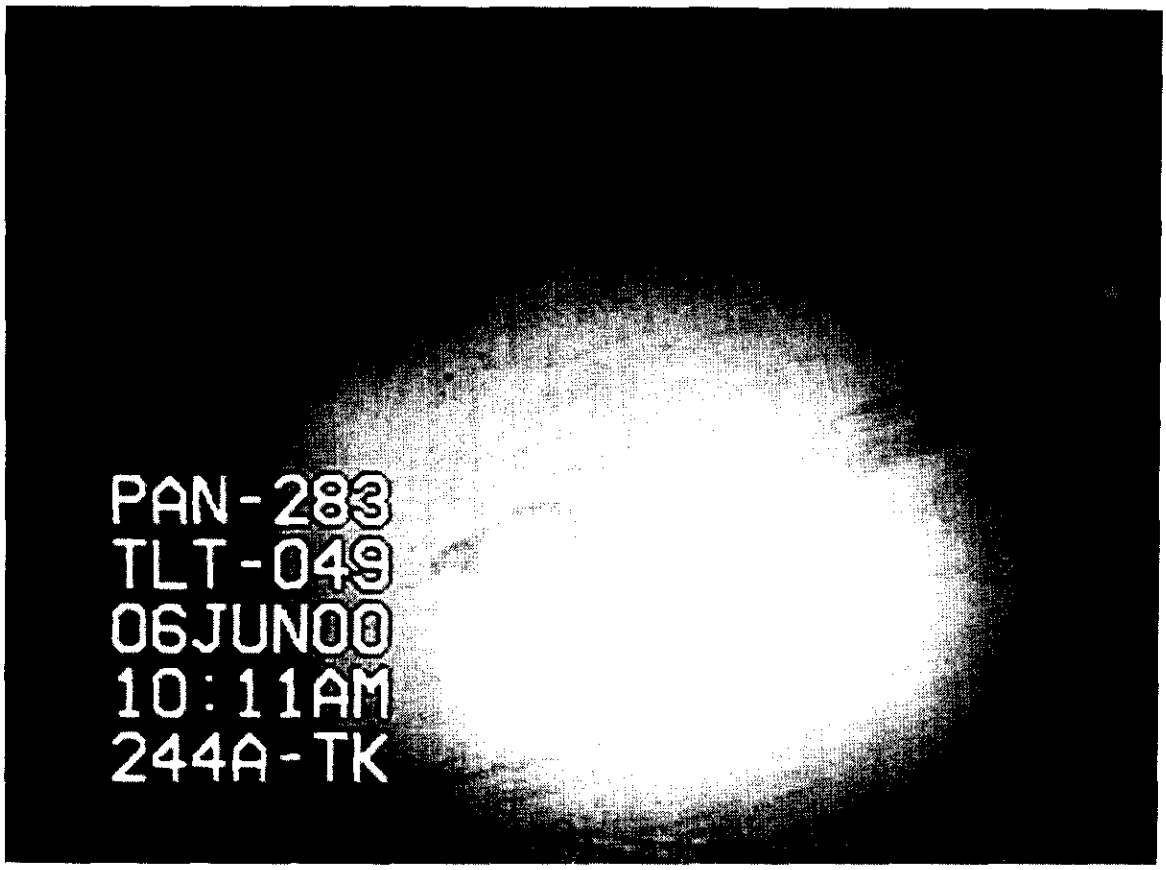


Figure H35.
View of Possible Geometric (Dark) Defect in Upper Right of Photo, at Border between Dark and Light Regions, 244-A DCRT Interior. Upper Right is Southeast Baffle Plate.

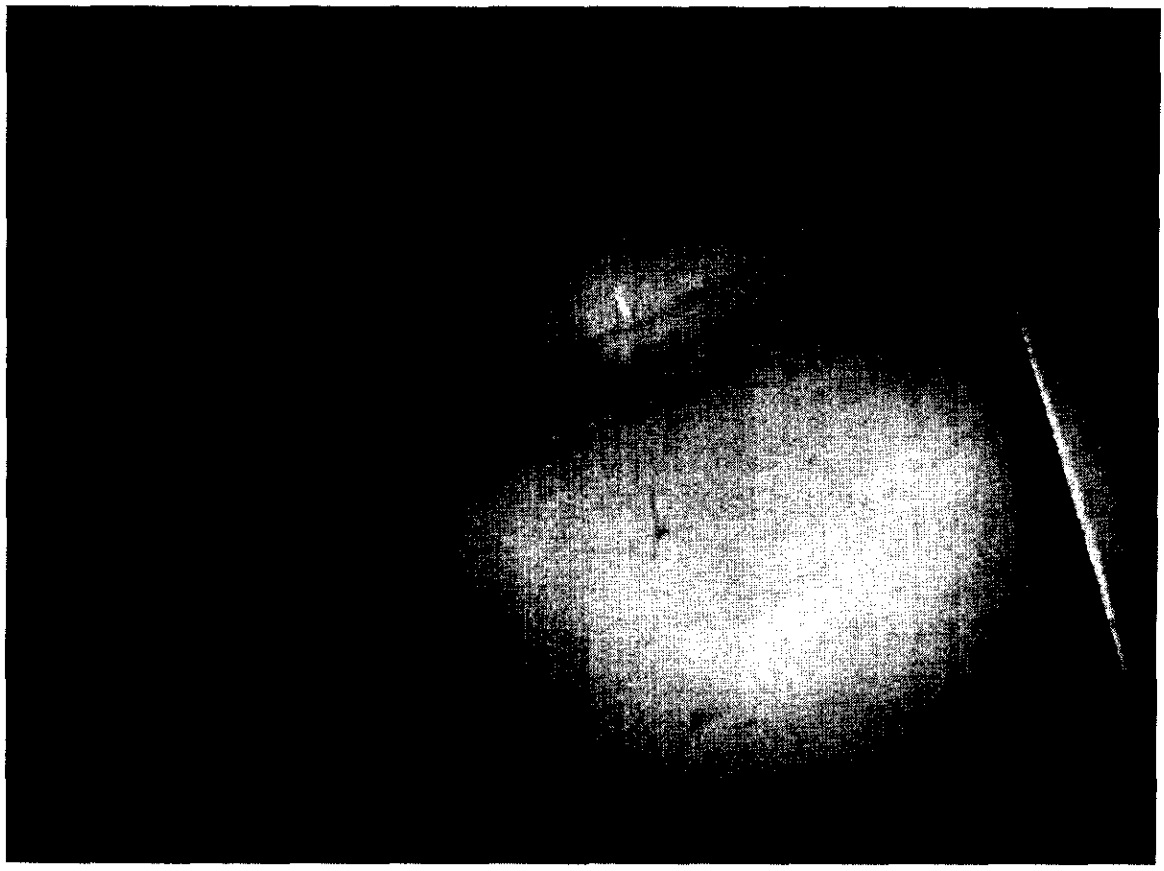


Figure H36.
View of Possible Internal Defect, about 2-4 ft below Main Girth Weldment of Receiver Tank, 244-A DCRT, Southeast Baffle Plate at Right

(videotape from 9/9/96 inspection)

Figure H37.
244-A Vertical Temperature Element Pipe (left) and Possible Indented Wall Defect (about 2 to 3 ft Right of Pipe) Adjacent to Vertical Light, Black Mark (right) Northwest Direction

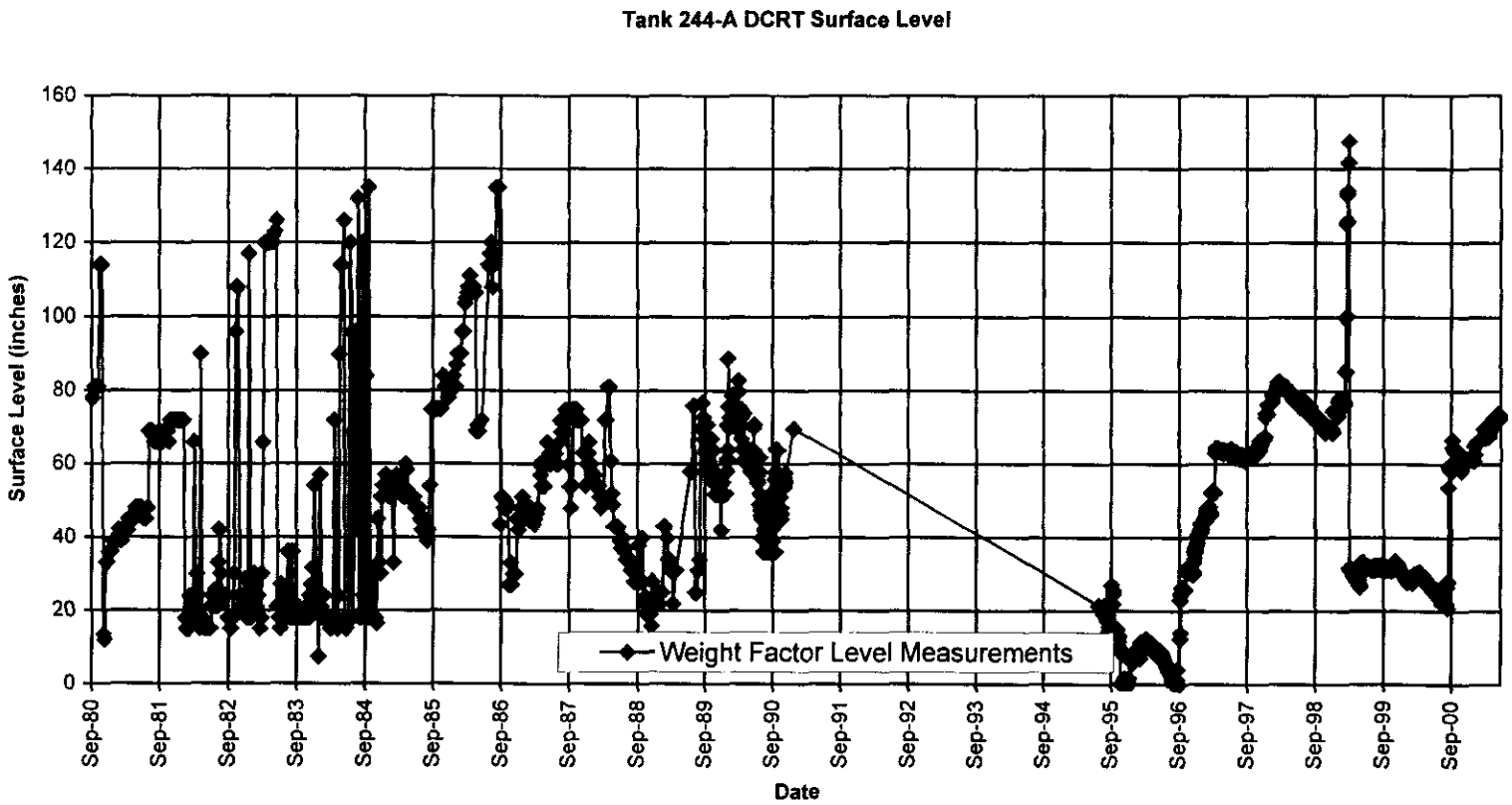


Figure H38. General Fluid Level Activity, 1980 to 2001, 244A DCRT

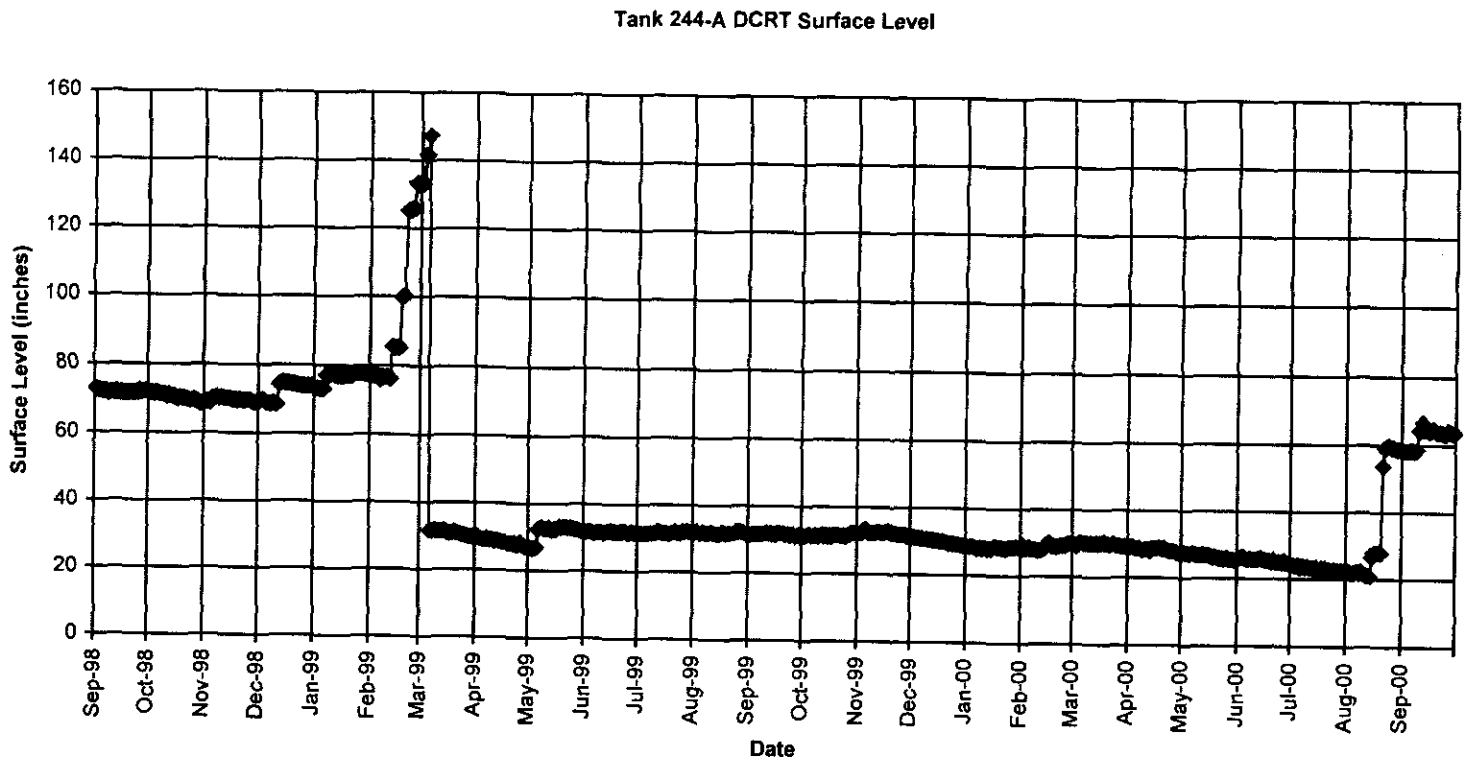


Figure H39. Surface Level Activity from September 1998 to May 2001

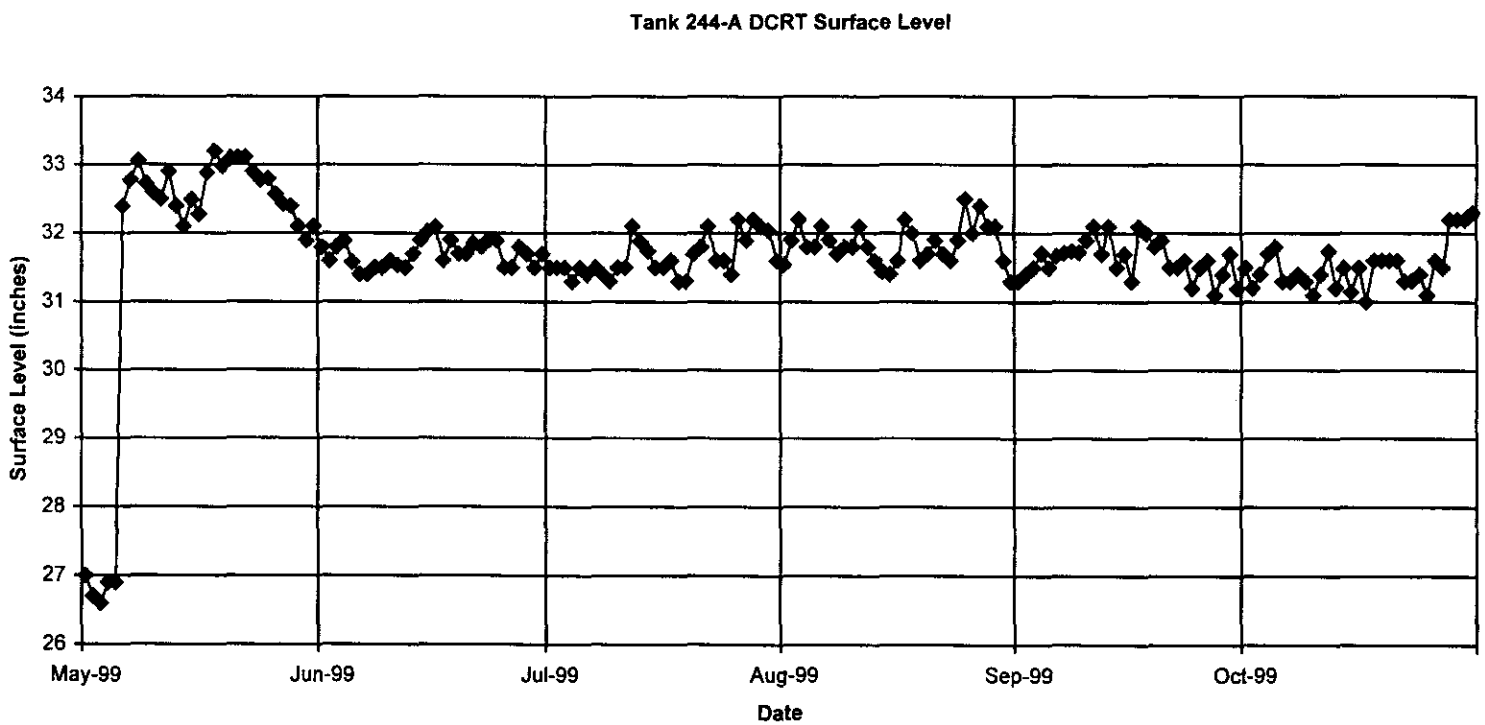
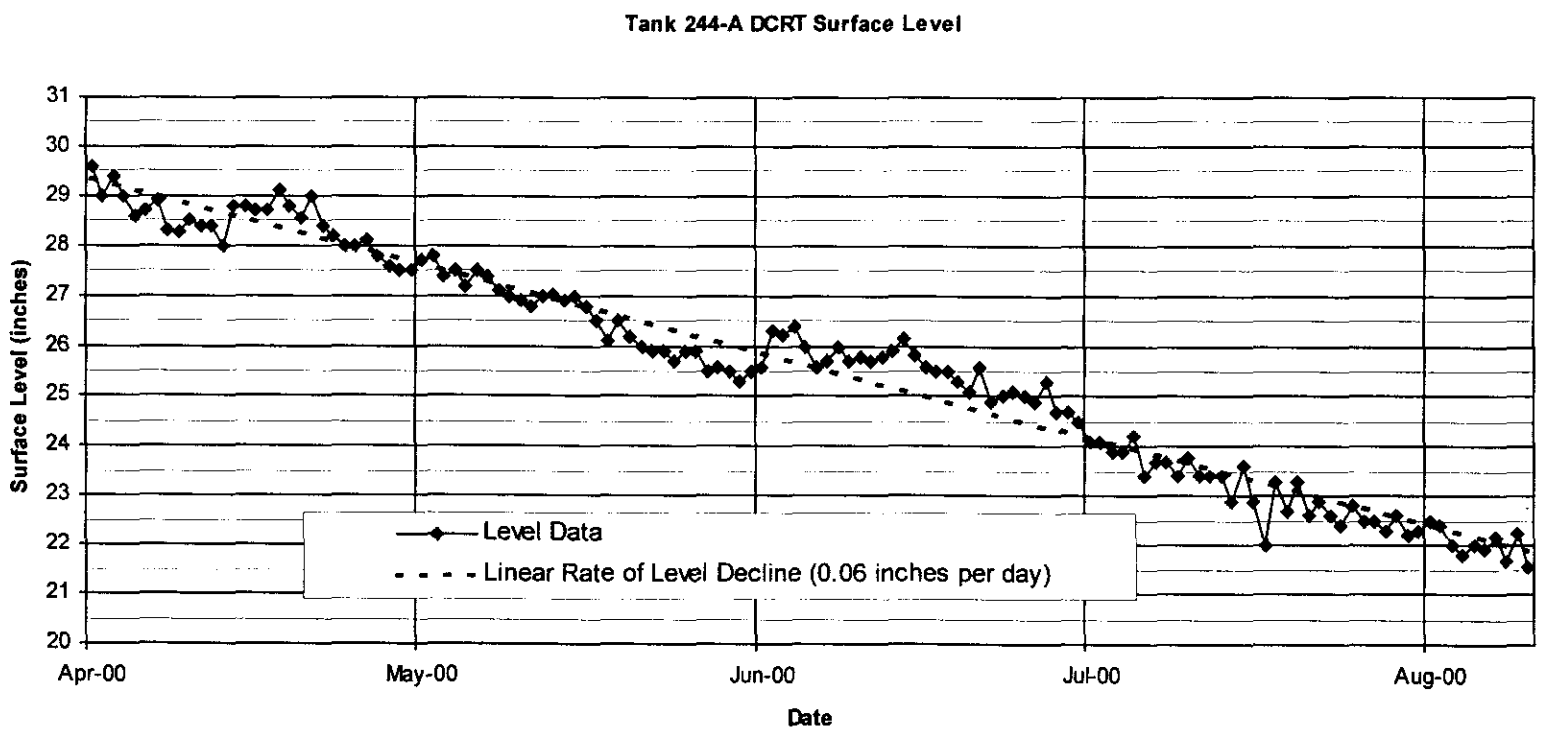


Figure H40. Surface Level Activity from May to October 1999



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APPENDIX I

204-AR WASTE UNLOADING FACILITY

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CVI	Certified Vendor Information
DTA	differential thermal analysis
FFTF	Fast Flux Test Facility
PFP	Plutonium Finishing Plant
PUREX	Plutonium Uranium Extraction (Facility)
RHA	Records Holding Area
RMIS	Records Management Information System
SS	stainless steel
SSC	stress corrosion cracking
SSE	safe shutdown earthquake
TRU	transuranic
TWRS	Tank Waste Remediation System
UT	Ultrasonic
VCR	Video Cassette Recorder
VITIS II	Video In-Tank Inspection System
WESF	Waste Encapsulation and Storage Facility

1.0 INTRODUCTION

The 204-AR Waste Unloading Facility is located just south of the 244-AR vault, in the 200 East Area of the Hanford Site (Figure I1). The 204-AR facility is used to transfer waste generated at other Hanford facilities. Waste from other facilities is loaded into a rail car tanker, or in some cases a truck-trailer tanker and shipped to the 204-AR facility. At the 204-AR facility, the waste is unloaded from the tanker and sent via the waste transfer pipeline system to selected underground storage tanks in the 200 East Area tank farm.

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the 204-AR catch tank components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, ultrasonic (UT) thickness examination, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the 204-AR catch tank pit (vault) and catch tank (TK-1). The scope of the examinations includes a visual examination of the 204-AR catch tank and pit, a leak test and a UT inspection of the vertical wall of the catch tank.

4.0 DESCRIPTION

The 204-AR Facility contains several tanks as part of its waste unloading and transfer system. One of these tanks is used as a catch tank and is commonly referred to as Tank No. 1 (TK-1). This tank is located in a pit below the main floor of the facility and is used to collect a variety of

wastes that can result from operation of the waste unloading facility. The pit acts as a secondary containment to the tank (See Figures I1 thru I3).

4.1 RECEIVER TANK CONTAINMENT VAULT (CATCH TANK PIT)

The floor and walls of the below ground catch tank pit are constructed of reinforced concrete. The inside dimensions are 6-ft wide by 7-ft long by 15-ft deep. The pit walls are 10- to 23-in. thick. The pit is lined with a 1/4-in.-thick stainless steel plate (Vitro 1977a). The liner plate covers the pit floor and walls up to a height of 10.5 feet. The 18-in.-thick concrete floor slab of the pit is sloped towards a 1-ft-wide by 1-ft-long by 8-in.-deep sump. The top of the pit is fitted with two sections of removable steel grating for access to the catch tank and the pit.

4.2 RECEIVER TANK (TK-1)

The 204-AR catch tank is cylindrical in shape, positioned with its axial centerline oriented vertically, and has a flat plate bottom and top. The bottom (plate) is sloped a few degrees relative to the tank wall, so as to minimize the residual heel volume below the pump-out line. It is fabricated of 1/4-in.-thick, type 304L stainless steel (SS), per ASTM A240 (ASTM 1973), and is approximately 102-in. high by 66-in. in diameter (WBM 1978, Vitro 1977b). Tank volume is nominally 1,500 gallons, and operations requirements (CHG 2000a) dictate a maximum allowable waste volume of 80-percent (i.e., about 1,145 gallons maximum). The catch tank is enclosed in a reinforced concrete pit having interior surface of walls lined with welded stainless steel plates (Figures I3).

5.0 DESIGN EVALUATION

This section discusses the design requirements and other information used in assessing the integrity of the 204-AR catch tank, and the pit (annulus).

5.1 DESIGN STANDARDS

Design and construction of the 204-AR facility began around 1979 and started receiving waste shipments in early 1982. The catch tank was fabricated by Welk Bros., Metal Products, Inc., of Spokane, Washington (WBM 1978). The following list identifies the sources searched for applicable requirements regarding design, material, fabrication, testing, inspection, and operating specifications.

- Conceptual Design Report (ARH 1975)
- Functional Design Criteria (ARH 1976)
- Construction Specification (Vitro 1978)
- Certified vendor information (CVI)
- Records Management Information System (RMIS)
- drawing list from Hanford Document Control
- Records Holding Area (RHA)
- Interviews with the Tank Farm Engineering

5.1.1 Catch Tank

The catch tank (TK-1), located in the 204-AR building, was designed, fabricated, and inspected in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Division 1, 1977 (ASME 1977, Vitro 1977b, WBM 1978). No code stamp was required. The tank was designed for an operating temperature of 60 degrees F. The tank was leak tested by filling it with water and holding for 30 minutes with no visible leaks observed (Vitro 1977b, WBM 1978).

To prevent the overfilling of the catch tank during operation, the operating specification OSD-T-151-00008 (CHG 2000a) limit maintains the liquid level in the catch tank at or below 80-percent of capacity. The catch tank is monitored by a level indicator/alarm. These instruments are interlocked through an electric relay to motor-operated valves. These valves are closed when the monitored liquid level is detected to be at or above the established 1,145 gallons, blocking flow to the catch tank.

The 204-AR Waste Unloading Facility is equipped with a floor drain system that drains waste into the catch tank. The catch tank has a sloped bottom (1/16-in./ft) with its lowest bottom elevation in the vicinity of the liquid waste pump-out pipe. Support of the tank, about 1 in. above the floor bottom is provided by four equally spaced 1/4 in.by 1.in. SS bars that are welded to the tank bottom. Anchorage is provided by two, 2 by 2 by 1/4 angles each attached to about one-quarter of tanks circumference at its bottom.

Waste in the catch tank can be chemically adjusted as required to meet tank farm operating specifications for waste transfers. The catch tank is equipped with a re-circulation line so that tank contents can be re-circulated for blending. Normally five to 10 minutes is adequate time for re-circulation.

A small sluicing unit located within the catch tank is used to help remove sludge (solids) buildup in the catch tank. During sluicing, water is directed downward to prevent water from entering the catch vent system (i.e., to a HEPA filter, etc.) and the catch tank overflow piping system.

5.1.2 Catch Tank Pit

The concrete pit was constructed per Project B-133 specifications (Vitro 1978). The catch tank pit is lined with a 1/4-in. stainless steel liner plate ASTM A167 (ASTM 1973, Vitro 1977a). The drawing indicates that a vacuum box leak procedure was performed. A procurement data transmittal also shows that leak testing was performed and the vacuum box leak check procedures transmitted.

The liner was fabricated off-site, placed onto the slab pour, and utilized as a form for the pit wall concrete. When the liner was installed, 1/4-in. diameter by 4-in. long steel studs were welded to the liner (Vitro 1977a). Material strength and design parameters for the pit were (Vitro 1977b):

- Structural concrete compressive strength.....= 3,000 psi
- Reinforcing steel, Fy.....= 60,000 psi
- Soil bearing pressure.....= 4,000 psf
- Live load of the lateral soil pressure coefficient....= 0.4

The catch tank pit was classified by the project as a Level I system (RHO 1977). Level I is defined as a system, or portion of a system (structures and/or components) whose failure might cause or increase the severity of a radioactive, hazardous, or toxic material release in to the environment and/or increase severity of damage to components vital to the safe shutdown or isolation of the process system. The catch tank pit was required to be designed and analyzed for seismic forces generated by a safe shutdown earthquake (SSE) event, in accordance with criteria for Category I facilities (SDC 1974).

Any liquid in excess of catch tank capacity will overflow into the catch tank pit. Both the catch tank and the catch tank pit (sump) are equipped with high-level alarms that annunciate in the 204-AR facility's control room, as well as at the 242-A Evaporator facility. Alarm signals are interlocked to close with other motor operated valves to prevent further flow into the catch tank. When an overflow of waste or a leak has been detected, the waste can be transferred to the DST farm. If the tank leaks or overflows, the environment is protected by the secondary containment of the concrete catch tank pit with a stainless steel liner. The tank has been overfilled in the past, filling the pit due to a back flow preventer valve failure in the sanitary water line (CHG 2000b).

The facility has been in service for approximately 20 years. No documentation has been found that shows any leaking or rupture of the tank in this timeframe. As a result of this evaluation, the tank is considered adequately designed to handle the waste.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

Over its approximate 20-years of operating service, the wastes sent to 204-AR primarily arrived by railcar tanker. The railcar tankers could hold up to approximately 20,000 gallons, with some shipments being near this capacity limit. In late 1998, the railcar tanker transportation system was terminated, so future shipments will only be by truck-trailer tanker. Truck-trailer tankers hold up to approximately 10,000 gallons. Discussions with tank farm engineering personnel revealed that since about mid-1998, the facility has not been accepting waste shipments for transfers to tank farms (Randklev 1999).

During a period of facility upgrades (mid-1998 to mid-1999), waste volume in the catch tank remained within the range of about 200 to 400 gallons, according to the daily (hardcopy) records (i.e., minimum of one reading per day required for this catch tank). About 200 gallons of waste inventory is needed to ensure that the inlet (bottom) openings of the level measuring instrument (bubbler pipe) and the pump-out pipe, etc., remain immersed in the liquid waste, which helps avoid plugging problems from wastes depositing out from the vapor phase above the waste.

5.2.1 Facility Sources and Waste Character of Past Shipments

Over its operating history, there have been numerous sources of the various (liquid) facility wastes sent to the 204-AR facility for transfer to tank farms. As described by Koerner (Koerner 1986), the 204-AR facility began receiving waste shipments in January of 1982, with the expectation of receiving Hanford facility waste that originated primarily in the 100N and 300 Areas. The recent review of the waste transfer records revealed that during its history, the facility has performed waste transfers from a much larger set of facility sources. These sources are as follows: 100N in the 100 Area; 222S/219S Labs, T Plant and the Plutonium Finishing Plant (PFP) in the 200 West Area; B Plant and PUREX in the 200 East Area; the Fast Flux Test Facility (FFTF) in the 400 Area; and the 340 Collection Facility in the 300 Area.

The chemical character of these wastes varied considerably from source-to-source and even between certain shipments from the same source facility. All wastes shipped to the 204-AR facility, for pipeline transfer to tank farms, have had to meet certain chemical composition requirements (Kirch 1984). Over the past 10-years (1990s), this set of requirements has become both topically more extensive and progressively more restrictive. In addition to the standard set of requirements, there can be additional requirements imposed on a proposed waste transfer, depending on the subject waste, the destination tank, and the waste already in it.

In the past 10-years or so (1990s), additional requirements have been imposed as revisions to the operating specifications for the 204-AR Waste Unloading Facility (LMHC 1999). One requirement was that there be no separable organic phase in the waste. Further, differential thermal analysis (DTA) test results must confirm that there are no exotherms below 450 degrees F. This was later changed to 335 degrees F. A maximum limit was set on the allowable concentration of plutonium (Pu) in the waste received and transferred. Nitrate limits were set at 0.001M and 5.5 M for incoming waste. Hydroxide lower limit was set at 0.1M. Finally, chloride levels were set at 0.01M but with an exception for some types of waste shipments where it had to be 3.5 M. A particularly extensive set of requirements were imposed starting in 1995, per DOE Agreement with Ecology as outlined in the Washington state regulations for dangerous waste (WAC 1998).

Since the mid-1990s, the operating specifications (LMHC 1999) require that a comprehensive assessment of waste compatibility (i.e., evaluating the potential of flammability, ignitibility, and reactivity, which includes corrosion, etc.) must be performed as part of the authorization of any waste transfers. This waste compatibility assessment pertains to the waste and its possible interaction with the transfer system, the tank, and the wastes already residing in the tank proposed for receiving the waste shipment. The compatibility assessment includes topics, such as flammable gases, energetics (organics, etc.), corrosivity, chemical compatibility (i.e., tank farm waste), transuranic (TRU) waste segregation, heat generation, complexant waste segregation, phosphate waste, and Reynolds number. These are described in detail in five documents: (Fowler 1995), (Cox 1997), (HNF 1997), (Mulkey and Miller 1997) and (Mulkey 1998). To do such an assessment requires detailed compositional analyses of samples taken from the subject waste. Blaak 1997 is an example of a compatibility assessment that was applied to a shipment of 222-S Laboratory waste prior to shipping it to the 204-AR facility and on to

tank farms. Such assessments also describe in detail how the above mentioned compatibility assessment topics are evaluated.

5.2.2 Waste Delivery Lines and Character of Wastes Entering the 204-AR Catch Tank

There are 12 pipelines that enter the 204-AR catch tank, and seven of these pipes can provide pathways for wastes to enter the catch tank (i.e., radioactive and/or non-radioactive waste streams within 204-AR process). The (non-radioactive) solutions in the chemical adjustment tanks can reach the catch tank by several of these pathways (e.g., overflow or draining to the floor drain system, water flushing of the process delivery lines for these chemicals, or routing directly from the chemical adjustment supply tanks to the catch tank). The floor drain system and vent lines (e.g., steam condensate) can deliver either or both non-radioactive and radioactive wastes to the catch tank, but most of these wastes arrive highly diluted by raw water used in washdown activities. The catch tank pit, including its sump, can be pumped out and the subject wastes can be routed, if need be, to the catch tank for later transfer to tank farms. The 204-AR waste transfer process is controlled to ensure that the catch tank only receives very small quantities of tanker waste and in a condition that is highly diluted with raw water (e.g., via unloading lines, washdown of the unloading room, etc.). Unlike most other Hanford Site catch tanks, no significant amounts of rainwater or snowmelt water reach this catch tank, because the unloading room is closed except when the waste tanker arrives and departs.

5.2.3 Future Waste Transfers

As noted earlier, the 204-AR waste unloading and transfer facility is slated to continue operating for years to come. The following is a list of facilities that are expected to continue operating and shipping facility wastes to the 204-AR facility for transfer to tank farms:

- 222-S Laboratory -- (a variety of laboratory waste-some challenging various 204-AR acceptance limits)
- T Plant -- (dilute aqueous solutions of decontamination waste-originating from other facilities)
- Waste Encapsulation and Storage Facility (WESF) -- (operations waste)
- Fast Flux Test Facility (FFTF) -- (operations waste-if it returns to operation)
- 325 Laboratory and testing facility -- (a variety of laboratory waste, some of which may challenge various 204-AR acceptance limits)

Chemical compatibility, between the 204-AR catch tank and the wastes it receives and stores, is accomplished by the combination of tank design and operations and the control of certain characteristics of the wastes involved. These were described earlier in Section 5.2 under *Facility Sources and Waste Character of Past Shipments.* Because of the very satisfactory combination of the facility's chemical controls and the tank's appropriate design and construction the tank is considered adequate for handling and storing waste.

5.3 CORROSION PROTECTION

As mentioned in Section 5.2, the concerns about waste compatibility cover not only the topical concerns regarding waste interactions, but also cover the topical concerns regarding waste-metal interactions, which could involve containment equipment, such as the subject catch tank. In this section, possible corrosion attack of the tank by waste it might hold during 204-AR operations and the corrosion protection measures that are in place are discussed.

Corrosion protection of the 204-AR catch tank is provided primarily by the combination of design and corrosion control, which is implemented per the operating requirements.

The tank is made of welded 304L stainless steel, per ASTM A240 (ASTM 1973). This alloy is resistant to uniform corrosion attack from typical Hanford caustic wastes (i.e., containing relatively dilute concentrations of nitrate, nitrite, and hydroxide in water and sludges). It is also resistant to uniform corrosion attack by dilute solutions of water. This alloy is, however, susceptible to localized attack by pitting corrosion and by stress-corrosion cracking mechanisms. Both of these types of localized corrosion attack are especially affected by the concentration of chloride ions in the corrosion media contacting this alloy. The influence of chloride is especially high when the pH conditions are near-neutral (i.e., pH about 6 to 8).

For the 204-AR catch tank, this media is typically highly dilute aqueous solutions of radioactive and non-radioactive chemical wastes from various Hanford processing or waste sample analysis facilities. Much of this dilution comes from the raw water flushing (e.g., chemical adjustment tanks, the various piping lines in the 204-AR waste transfer process), and from wash-down activities (e.g., decontamination of the tanker unloading room). These are common and routine activities performed as part of normal 204-AR waste transfer operations, which contribute such aqueous waste solutions to this catch tank. Hence, it is likely that on some occasions, the waste in this catch tank could have had a pH condition that was in the near-neutral range noted above. The incubation times associated with pitting corrosion attack and with stress-corrosion attack of such an alloy (i.e., 300 series stainless steels) could be less than a year. This catch tank has been in service for about 18 years, so relative to exposure time, such attack may be occurring.

In non-welded austenitic stainless steel, the probability of chloride-stress corrosion cracking (SCC) decreases significantly below about 130 degrees F (Smets and Bogaerts 1992). However, in welded austenitic stainless steel, chloride-SCC continues to occur even at room temperature (McIntyre 1990). While the probability of its occurrence is low, it is not eliminated as a damage mechanism.

The recent examination (Section 6.0) of 204-AR (TK-1) revealed no degeneration of tank wall, and the tank is not leaking.

5.4 AGE OF THE TANK SYSTEM

The age of the 204-AR facility is approximately 21 years, which includes nearly 20 years of operation. Construction of the 204-AR building started in the early part of 1979 with full service available in 1982. Since then, the facility has been operated by transferring waste from the 100N and 340 building, which are the two major suppliers of the waste. Other areas from which waste is transferred are the 222-S labs, the PFP, T Plant, and B Plant. No integrity assessment of this facility has been performed since its construction.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations (both visual and ultrasonic inspection) were performed in 2000. These examinations were done to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since completion of construction approximately 20 years ago.

6.1 VISUAL EXAMINATIONS

Visual examination was conducted in the tank annulus with a video camera. Date of examination of the pit and tank exterior was August 16, 2000. The tank was partially full with 515 gallons, which is approximately one-third the capacity of the tank.

Visual examination details and data sheet findings are included in 16 photographs (Figures I4 through I19) and one video examination data sheet (Table I1). The 16 individual 'still photographs,' taken from the videotapes and presented in the above noted figures, show the very satisfactory condition of the pit and catch tank exterior.

6.1.1 Catch Tank Visual Examination Details

Access to the tank exterior (annulus) was obtained by lifting movable portions of the tank grating cover (the northwest and northeast corners of the pit). A Circumspector™ video camera, with attached light, was lowered into the pit in both corner regions (see Figure I3 for orientation of the catch tank in its pit). Additional lighting was provided by a fluorescent tube-light. No time, date, pan, tilt, nor tank designation information was provided in the field-of-view of the camera. As a result, the only identification noted for each photograph is its time-position on the videotape, when the still photo was taken.

Eight photographs of the tank exterior region were taken, and are shown in Figures I4 through I8 and I13 through I15. These photographs were taken from both corners of the pit. In general, the tank exterior surfaces appeared to be in very satisfactory condition. Only insignificant markings or blemishes, on the tank, were noted.

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Because of access limitations, no internal visual examinations were performed for this tank. However, to increase confidence in the integrity of the tank, ultrasonic inspection of the tank wall was performed from the tank exterior.

6.1.2 Catch Tank Pit Visual Examination Details

Eight photographs (Figures I9 through I12 and I16 through I19) were taken of the annulus or pit, sidewalls and bottom. Like the tank exterior, the pit also appeared in very good condition. Some innocuous, oily-like substance appeared to have been spilled or, at least collected in, a region of the pit near the sump (Figure I9). All weldments appeared satisfactory, although one vertical liner wall-to-wall weld showed an apparent weld stop and re-start defect (Figure I10). The height of this defect precludes it from coming in contact with waste if the catch tank were to fail.

Visual examination of the 204-AR catch tank and pit (annulus) indicates that the tank has not leaked and that it is in very satisfactory condition.

6.2 ULTRASONIC INSPECTION OF TANK WALL

The ultrasonic (UT) inspection was performed on August 15, 2000. Because of inaccessibility to the interior of the tank, UT inspection of the tank wall was performed from the exterior of the tank. The equipment used was a 1/2-in.-diameter spring-loaded transducer mounted at the end of a pole, with water as a couplant. To take readings, this transducer mounted pole head was lowered in succession along the tank wall. Tank wall thickness was measured at two vertical locations along its entire height and separated approximately 90 degrees apart. This equipment was used to measure wall thickness only and did not have any capability to record other indications such as pits or cracks. Thickness readings were taken at approximately 6-in. intervals. The UT results showed that the minimum tank wall thickness measured was 0.264-in. and maximum was 0.309-in. The nominal design tank wall thickness is 0.25-in. The UT results were interpreted by Level II UT Inspectors and reviewed by a Level III UT Inspector (see Attachment 1). The fact that the UT-measured wall thicknesses are greater than 0.25-in. thick is likely due to three possible factors: the fabrication procedure used during tank manufacturing, normal minor variations in remote UT measurement system, and wall thickness tolerance (see Attachment 2). The UT measurement process was checked and verified in the Hanford 306 E laboratory, prior to 204-AR tank inspection (see Attachment 3). In addition, the UT measurement system was checked using a calibrated step block, just before, and after inspection. Pacific Northwest National Laboratory (PNNL), as an independent third party, also reviewed the UT results. PNNL's evaluation is provided in Attachment 4.

6.3 LEAK TEST

A 120-hour leak test on the 204-AR catch tank (also designated LI-Tk-1) was conducted July 19 through July 24, 2000. Prior to the start of the test approximately 1,150 gallons of waste had been allowed to accumulate. Liquid waste that would have normally flowed to the tank was halted in order to ensure that the waste level did not increase during the course of the test period. A 50-hour duration was considered as the minimum time over which the leak test needed to be

conducted to satisfy the established leak detection criteria of a volume change. Leak test data presented in Tables I2 and I3 show no measurable change in liquid level between July 19 and July 24, 2000. Thus the tank is not leaking.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluations in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The tank has been in service underground for about 20-years without any leaks reported, and during the visual examination of the tank pit and tank, no evidence of leaks was observed. At the time of its construction, adequate design controls were used to withstand applicable design loads.

2. Chloride-induced pitting corrosion and stress-corrosion cracking, initiating from the tank's interior, are possible modes of long-term leakage failure. These types of failure processes are caused by dilute solutions of waste that may be near-neutral in pH value. Therefore, every two years a visual examination of the tank exterior is recommended to monitor for possible leakage due to chloride-induced pitting and cracking.

3. The 204-AR catch tank (TK-1) system is in a very satisfactory condition. Another UT inspection should be performed within the next 10-years.

8.0 REFERENCES

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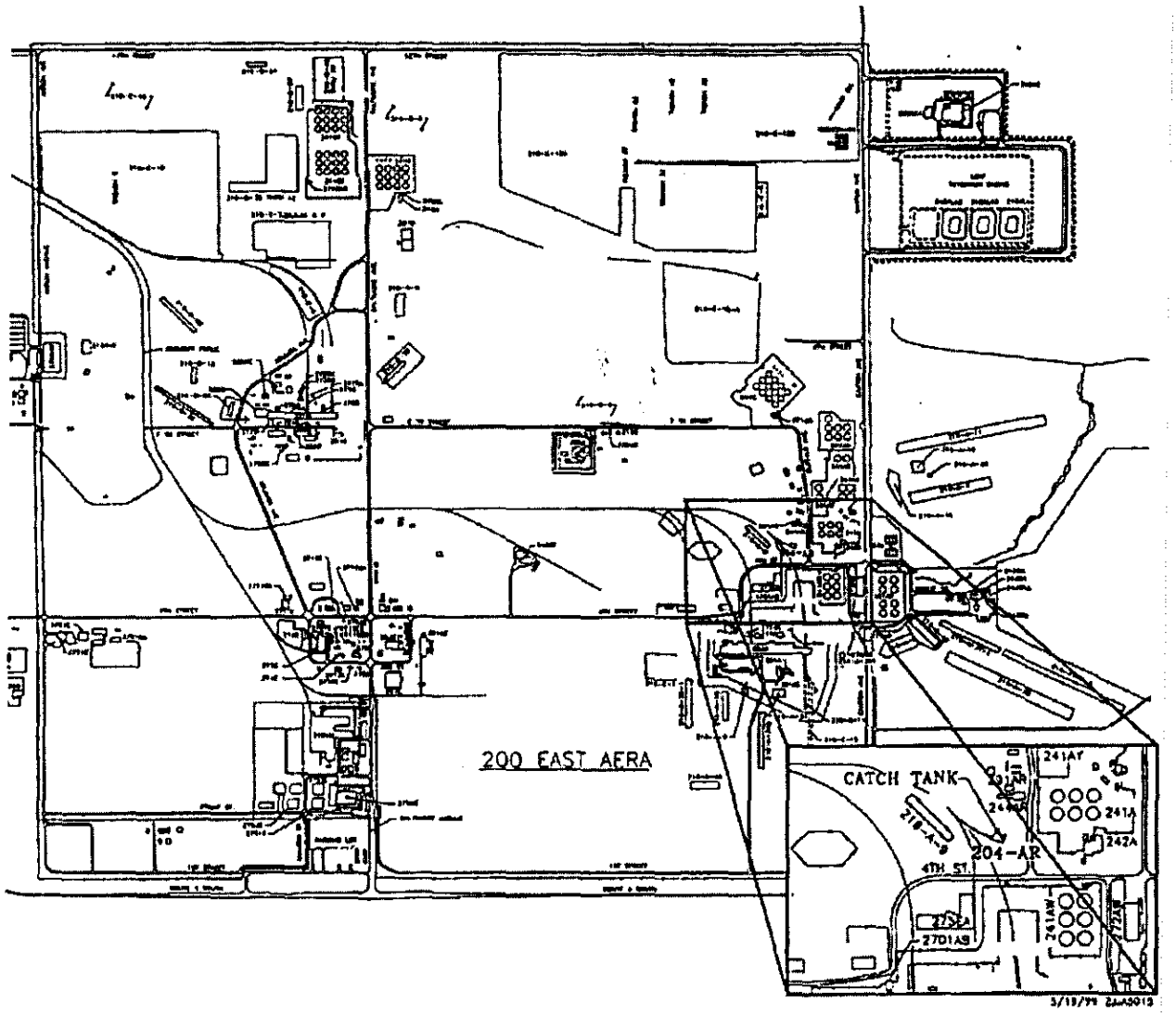


Figure I1 204-AR Site Plan

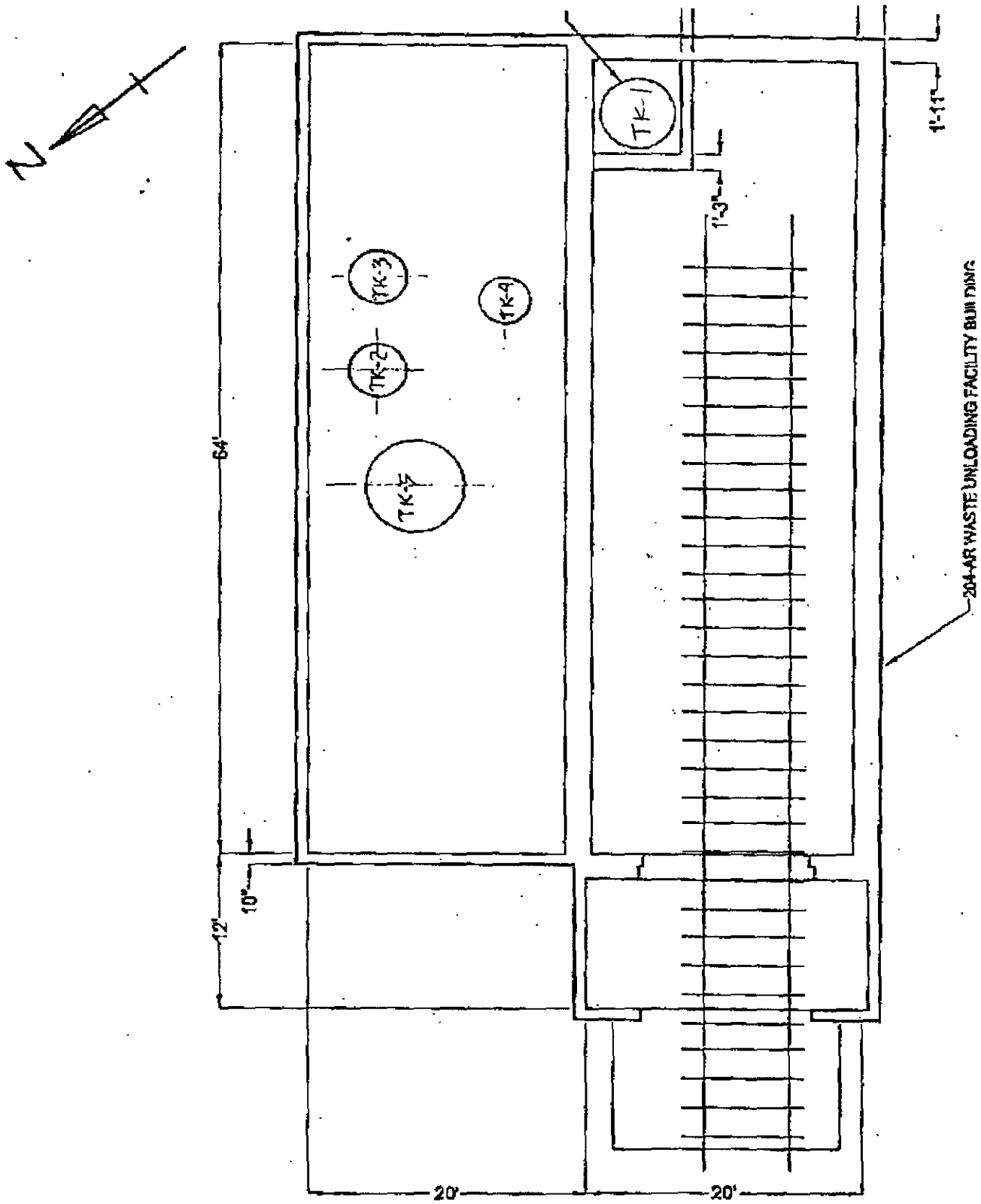


Figure I2 204-AR Waste Handling Facility

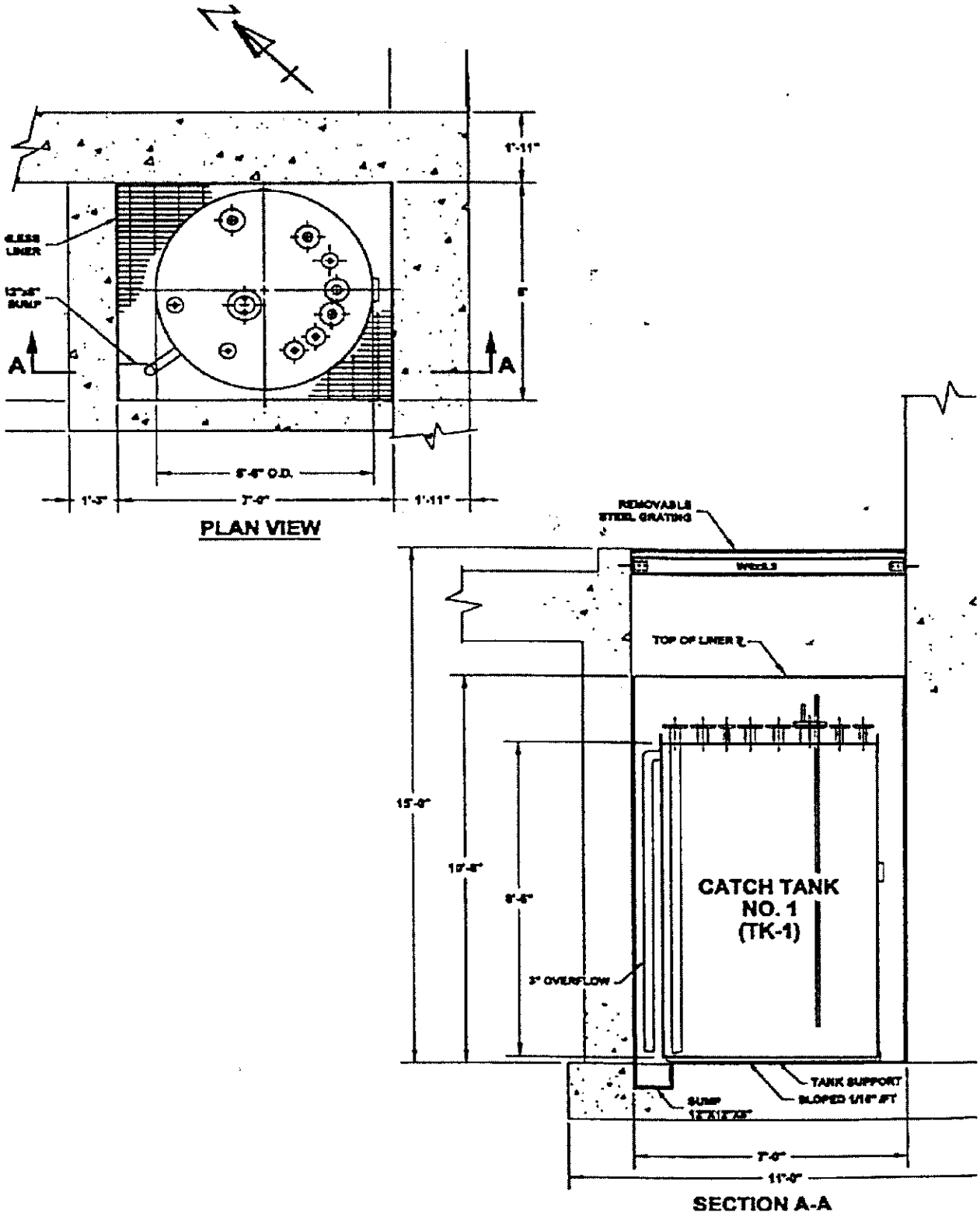


Figure I3 204-AR Catch Tank

Table I1. Video Examination Data Sheet, 204-AR Waste Unloading Facility Catch Tank TK-1

Examination Date: 8/16/00

Person In Charge: D. P. Niebuhr Camera Operator: W. A. Morris Video Examiners: E. B. Schwenk

Riser: Entrance Through Movable Gratings Above Tank

Video Tape Reviewer: E. B. Schwenk Date: 9/00

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The catch tank in the 204-AR Facility was examined with a Circumspector Camera and light. Ingress of the camera was provided by lifting portions of an overhead grating, which was located about 6-ft. above the tank. Location of the ingress was, essentially, in the northwest and northeast corners, respectively of the pit (or annulus); see plan view of Figure I-2. Proximity of the tank to the walls of the pit (as low as about 6-to 9-in.) precluded the use of the longer, and more flexible, VITIS II Camera. The relative magnification level of the following photographs, made with the Circumspector camera, depend mainly on the distance of the camera's lens from the subject. Never-the-less, reasonable quality videotaping (and photographs) was still obtainable. It was not possible, electronically, to put facility-specific information in the field-of-view of the camera. For example, there is no indication of the facility number, date, pan, and tilt on the photographs. Time, as shown by the video cassette recorder (VCR) is shown in each Figure caption. Additional lighting was provided by a fluorescent tube light.
					The following narrative and photographs demonstrate that the approximately 20-year old tank stainless steel (SS) tank and its SS-lined pit are in very satisfactory condition.
					A view of the very good condition, of a portion of the top circumferential weld in the 204-AR Catch Tank, is shown in Figure I4. Some innocuous vertical paint-marks are also evident.
					Two, intersecting light dents in the sidewall of the catch tank are shown in Figure I5.

Table I1 Video Examination Data Sheet, 204-AR Waste Unloading Facility Catch Tank TK-1 (continued)					
					Two proximal circumferential welds, near the bottom of the tank, are shown in Figure I6. Both appear very satisfactory. The second weld may have been required, during fabrication, to produce a slightly sloped bottom to the tank.
					A closer-view of the bottom circumferential weld, and some non-significant circumferential scratches (or, perhaps roll marks) are evident in Figure I7.
					Figure I8 shows a typical view of the sidewall of the 204-AR catch tank. Some light blemishes, scratches and typical minor pits are evident.
					Figure (I9) begins a series of four photographs (I9-I12) typical of the joints in the pit's welded SS liner. Both the bottom-wall and wall-to-wall welds appear satisfactory. The dark substance at the pits' northwest bottom appears to be an oily-like substance that had probably been spilled from above the catch tank.
					Approximately ½-way up the wall, of the northwest corner of the annulus, is a point where the weld process may have been stopped and re-started, leaving a minor notch-effect and potential leak-path to the concrete (Figure I10). Even if the tank were full, and leaked fully, it is unlikely that the level of the waste would reach this point.
					A close-up view of the northwest corner weldment, with some minor, typical porosity is shown in Figure I11.
					Figure I12 shows the top of the welded SS liner. The material around the top of the liner is probably a sealant between the steel and its contiguous concrete.
					Figures I13 through I15 show views of the very adequate condition of various fittings and piping on top of the tank.
					The next three figures, I16 through I18, show the very satisfactory condition of each of the other corners of the top of the pit, where the SS liner adjoins the concrete.
					Figure I19 shows what appears to be a lifting lug, on the side of the tank.

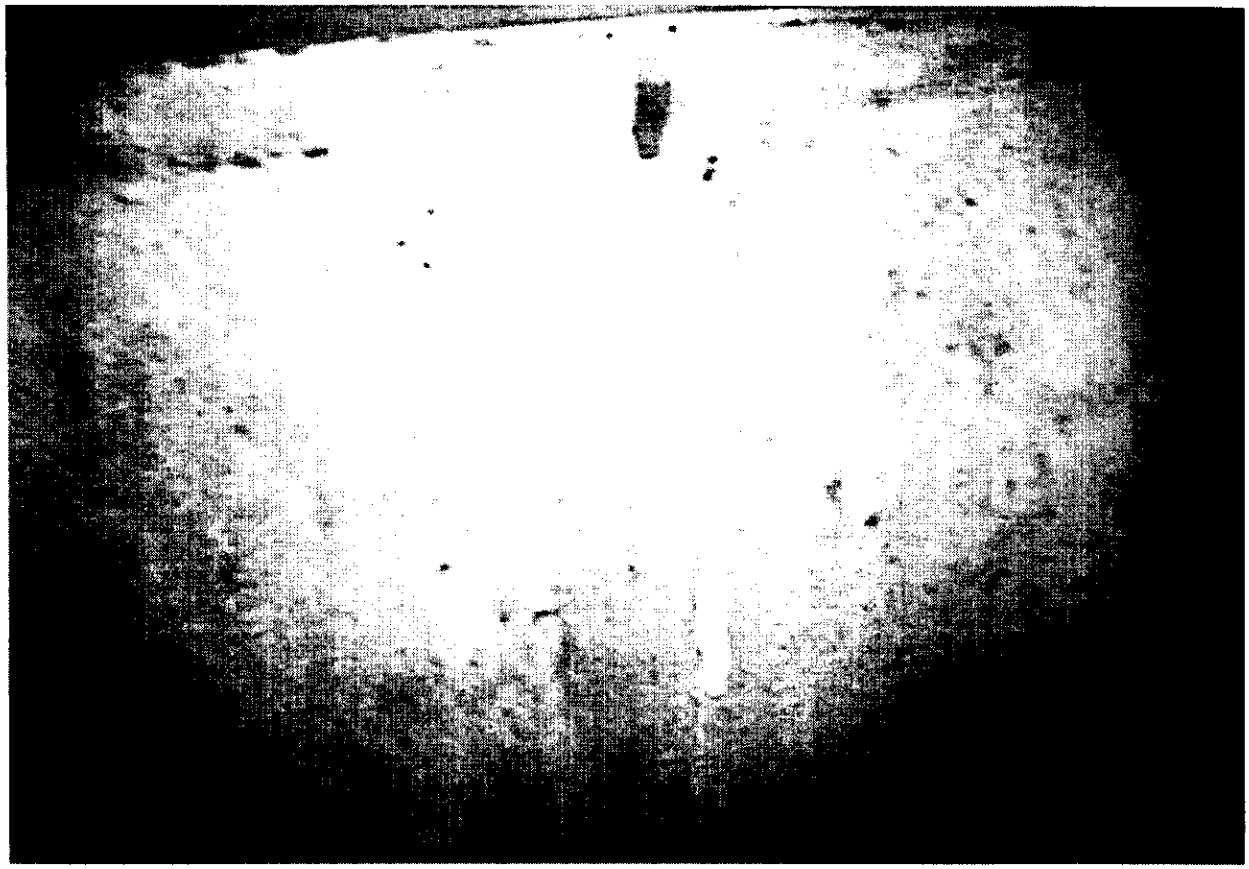


Figure I4
View of Top Circumferential Weld, 204-AR Tank Tk-1. Entrance at Northwest Corner of Pit. Time: 14-min.

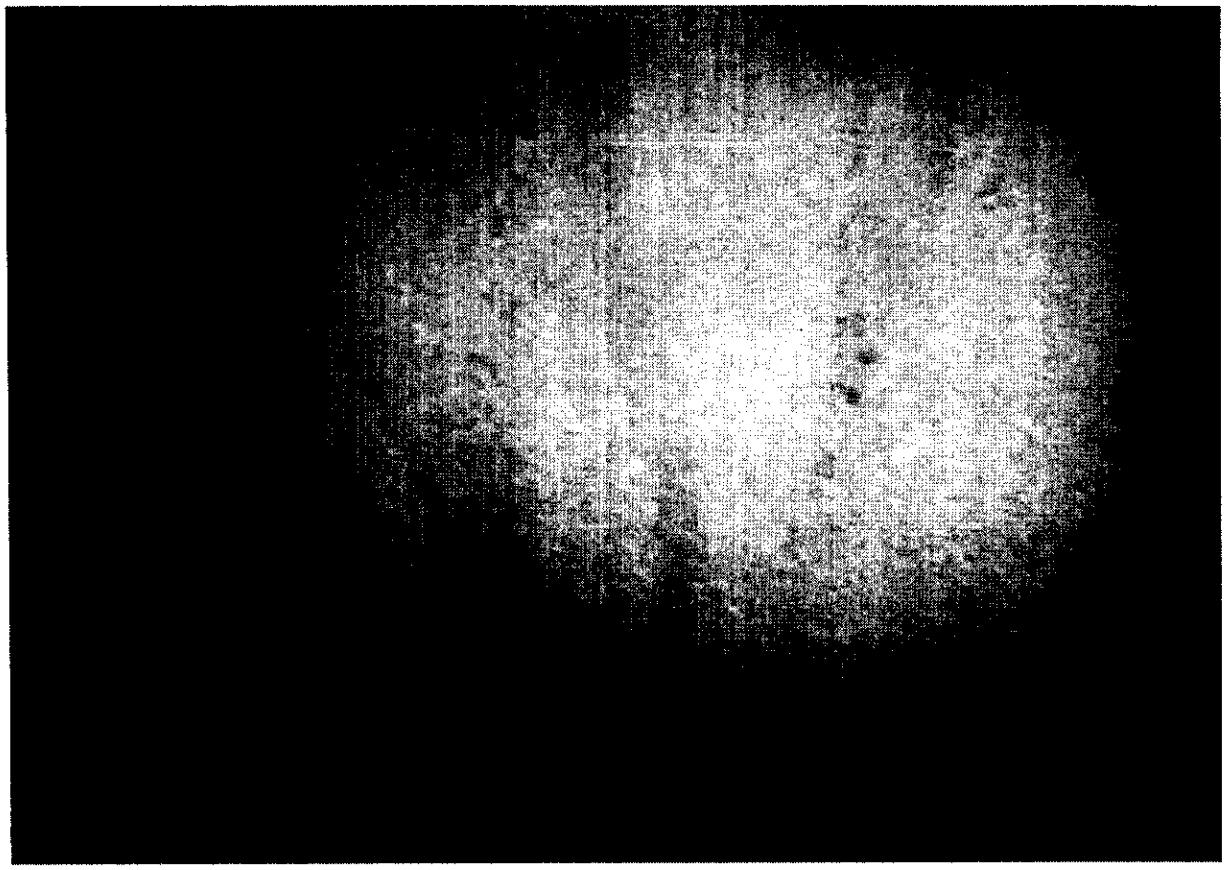


Figure I5
View of Intersection of Horizontal and 45° Angle Dent-Like Marks (left-and-below-center) in Sidewall of 204-AR Tank Tk-1. Entrance @ NW Corner of Pit. Time: 5-Min.

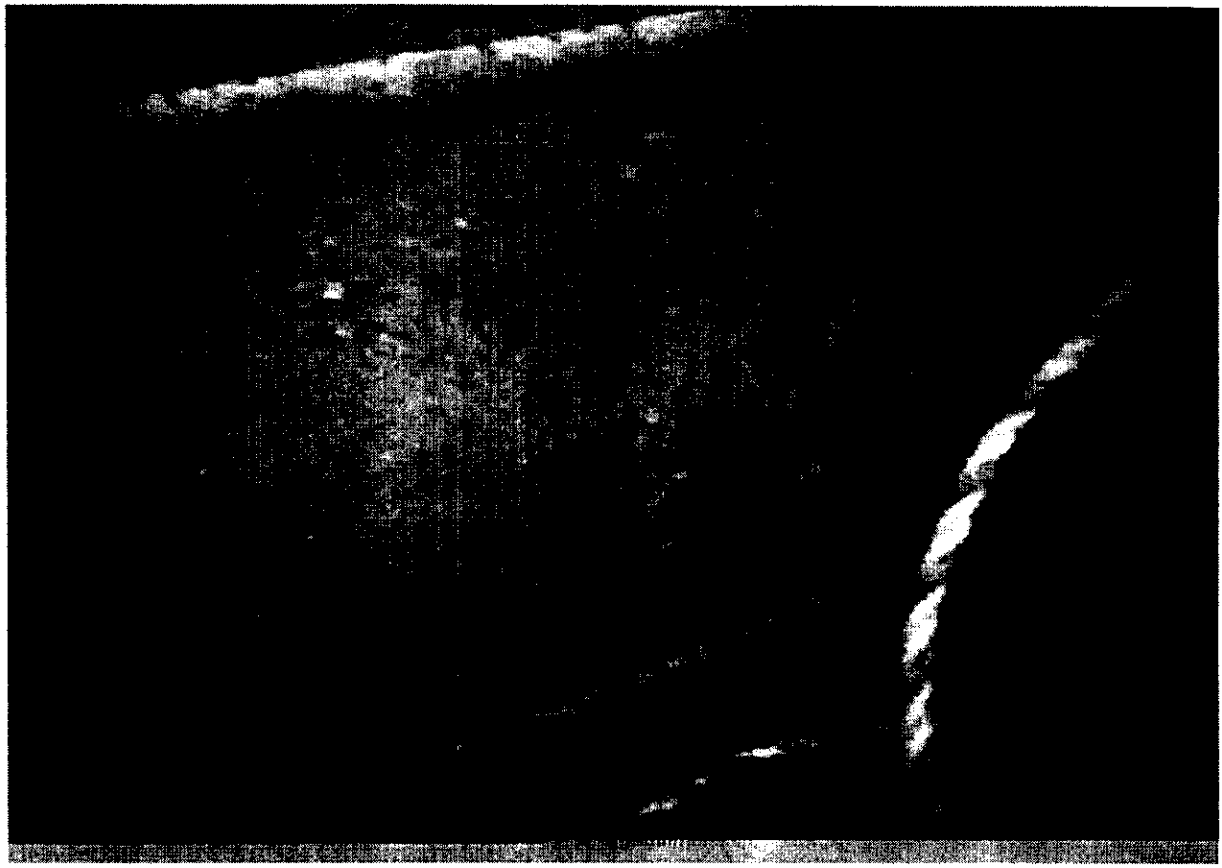


Figure I6
View of Two Circumferential Welds: One at Tank Bottom and One About 6-in. Above, 204-AR Tank Tk-1. Entrance @ NW Corner of Pit. Time: 17-Min.

Figure I7
View of Bottom Circumferential Weld and Scratches, 204-AR Tk –1.
Entrance @ NW Corner of Pit. Time: 16-Min.

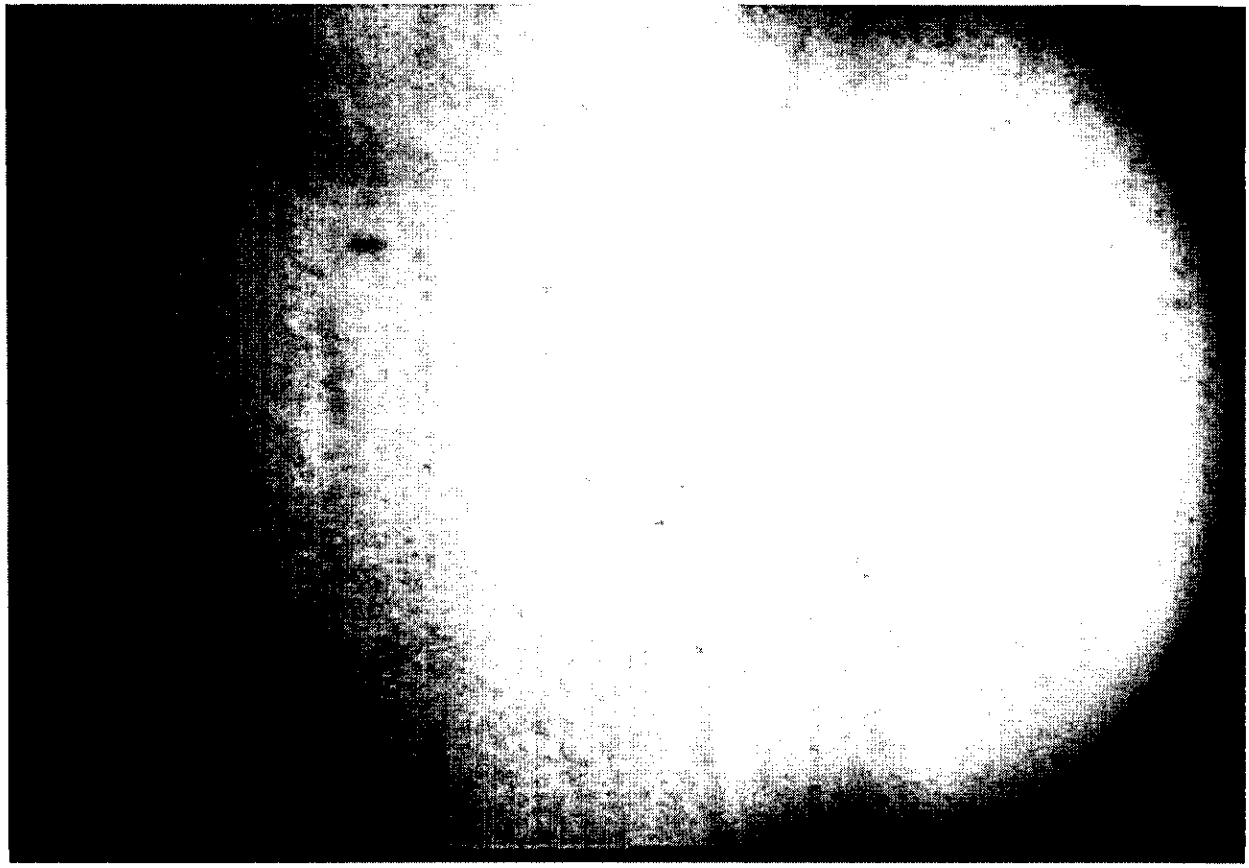


Figure I8
Typical View of Tank Sidewall, 204-AR, Tk-1. About ½-way Point on Wall. Entrance @ NW Corner of Pit. Time 17.5-Min.

Figure I9
View of Northwest Corner and Bottom of Annulus, 204-AR Tank Pit.Time: 23.5 Min.

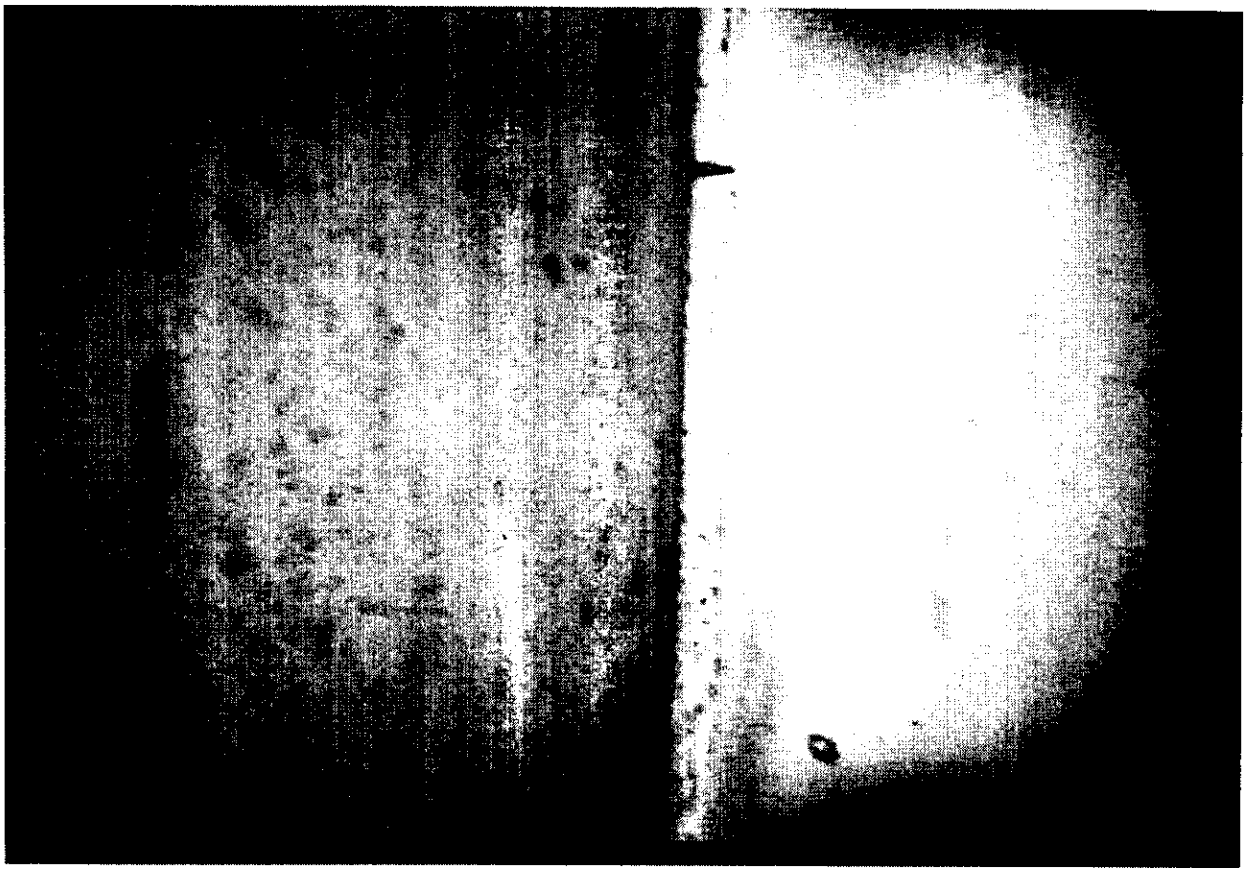


Figure I10
View of Welded Northwest Corner of Annulus About 1/2-way Up Pit Wall, 204-AR Tank Tk-1. Possible Weld Stop and Re-Start, Near Top. Time: 24-Min.

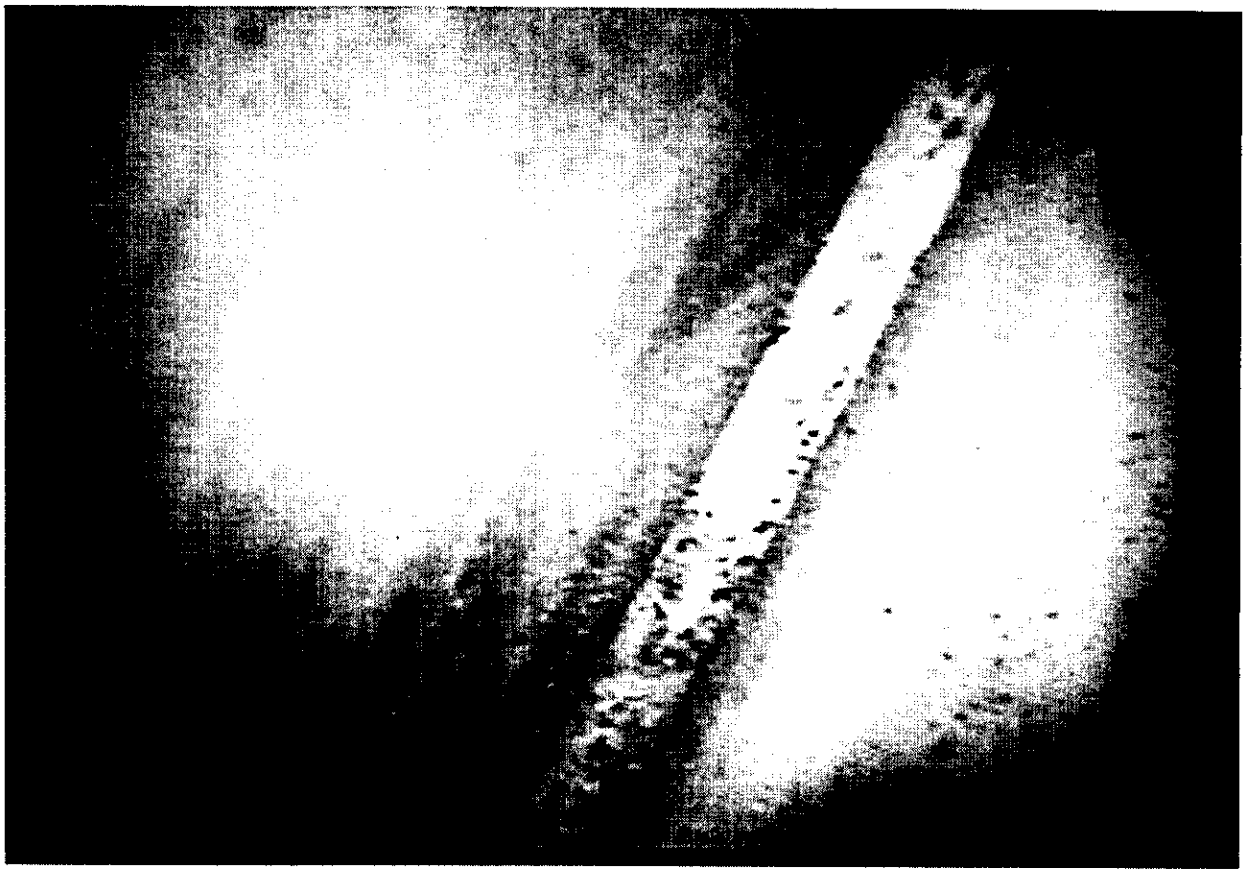


Figure I11
Close-Up of Vertical Weld in Northwest Corner of Pit, About ½-way Up Sidewall, 204-AR Tk-1. Time: 25.5-Min.

Figure I12
View of Northwest Corner of Pit, at Top of Stainless Steel Liner, 204-AR, Pit.
Time: 30-Min.

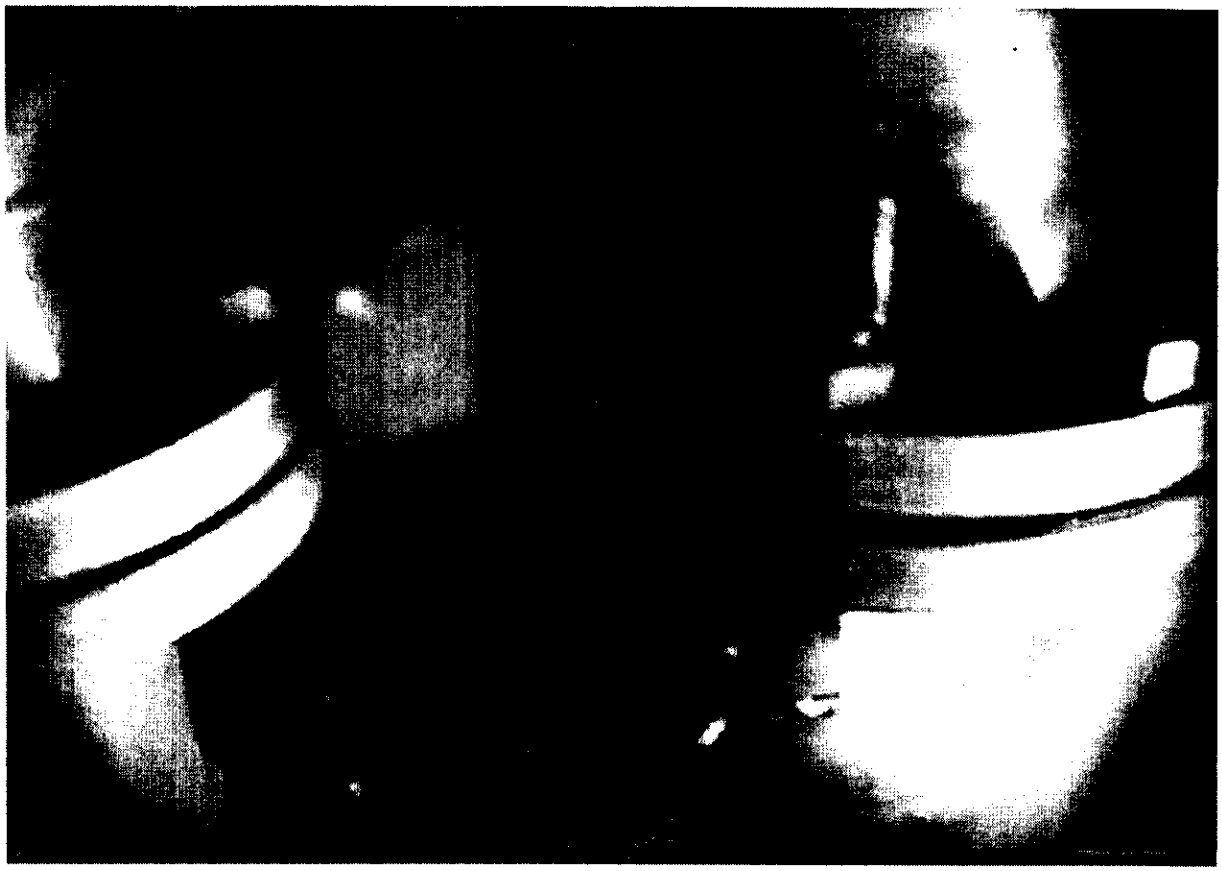


Figure I13
View of Two Flanged Fittings, Top of Tank, 204-AR Tk-1. Time: 19.5-Min.

Figure I14
View of Additional Flanged Fittings and Piping on Top of 204-AR Tank Tk-1. Time: 32-Min.

Figure I15
More Flanged Fittings and Piping, 204-AR Tank Tk-1, Time: 32-Min.

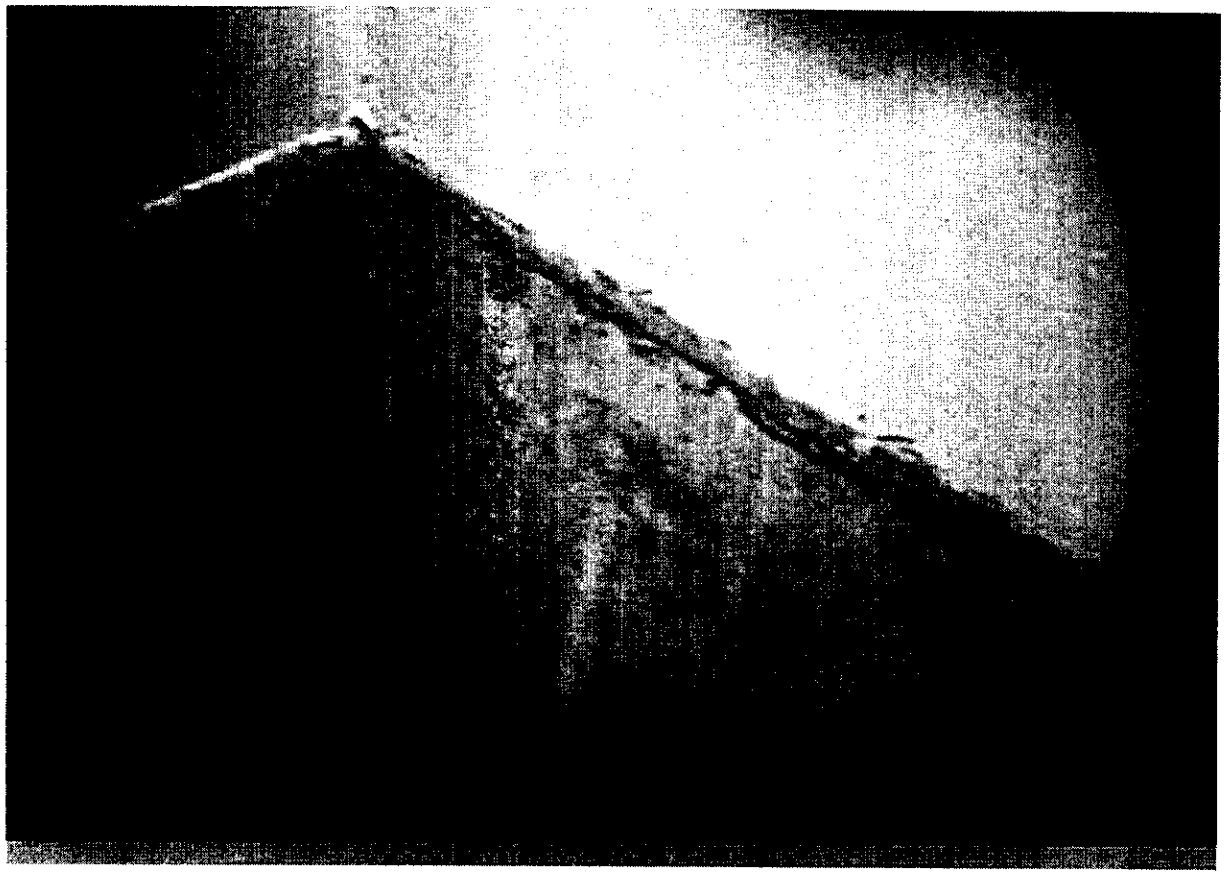


Figure I16
Southwest Corner of Annulus, Boundary Between Stainless Steel Liner and Reinforced Concrete Structure, 204-AR Tank Tk-1. Time: 33-Min.

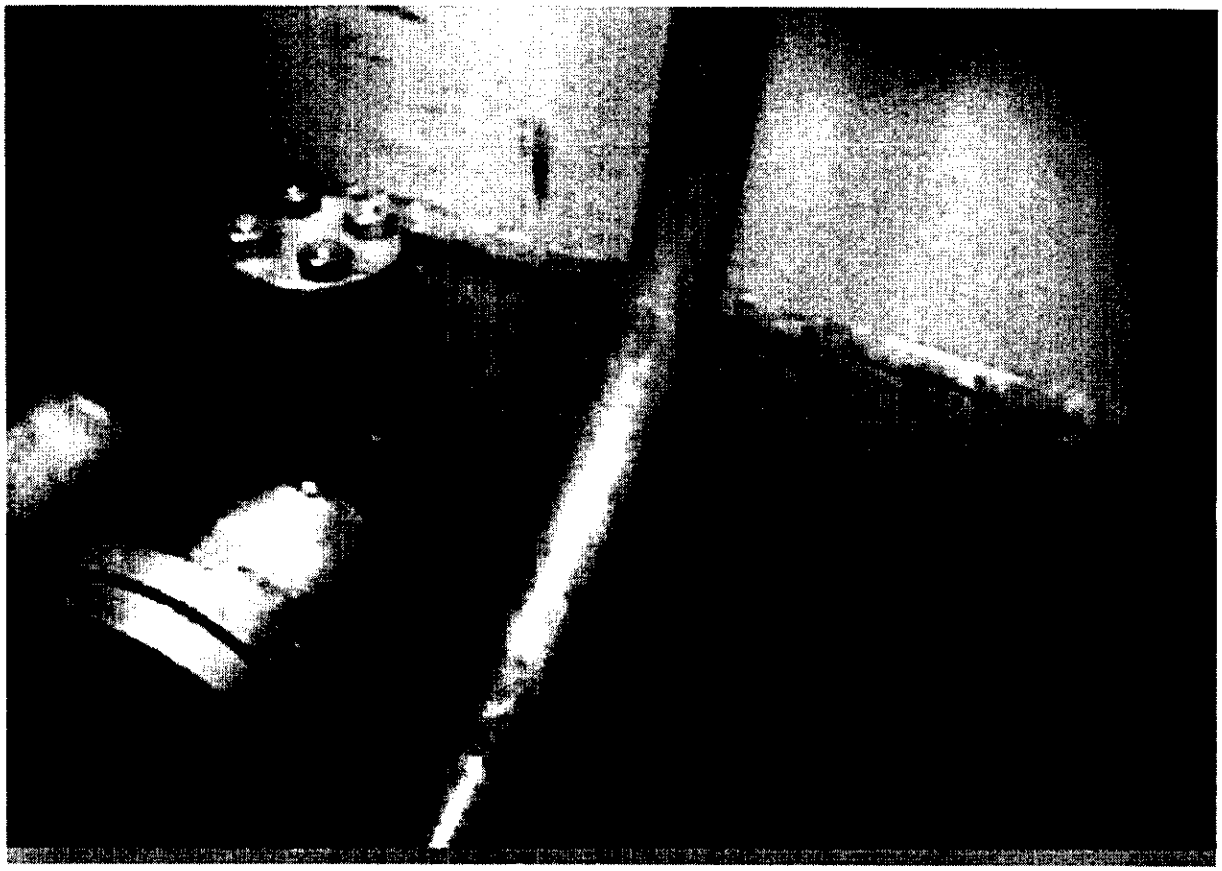


Figure I17
Boundary Between Stainless Steel Annulus and Concrete Wall, Northeast Region, 204-AR Tank Tk-1. Time: 32-Min.

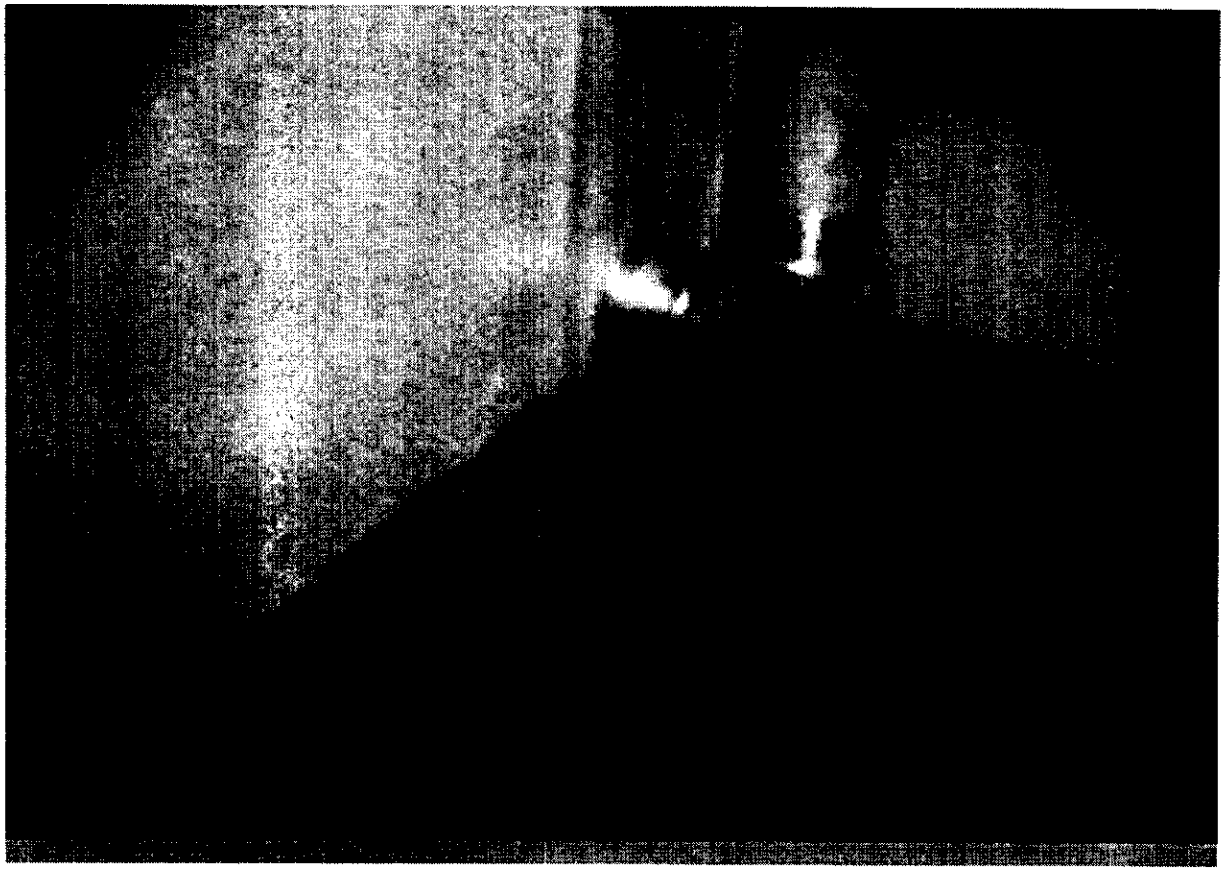


Figure I18
View of southeast Corner Boundary Between SS Annulus Liner and Concrete 204-AR, Tk-1 Tank. Time: 32.5-Min.

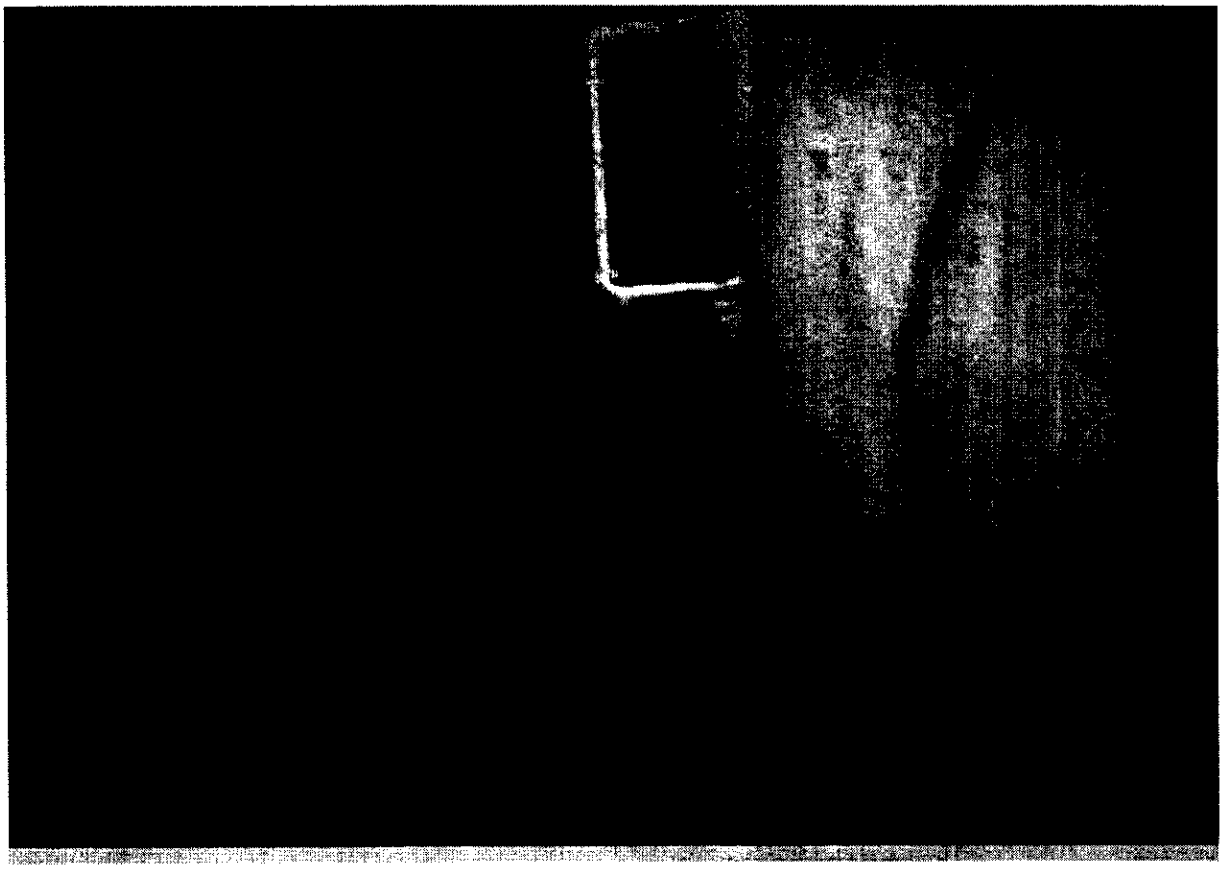


Figure I19
Possible Lifting Lug, 204-AR Tk-1 Tank. Time: 44-Min.

WORKING COPY Printed on: Jul 14, 00 12:51 pm

DATE STARTING: JUL 17 2000

PARAMETER	NORMAL RANGE	OSD LIMIT	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
			READINGS ARE TAKEN ON DAYS						
204-AR CONTROL ROOM									
Main Control Panel									
LI-TK-1, TANK 1 LEVEL (GAL)	150-1003	1165	660	1050 ①	1150 ①	1150 ①	1150 ①	1150 ①	1150 ①
Unloading Room Viewing Window									
UNLOADING ROOM AMBIENT TEMP (°F)			83	86°	84	85	89	90	87
CATCH TANK TEMP DIFFERENTIAL, TIC-TK-1 (-) UNLOADING ROOM AMBIENT TEMP	>5° F		27	24	26	25	21	20	23
DPI-5, CATCH TANK HEPA FILTER (IN H_2O) (black indicator)	0.2 - 3.5	5.9	.5	.5	.5	.5	.5	0.5	.5
TOTAL FILTER DIFFERENTIAL, DPI-5 (+) DPIAS-1		5.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5
DPI-6, CATCH TANK DEENTRAINER (IN H_2O) (red indicator)	0.0-1.0		.7	.7	.8	.8	.8	0.8	.8
DPIAS-2, PRIMARY HEPA FILTER (IN H_2O) (black indicator)	0.2-3.5	5.9	1.1	1.1	1.1	1.1	1.1	1.1	1.1
TOTAL FILTER DIFFERENTIAL, DPIAS-1 (+) DPIAS-2		5.9	2.1	2.1	2.1	2.1	2.1	2.1	2.1

① performing leak check for LI-TK-1 Sam [illegible] 7/17/00 [illegible] 7/20/00 catch tank transfer scheduled for Monday 7/24/00 [illegible]

COMMENTS:

Quality Record-Lifetime	Type	Document No.	Rev/Mod	Release Date	Page
	CONTINUOUS	TF-OR-EF-204AR	C-6	4/17/2000	3 of 7

Table I2 Leak Test Data Sheet 1 (204-AR Tank TK-1)

WORKING COPY Printed on: Jul 21, 00 7:40 am

JUL 24 2000

DATE STARTING:

PARAMETER	NORMAL RANGE	OSD LIMIT	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
			READINGS ARE TAKEN ON DAYS						
204-AR CONTROL ROOM									
Main Control Panel									
LI-TK-1, TANK 1 LEVEL (GAL)	150-1000	1145	1150 ①	460 ②	500 ③	500	500	500	500
Unloading Room Viewing Window									
UNLOADING ROOM AMBIENT TEMP (°F)			86	86	85	88	90°	90°	94°
CATCH TANK TEMP DIFFERENTIAL, TIC-TK-1 (-) UNLOADING ROOM AMBIENT TEMP	>5° F		26	30	28	25	25	20°	16°
DPI-5, CATCH TANK HEPA FILTER (IN H_2O) (black indicator)	0.2 - 3.5	5.9	.5	.5	.5	.5	.5	.5	.5
TOTAL FILTER DIFFERENTIAL, DPI-5 (+) DPIAS-1		5.9	1.5	1.5	1.5	1.5	1.5	1.5	1.5
DPI-6, CATCH TANK DEENTRAINER (IN H_2O) (red indicator)	0.0-1.0		.85	.85	.8	.8	.8	.8	.8
DPIAS-2, PRIMARY HEPA FILTER (IN H_2O) (black indicator)	0.2-3.5	5.9	1.2	1.2	1.2	1.2	1.2	1.2	1.1
TOTAL FILTER DIFFERENTIAL, DPIAS-1 (+) DPIAS-2		5.9	2.05	2.05	2.2	2.2	2.2	2.2	2.1

COMMENTS: ① Full for an integrity test Sonna Bagg 7/24/00 ③ TANK GAS PURGE AFTER TRANSFER LINE TO VALVE 508 NOT BEING COMPLETELY CLOSED. PDL 07-25-00

Quality Record Lifetime	Type	Document No.	Rev/Mod	Release Date	Page
	CONTINUOUS	TF-OR-EF-204AR	C-6	4/17/2000	3 of 7

Table I3 Leak Test Data Sheet 2 (204-AR Tank TK-1)

ATTACHMENT 1

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE

AND TEST REPORT

204-AR CATCH TANK

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

COGEMA ENGINEERING CORP.

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT
NONDESTRUCTIVE EXAMINATION
306E BLDG., 300 AREA - TEL. 376-5452

Job No. 00-13

Requester (client)	Company	MSIN	Bldg.	Area
R.W.Lysher	COG	S7-12	2704HV	200E

Project/System/Work Package/Traveler No.
Integrity Assessment Project: Ultrasonic Thickness Testing on the 204-AR Catch Tank @ 6" Intervals along vertical length in two places, approx. 180 degrees apart.

Acceptance Std. / Section / Para. / Date ☒ NA
Information only; Acceptance by clint.
CACN=106695,COA=CA40

PART INFORMATION
Material 304-L Stainless Stl.
Wall Thickness 0.250" Nominal ☐ NA
Diameter ☒ NA
Schedule ☒ NA
Size ☒ NA

Dwg. No. ☐ NA
H-2-70685
For Refrnce

NCR ☒ NA

PROCEDURE NO.
SVUT-PRC-007 Rev. 0
Appendix B Revision No. 0

Special Technique No. ☒ NA

COVERAGE
☐ 100% of Area Requested
☒ Other Readings taken at 6" intervals down the side of the tank, 180° apart.

INSTRUMENTATION
Mfg. DuPont Model "Quantum"
S/N or Standards Lab No.
CFT-2, 584-31-50-028, WC38098

CALIBRATION STANDARD(S)
Identification No. 11-Step, SST
Identification No. 584-99-30-135

TRANSDUCER
Diameter 1/2 Inch
Frequency 5 Mhz.
Mfg. Staveley/NORTEC
Serial No. 926419
Stand Off Model 8X-M-1/2-5

Couplant Water
Batch No. n/a

RESULTS

[Work performed per Step 8.5.3.1 of Package 2E-98-02696.]

NOTES:

1.) Catch Tank (TK-1) is approximately 5.5' diameter X 8' tall

2.) All thickness measurements are in inches.

3.) One thickness reading on Area 2 is unavailable. The "reach-rods" holding the ultrasonic transducer bumped into grating, piping, or wall-mounted equipment.

4.) Maximum thickness noted = 0.309"
Minimum thickness noted = 0.264

5.) Total thickness readings taken = 33

(See attached pages for sketch and thickness readings.)

Technician	UT Level	Interpreted by	UT Level	Reviewed by	LEVEL
J.N.Furth	II	J.N.Furth	II		III
B.J.Sewart	II	B.J.Sewart	II		
Date of examination: August 15, 2000		Date of examination: August 15, 2000		Date: 8/17/00	

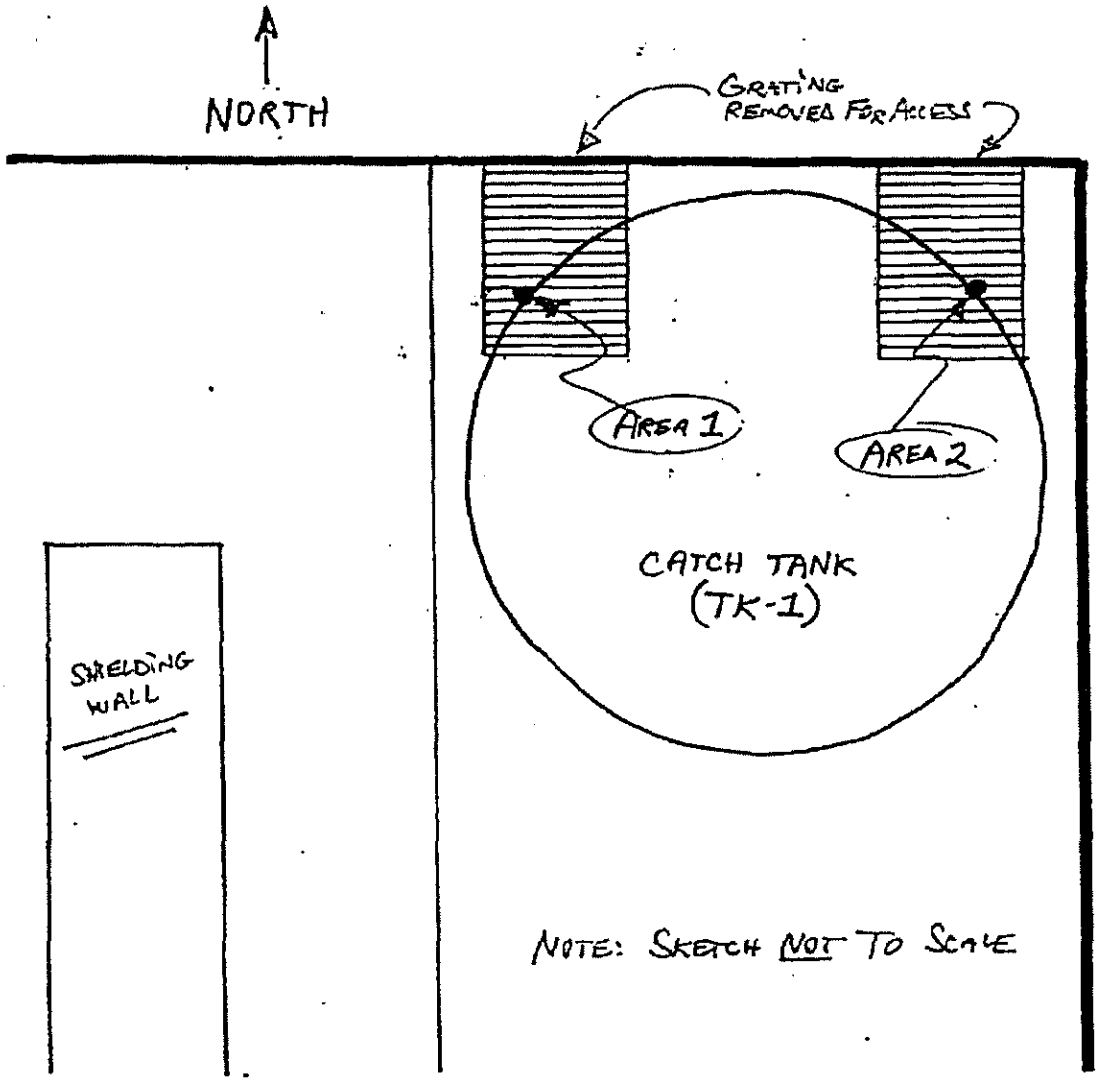
COGEMA ENGINEERING CORP.	NDE TEST REPORT CONTINUATION NONDESTRUCTIVE EXAMINATION 306E BLDG., 300 AREA TEL 376-5402	Job No. 00-13 Date August 15, 2000

	Area 1 (See Sketch on page 3)	Area 2 (See Sketch on Page 3)
1.)	0.278" (@ 2" from top of tank)	0.283" (@ 2" from top of tank)
2.)	0.285"	0.290"
3.)	0.292"	0.293"
4.)	0.294"	0.294"
5.)	0.299"	0.301"
6.)	0.300"	0.301"
7.)	0.301"	0.306"
8.)	0.308"	0.306"
9.)	0.304"	0.301"
10.)	0.309"	0.308"
11.)	0.299"	0.301"
12.)	0.299"	0.300"
13.)	0.294"	0.297" (0.299" repeat)
14.)	0.293"	0.295" (0.299" repeat)
15.)	0.294"	(No thickness reading available.)
16.)	0.285" (@ 2" from bottom of tank)	0.264" (@ 2" from bottom of tank)

Technician	Level	Interpreted by	Level	Reviewed by	Level
J. N. Furth	II	J. N. Furth	II		III
B. J. Sevart	II	B. J. Sevart	II		
Date of Examination August 15, 2000		Date of Examination August 15, 2000		Date 8/19/00	

A-5001-037 (04/99)

COGEMA ENGINEERING CORP.	NDE TEST REPORT CONTINUATION NONDESTRUCTIVE EXAMINATION 306E BLDG., 300 AREA TEL 376-5402	Job No. 00-13 Date August 15, 2000



Technician	Level	Interpreted by	Level	Reviewed by
J. N. Furth	II	J. N. Furth	II	
B. J. Sevart	II	B. J. Sevart	II	
Date of Examination August 15, 2000		Date of Examination August 15, 2000		Date 8/17/00

A-6001-037 (04/99)

ATTACHMENT 2

RESPONSE TO REQUEST

FOR

INFORMATION REGARDING UT-THICKNESS OVERAGE OF 204-AR

Date: September 26, 2000

To: D. L Becker.

cc. T. S. Hundal
K.V. Scott

From: E. B. Schwenk

Subject: **RESPONSE TO REQUEST FOR INFORMATION REGARDING UT-THICKNESS OVERAGE OF 204-AR**

The fact that the UT-measured wall thicknesses are greater than 0.25-in. thick is likely due to as many as four factors: two associated with the normal thickness allowances on plant-rolled stainless steel plate, the normal fabrication-rolling procedure used by the tank manufacturer, and normal minor variations in remote UT-thickness measurements.

First, the controlling specification for stainless steel plate thickness, as it comes from the base metal manufacturer, is presented in ASTM A 480. It shows, for plates between 3/16- and 3/8-in. thick (and over 84-in. in width), that the allowable overage is 0.050-in. or a 0.300-in total thickness. No underage is noted.

Second, thickness is typically measured along the plate's longitudinal edges. Specifically, the measurements are made no less than 3/8-in, and no more than 3-inches from those longitudinal edges. Consequently, a given plate could be, and likely is, thicker toward its center because of normal elastic bending, accentuated at the center of the rolls, coupled with greater freedom of width expansion (and thickness reduction) at the plates longitudinal edge regions.

Third, if ¼-in (nom.) thick plate had been used by the tank manufacturer, subsequent cold rolling, to form the tank's 5-1/2-ft. diameter, would likely reduce its thickness. Further, the plate thickness, particularly at its longitudinal edges could be reduced below the ¼-in. drawing callout. Thus, to minimize possible rolled underage at the edges, it is possible that the tank manufacturer started with thicker plate, probably 5/16-in. thick.

Fourth, all UT-thickness measurement systems display minor variations during the measurement process. To allow for these variations, and for the increased difficulty of manually measuring thickness remotely (about 15-ft. away), the UT-transducer system was calibrated and tested before being used on the 204-AR tank wall.

Bench calibration with a calibrated step block (0.100, 0.200 and 0.300-in.) showed that the system measured to within 0.002-in (or better) for all three thicknesses. Bench measurement of a flat plate with three machined flats showed a variation of as much as 0.006-in. between measurements. Last, a curved plate specimen, with three machined flats was put into an approximately 15-ft. deep pit in the 306 E building. Manual measurements (from 15-ft.

measurements. Last, a curved plate specimen, with three machined flats was put into an approximately 15-ft. deep pit in the 306 E building. Manual measurements (from 15-ft.

away) showed some minor variations as expected. The largest differences were 0.010, 0.006, and 0.006-in. for machined flats that were of 0.125, 0.163 and 0.208-in. remaining thicknesses. Thus, the maximum variations were 8%, 6% and 3%, respectively. All UT-measured values fell within the requested 0.012-in.(or within ± 5% of the 0.250-in nominal thickness of 204-AR.

In summary, the factors that explain the tank thickness readings are:

- The original plate is within the ASTM requirements if the thickness, as measured along the plate edges, is a much as 0.30-in.
- The tank UT-thickness measurements were taken at positions where the plate is likely to be thicker.
- The tank manufacturer may have started with a thicker plate, to ensure after forming, that the plate would not be thinned below 0.25-in.
- The accuracy of the UT measurements is ± 0.012-in.

ATTACHMENT 3

CHECKOUT OF UT-THICKNESS MEASUREMENT SYSTEM

FOR

204-AR WASTE UNLOADING FACILITY CATCH TANK

Date: December 12, 2000

To: K. V. Scott, et. al.

From: E. B. Schwenk

Subject: **CHECKOUT OF UT-THICKNESS MEASUREMENT SYSTEM FOR 204-AR WASTE UNLOADING FACILITY CATCH TANK**

At 7:00 AM April 2000, I attended a UT-thickness measurement demonstration by Wes Nelson and Bill Purdy at Building 306 E in the 300 Area. The purpose was to demonstrate that tank wall thickness measurements could be made using a 20-ft. long pole in an approximate 15-ft. deep pit in 306E. The 204-AR tank, which is located about 20-ft. below the area where thickness measurements are to be made from, is fabricated of welded, Type 304L stainless steel (SS) and is noted to be ¼--in. thick.

A three-fold approach was used to check out the measurement system. First, the UT-sensor was manually checked out using a calibrated UT step block. Next, the same sensor was manually scanned, on the unnotched side, of a ¼-in. thick SS plate that contained three wide, flat-bottom notches. Third, the UT sensor was put in its holding block and attached to a 20-ft. pole. Next, the vertically curved plate, that also contained three flat bottom notches, was lowered to the floor of the pit. Wall thickness and flat-bottom remaining thickness measurements were made by pressing the UT block against the plate (also from the unnotched side) by manually applying a bending load, at the top of the 20-ft. long vertical pole. Water was the coupling agent for all of the measurements. A small transparent plastic tube was used to convey the water from the pit topside, down the 20-ft. pole to the sensor block.

The electronic equipment used for the checkouts were: 1) a 5 MHz, 1/2-in. diagram Nortec UT sensor and 2) a portable, handheld DuPont Quantum, model QFT-2 oscilloscope. The calibrated stepblock (S/N 584-99-30-135) had thickness step increments of 0.100, 0.200, 0.300-in., etc.

Stepblock Measurements

Mr. Nelson manually, made consecutive measurements, three times, on the 0.100, 0.200, and 0.300-in. thick steps of the stair-step, Type 304L stainless steel calibration block. Results are shown in Table 1.

Table 1. Comparison of UT-Thickness Measurements with Step-Block Thickness (S/N 584-99-30-135)

UT Measurement	Step Thickness (in.)		
	0.100	**0.200**	**0.300**
1	0.099	0.201	0.302
2	0.101	0.202	0.302
3	0.101	0.202	0.302
Average	*0.100*	*0.202*	*0.302*
Maximum Variation	*0.001*	*0.002*	*0.002*

7.1 Manual Plate Measurements (flat plate)

The plate dimensions are 0.245-in. thick and about 15-in. square. It contains three, flat-bottomed notches. The notch depths were mechanically measured, prior to the UT scan, and subtracted from the plate's average thickness. Those remaining thickness values are shown in the table below. The method of scanning was to start on the plate to the left of the 0.129-in. (remaining thickness) notch, and manually progress to the right across each notch, stopping near each notch center. After the last notch remaining thickness was noted, the UT sensor was moved to the right to again measure the plate thickness, but at the opposite side of the plate. The readings were repeated two more times. Results are shown in Table 2.

Table 2. Comparison of UT-Thickness Measurements with Remaining Plate Thicknesses in Notched Flat Plate Specimen.

UT Measurement No.	Remaining Plate Thickness (in.)				
	8.0 PLATE 9.0 0.245 (NOM.)	**0.129** (avg) [@Flat-BottomedNotch (typ.)]	**0.166** (avg.)	**0.207** (avg.)	**Plate**
1	0.241	0.122	0.160	0.205	0.240
2	0.244	0.124	0.164	0.205	0.244
3	0.247	0.126	0.164	0.207	0.246
Avg.	*0.244*	*0.124*	*0.163*	*0.206*	*0.243*
Maximum Variation	*0.004*	*0.007*	*0.006*	*0.002*	*0.005*

Manual Pole Measurements (curved plate)

The curved plate has dimension of about 0.250 and is about 15-in. square. Prior to the UT measurements made herein, the plate thickness and notch depths were mechanically measured. Subtraction of the respective notch depths from the average plate thickness (0.250-in.) yielded the remaining thicknesses of 0.125, 0.163, and 0.208-in.

Table 3. Comparison of UT-Thickness Measurements with Remaining Plate Thicknesses in Notched Curved Plate Specimen.

UT Measurement No.	Remaining Plate Thickness (in.)			
	9.1 Plate 0.25-nom.	0.125 [@ Flat-Bottomed Notch (typ.)]	0.163	0.208
1	0.248	0.130	0.165	0.203
2	0.248	0.133	0.168	0.213
3	0.251	0.135	0.169	0.214
Avg.	*0.249*	*0.133*	*0.167*	*0.210*
Maximum Variation	*0.002*	*0.010*	*0.006*	*0.006*

9.2 Comparison of UT-Measurement Variability Values

The intent here is to determine measurement variability for all three "calibration-type" measurements presented in Tables 1, 2, and 3, above.

- For the stairstep block, all measurements are within 0.001 to 0.002-in. of the respective step thicknesses (0.1, 0.2, and 0.3-in.), or about 1%, of the value being measured.

- For the notched flat plate specimen, the numbers are also favorable. The UT measurement of the nominal 0.250-in. thickness, is within 0.005-in., or about 2%. For the material thickness values, at the flat-bottomed notches, the largest differences are 0.007, 0.006, and 0.002-in., respectively. These are about 3, 2, and 1%, of the three thickness values relative to the 0.25-in. plate thickness.

- For the notched curved plate specimen, the UT-measurements also appear very satisfactory. The UT measurement, of the full plate thickness, is within about 0.002-in. or about 1%. For the material thickness values, at the flat-bottomed notches, the variability improves nominally with increasing thickness. For example, the largest differences are 0.010, 0.006, and 0.006-in., respectively for the 0.125, 0.163, and 0.208 values, respectively. Thus, the variations here are about 8%, 4%, and 3% respectively of the total plate thickness (0.25-in.).

All UT-measured values fall within the requested 0.012-in. (or within about ± 5% of the 0.250 thickness of the 204-AR tank wall: see e-mail, T. S. Hundal to J. C. Krogness et. al., Mar 24, 2000).

ATTACHMENT 4

PACIFIC NORTHWEST NATIONAL LABORATORY REVIEW

Of

ULTRASONIC EXAMINATION OF 204-AR CATCH TANK

Pacific Northwest National Laboratory
Operated by Battelle for the
U.S. Department of Energy

December 4, 2000

Mr. David L. Becker
Numatec Hanford Corporation
P.O. Box 1300 – MS R1-04
Richland, WA 99352-1300

Dear Mr. Becker,

This letter supercedes letter dated November 1, 2000 from A. F. Pardini to Mr. David L. Becker.

Attached is a copy of the PNNL letter report dated December 4, 2000 describing the results of its third party evaluation of the data recorded by COGEMA on the Ultrasonic Examination of the 204-AR Catch Tank. Details are given in this report. The ultrasonic measurements of wall thickness on the 204-AR Catch Tank ranged from 0.264 in. to 0.309 in. with the thicker portions midway down the tank wall. The nominal thickness indicated in the COGEMA report dated August 15, 2000 and in the Engineering Task Plan, RPP-5963 Rev. 0 is 0.250 in. Actual measurements are as much as 0.059 in. greater than this nominal thickness. Overage of up to 0.050 in. was allowable according to the ASTM Code used during fabrication of the 204-AR Catch Tank. Also, the rolling process tends to allow thickening in the middle section of plate material. Based on this information, it seems that the data supports the fabrication methods. PNNL reviewed the preliminary inspection test documentation in letter report from E.B. Schwenk to D. L. Becker dated September 26, 2000 and conducted on a mockup in the 306E test cell. PNNL also reviewed COGEMA's ultrasonic test procedure and calibration technique and found them to be in compliance with established standards. Therefore, PNNL believes the measurement data to be accurate. Since no previous baseline data was taken on this tank, it can be assumed that the original plate thickness was at least 0.250 in., which is the minimum thickness allowed under the fabrication standard. Based on this assumption and the nominal wall thickness information given in the Engineering Task Plan, as well as the fact that this is a stainless steel tank, which is corrosion resistant, it can be stated that there is no evidence of any corrosion taking place. PNNL recommends that the 204-AR Catch Tank be examined again within a one year time period to provide a more accurate account of any corrosion activity that may be taking place. Measurements should be taken in approximately the same areas and compared to those done in the COGEMA data report dated August 15, 2000.

If there are questions or if additional information is needed, please contact Jerry Posakony or myself.

Sincerely,

Allan F. Pardini

Allan F. Pardini

Attachment: "Ultrasonic Examination of 204-AR Catch Tank"

cc: G.J. Posakony – PNNL
S.M. Bowyer - PNNL

902 Battelle Boulevard • P.O. Box 999 • Richland, WA 99352

Ultrasonic Examination of 204-AR Catch Tank

Allan F. Pardini and Gerald J. Posakony
Pacific Northwest National Laboratory

Background

COGEMA Engineering Corporation (COGEMA), under a contract from CH2M Hill Hanford Group, Inc. (CHG), has performed an ultrasonic examination of selected portions of the 204-AR Catch Tank. The purpose of the examination was to provide information that could be used to evaluate the integrity of the tank wall. The requirement for the ultrasonic examination of the 204-AR Catch Tank was to locate and record measurements made of wall thickness in the tank wall.

Under the contract with CHG, all data is to be recorded and hard copies of all measurements are to be provided to PNNL for third party evaluation. PNNL is responsible for reviewing the data and preparing report(s) that describe the results of the COGEMA ultrasonic examinations.

Information contained in PNNL Letter Report on personnel qualification, dated December 4, 2000, provides detailed information on requirements for personnel qualification, ultrasonic test procedure and ultrasonic test equipment that are to be used for the inspection of the 204-AR Catch Tank.

Ultrasonic Examination

The ultrasonic test system used for the examination of the 204-AR Catch Tank consisted of a Dupont Quantum QFT-2 ultrasonic thickness-measuring instrument. The probe used was a Staveley/NORTEC, 5 MHz, 0.5 in. contact transducer. The COGEMA ultrasonic test procedure, SVUT-PRC-007 Revision 0, Appendix B Revision 0 was used for the inspection of the 204-AR Catch Tank. The personnel involved in the inspection were specifically trained to perform the inspection. A mockup of the examination was built in the 306E facility in Hanford's 300 area to allow preliminary training and testing. To perform the ultrasonic examination, the transducer was fixed on a rigid pole (s) and lowered to the side of the 204-AR Catch Tank. Water flowed in an adjoining tube to provide coupling of the transducer to the tank wall. Spot measurements were taken as shown in Figure 1. The cylindrical section of the 204-AR Catch Tank is 8 ft. 6 in. high and has a diameter of 5 ft. 6 in.

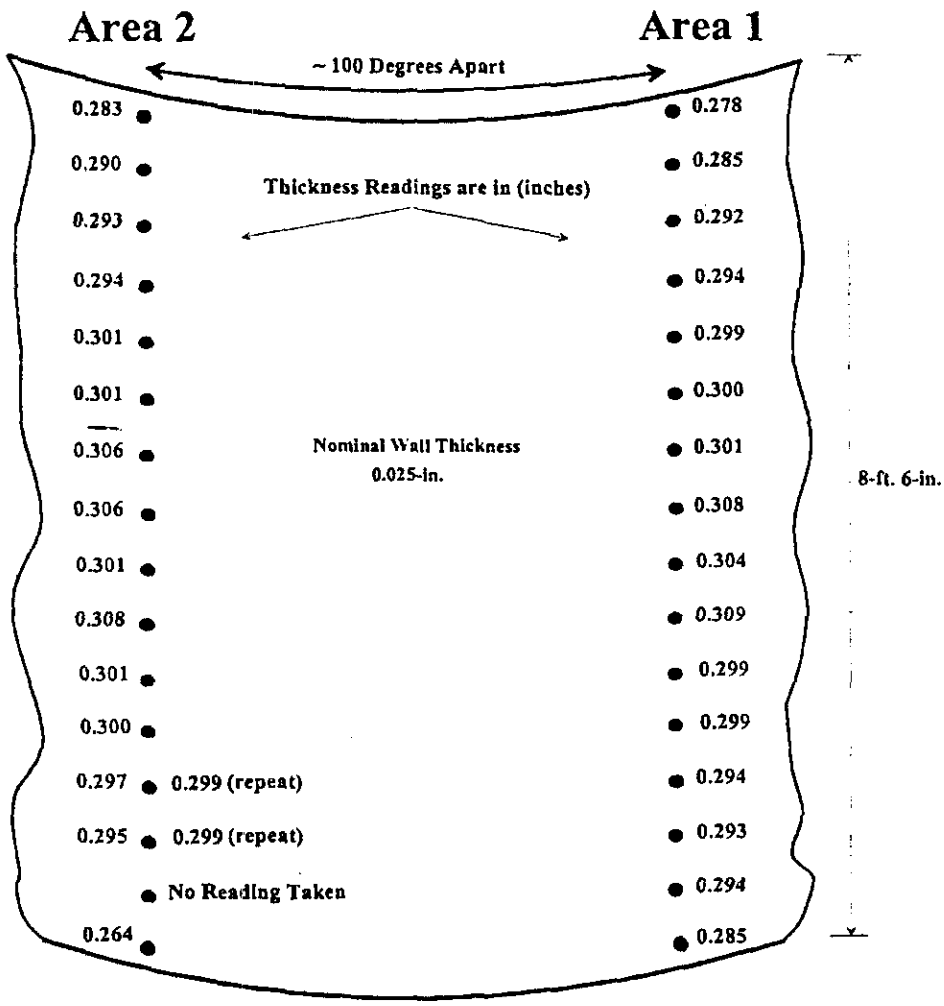


Figure 1. Sketch of Vertical Spot Measurements used for the Ultrasonic Examination of the 204-AR Catch Tank [1]

[1] *All historical dimensioning for the design, development and construction of this tank are in English units; consequently, English units are the primary units used in this report. Use 1.0 in. equals 25.4 mm to convert to metric.*

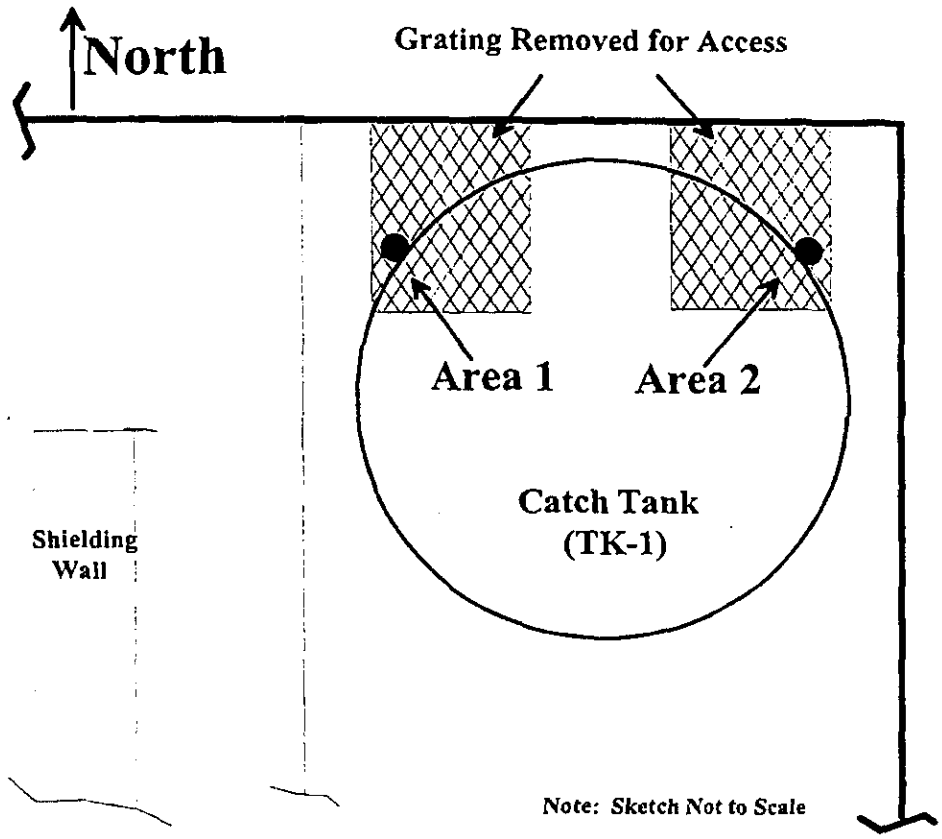


Figure 2. Sketch of Areas Inspected for the Ultrasonic Examination of the 204-AR Catch Tank

Results from the Ultrasonic Examination of the 204-AR Catch Tank

The data in Tables 1 and 2 were taken from the "Automated Ultrasonic Thickness Data Report" dated August 15, 2000 prepared by the COGEMA analyst describing the results of the examination of the tank wall. The data that appears on the analyst's data report is the thickness reading at that particular point on the tank surface. The first column in the tables indicates the vertical data position. The first reading was taken 2 in. down from the top of the tank. The next reading was taken approximately 8 in. down from the top etc. Wall thickness is shown in the second column.

Table 1. Data from the Vertical UT Measurements on the 204-AR Tank Wall – Area 1

Measurements Taken Down Tank Wall (Measurements Were Taken in Approximately 2 in. Intervals)	Thickness Measurement (in.)
1 (@ 2.0 in. from top of tank	0.278
2	0.285
3	0.292
4	0.294
5	0.299
6	0.300
7	0.301
8	0.308
9	0.304
10	0.309
11	0.299
12	0.299
13	0.294
14	0.293
15	0.294
16 (@ 2.0 in. from bottom of tank)	0.285

Table 2. Data from the Vertical UT Measurements on the 204-AR Tank Wall – Area 2

Measurements Taken Down Tank Wall (Measurements Were Taken in Approximately 2 in. Intervals)	Thickness Measurement (in.)
1 (@ 2.0 in. from top of tank	0.283
2	0.290
3	0.293
4	0.294
5	0.301
6	0.301
7	0.306
8	0.306
9	0.301
10	0.308
11	0.301
12	0.300
13	0.297 (0.299 repeat)
14	0.295 (0.299 repeat)
15	*No thickness reading
16 (@ 2.0 in. from bottom of tank)	0.264

* Thickness reading was unavailable due to equipment obstructions.

4

Summary

The ultrasonic measurements of wall thickness on the 204-AR Catch Tank ranged from 0.264 in. to 0.309 in. with the thicker portions midway down the tank wall. The nominal thickness indicated in the COGEMA report dated August 15, 2000 and in the Engineering Task Plan, RPP-5963 Rev. 0 is 0.250 in. Actual measurements are as much as 0.059 in. greater than this nominal thickness. Overage of up to 0.050 in. was allowable according to the ASTM Code used during fabrication of the 204-AR Catch Tank. Also, the rolling process tends to allow thickening in the middle section of plate material. Based on this information, it seems that the data supports the fabrication methods. PNNL reviewed the preliminary inspection test documentation in letter report from E. B. Schwenk to D. L. Becker dated September 26, 2000 and conducted on a mockup in the 306E test cell. PNNL also reviewed COGEMA's ultrasonic test procedure and calibration technique and found them to be in compliance with established standards. Therefore, PNNL believes the measurement data to be accurate. Since no previous baseline data was taken on this tank, it can be assumed that the original plate thickness was at least 0.250 in., which is the minimum thickness allowed under the fabrication standard. Based on this assumption and the nominal wall thickness information given in the Engineering Task Plan, as well as the fact that this is a stainless steel tank, which is corrosion resistant, it can be stated that there is no evidence of any corrosion taking place. PNNL recommends that the 204-AR Catch Tank be examined again within a one year time period to provide a more accurate account of any corrosion activity that may be taking place. Measurements should be taken in approximately the same areas and compared to those done in the COGEMA data report dated August 15, 2000.

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LIST OF TERMS

A-350	241-A-350 lift station
ASME	American Society of Mechanical Engineers
ASTM	American Society for Test and Materials
CVI	certified vendor information
FFTF	Fast Flux Test Facility
HDCS	Hanford Data Control System (database)
HLAN	Hanford Local Area Network
NDE	non-destructive examination
OSD	Operating Specification Document
PCSACS	Personal Computer Surveillance Analysis Computer System
PNNL	Pacific Northwest National Laboratories
RHA	Records Holding Area
RMIS	Record Management Information System
UT	ultrasonic testing
VITIS	Video In Tank Inspection System
WESF	Waste Encapsulation and Storage Facility
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

The 241-A-350 lift station (A-350) is located southeast of Tank A-106 in the 241-A Tank Farm of the Hanford Site (Figure J1). The catch tank receives waste drainage from numerous sources including the 241-A-A and 241-A-B valve pits, the 241-A clean-out boxes, and the 241-A service pit, and flush pits (241-A-A and 241-A-B). It also acts as a lift station for transferring waste from the 207-A retention basin to Tank 241-AW-102. This transfer function is needed when the 242-A Evaporator condensate, staged in the retention basin, is sampled and found to be out of specifications for the Treated Effluent Disposal Facility. This latter use of the catch tank is primary containment. In terms of volume and composition, the waste this catch tank receives is heavily dominated by natural precipitation (rain and snowmelt), along with some washdown water (i.e., decontamination wash-water from valve pits).

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine if the A-350 lift station components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the A-350 Lift station pump pit, vault, and catch tank. The scope of the examinations includes remote (video) visual examination of the A-350 catch tank external surface, pump pit, and vault; a leak test of the catch tank; and ultrasonic examination of the tank wall.

4.0 DESCRIPTION

The A-350 lift station structure consists of a reinforced concrete pump pit, that is positioned over a cylindrical-walled (corrugated steel) caisson (vault) positioned on a reinforced concrete floor, which includes a sump. The A-350 catch tank is located in this vault (see Figure J2).

4.1 PUMP PIT

The pump pit is a reinforced concrete structure 9-ft-long by 9-ft-wide by 11-ft-deep, inside dimensions with 1-ft-thick walls and floor slab. The floor of the pump pit slopes to a 3-in. drain line directed to the catch tank below. The pump pit has two sections of 20-in.-thick, removable concrete cover blocks for access. The pump pit houses two pumps and an assortment of jumpers, connectors, and valves.

4.2 VAULT

Directly below the pump pit is a cylindrical (steel wall-grout backed) caisson (vault) which is approximately 8-ft in diameter and 17-ft-tall. At the bottom of the caisson is a sloping 8-in.-thick reinforced concrete floor slab with a 12-in.-diameter by 8-in.-deep sump. The catch tank is located at the bottom of this caisson enclosure and rests on its concrete floor slab.

4.3 CATCH TANK

The vertical cylindrical catch tank is 4-ft 6-in. in diameter by 6-ft 11-in.-tall. It was fabricated by shaping and welding 3/8-in.-thick stainless steel plates. The alloy composition of the tank walls (top, sides, and bottom) was listed in the drawing and reporting records (GECHW 1947) as 25Cr-12Ni-Cb, which is an austenitic stainless steel stabilized with the element columbium to improve corrosion resistance. It has a sloped floor to facilitate its waste pump-out. Both the tank and the sump in the caisson enclosure are listed as having a pump. The catch tank, as originally proposed for the A-350 lift station, was intended to have automatic pumping capabilities, but this capability was not installed.

5.0 DESIGN EVALUATION

The design standard for the 241-A-350 catch tank, pump pit, and vault, the waste characteristics and compatibility for waste transfers, corrosion protection, and the age of the system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of A-350 lift station. A thorough search was conducted to identify the available design requirements, and design and fabrication documents for the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information (CVI) Files
- drawings in the Hanford drawing list at Document Control Center

- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System data base (HDCS)
- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Engineering personnel.

There are several points of inconsistency worth mentioning in the information records (e.g., drawings, and reports) for this catch tank. One is that this tank was originally designed and fabricated for an application that predated, by many years, its later modification and use in the A-350 lift station. The information search indicated that the catch tank now in the A-350 lift station was apparently designed and fabricated by the General Electric Company – Hanford Works for the Hot Semi-Works. Refer to Hanford Drawing H-2-4163 dated 1950, and Drawing DET-62002, dated 1943, for details regarding its original design. DET-62002 cites numerous details on fabrication that involve E.I. DuPont de Nemours Co. materials specifications and procedures (e.g., heat treatment). The information search for this report did not reveal exactly when the tank was fabricated, nor did it reveal whether it was actually put into service for its original purpose. This history as to the tank's fabrication, etc., does raise some unknowns about its specific condition at the time it was modified and put into use in the A-350 lift station. Again, the information search did not fully resolve this matter.

Another topical inconsistency in the records concerns the details as to how this catch tank is mounted on the floor of its caisson, and the extent of containment around the tank. The drawing records and some of the reporting indicates that the tank has short post-like legs (feet). A safety analysis report (Hanson 1989) and a technical basis document regarding operating specifications (Jonas 1988) state that this A-350 Lift station catch tank was positioned with its feet on the reinforced concrete floor, as shown on the available drawings. However, both of these references further state that the bottom of the tank was later embedded in several inches of concrete for the purpose of aiding in its seismic qualification. The record indicates that this additional concrete pour extended at least up to the top of the tank legs (feet), and thus the bottom of the tank. The Jonas (1988) report contains an attachment that indicates it might have been extended several inches higher up from the bottom, which, if true, would potentially provide some added containment to whatever the level was for this added concrete layer. A visual examination conducted March 7, 2001, indicated that the concrete did extend some distance above the support feet but several inches the attached steam jacket. The safety analysis report by Hanson (1989) states that the added concrete layer was 12-in.-thick, so the depth of the sump was increased accordingly. The Hanson (1989) reference was chosen as the preferred (senior) reference regarding this topic in relation to this design evaluation report.

Reference reporting (Jonas 1988, Hanson 1989, Ryan 1994, Palit 1996, Mattichak 1997) indicates this catch tank receives waste drainage from numerous sources. The following paragraphs provide the design requirements and other factors used in evaluating the integrity of the A-350 lift station.

5.1.1 Catch Tank

The following requirements were identified using a drawing (DET-62002) prepared by E.I. DuPont de Nemours (1943).

- The tank was welded in accordance with American Society of Mechanical Engineers (ASME) Code paragraph U69. The tank was made of a (austenitic) stainless steel alloy (25Cr-12Ni-Cb stabilized), in accordance with an unidentified DuPont specification. This alloy composition appears to correspond to a type 347 Cb alloy detailed in a General Electric Hanford specification (GECHW 1947) that was found during this information search. Some of the 1990s reporting (Jonas 1988, Palit 1996, Ryan 1994) refer to the alloy type as 309Cb, or at least close to this alloy type. The metallurgy literature on this type of stabilized alloy (i.e., via the Cb alloying) indicates that it is particularly important that heat treatments be conducted per appropriate temperature conditions (Fontana and Greene 1978). The tank was fabricated some years before it was modified and installed (i.e., per Project B-120) in the A-350 Lift station, around 1979. The original fabrication date and specific history of any process usage of this tank prior to its service in the A-350 lift station is somewhat in doubt, according to the information search performed for this reporting, which will be discussed later.

- After welding, the tank was heat-treated in accordance with an unidentified DuPont procedure. The quality of the record system's archive copy of the Drawing DET-62002 is poor, and it was not possible to identify the specific designation of the DuPont procedure cited for the heat treatment.

- The cooling jacket on the exterior of the main tank shell was also made of a (austenitic) stainless steel alloy (18Cr-8Ni-Cb stabilized) and welded in place after the tank was heat treated.

- Additional welding of the tank (i.e., the 25Cr-12Ni-Cb alloy), after the heat treatment, was not allowed unless specifically authorized.

- The tank interior was passivated by filling with warm 20-percent to 40-percent nitric acid for 30 minutes.

- All exposed carbon steel components were painted with one coat of zinc chromate primer and two coats of gray paint.

The catch tank was installed in the A-350 lift station in the late 1970s. The information derived from the drawings could not be verified by any original specifications or test documentation. Additional design requirements for the catch tank are listed below.

- The working pressure in the tank is atmospheric.
- The capacity of tank is 790 gallons.
- The catch tank is watertight when filled with water.
- The cooling jacket qualified to 30 psi hydrostatic pressure.
- The working pressure in cooling jacket is 20 pounds psi.
- The capacity of cooling jacket is 27 gallons.

There is inconsistency in the records involving the status of a metal jacket (i.e., steam or water) that was apparently a part of its original fabrication. One of the modifications to this tank, in preparing it for use in the A-350 Lift station, was that the jacket system was disconnected and not used. The visual examinations reported in Section 6.0 revealed that the jacket was not removed.

5.1.2 Pump Pit

The reinforced concrete pump pit and associated piping was installed in conjunction with installation of the catch tank. The pump pit was constructed to the requirements of Specification B-120-C7 and according to Hanford Drawing H-2-70318 details. The concrete used was 3,000 psi with American Society of Testing Materials (ASTM) A615, Grade 60 reinforcing steel.

5.1.3 Vault (Caisson)

Directly below the pump pit is the vault constructed from galvanized corrugated 12 gage liner plate. The outside of the vault liner plate was grouted to prevent sloughing of soil and is supported by a reinforced concrete floor. The caisson was designed for lateral equivalent fluid pressure of 45 H psf (where H is distance in feet from grade). All work was done in accordance with Specification B-102-C1 and Hanford Drawing H-2-69153. The concrete used was 3,000 psi with ASTM A 615, grade 40 reinforcing bars. Floors were designed for 50 psf live load. The Hanson (1989) and Mattichak (1997) references indicate that an additional pour of concrete was made to effectively extend the floor of the caisson up around the legs (feet) of the tank, to at least the bottom of the tank. The Mattichak (1997) reference and its 1981 attachment implies that this concrete pour was to extend several inches up from the tank bottom to a gusseted stiffener ring attached to the exterior of the tank. The Hanson (1989) reference states that the added pour of concrete was extended up to just beyond the tank legs (feet) and tank bottom. This added concrete pour also resulted in the pit sump being larger (i.e., a deeper cylindrical cavity). The added pour of concrete essentially anchored the tank to the overall floor structure of the caisson, and was done for seismic safety considerations. See Figure J2 for an illustration of the A-350 lift station, including its pump pit.

A structural assessment report (Westinghouse Hanford Company [WHC] 1996) of numerous facilities subjected to various accident loading conditions was performed for the safety analysis reporting. This assessment determined that the A-350 tank system could fail because of impact loads of missile transient pressure caused by a gasoline fire.

Review of this document (WHC 1996) indicates that the analysis methods used were crude and simple with very conservative assumptions and loadings but are mitigated by design and administrative controls. The facility has been in operation for about 30 years without any incident.

It is judged that refined analysis or revision of WHC 1996 document will indicate that the facility has adequate strength to withstand normal operating loads. A refined analysis of similar facility (Julyk 1999) showed that it has adequate strength which implies that the A-350 lift stations will also be adequate for applicable normal loads. Further, failure because of imposed loads due to a gasoline fire is precluded by implementation of administrative controls.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The catch tank in the 241-A-350 lift station has been in service as part of the lift station for approximately 20 years. During that time, its usage (function) has remained that of a catch tank; it provides containment for relatively small volumes of wastes that can drain into this tank from several sources. Wastes draining into the tank, from most of the sources, are composed primarily of water. And one of the principal volume sources is natural precipitation (i.e., rainwater and snowmelt). Only a few of these sources contribute waste that could be expected to contain even a few weight percent of suspended solids. Given that most of the incoming waste is composed of water, and that the tank is frequently pumped out (i.e., given its relatively small size and operating specification limits imposed), sludge buildup is not likely.

Only one of these potential waste sources requires that the A-350 lift station catch tank function as a primary containment (Mattichak 1997). This waste source is the 241-A-207 retention basin, and in this case, the A-350 catch tank would serve as part of the waste transfer route from the basin to the 242-A evaporator feed tank (241-AW-102) (Jonas 1988, Mattichak 1997, Palit 1996, Hanson 1989). This waste transfer is only needed "when the 242-A Evaporator condensate, staged in the retention basin, is sampled and found to be out of specifications for the Treated Effluent Disposal Facility," (Mattichak 1997). Before this latter disposal facility was available, the specification limits in question were those for discharge to B Pond (Palit 1996). Mattichak (1997) states that "the retention basin transfer is a contingency which is not likely to ever be required; it would only be necessitated by failure of the steam tube bundle in the evaporator." The other sources of waste are just contributing drainage-type input to this catch tank (i.e., leakage from valve pits, weather water, etc.), so for these wastes the tank fulfills the function of providing secondary containment.

As part of its secondary containment function, this catch tank receives drainage waste from each of the following waste source groups:

- 241-A-A and 241-A-B valve pits
- nine clean-out boxes in the 241-A tank farm
- floor drainage from A-350 pump pit (above this tank caisson); and d)
- ventilation system drainage from the 241-A-431 facility (Hanson 1989, Ryan 1994, Mattichak 1997, Palit 1996).

Hanson (1989) states that the waste drainage from these sources enters the top of the catch tank, via a separate line for each of these four source groupings. In addition, there are pipe entries into the top of the tank for each of the following: a 3-in.-flanged penetration for instrumentation (e.g., dip tubes for liquid level and volume determination); two 3-in. flanged penetrations for (water) spray nozzles; and a 12 in. flanged penetration for the P-350-1 pump (apparently the automated unit that was not installed) (Hanson 1989).

The types of drainage wastes from the sources itemized above can be generally categorized into two groups, on the basis of volume and chemistry, coming into the catch tank. The first group (drainage wastes) makes up a large majority of the total volume of waste received by this tank (e.g., over several months or a year) and is chemically dominated by water from two sources. These wastewater sources are natural precipitation, which is by far the major contributor, and water used in washing down some of the installations that drain to this catch tank (e.g., the pump pit, and the two valve boxes).

Currently this volume of drainage input to the tank is estimated to be about 740 gallons per year (Blaak 1999). This is by far the largest predictable volume source of waste that comes into this catch tank, and results in considerable tank farm operations activity to monitor and pump out the tank to maintain the residual volume within operating limits (WHC 1994).

The primary drainage sources of both the weather water and the washdown water are the A-350 pump pit, the two valve boxes, and to a lesser extent the nine clean-out boxes (Jonas 1988; Hanson 1989; Palit 1996; and Mattichak 1997). Discussions with the Tank Farm Engineering staff members for the A-350 lift station confirmed these drainage sources (Randklev 1999). These discussions also revealed that the natural precipitation primarily enters these drainage sources (especially the A-350 pit and the 241-A-A and 241-A-B valve boxes) via the unsealed seam around the perimeter of their respective cover blocks.

The second of these two groups of drainage wastes consists of any drainage to the catch tank in the two valve pits. It also includes the drainage from the 241-A-431 facility, which Hanson (1989) lists as consisting of drainage from the T-401 cyclone de-entrainer, the 401-2 seal loop, and the bypass seal pot. This last group of wastes make up a minor volume contribution to this catch tank over the course of few months or a year.

The chemistry of the radioactive waste involved in possible drainage from the two major valve pits (241-A-A and 241-A-B) and the nine clean-out boxes, comes essentially from tank waste transfers involving the 241-A Tank Farm complex (e.g., between tank farm underground storage tanks or 204-AR unloading facility transfers to a tank farm storage tank). The wastes involved in such transfers are controlled in their chemistry by the operating specifications documents (OSDs), for such transfers (e.g., WHC 1994 regarding the 204-AR facility; Jonas 1988, as amended, for technical basis of operations specifications of the A-350 lift station, and other tank farm miscellaneous facilities).

Review of the waste level status for this catch tank since 1995 revealed that most of the comments regarding incoming wastes had to do with operations involving the 241-A-A valve pit and associated installations, including the waste transfer pipe line that it supports. Palit (1996) describes the 241-A-A valve pit as servicing the LIQW-702 waste transfer pipeline, which in turn is used to service waste transfers made from the 204-AR Waste Unloading Facility. In the past, the 204-AR facility has received facility wastes from a large number of sources; namely, the 100 Area --100N facilities; 200 West Area -- S Plant, T Plant including the 222-S Laboratory; the 200 East Area – B Plant, and PUREX; 300 Area-340 collection facility and 325 Building and its new collection facility; and 400 Area Fast Flux Test Facility (FFTF).

Several of these sources (222-S Laboratory, T Plant, B Plant/Waste Encapsulation Storage Facility (WESF), FFTF, and the 325 Building) are expected to continue to ship wastes to the 204-AR facility during the coming years. Hence, the A-A valve pit will continue to provide some waste drainage, including washdown water when needed, into the A-350 catch tank. Project W-314 has within its scope a transfer line that would bypass the two (241) valve pits that contribute waste drainage to this A-350 catch tank.

This catch tank is considered to be of appropriate design and construction to deal with such wastes, per the operating specifications and procedures for this facility. For additional information on Hanford waste compatibility program and administrative controls see Mulkey, (1997), Cox (1997), Kirch (1984), and Fowler (1995).

5.3 CORROSION PROTECTION

As mentioned in Section 5.2, the concerns about waste compatibility cover not only waste interactions, but also the concerns regarding metal (alloy) interactions, which could involve containment equipment such as the subject catch tank. In this section, the topic of corrosion is discussed, in context of design features of the A-350 catch tank and its operating history and future use. In addition, a description is provided of any corrosion protection measures that are installed and operable for this tank.

Overall, corrosion protection of the A-350 catch tank is achieved primarily by the combination of design and corrosion control, as implemented by the tank's fabrication, installation, including ancillary equipment, and operating requirements for the tank.

5.3.1 Types of Corrosion Attack

The tank is made of welded stainless steel (25Cr-12Ni-Cb stabilized), which appears to be type 347Cb, according to the drawing records (Hanford Drawing H-2-4163; DET-62002) and a specification record (GECHW 1947). This alloy is resistant to uniform corrosion attack from typical Hanford caustic wastes (i.e., containing nominal concentrations of nitrate, nitrite and hydroxide in water and sludges). It is also resistant to uniform corrosion attack by very dilute solutions. This alloy is, however, still somewhat susceptible to localized attack by pitting corrosion and by stress-corrosion cracking mechanisms. Both of these types of localized corrosion attack are especially affected by the concentration of chloride ions, in the corrosion media contacting this alloy, and the influence of chloride is especially high when the pH conditions are near-neutral (i.e., pH about 6 to 8). For the A-350 catch tank, the waste is usually composed of natural precipitation with some radioactive contamination picked up along the respective pathways that bring such drainage waste to this catch tank. As discussed in Section 5.2, there are also several sources that can result in some drainage of radioactive wastes to this catch tank. Much of this dilution (via water) comes from the raw water flushing associated with making a waste transfer via the pipeline system, or from washdown activities of pits or vaults to lower contamination levels as needed to support operations.

Given the general character of the primary volume contributors to the wastes coming into the A-350 catch tank, it is likely that, at least on some occasions, waste in this tank could have a pH condition in the near-neutral range, which would be of particular concern relative to the types of localized corrosion attack discussed earlier. The incubation times associated with pitting-corrosion attack and stress-corrosion attack of such an alloy (i.e., 300 series stainless steels) are often less than a year. This catch tank has been in service for approximately 20 years, so relative to exposure time, such attack could have occurred during at least some periods of its exposure to certain waste compositions.

Stress-corrosion cracking has the appearance of brittle fracture, yet it can occur in highly ductile materials, such as 300 series stainless steels, and it can frequently occur at stress levels that are far below the upper limit for the design (usage) of the subject item. Stress-corrosion is a term used to describe the corrosion attack and failure of a metal, by crack propagation, when the metal is in contact with a liquid environment that is not highly corrosive to this metal by general corrosion attack. Attack by stress corrosion requires the simultaneous presence of applied and/or residual tensile stress (e.g., weldments) and the presence of certain corrosion agents in the liquid environment (e.g., small concentrations of chloride ion in near-neutral pH water, as noted earlier). The cracks form and grow in such regions, usually at right angles to the direction of the subject tensile stress (Fontana and Greene 1978). Because the catch tank has no significant mechanical loading to contribute to the weld-induced residual stresses, growth of stress-corrosion cracks will attenuate these local driving-force stresses. If this attenuation is sufficient, they can eventually stop growing, providing the crack doesn't reach a through-wall condition first. Recall that the wall thickness of the stainless steel alloy (type 347Cb) used in constructing the A-350 catch tank was specified to be (nominally) 3/8 in. in thickness. Attack by pitting corrosion can occur anywhere on the surface of an alloy structure that is susceptible to such corrosion attack (i.e., it does not require local residual stress conditions such as around weldments, etc., as is needed for attack by stress-corrosion cracking). Attack by pitting is known to be locally preferential to regions such as where the liquid – gas interface marks the metal alloy (e.g., water level in a tank). In the A-350 catch tank, the waste volume apparently has not been at any one level for long periods of time, mostly because of the relatively large volume of natural precipitation it receives and the frequent pump-outs that are performed to accommodate that situation.

5.3.2 Status Monitoring of the Tank and Pit

The pit containing this catch tank is instrumented with both radiation sensors and a conductivity sensor, which would be expected to provide first indication of waste overflow or leakage, from the tank. The catch tank itself is fitted with bubbler tubes for determining weight factor values. With the use of specific gravity values, the equivalent volume values can also be determined. The weight factor values for the A-350 catch tank are monitored in the 242 Evaporator Facility.

The operator-rounds records for the A-350 catch tank were reviewed to assess in more detail (i.e., on a daily basis) what the history of waste level measurements has been in recent years.

Discussions with the cognizant engineer for the A-350 lift station revealed that operators take and record (on hard copy) two readings of the waste level in this tank each day. Review of these operator rounds, according to the Personal Computer Surveillance Analysis Computer System (PCSACS) files, did not reveal any indication of unusual events that might be related to leakage from the tank.

The A-350 catch tank is made of welded stainless steel, type 347Cb, with a nominal side wall and bottom (floor) thickness of 3/8 in. One conclusion of this review and assessment is the subject's wastes are not expected to have caused significant damage to the internal surface of this catch tank as the result of uniform (general) corrosion attack. However, it is possible that some degradation of the tank's containment integrity may have occurred by localized corrosion attack (e.g., pitting and stress-corrosion cracking), during its approximate 20 years of service. The types of localized corrosion attack are known to be sufficiently aggressive for the 300 series stainless steel alloys to warrant at least some concern about confirming its present status. This situation is especially true for a tank involving welded construction, and for certain liquid (aqueous) waste conditions (e.g., near neutral pH with dissolved chloride ion concentrations) that could have occurred during at least some periods of this tank's operating history. As discussed previously, these types of localized corrosion are capable of inflicting damage even for the seemingly mild thermal and waste chemistry conditions (e.g., highly dilute aqueous solutions, including those of mostly rain water or snowmelt) that this tank appears to have been subjected to during its service.

5.4 AGE OF THE TANK SYSTEM

The service age of the catch tank in the A-350 lift station is approximately 21 years (about 1979 to present). Since the original date of fabrication and its possible usage history prior to use in the A-350 facility are not fully resolved, the total service age beyond the A-350 usage is unknown. The records indicate that the tank could have been fabricated as early as 1944. It was apparently modified around 1950 (see Hanford Drawing H-2-4163), for the Hot Semi-Works, but as noted in Section 5.1, it is not known whether it ever went into service. The drawing and reporting records show that the tank was modified in the late 1970s and put into the A-350 Lift station.

6.0 INTEGRITY EXAMINATIONS

Integrity examinations of 241-A-350 catch tank involved visual examinations of the pump pit and catch tank vault or pit, a leak test assessment based on tank waste level records, and an ultrasonic (UT) thickness evaluation of the exterior of the outer surface of the tank.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted of the pump pit on October 19, 2000 and the catch tank vault on January 8, 2001, with some additional viewing during the final UT-thickness evaluation on March 7, 2001. Visual examination details and data sheet findings are included in this appendix.

6.1.1 Pump Pit Visual Examination

Access to the pump pit was accomplished by removing the reinforced concrete cover blocks. The Video In-Tank Inspection System (VITIS II) camera and associated lighting (used for viewing all facility components) was manually lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or lesser-angle setting) used to view details of interest. Table J1 provides a general description of the pump pit and details regarding the photographs.

Still photos taken from the color videotape dedicated to the pump pit showed that the condition of the walls, nozzles, transfer pumps, floor, wall-floor joints, and various ancillary equipment, appeared very satisfactory (Figures J3 through J11). Some normal dust and dirt on parts of the floor prevented the reviewer from seeing the entire coated concrete floor and joints. However, where visible, all appeared very satisfactory. A partial malfunction in the video camera produced horizontal, wavy lines across the video screen, and thus show up on the video still photos. While this effect distorts a given photo, normal movement of the camera, during the examination, allows the same distorted area to be seen in a non-distorted condition.

During preparation for the visual examination, it was found that an exterior valve handle was locked in place. A crane was needed to break (lift) it loose. Later, during the visual examination, it was apparent that the end of the valve handle had become rust-entrapped in the valve funnel, as shown in Figure J12. No other region of the pump pit was seen to be so intensely rusted as was the valve funnel, near its bottom in the figure. Also, no apparent damage was produced by the lifting action.

6.1.2 Annulus Visual

Examination access to the catch tank vault or pit (sometimes termed annulus) was through a size-limited 2-ft by 2-ft opening, after its seal plug had been removed.

In general, the approximately 57-year-old tank, and its associated 21-year-old pit, appeared in very satisfactory condition.

Fogginess, caused by the mixing of cold exterior air (20 to 25°F) with the warm and humid, fixant-sprayed vault region air (probably around 60°F), produced a continual fuzzy appearance to the videotape (and to the still photographs) made during the January 8, 2001 vault entry. The second entry, made at a later date (March 7, 2001, a warmer evening), was not hampered by this condition.

Table J2 provides a general description of the annulus and details regarding the photographs. Still photos taken from the videotape of the examination of the annulus are presented in Figures J13 through J22.

Figure J13 shows the handling of the seal plug. A plan view of the seal plug opening and the proximal pump pit floor, and a partial view of the catch tank and annulus region is shown in Figure J14. Leak-through of liquid fixant, that had been sprayed several times within the pump pit can be seen around the seat-edge of the seal plug opening. The fixant, along with previously

deposited wind-blown dust and dirt, tended to give all the flat surfaces a reddish-brown tinge as also seen in Figure J15 and J16. Some lead (Pb) sheet had been left in the vault, probably as a need for radiation protection during an earlier personnel entrance (Figure J16, J19 and J20). A sidewall view of the tank and caisson wall, unblemished by the colored fixant, can be seen in Figure J17. Both the stainless steel tank and the galvanized and corrugated caisson wall, appear in very satisfactory condition. Some minor chalking of the caisson zinc coating (along with liquid fixant collected on the floor) can be seen in Figure J18. Views of the satisfactory condition of various piping elements and the leak detector can be seen in Figures J-21 and 22, respectively.

6.2 LEAK TEST

To assess leak tightness of 241-A-350 catch tank, a review was made of historical fluid level records. For A-350, only weight factor liquid level measurement system data are available on the PCSACS. Four hours is considered the minimum hold time necessary to meet the leak detection criteria.

Surface level records were reviewed from 1980 to 2000 (Figure J27). Three recent time-periods, during which the surface level was nearly constant, were selected (Figures J29 through J32) for analysis.

Figures J28 and J29 show a 5-day period (in September 1994), during which the waste level was constant at 33.8 in. Further, this consistency occurred within an approximate 45-day period (during September and October 1994), during which the waste level was, overall, slightly increasing. Figures J30, J31, and J32 show a three-and a seven-day period during September and October 1999 when the fluid level is nearly constant (29.8 and 29.3-in.). Here, the constancy is occurring within an approximately 2-month period, where the overall waste level is slightly decreasing. The fourth time-period, mid-April 2001, showed a constant level of 33.8 in. for four days. Because the waste level is basically constant for these three time-periods, the tank is judged to not be leaking.

6.3 ULTRASONIC INSPECTION OF TANK WALL

Ultrasonic (UT) inspection of the 241-A-350 tank wall was conducted March 7, 2001. Inaccessibility to the tank interior, as well as limited accessibility to the tank exterior, required two initial attempts at physical exterior entrance (December 19, 2000 and December 21, 2000) followed by two more such entrances to conduct UT examinations (January 8, 2001 and March 7, 2001).

6.3.1 UT Equipment and Approach

Equipment used to conduct the UT-examinations consisted of a 1/2-in. diameter, spring-loaded UT transducer (5 MHz) mounted at the right-angle end of an approximately 30-ft long, aluminum pipe-pole. Figure J23 shows a view of the crane-lifted pole being lowered into the pit. Figure J24 is a close-up view of the right-angle arm/UT transducer module being pressed against the A-350 tank.

A model QFT-2, DuPont Quantum Nondestructive Examination System was used to condition and readout tank wall thickness values. The plan was to lower the pole-transducer system (with a pit-side crane) into the ground-level pump pit and through a 2-ft by 2-ft square, seal-plug opening, into the annular region of the catch tank. Decremental steps of about 4 to 6-in., starting at the top of the tank, were planned so that an adequate number of thickness readings would be made vertically, along the tank wall. At a given vertical location, a UT technician would manually activate an articulating arm at the bottom of the pole. This arm would rotate and press against the pit wall, such that the UT transducer would be pressed, in the opposite direction, into contact with the tank wall. A more detailed description of this approach is provided in Attachment 1 entitled, "Threefold Calibration of UT-System for A-350 Examination." In addition, a measurement sensitivity of ± 5% (or ± 0.019-in.) was prescribed, and is discussed in Attachment 1.

Attachment 1 also describes how the DuPont Quantum UT-measurement system was first manually calibrated, in the laboratory, using a National Institute of Standards and Technology (NIST)-traceable step wedge system, immediately followed by a second manual calibration of the same system against a 3/8-in.-thick, mechanically-measured plate that contained three flat-bottomed notches. The immediate final (third) calibration involved application of the same UT-transducer head to the same notched-plate, but from about 30-ft vertically above the plate, simulating the approach to be used in the field.

6.3.2 Results

During the first UT entrance January 8, 2001, it was found that the site drawing showing the location of the catch tank within its caisson was in error. The radial distance between the caisson wall and the tank was less than that shown on the drawing. As a result, the approximately 18-in. long right-angle arm was too long to allow the 30-ft pole to be rotated so that the UT-transducer would simultaneously be in radial registry with the tank and the caisson wall.

The pole was removed and a hacksaw used to reduce the arm length to about 12-in. The tape-secured arm and pole was placed back into the annular space and immediately lowered to the tank bottom. A number of tank-connected attachments (Figure J25) made it difficult to orient the transducer module perpendicular to the tank, at the very bottom. This was accomplished but, proximal outstanding lugs and other paraphernalia attached to the tank, damaged the UT-transducer cable and the work had to be stopped.

A second entrance was made on March 7, 2001. During this entrance, UT measurements were made starting at the top of the tank, progressing downward through the same, space-limiting 2-ft by 2-ft square opening. Again, there was much difficulty trying to work around the various tank attachments so the first tank-top region to be measured, was skipped. Six thickness measurements below that, showed values ranging from 0.130 to 0.143 in., the approximate thickness of the tank's water jacket. The last (sixth) measurement made, about 10-in. (est.) above the bottom, was still within the tank's water jacket. UT-thickness data are reported in Attachment 1. The UT thickness results were evaluated by the COGEMA Engineering UT Level III inspector (Attachment 2) and by Pacific Northwest National Laboratories (PNNL) Level III inspectors (Attachment 3). Both evaluations found the collection of thickness measurements to be appropriate and the measurements to be valid.

A great deal of effort was then expended to thread the pole and transducer head down to the pit floor. The video camera, also lowered with difficulty to contact the floor of the pit, showed that the water jacket extended down to within several-inches of the concrete floor. There may have been additional tank surface below the concrete floor, as was discussed above.in Section 5.1. Recall, that concrete had been poured around the feet of the tank for added seismic stability and that it probably extended partially up the tank side. In addition, the various noted tank attachments prevented any circumferential movement of the UT transducer, at that point. The only area accessible with the transducer, for obtaining a thickness measurement, also coincided with the intersection of a broad circumferential tank weld and a small diagonal weld (see also Figure J26). However, because of the normal weld buildup (crown) and attendant irregular surface, and other debris on the wall and floor, no UT measurement was physically possible at this bottom location, where the nominal tank wall thickness would likely be about 3/8-in.

Next, with extreme and enervating difficulty, the pole was threaded up to the top of the tank, around the space-confining lifting lug and support bracket (see Figure J24 and J25). At this point, the UT-technician staff had been on mask and in almost continual manual operation of the pole, for over six hours. One technician was so physically exhausted that he could no longer lift his arms to actuate the rotatable arm of the pole. Here, within about 4 to 6 in. from the tank top a wall thickness measurement of 0.371-in. was finally obtained.

Upon removal of both the pole and the camera, only very low levels of radiological contamination were found on both (hundreds of count). These low levels, in concert with the positive leak test results described above, indicate that no significant leakage has ever occurred.

In summary, the one thickness measurement (0.371 in.) showed that the wall thickness is well within the prescribed measurement sensitivity of $\pm$0.019 in. of 3/8 in., and that no significant wall thinning has occurred at the top of the tank.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The approximately 57-year old tank has been in service underground for about 25-years without any leaks reported, which proves that at the time of its construction adequate design controls were used to withstand applicable design loads.

2. The tank is not leaking at the leak check level of 29.8 in. However, to qualify its leak tightness at a higher level, a leak test should be conducted.

3. The design does not prevent entry of water (rainwater and snowmelt) into the tank. The water leaks through the cover blocks then drains into the tank through the pit floor drains. This water adds to the waste inventory and increases the potential for corrosion inside the tank and of the components in the pump pit. This should be mitigated by effectively sealing the cover block seams.

4. The structural assessment analysis (WHC 1996) should be revised with refined analysis methods using realistic assumptions and loading conditions to demonstrate and justify the continued operation of the facility.

5. Visual examination showed that the pump pit, the catch tank vault and tank, and their associated equipment, appeared very satisfactory.

6. Ultrasonic thickness evaluation of the catch tank's wall was partially successful. One thickness measurement, near the tank top, outside of the nearly omni-covering steam jacket, showed that no significant uniform corrosion had occurred.

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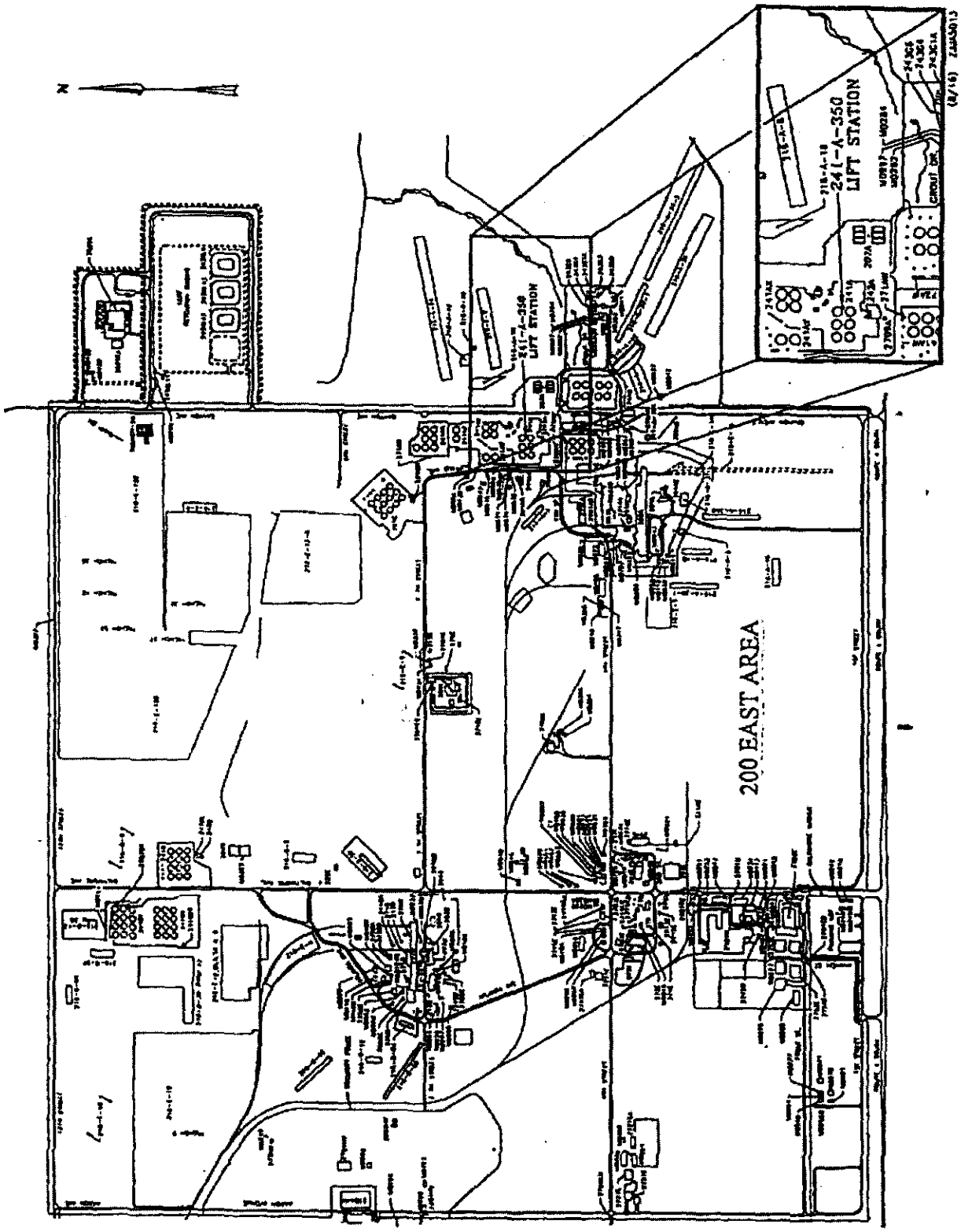

Figure J1 Location of 241-A 350 in the Site Plan

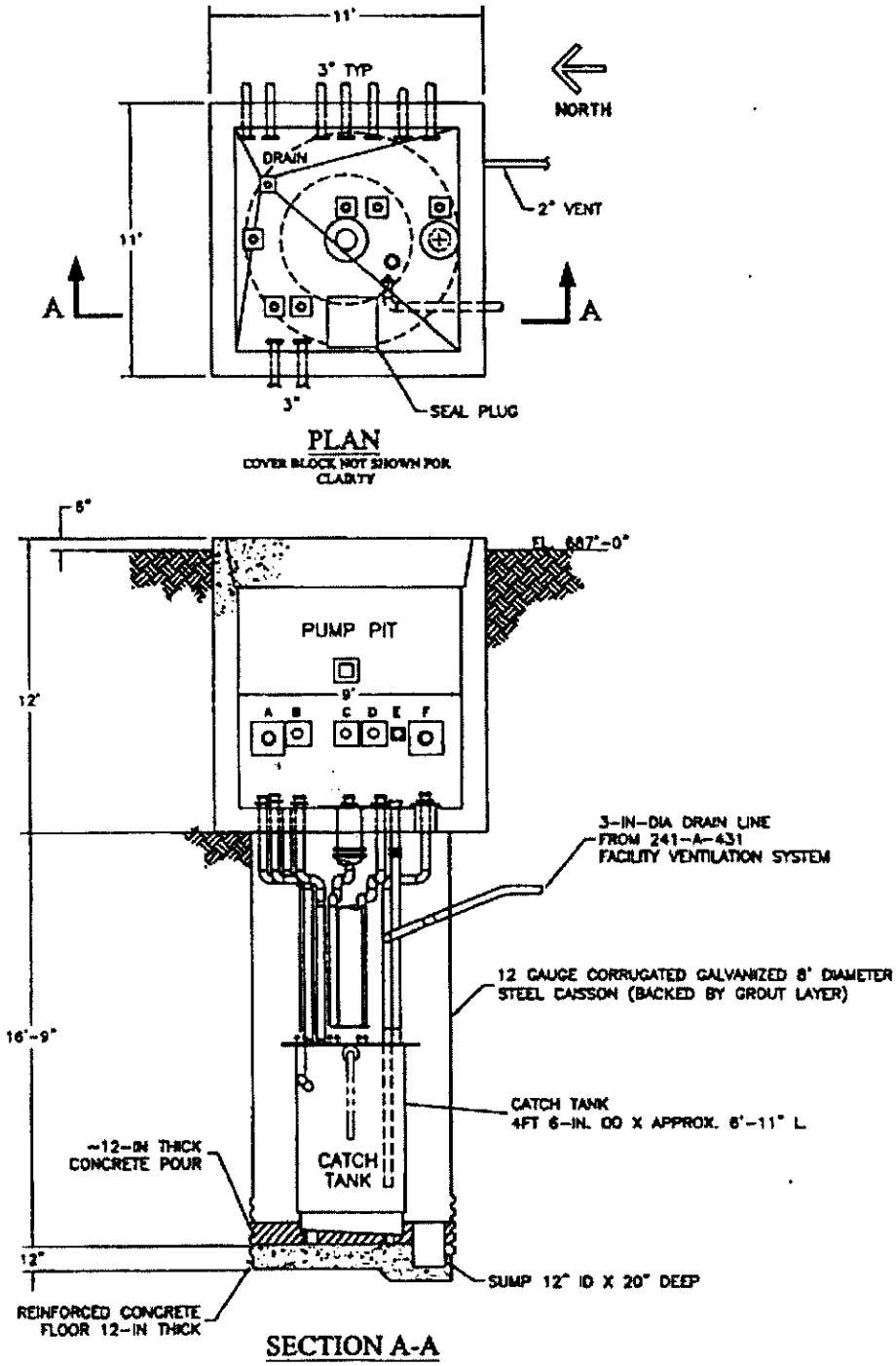

Figure J2 241-A 350 Lift station

TABLE J1. VIDEO EXAMINATION DATA SHEET, 241-A-350 PUMP PIT

Examination Date:

PIC: S. R. CHAPMAN **CAMERA OPERATOR:_____** **VIDEO EXAMINERS: T. S. HUNDAL**

RISER: COVER BLOCKS REMOVED

Video Tape Reviewer: E. B. Schwenk **Date: 12/00**

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Entrance to the interior of the 241-A-350 Pump Pit was accomplished by removal of the near ground-level, reinforced concrete cover blocks. The pit sits directly above the catch tank pit. Interior Pump Pit dimensions are about 9 by 9-ft. by about 10-ft deep, below the bottom surface of the cover blocks. The following photographs, and accompanying narrative, demonstrate that the approximately 21-year old pit and its associated equipment, appear to be in very satisfactory condition. Comments are made herein confirming the generally satisfactory conditions seen. Video/still photographs are included that show most of the structure and its associated equipment. Pan & Tilt refers to the angles of the viewing video camera. Pan (horizontal) ranges from about 0 to 360°, while tilt covers about ½ that range (180° is straight down, to 0°). Hanford Drawing H-2-70538, "Piping Arrangement Drainage Lift station," 241-A-350, is helpful for orienting the camera with respect to the 'still' photographs of the pump pit interior.
1128 AM		210	180		Figure J3 is a near straight-down view of the centrally located waste transfer pump, its flange, and related piping and nozzles. The condition of the components appears satisfactory; some minor amounts of wind-blown dirt are on the floor. The horizontal optical aberration, that passes through the date and time caption (19OCT00 and 11:28AM) was apparently caused by the video camera, and shows up in the majority of the following video 'stills.'
1128 AM		210	152		Raising the camera upward, Figure J4 shows the northwest (NW) corner and floor of the pit. The walls are clean; a small amount of dirt is on the floor. All structural joints appear satisfactory. Sidewall nozzles G & H, along with two floor-located nozzles (with vent seals attached), and related piping are also shown. The black, semi-circular item at the bottom right of the photo is the camera-attached light.

Table J1 Video Examination Data Sheet, 241-A-350 Pump Pit (continued)					
1131 AM		197	083		Raising the camera further, brings the top corner of the opened pit into view (Figure J5). Some minor rusting can be seen along the steel angle-edged cover block shelf support. The upper end of the vertical paint striping can be seen extending to the top of the pit edge.
1135 AM		042	106		Figure J6 shows the SE Corner of the pit, about midwall. All portions of the structure and components appear satisfactory. The off-angle piping is apparently a pole used for manual movements or adjustments at the bottom of the pit.
1135 AM		001	106		Panning further to the left (Figure J13) is a mid east wall spray nozzle, minor vertical rust stains, and a continuation of the horizontal diptube piping elements. The vertical striping extends down (out of the field-of-view) to sidewall nozzles C, D, and E (right side of photo).
1135 AM		001	136		Tilting downward from Figure J7 above, brings into view (Figure J8) the five sidewall nozzles (A thru E) and associated equipment on the floor of the pit. As noted earlier, the typical optical aberration tends to mask the region across the header information; this same effect however, does not appear on viewing screen either during static or dynamic operation of the videotape.
1136 AM		053	144		Progressing to the right brings into view the SE corner and floor of the pit (Figure J9). Additional floor nozzles, piping, and pumps appear to be in satisfactory condition.
1136 AM		095	144		Further panning to the right brings the SW corner of the pit into view (Figure J10). Floor and wall joints, like before, appear satisfactory, as do the pumps and related equipment.
1138 AM		165	147		Figure J11 shows the approximate 2-ft. square floor seal plug (entrance to catch tank pit) under the nozzle/jumper, related floor equipment, and sidewall nozzles G and H (west wall).
1140 AM		165	153		Some through-wall corrosion occurred in one component as seen in Figure J12. The valve funnel rusted through-wall, in the region where a T-Handle was previously rust-bound. Not other region showed any significant amount of corrosion. It is speculated that rainwater/snowmelt trickled down the valve handle resulting in significant local rusting.

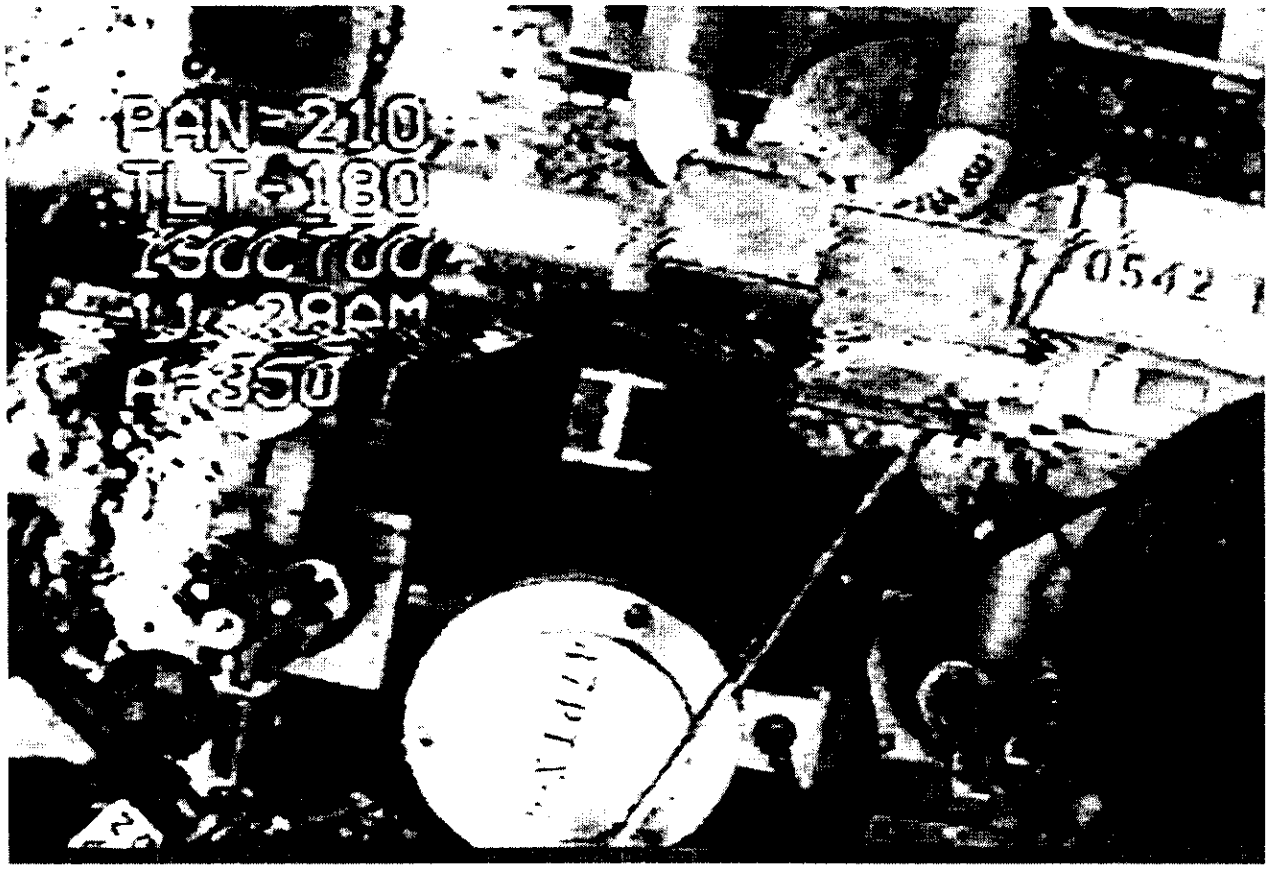

Figure J3.
View of Pump, Nozzles and Piping, Approximate Center of A-350 Pump Pit.

Figure J4
Northwest Corner and Floor of Pit. Nozzles G & H, 1/1/2–in. Piping (on North wall), Floor Nozzles with Vent Seals, etc.

Figure J5.
View of NW Corner of A-350 Pump Pit Showing Cover Block (removed) Support Shelf and Vertical Paint Striping Leading Down to Wall Nozzles G & H.

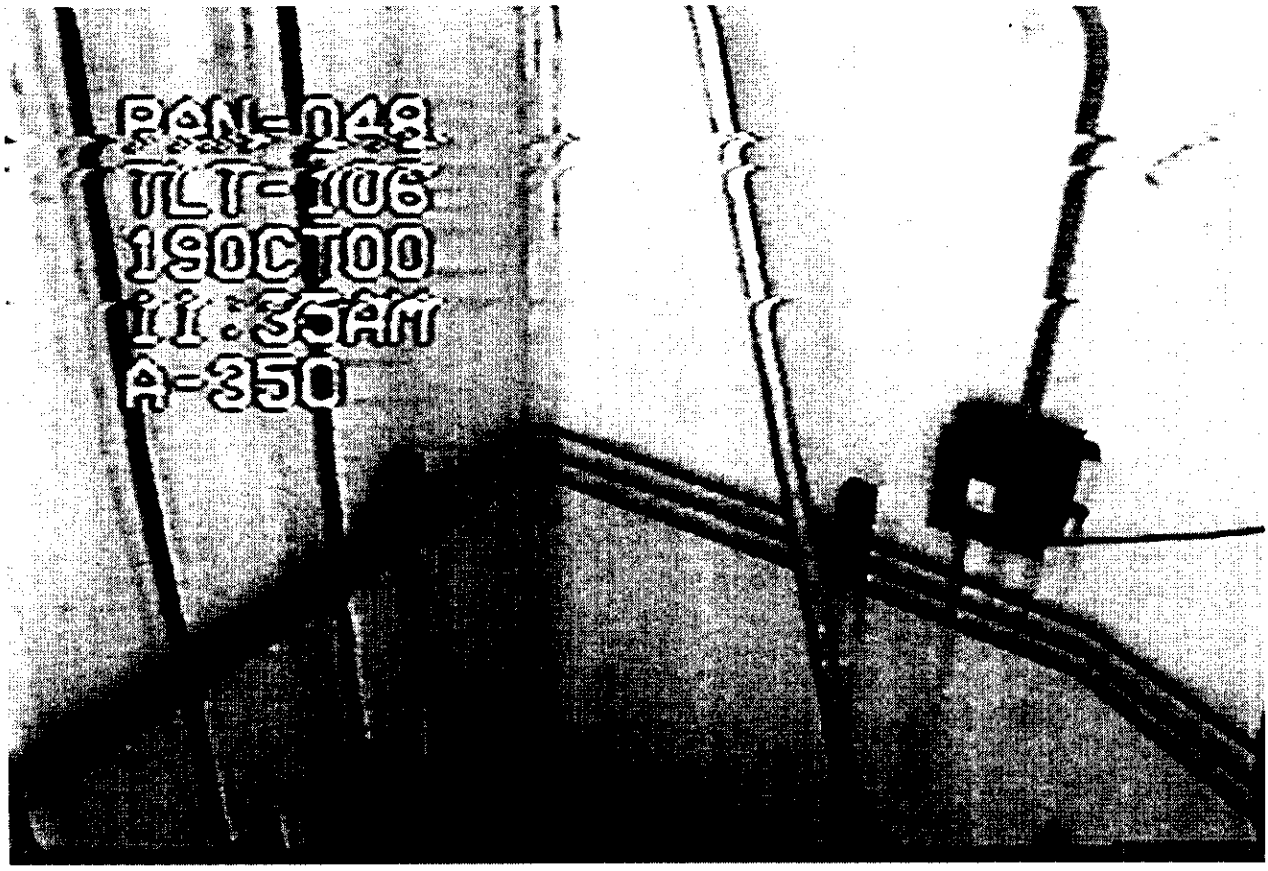

Figure J6.
View of SE Corner–Midwall of A-350 Pump Pit. Vertical Stripes to Nozzles F (and E), Horizontal Diptube Elements (3), Near-Vertical Pole, etc.

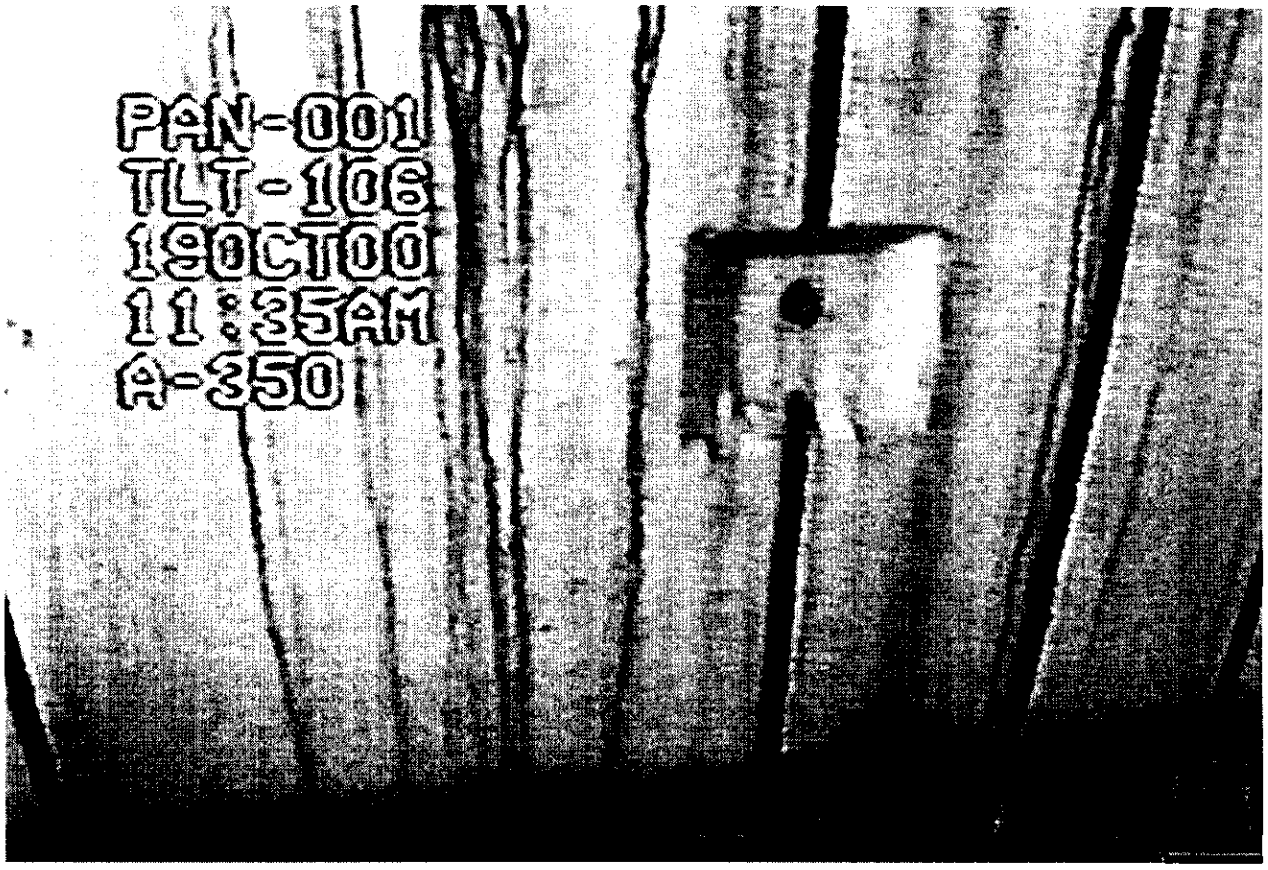

Figure J7.
View of East Midwall: Spray Nozzle (center), Minor Vertical Rust Stains, and Vertical Stripes to Nozzles C, D, E (right side).

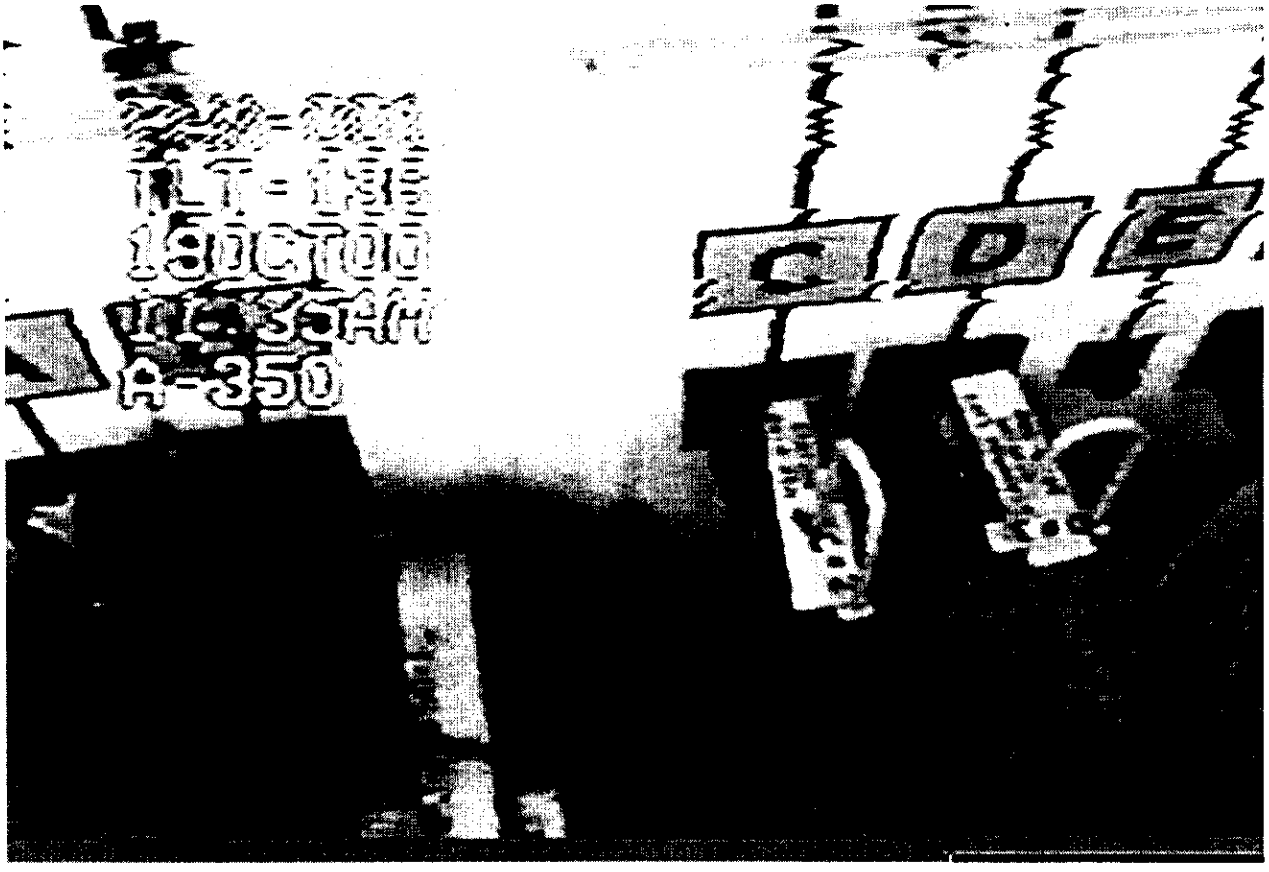

Figure J8.
View of East wall and Floor of A-350 Pump pit including Nozzles A to E and Vertical Paint Stripes.

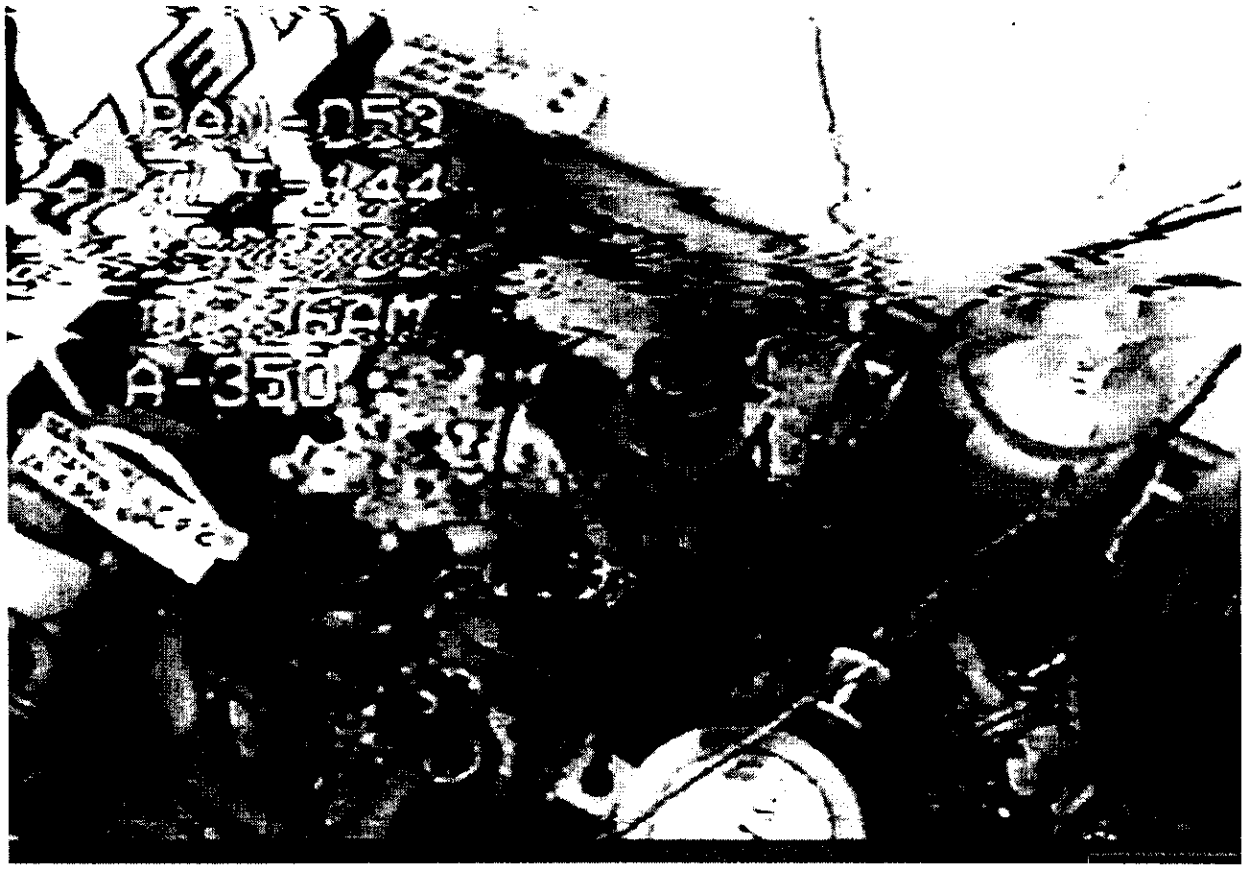

Figure J9.
View of SE Corner and Floor of A-350 Pump Pit. Nozzles, Pumps, and Related Piping.

Figure J10.
View of SW Corner of A-350 Pump Pit, Including Pumps, Nozzles, and Piping.

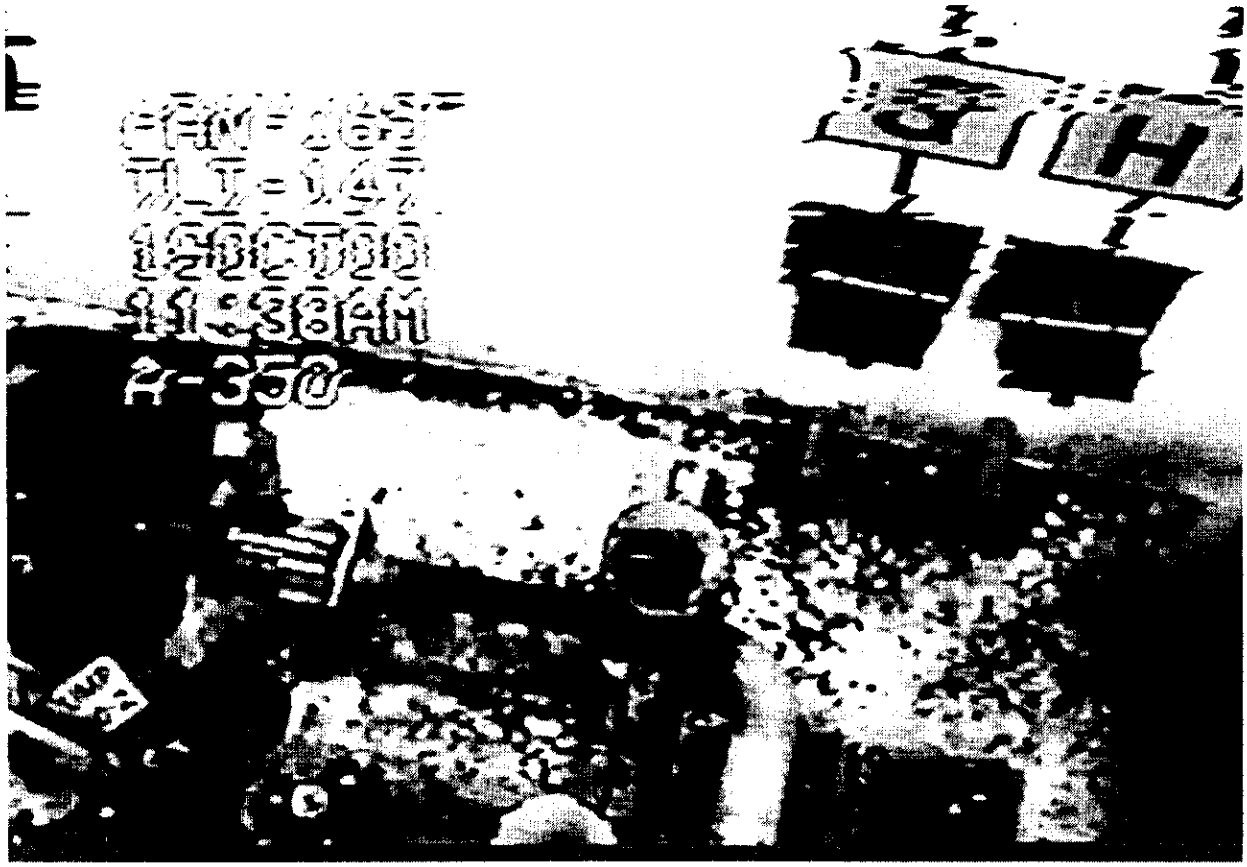

Figure J11.
View of West Wall and Approx. 2-ft. Square Floor Seal Plug (yellow boundary), Under Nozzle/Jumper.

Figure J12.
View of Rusted-Through Valve Funnel. T-Handle was Previously Rust-Bound Within this Device.

TABLE J2. VIDEO EXAMINATION OF 241-A-350 LIFT STATION CATCH TANK

Examination Date: 1/8/01 & 3/7/01

PIC: S. R. CHAPMAN **CAMERA OPERATOR: B. W. PEAK &** **VIDEO EXAMINER: E. B. SCHWENK**

RISER # : COVER BLOCKS AND SEAL PLUG REMOVED

Video Tape Reviewer: E. B. Schwenk **Date: 1/01 & 4/01**

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Entrance to the interior of the 241-A-350 Pump Pit was accomplished by removal of the near ground level, reinforced concrete cover blocks and described in the A-350 Pump Pit Examination. The following photographs, and accompanying narrative, demonstrate that the approximately 57-year old tank pit and its associated 21-yr. old equipment and surrounding caisson, appear to be in very satisfactory condition. Comments are made herein confirming the generally satisfactory conditions seen. Video/still photographs are included that show most of the structure and its associated equipment. Pan & Tilt refers to the angles of the viewing video camera. Pan (horizontal) ranges from about 0 to 360°, while tilt covers about ½ that range (180° is straight down, to 0°). Hanford Drawings H-2-70358 and H-2-69153 may be useful for approximately orienting the camera with respect to the 'still' photographs of the A350 annulus region shown below.
8:13 PM		182	104		Figure J13 is an illuminated nighttime view of operators and engineering staff (all on-mask) overseeing the lifting out of the pump pit seal plug. Plastic sheeting is being prepared to wrap the plug (for contamination control) before setting it on the ground, nearby.

Table J2 Video Examination of 241-A-350 Lift station Catch Tank (continued)					
8:17 PM		181	139		Looking straight down through the seal plug opening between the pump pit and the catch tank annulus, is the pit caisson corrugated wall (bottom left), about ½ of the plan view of the catch tank, including some of the catch tank piping elements and one of the sidewall lifting trunnions (Figure J14). The fogginess of the catch tank pit region, was caused by the cold nighttime air (about 20 to 25°F) mixing with the warm (> 60°F) humid air of the pit.
8:32 PM		218	095		A view of the top of the A-350 Catch Tank, including several outboard risers and central pump riser, is shown in Figure 15. Some staining, probably caused by spraying of fixative, along with a light layer of normal windblown dust/dirt can also be seen.
8:30 PM		030	184		Another view of the top of the tank is shown in Figure J16, along with some loose lead (Pb) sheeting. The lead sheet had likely been used during a prior human entrance for radiation attenuation. The spot markings on top of the tank appear to be mainly local areas of dust/dirt accumulation along with coloration due to the fixative.
8:37 PM		066	119		This photo (Figure J17) was taken during the next pit/annulus entrance (07Mar). Because the nighttime temperature was considerably warmer, no fogginess occurred in the air surrounding the tank. Several other factors are notable. First, the galvanized, corrugated wall of the pit is in relatively good condition. Some light chalking of the zinc coating is seen, along with minor accumulations of dusts and dirt on the horizontal ledges. In the foreground, the vertical carbon steel pipe likely connects with a pump, and extends down to the sump. To the left is the relatively clean and shiny stainless steel (SS) tank wall, not coated with fixative. The yellow paint-coated region below the narrow ledge is the beginning of the steam jacket. The outstanding cylindrical shaped item at the top of the photo was probably a prior connection to the tank (that was subsequently sealed-off) after it was removed from service and placed within the A-350 complex. Also, the uppermost left shell course of the tank is the tank wall. The pink-colored arc, to the right, is due to the camera's attached light.
8:35 PM		070	122		Figure J-18 is an expanded view of the bottom of Figure J23, showing the annulus floor (left), zinc-coated (and lightly chalked) caisson wall, and a pipe-plug, threaded into an apparent coupling. The annulus floor coloring is probably due to normal fixative spray accumulation.
8:40 PM		348 (335)	090 (079)		Traversing back up toward the top of the tank (Figure J19) is seen some Pb wrapping placed around one of the horizontal SS pipe elements. The cylindrical shaped object in the center of the next photo (Figure J20) is seen to be a threaded bolt (or equivalent) jutting out from the lead sheet wrapping.
8:31 PM		316	128		Figure J21 is a higher elevation view of some of the SS piping elements, some carbon-steel piping associated with the tank and sump pump, and a vertical electrical lead connected to the floor-bound leak detector.
8:43		013	091		A close up view of the leak detector is seen in Figure J22.

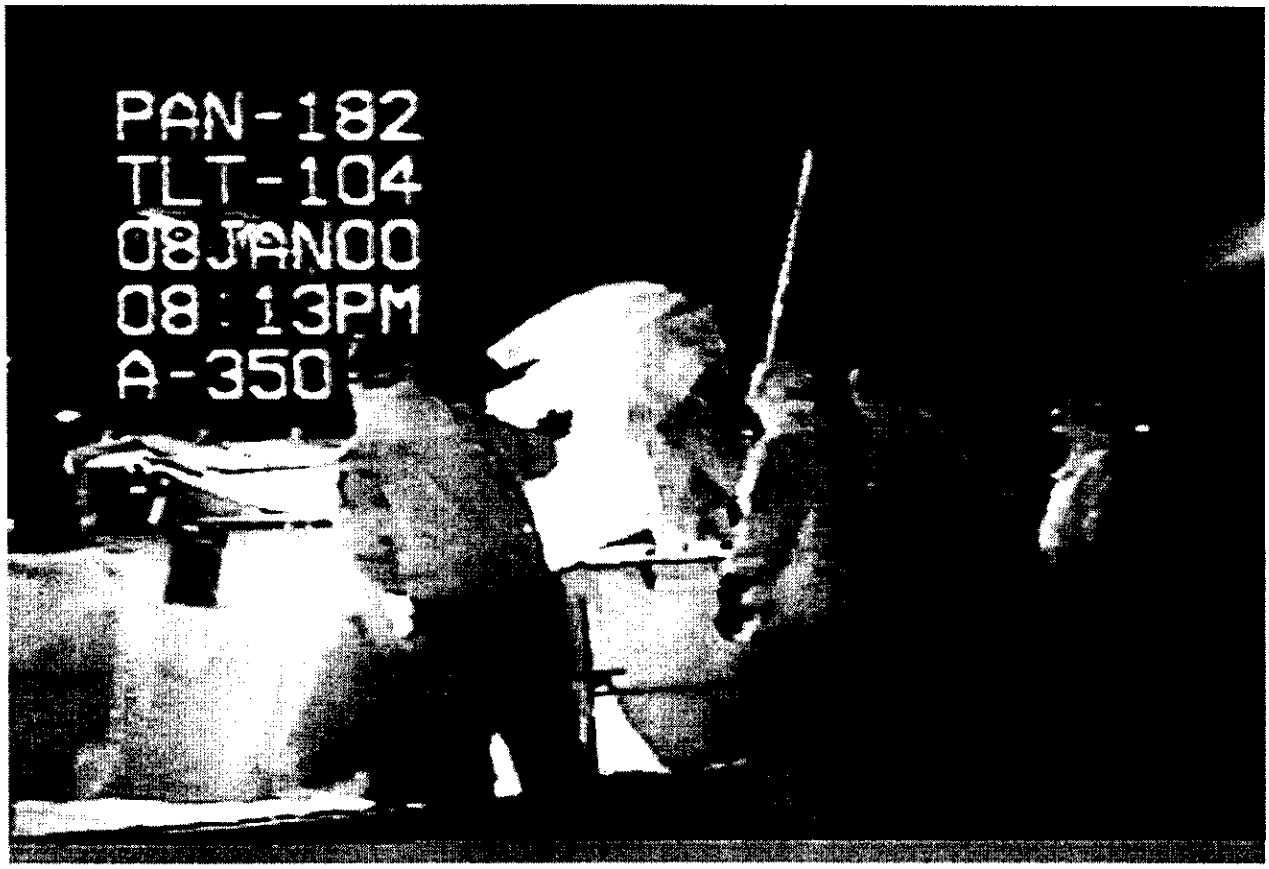

Figure J13.
A-350 Pump Pit Seal Plug Being Lifted Over Canvas Fence; White Plastic Wrapping is for Contamination Control.

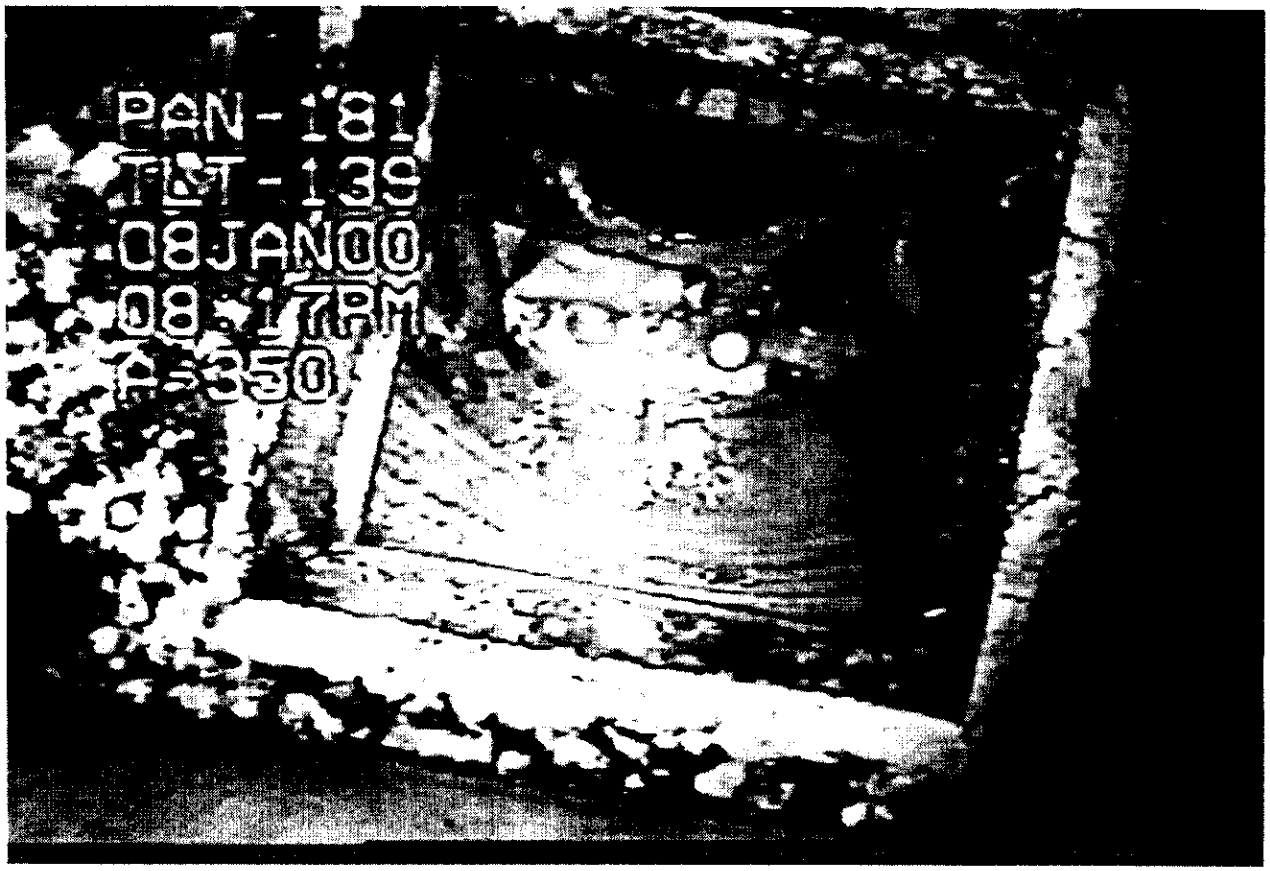

Figure J14.
View of 2-ft x 2-ft. Seal Plug Opening from Pump Pit to Catch Tank Annulus, 241-A-350 Lift station. Photo Appears Fuzzy due to Remnant Fog.

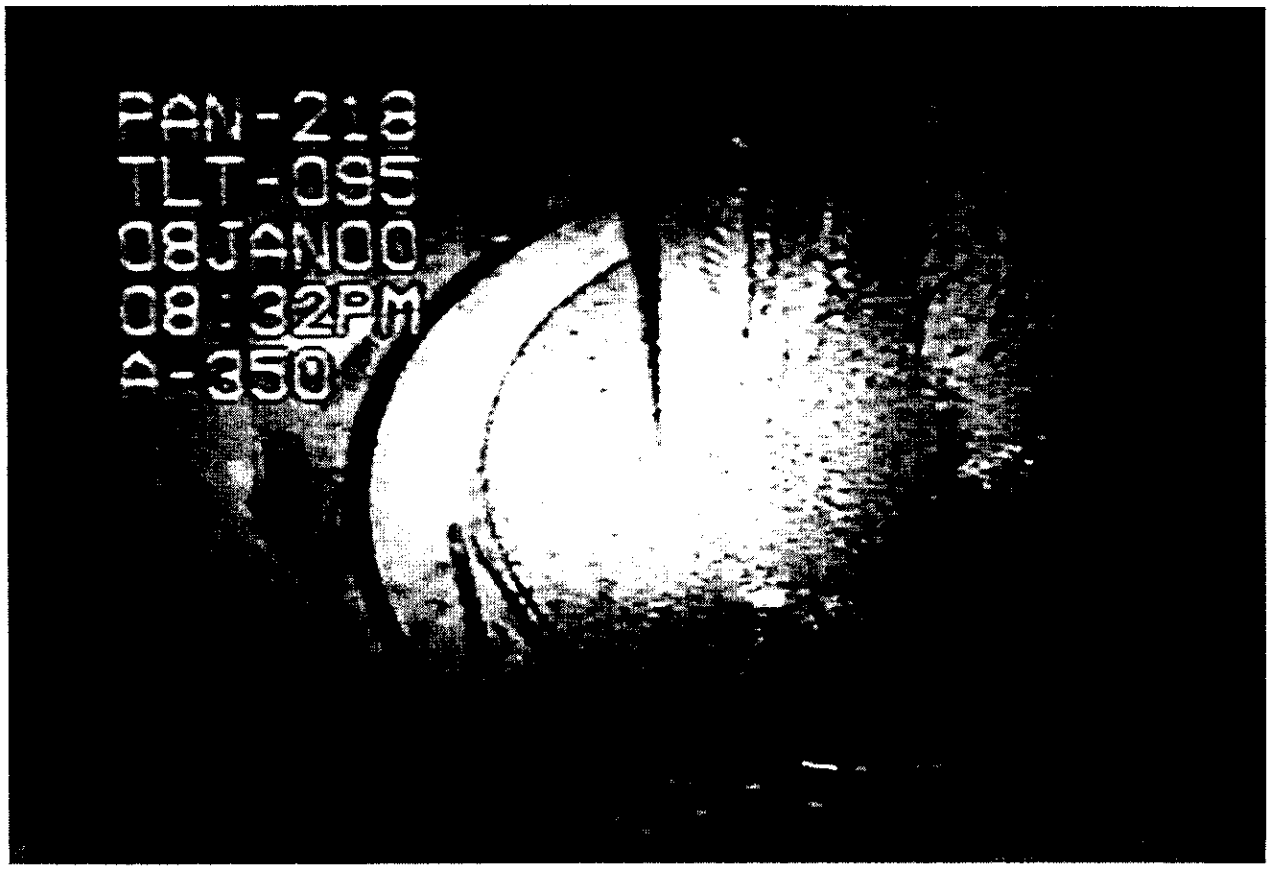

Figure J15
View of Top of A-350 Catch Tank Including Several Outboard Risers and Central Pump Riser.

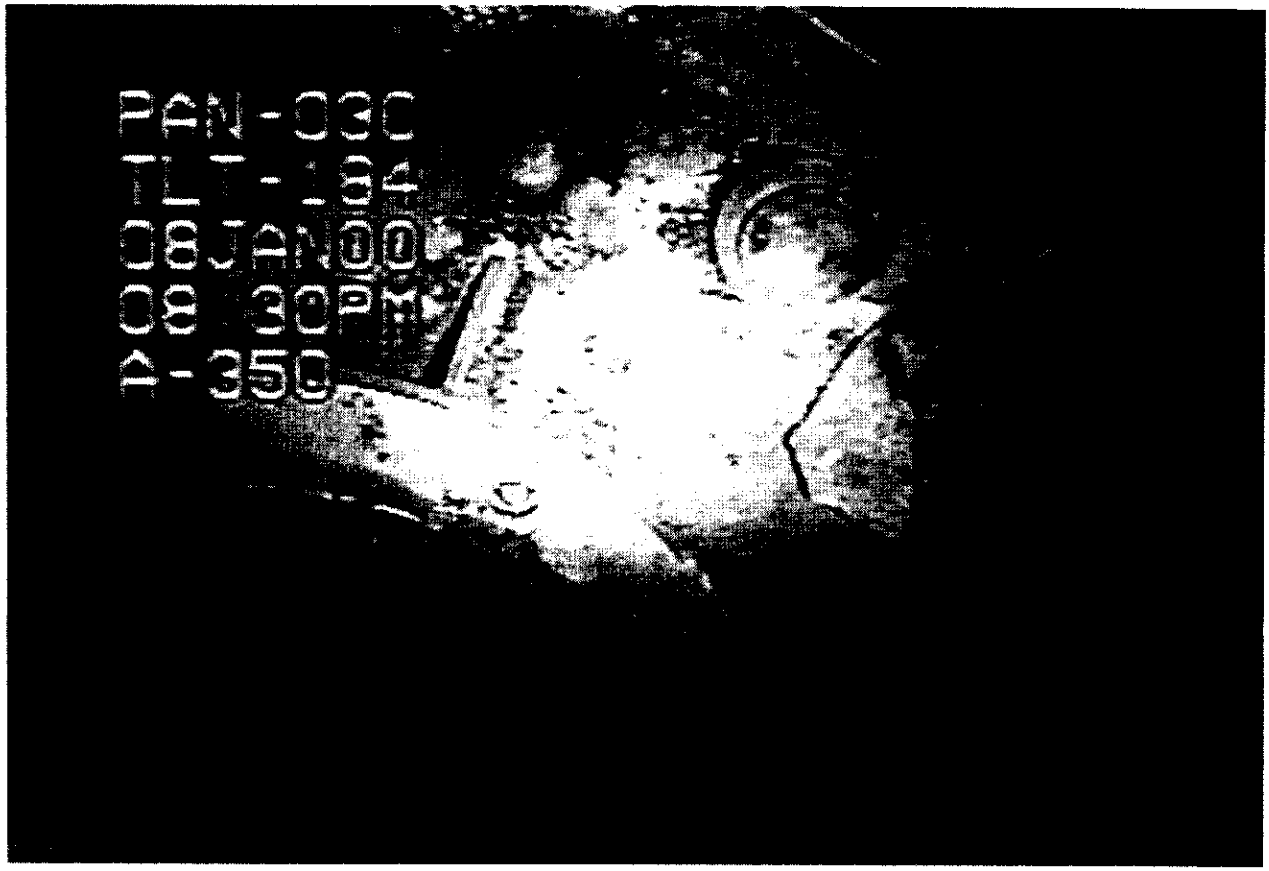

Figure J16.
Possible Lead Sheet (right) on Top of A-350 Stainless Steel Catch Tank.

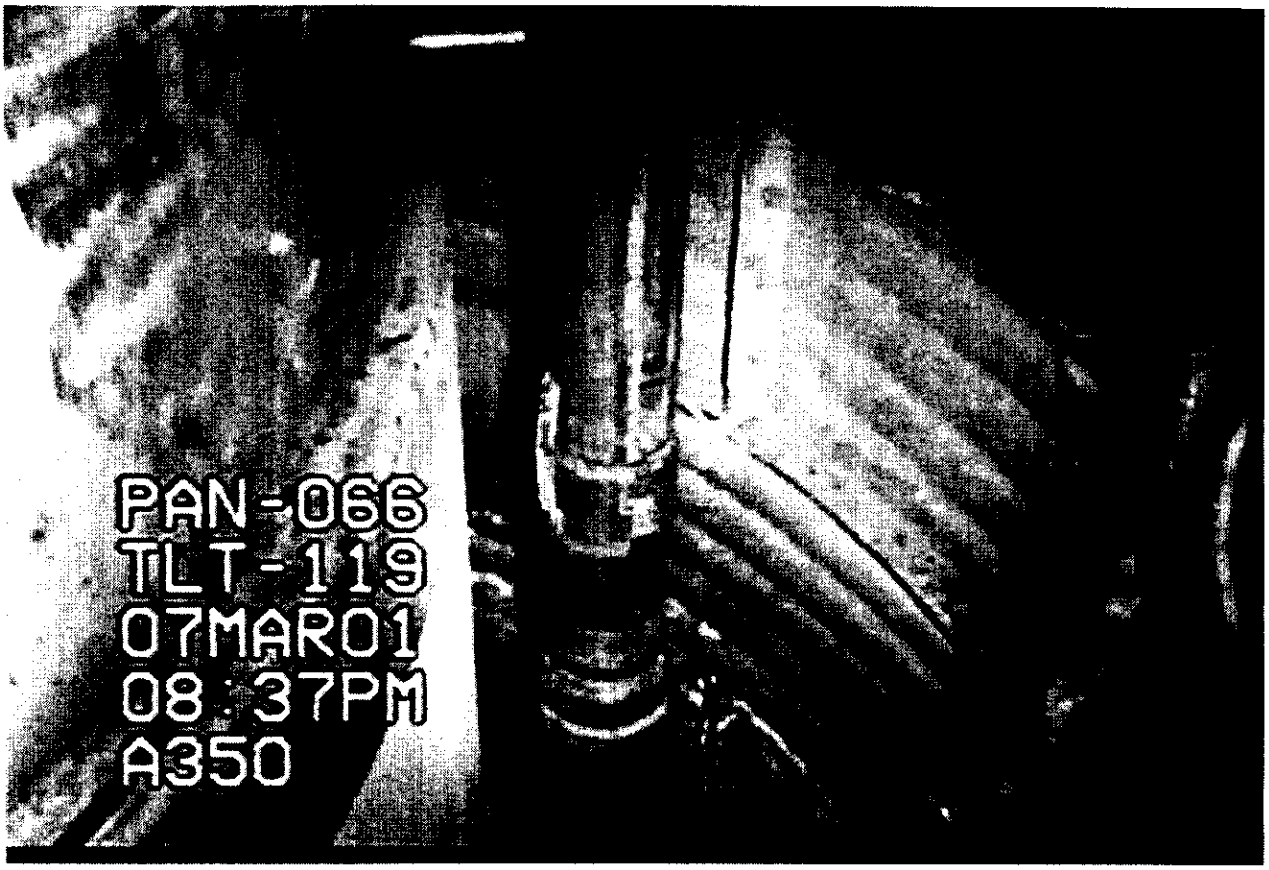

Figure J17.
View of Sidewall of A-350 Tank Showing Ledge (left) Where the Steam Jacket Begins. Carbon-Steel Pipe in Background is part of Sump Pump.

Figure J18.
Plugged Pipe Opening in Caisson Wall Adjacent to Annulus Bottom and Some Minor Corrosion and Chalking in Galvanize Coating. 241-A-350.

Figure J19.
Overall View of Lead Sheet Wrapped Around Horizontal SS Pipe, Above Catch Tank 241-A-350.

Figure J20.
View of Threaded Bolt (or equivalent) Jutting out from Opening in Lead Sheet Wrapped Around SS Piping Above 241-A-350 Catch Tank

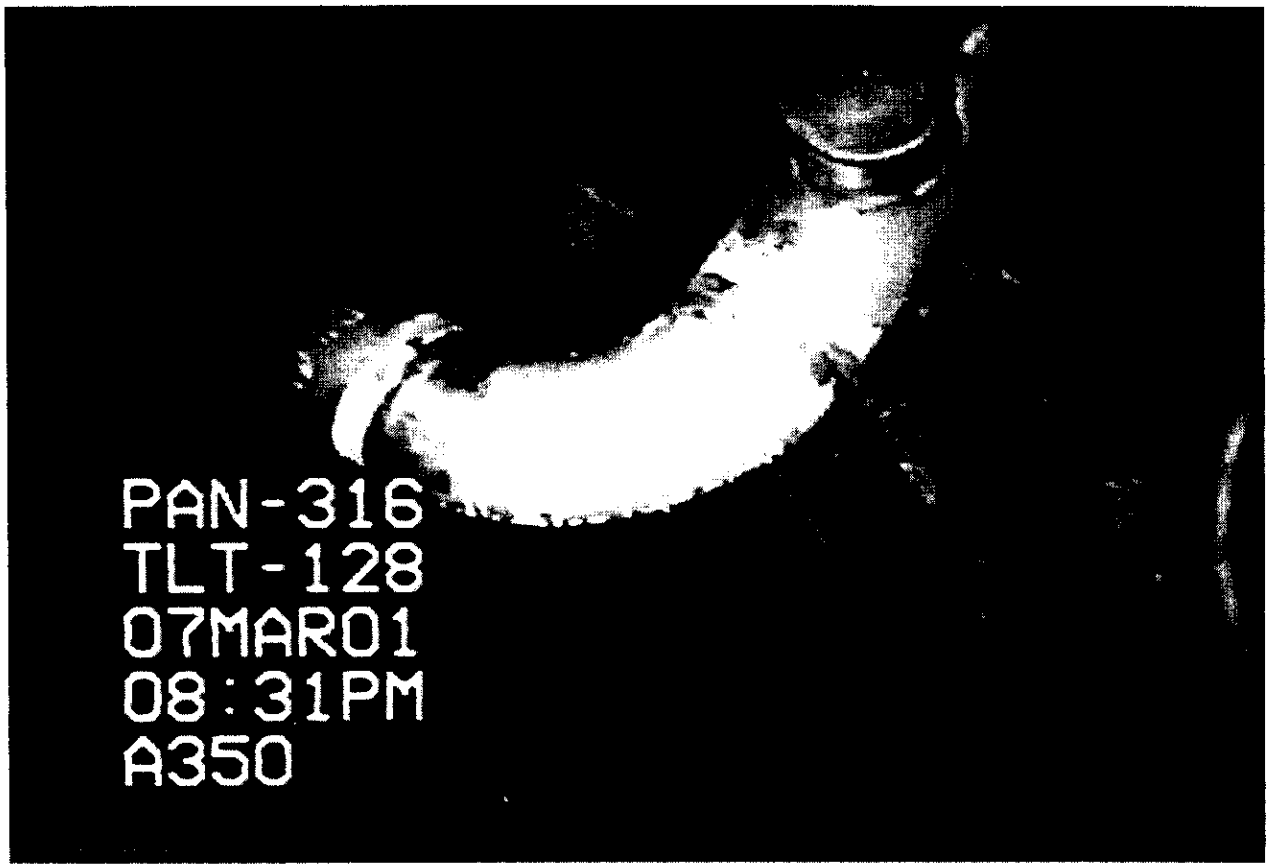

Figure J21.
View of SS Pipe elbow and Capped Tee, Including Jointed and Bolted, Galvanized Caisson Wall (right). 241-A-350 Catch Tank.

Figure J22.
View of Leak Detector on Annulus Floor, 241-A-350 Catch Tank.

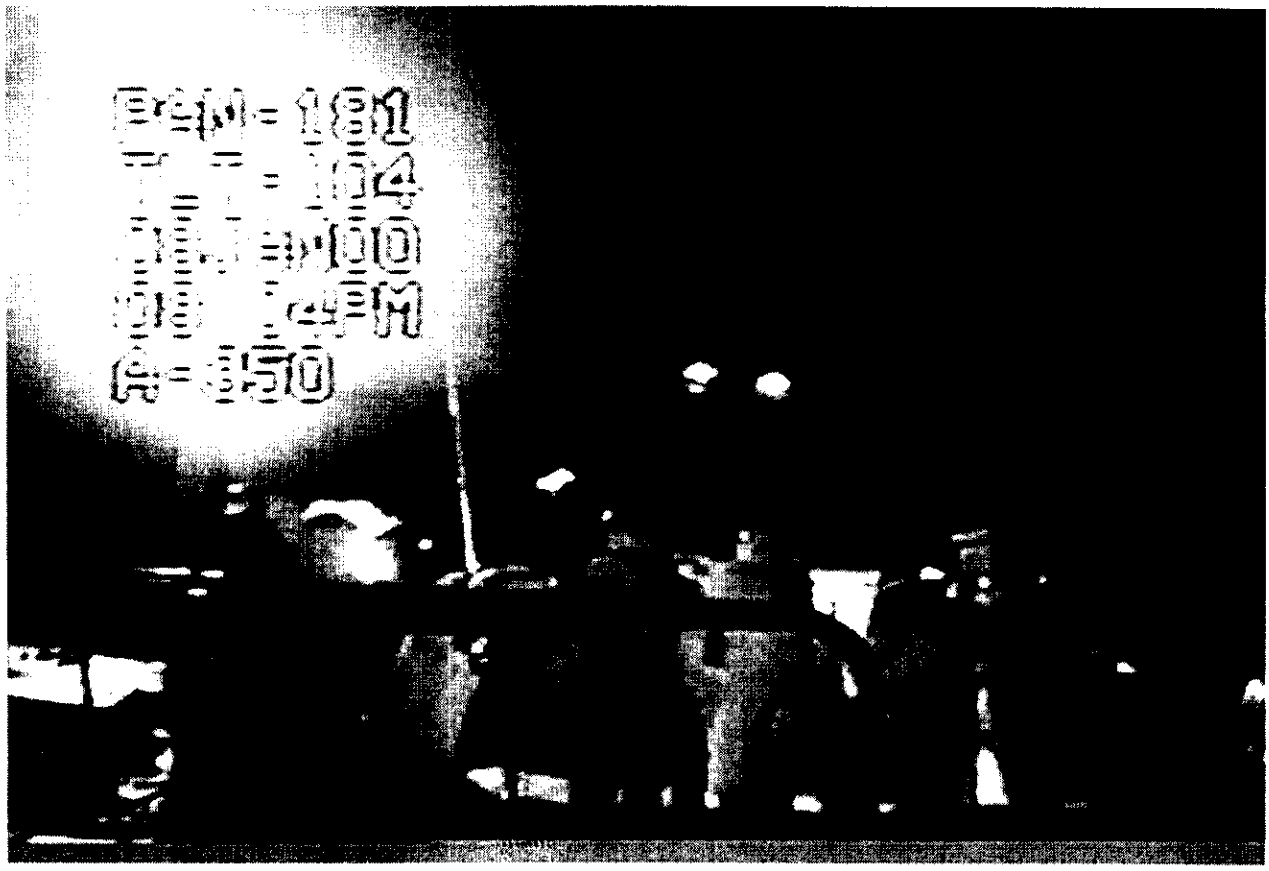

Fig. J23.
Pit-Side Crane Being Used for Lifting and Inserting Various Components, For a UT-Thickness Evaluation 241-A-350 Catch Tank.

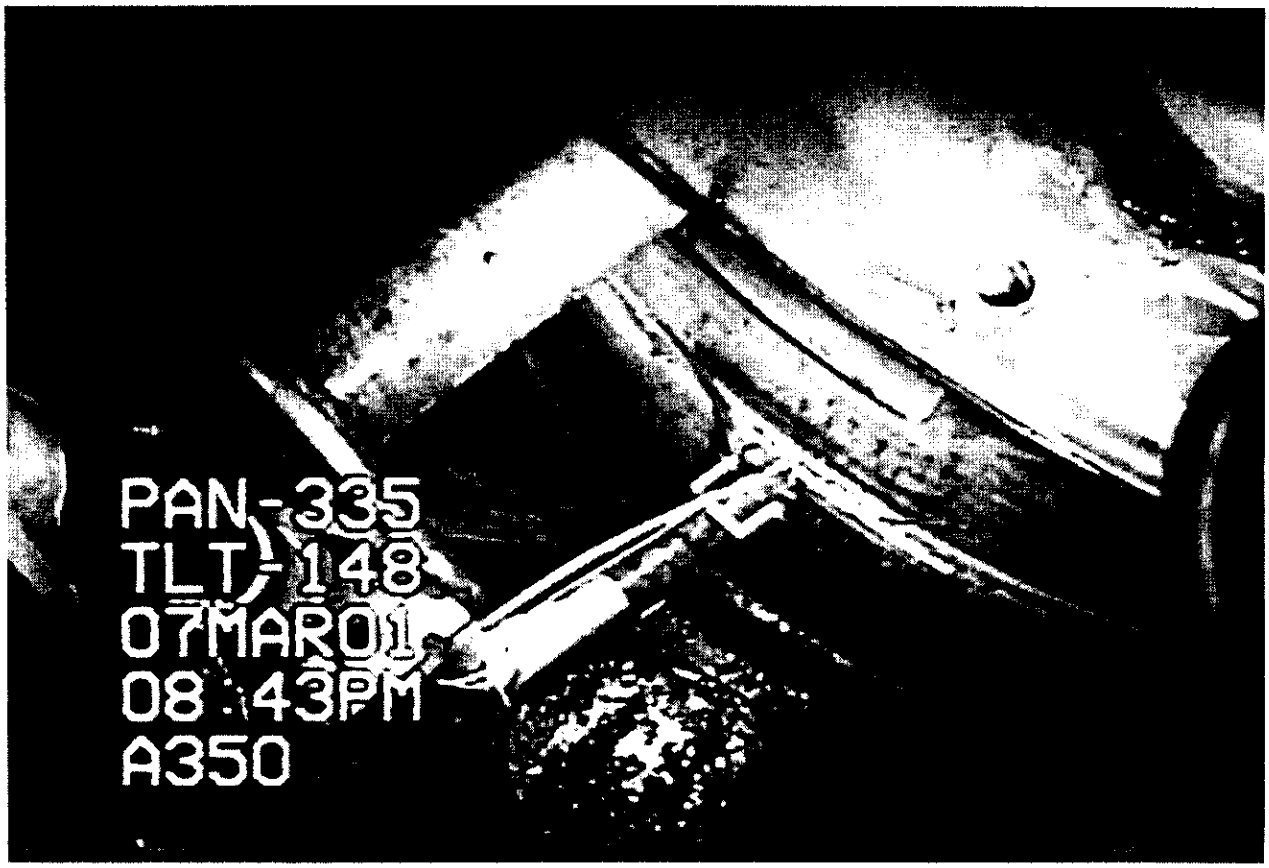

Fig. J24.
Right-angle UT-Transducer Head in an Unsuccessful Attempt at Being Pressed Against the Top Shell-Course in Catch Tank A-350. Interference Caused by Tank Lifting Trunnion and Brace at Left.

Figure J25.
Another View of UT-Pole Interference at Lifting Lug and Bracket, Proximal Pit Caisson Wall at Left.

Figure J26.
View of Intersecting Circumferential and Diagonal Weldment at Bottom of Tank (upper right) with Bi-winged Transducer Head, Upper Left. Very Upper Right is Angle-Edged Circumferential Support for Steam Jacket. Lead to Leak Detector and leak Detector Foot in Foreground on Fixant-Wet Floor. 241-A-350 Catch Tank.

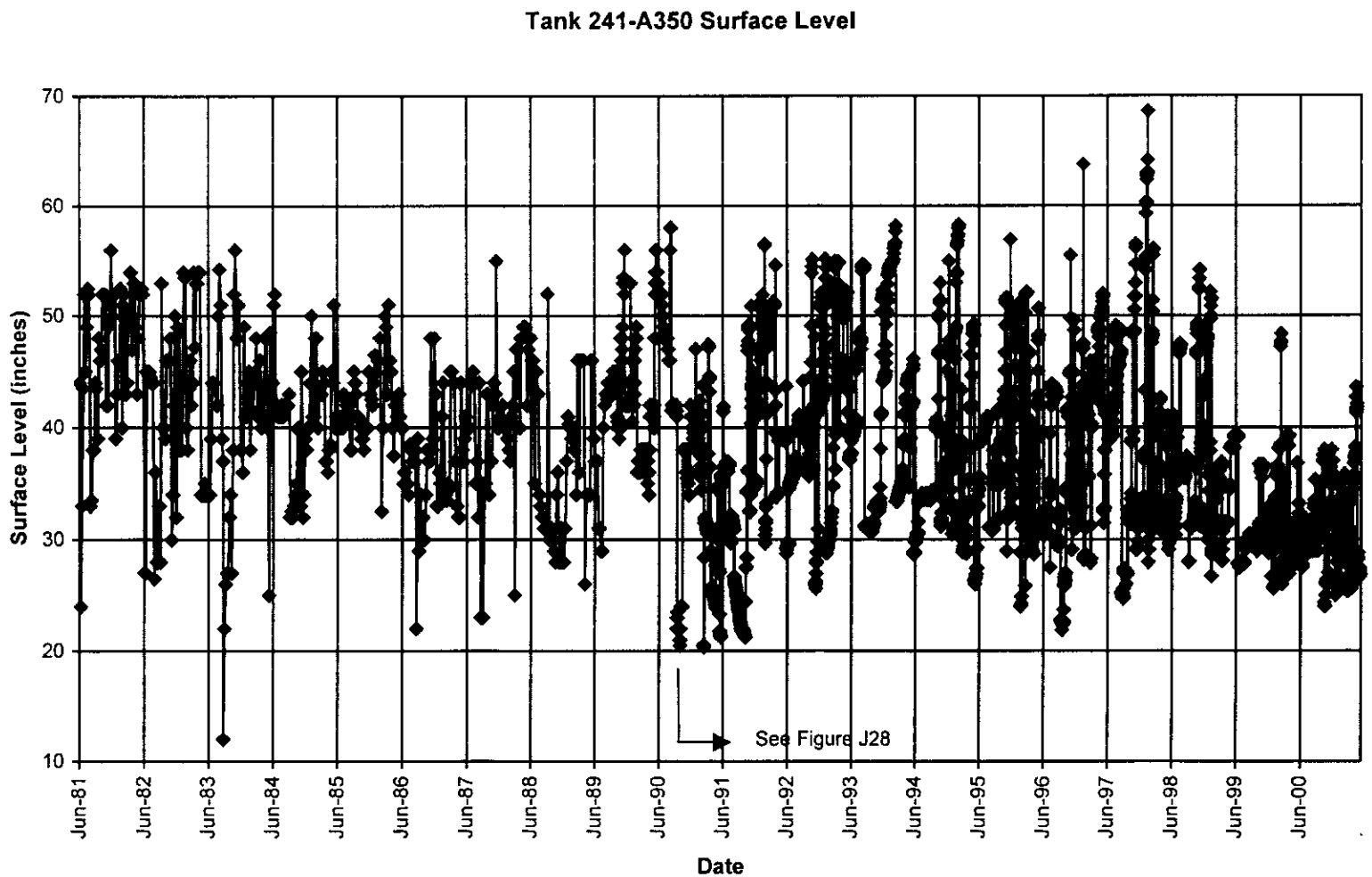

Figure J27 Surface Level versus Time, 1980-2000, 241-A-350 Catch Tank

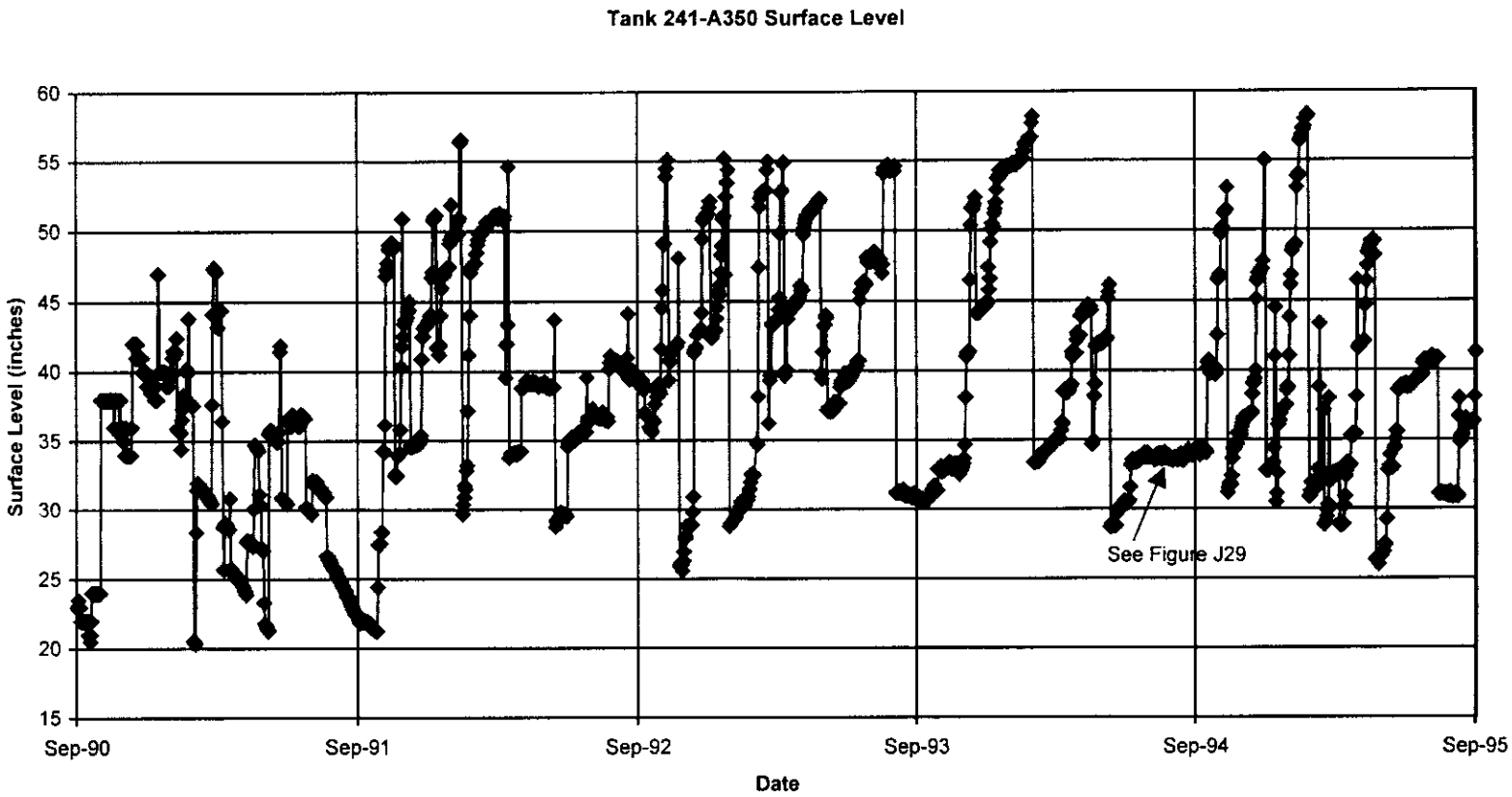

Figure J28 Surface Level versus Time, 1990-1995, 241-A-350 Catch Tank

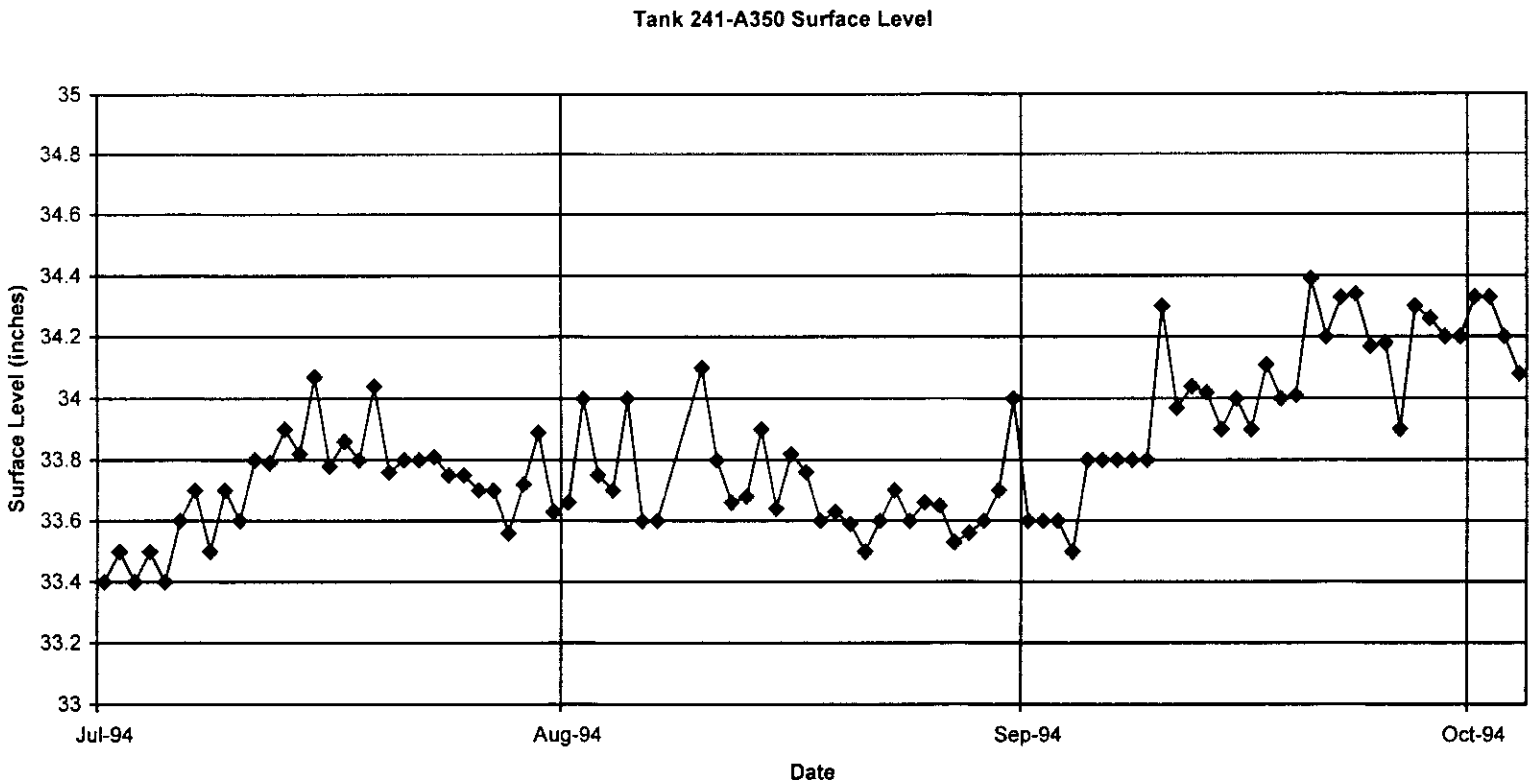

Figure J29 Expanded-time View, Surface Level versus Time, July 17, 1994 through October 13, 1994, Catch Tank 241-A-350

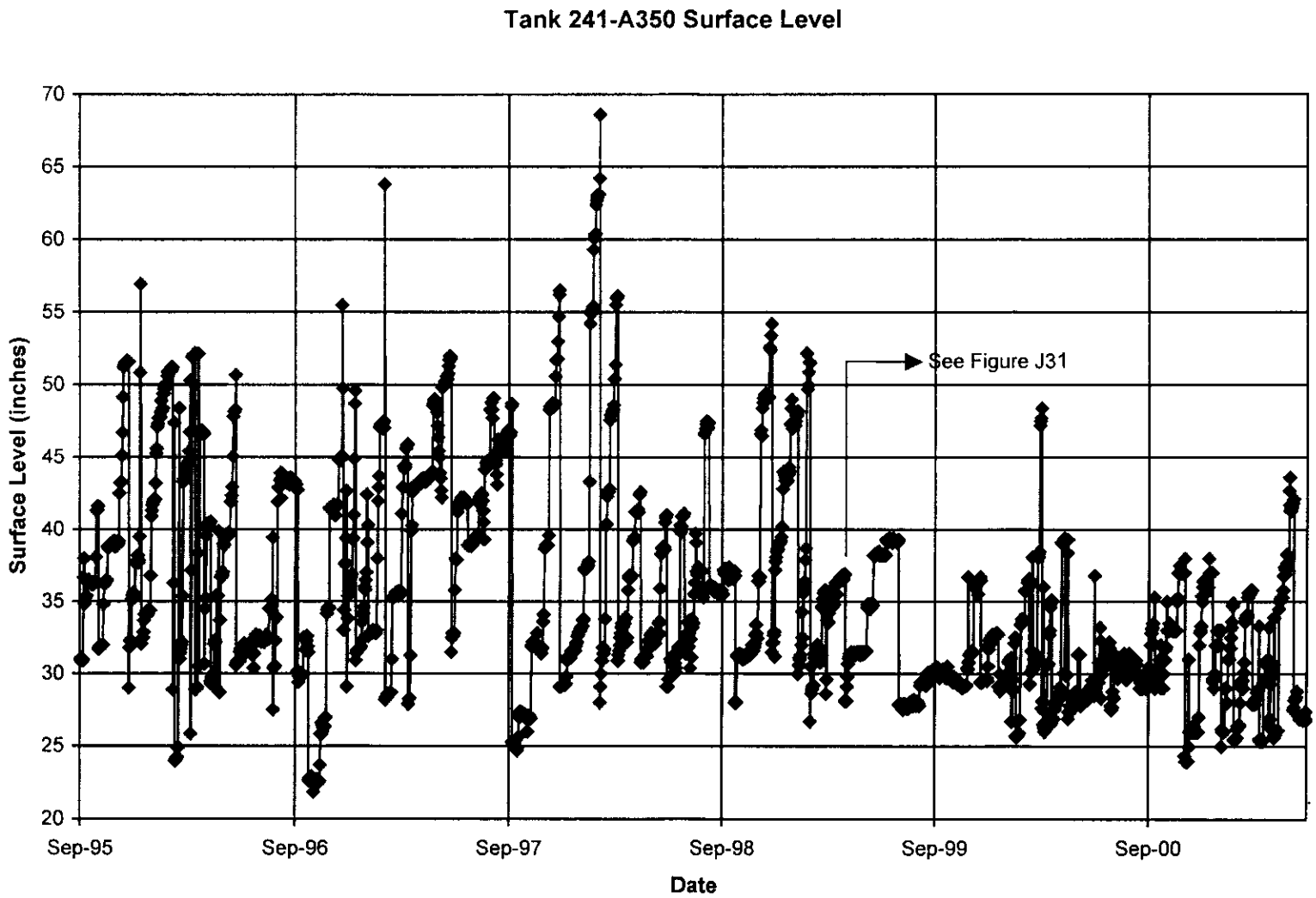

Figure J30 Surface Level versus Time, 1995 through 2000, 241-A-350 Catch Tank

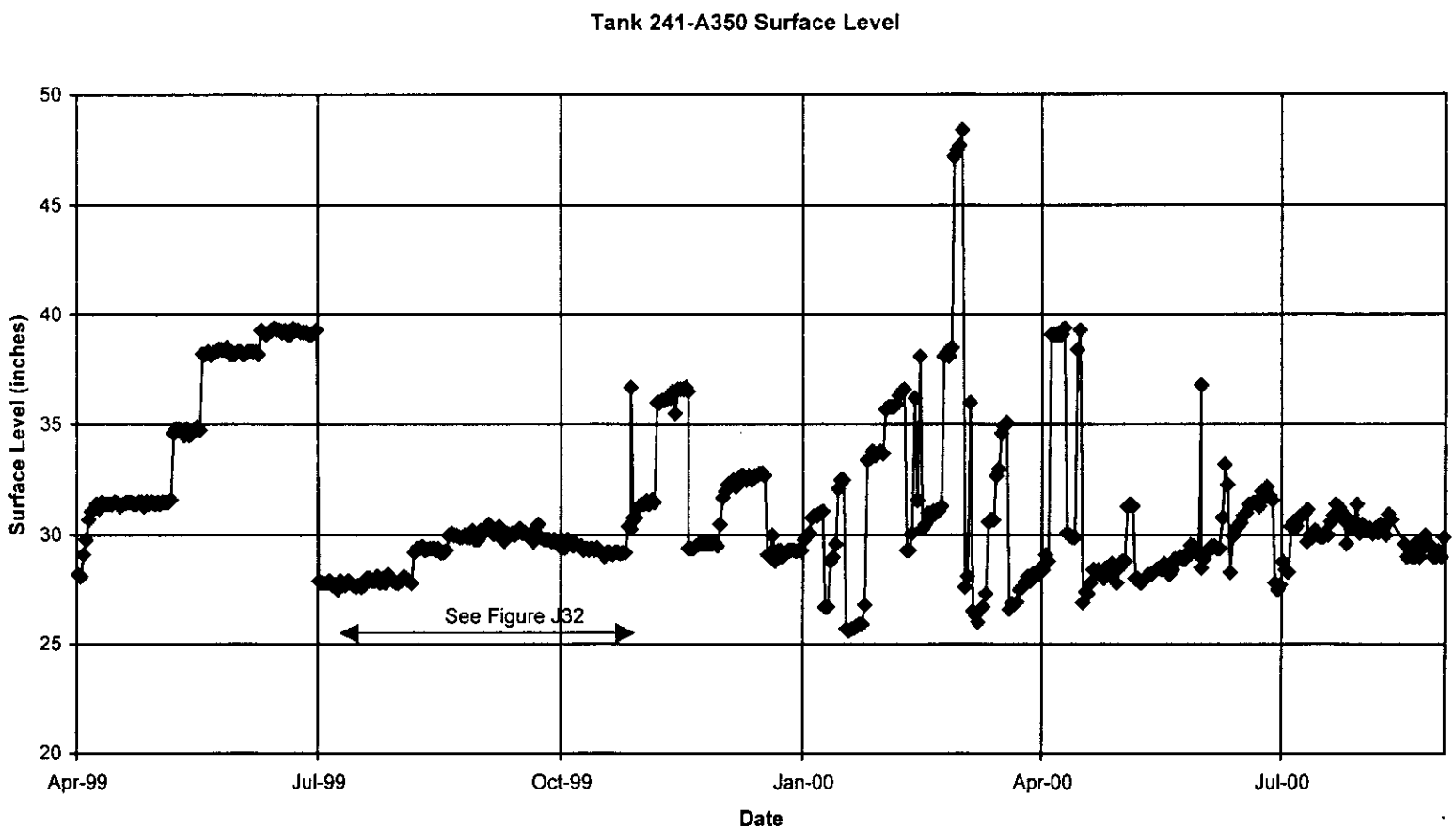

Figure J31 Surface Level versus Time, April 1999 through August 2000, 241-A-350 Catch Tank

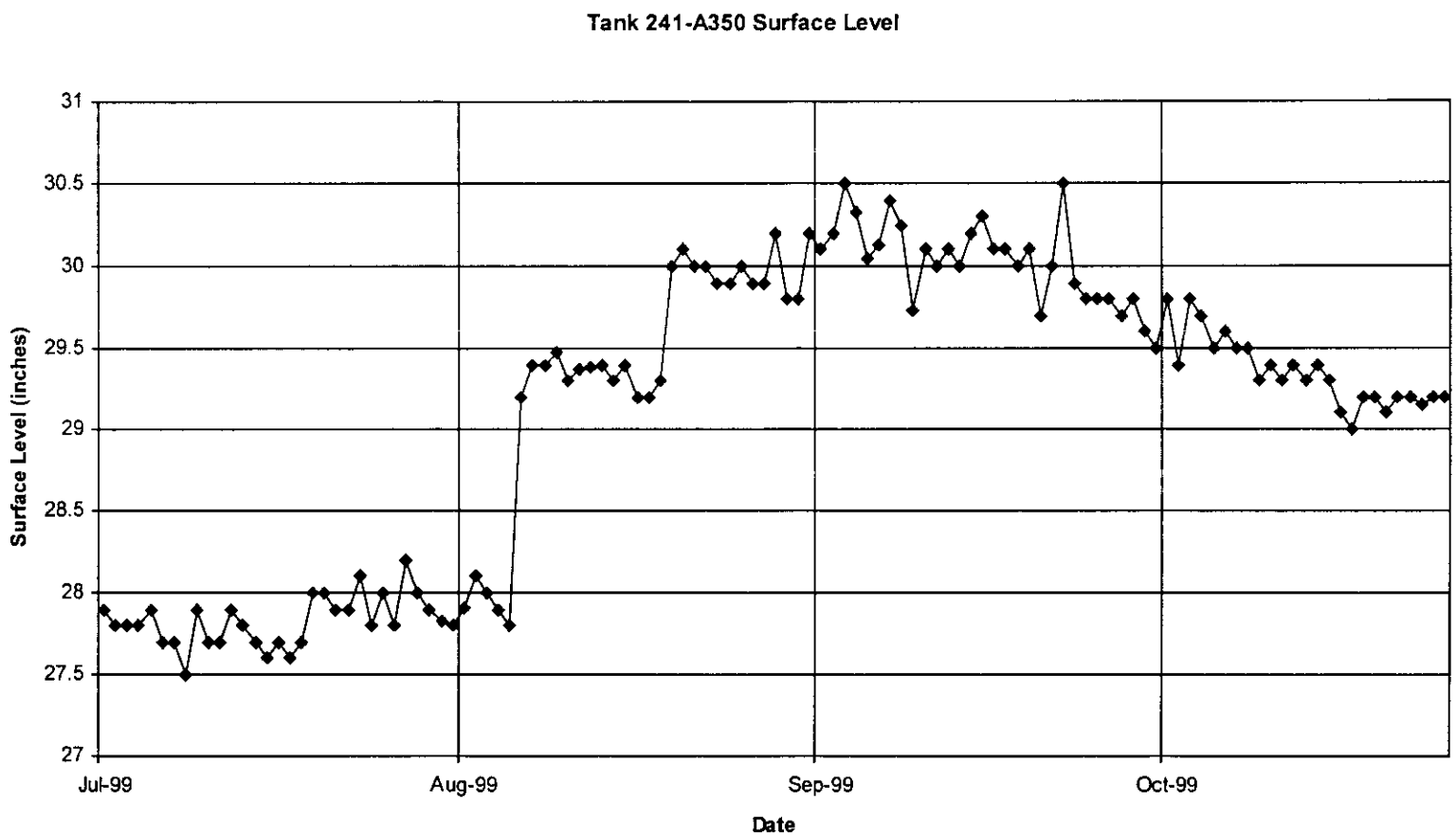

Figure J32 Expanded Time View, Surface Level versus Time, July through November 1999, 241-A-350 Catch Tank

ATTACHMENT 1

Threefold Calibration of UT-System for A-350 Examination

THREEFOLD CALIBRATION OF UT-SYSTEM FOR A-350 EXAMINATION

During the morning of Dec. 14, the subject UT system was successfully evaluated and calibrated using three, known-thickness mechanical standards. Two of the three calibrations were "Bench Calibrations." The third calibration involved the use of a 30-ft. long pole to apply the same UT-transducer to one of the same standards used in the bench calibration. The intent of the latter was to evaluate the UT-Transducer-on-a-pole (TOAP) technique under conditions that simulate application of the TOAP technique to remote wall thickness measurement of the A-350 Lift station catch tank. The A-350 tank is made of approximately type 347 Cb stainless steel and is nominally 3/8-in. thick; the tank is between about 30- to 40-ft. below grade.

The objective of the forthcoming UT-field measurements on the A-350 catch tank is to measure its wall thickness, where feasible, and at no greater than 6-in. vertical intervals, from top-to-bottom. If feasible, another set of measurements will be made as far as possible in the circumferential direction from the first set. UT-measurement precision is prescribed to be $\pm$ 5% of 0.375-in. or $\pm$0.019-in.

The electronic equipment used in this UT-calibration was:

a) A Nortec ½-in. diameter 5 MHz UT-transducer
b) A DuPont Quantum NDT System, model QFT-2 with built-in oscilloscope
c) A 50-ft. long UT transducer signal cable

1) UT STEP-BLOCK BENCH CALIBRATION

Mr. A. Smith (COGEMA Engineering), in conjunction with Mr. D. L. Becker (CH2M-Hill Group), and witnessed by J. Oliver (Fluor Daniel) and E. B. Schwenk (COGEMA Engineering), made consecutive thickness measurements, usually three times each, on the 0.100, 0.200, 0.300 and 0.400-in. steps of a NIST-traceable stepblock, S/N 584-99-30-135. The following table shows the results of the calibration check.

Table 1. Comparison of UT-Thickness Measurements with Step-Block Thicknesses

UT Measurement Number	Step Thickness – in.			
	0.100	**0.200**	**0.300**	**0.400**
1	N/A [a)]	0.194	0.296	0.399
2	N/A [a)]	0.194	0.295	0.399
3	N/A [a)]	0.195	0.296	0.400
Average	--	*0.194*	*0.296*	*0.399*
Maximum Variation	--	*0.006*	*0.005*	*0.001*

a) This UT measurement was not possible due to an interfering standing-wave artifact on the oscilloscope screen, which coincided with the 0.100-in. UT-reflection. Use of a 25-ft. lead eliminated the problem but, of course, it cannot be used during on-site measurements. This is not expected to be problem because the tank material starting thickness is 0.375-in. (nom.).

2) UN-NOTCHED & NOTCHED PLATE BENCH CALIBRATION

Two thickness-measured plates, one notched and the other unnotched, were used for this bench calibration of the same UT-transducer system.

The notched plate consists of a single stainless steel ¼-in. thick (nom.) plate (about 1-ft. square) with three, broad machined steps (about 1-in. wide) each traversing the entire plate width. The remaining areas of the plate, above and below the three-notched region, were left as is (unmachined). Average thickness of the plate, in the unmachined region, was 0.244-in. This particular plate had been machined for UT-system calibration before measuring wall thickness in the 204-AR catch tank (1/4-in. nom. thickness). The average thickness, of the remaining material in the wide notches, was 0.206-, 0.164-, and 0.125-in., respectively.

An unnotched stainless steel plate, 3/8-in. nominal thickness, was also mechanically measured and showed an average thickness of 0.373-in. The latter plate was used to simulate the nominal thickness of the A-350 catch tank.

Table 2. Comparison of UT-Thickness Measurements with Unnotched and Notched Plate Thicknesses

UT Measurement Number	Unnotched Plate	Notched Plate with Three Steps			
	0.373 thk.	Plate 0.244 thk.	0.206 Step	0.164 Step	0.125 Step.
1	0.377	0.249	0.205	0.164	0.125
2	0.375	0.249	0.205	0.161	0.124
3	0.378	0.248	0.206	0.162	0.124
4	0.377	--	--	--	--
5	0.377	--	--	--	--
Average	*0.377*	*0.249*	*0.205*	*0.162*	*0.124*
Maximum Variation	*0.005*	0.005	*0.001*	*0.003*	*0.001*

The same staff, noted above, conducted and witnessed the calibration-checks for the two plates.

3) SIMULATED FIELD CALIBRATION of the TRANSDUCER-ON-A-POLE, WITH NOTCHED PLATE STANDARD

Calibration of the same UT-transducer system, but attached to a 30-ft. long pole, was conducted using the ¼-in. nom. thickness notched plate used in 2) above. The work was conducted and witnessed by the same people noted in 1) and 2) above, with Mr. T. Delucchi (COGEMA Engineering) manually operating the TOAP system. Mr. Delucchi also designed and fabricated the very satisfactory jointed, mechanical pole system.

To press the UT-transducer against a structure, an operator at the top end of the pole manually pulls a rope. The rope, which is axially attached to the pole through eyebolts, transmits the manual rope force to a hinged-wheel lever arm at the UT-transducer end of the 30-ft. jointed pole. The lever arm-wheel combination simultaneously rotates and presses out against the simulated A-350 annulus wall thereby reacting the gimbaled UT-transducer (and couplant water) against the notched plate standard (or A-350 tank wall).

The simulated field calibration was carried out in the 306 E bldg, from the overhead penthouse area, which is about 30-ft. above the building's floor. The penthouse is an approximate 15-ft square by 10- to 15-ft. high structure located on the top of the 306 E building and contains a 3-ton capacity crane. The latter was used to support the upper end of the 30-ft. long aluminum pole, thereby allowing Mr. Delucchi (while in the penthouse) freedom to manually apply the UT-transducer against the notched plate standard through the hinged-wheel lever rope, at near-floor level. This mock-up arrangement in the 306E building simulated the A-350 Tank and Pit configuration as shown on engineering drawings. A small flow of water was used as the couplant between the transducer and the plate.

Results of the remote calibration are shown in Table 3.

TABLE 3. THICKNESS MEASUREMENT OF NOTCHED PLATE WITH THE TOAP SYSTEM

UT Measurement No.	Notched Plate with Three Steps – in.			
	Plate 0.244 thk.	0.206 Step	0.164 Step	0.125Step
1	0.245	0.206	0.162	0.125
2	0.248	0.206	0.164	0.125
3	0.247	0.207	0.162	0.124
Average	*0.247*	*0.206*	*0.163*	*0.125*
Maximum Variation	*0.004*	*0.001*	*0.002*	*0.001*

Comparison of UT-Measurement Variability Levels for Threefold Calibration.

For the three calibrations presented above, the measurement variability is very satisfactory.

- For the stair-step block bench calibration, the UT-measured thicknesses are within a maximum difference of 0.001-, 0.005-, and 0.006-in. of the 0.400, 0.300, and 0.200-in. steps, respectively. This amounts to a corresponding satisfactory variability of about 0.3, 1.7, and 3%. No UT-measurement at the 0.100-in. step was possible due to an overlapping UT-signal artifact, caused by the long lead-length (50-ft.).

- For the bench check of the full-thickness plates (¼-in. nom. and 3/8-in. nom.), the variability is nominally improved over the step-block. Both plate full-thickness values were measured within a maximum variability of 0.005-in. These equate to %-values of about 2 and 1.3, respectively.

- For the bench check of the notched plate steps (0.206-, 0.164-, and 0.125-in. thick), they were UT-measured similarly to maximum variability levels of 0.001-, 0.003-, and 0.001- in., respectively. These equate to %-values of about 0.5, 1.8 and 0.8, respectively.

- For the 30-ft.-long TOAP check of the same notched plate steps, the maximum variability values improved slightly to 0.001, 0.002, and 0.001-in., respectively. These correspondingly equate to very satisfactory %-values of 0.5, 1.2, and 0.8.

SUMMARY

In general the results of the two UT-bench calibrations and the 30-ft. long simulated field TOAP calibration were very satisfactory. All three calibration checks show that a ± 5% precision (or ± 0.019-in.) for a 3/8-in. nominal thickness catch tank is feasible.

ATTACHMENT 2

NDE ULTRASONIC THICKNESS MEASUREMENT

PROCEDURE AND TEST REPORT

INTEGRITY ASSESSMENT OF A-350 CATCH TANK

COGEMA ENGINEERING CORP.

PROCEDURE AND TEST REPORT

NONDESTRUCTIVE EXAMINATION
306E BLDG., 300 AREA - TEL. 376-5402

01-37A

Requester (client)	Company	MSIN	Bldg.	Area
DAVID L. BECKER	CHG	R1-04	2750	200E

Project/System/Work Package/Traveler No.
INTEGRITY ASSESSMENT OF A-350 CATCH TANK
2E-00-1840
114658/EJ00

Acceptance Std. BY CLIENT | Section | Para. | Date ☐ NA

PART INFORMATION

Material STAINLESS STEEL
Wall Thickness 0.375 NOM. ☐ NA
Diameter 52" ☐ NA
Schedule ☒ NA
Size APPROX. 83" ☐ NA
Dwg. No. ☒ NA | NCR ☒ NA

PROCEDURE NO.
SVUT-PRC-007 Rev. 1
Appendix B Revision No. 1

Special Technique No ☐ NA
REMOTE TRANSDUCER

COVERAGE
☐ 100% of Area Requested
☒ Other PER CLIENT DIRECTION

INSTRUMENTATION
Mfg. DUPONT Model QFT-2
S/N or Standards Lab No
584-31-50-028

CALIBRATION STANDARD(S)
Identification No. 584-99-30-135
Identification No

TRANSDUCER
Diameter 0.50"
Frequency 5.0 mHz
Mfg. NORTEC
Serial No. 932909
Stand Off NA

Couplant WATER
Batch No. N/A

RESULTS

PRE-EXAMINATION ULTRASONIC READINGS FROM THE CALIBRATION STEP WEDGE: 0.399 (0.400), 0.298 (0.300), 0.201 (0.200)AND 0.101(0.100)
NOTE: THE PHYSICAL MEASUREMENTS ARE SHOWN IN PARENTHESES.

THE FOLLOWING DATA WAS OBTAINED USING AN ULTRASONIC TRANSDUCER DEPLOYED ON AN ALUMINUM POLE TO REACH DOWN TO THE EXAMINATION AREA.

THE INITIAL READINGS WERE APPARENTLY ON THE NONFUNCTIONAL STEAM JACKET, WHICH COVERED MOST OF THE TANK LENGTH, AND WAS DIFFICULT TO DISTINGUISH WITH THE REMOTE VIDEO CAMERA. BECAUSE THE TRANSDUCER LOCATION COULD ONLY BE SEEN WITH THE REMOTE VIDEO CAMERA, THE FOLLOWING READINGS ARE REFERENCD TO THE TIMES RECORDED ON THE VIDEO TAPE.

0.130 AT 8:46 PM. 0.143 AT 8:48 0.137 AT 8:50

0.134 AT 8:52 0.136 AT 8:53 0.135 AT 8:57

DUE TO THE STEAM JACKET AND ACCESS LIMITATIONS, THE ONLY READING PRACTICABLY OBTAINABLE ON THE TANK WALL WAS 0.371 AT 9:41 PM. THIS READING WAS ON THE TANK WALL APPROXIMATELY SIX TO TWELVE INCHES FROM THE TOP OF THE TANK.

NOTE: *THE UNDERLINED INFORMATION ABOVE WAS ADDED TO THE ORIGINAL REPORT, WITH A REVIEW DATE OF 3/07/01, TO SHOW THE LOCATION OF THE READING WITHOUT NECESSITATING VIEWING THE VIDEOTAPE TO DETERMINE IT.*

POST EXAMINATION CALIBRATION READINGS WERE:
0.395 (0.400), 0.298 (0.300) 0.199 (0.200) AND 0.101 (0.100)

NOTE: ALL THICKNESS READINGS ARE IN INCHES.

Technician	UT Level	Interpreted by	UT Level	Reviewed by
J.N. FURTH	II	J.N. FURTH	II	
A.A. ANDERSON	II	A.L. SMITH	II	
Date of examination 3/07/01		Date of examination 3/07 /01		Date 5-16-01

A-6000-507 (02/99)

COGEMA ENGINEERING CORP.

NDE REQUEST/INSTRUCTION FOR NONDESTRUCTIVE TEST SERVICES

Nondestructive Examination
306E Building, 300 Area, Phone No. 376-5402

Requester	MSIN	Bldg.	Area	Phone No.	Company
Robert W. Lysher	S7-12	2704-HV	200E	376-0979	CEC

Project/System Identification
Tank Integrity Assessment (TIA) Project

Work Package/Traveler No.
2E-00-1840

Drawing No.
H-2-70538

CACN/COA
~~106694~~ FA10 114658/E300

Acceptance

	Code/Specification	Section	Paragraph	Date
○ NDE	COGEMA-SVUT-007 Thickness Measurements			
◉ Client				

Special Instructions (handling requirements, allowed markings, etc.)
Perform Ultrasonic Testing (UT) of the A-350 Catch Tank. Starting from either the bottom or top of the tank, take readings at 6 in. intervals (spot check) for the full vertical length of the tank (A-350 could have a "jacket" that covers the majority of the tank's mid-section, readings may not be possible in this area). Take readings at two circumfrential locations as far apart as possible (movement limited to boundary of entry port).

Safety/Radiological Conditions
Work will be in a radiological zone, see work package and RWP for specific details.

NDE METHOD
- ☐ Penetrant (PT)
- ☐ Magnetic Particle (MT)
- ☐ Leak Testing (LT)
- ☒ Ultrasonic (UT)
- ☐ Radiography (RT)
- ☐ Eddy Current (ET)

Part Location
A-350 Lift Station

Contact (PIC)
Dan Niebuhr

Phone No.
373-4639

Bldg./Room
272-AW/B

Part Information
A-350 Catch Tank is made of 3/8 inch thick Type 309Cb Stainless Steel, is approximatelt 20 years old and is located in an 8 ft. diameter steel caison approximately 29 ft. from top of grade to bottom of caison. The tank is approximately 4 ft.-6 in. diameter by 6 ft.-11 in. tall.

RESERVED FOR NDE USE ONLY

Request Accepted By:	NDE Job No.
Blaine Hopkins	01-37

A-8001-086 (02/99)

ATTACHMENT 3

RESULTS FROM the ULTRASONIC INSPECTION

of

241-A-350 LIFT STATION CATCH TANK

RESULTS FROM THE ULTRASONIC INSPECTION OF

A-350 Lift Station Catch Tank

G. J. Posakony and A. F. Pardini
Pacific Northwest National Laboratory

INTRODUCTION

This letter report describes the results of the ultrasonic wall-thickness measurements made on the A-350 Lift Station Catch Tank. These measurements were made under difficult conditions in that the tank is radioactive and is buried in the ground with access limited to a 2 ft by 2 ft seal plug opening that leads into the tank. All ultrasonic wall-thickness measurements were made remotely through this access. A manual inspection procedure and technique were developed that used a spring-loaded transducer mounted at the end of a 40- to 50-ft pole. Acceptance tests of this procedure were performed on a laboratory mockup to establish performance capability and to validate the calibration and operation of the pole-mounted ultrasonic transducer configuration, measurement procedure, and ultrasonic instrument.

To establish the performance capability of the ultrasonic system (electronic, long-pole transducer assembly and technique for wall-thickness measurement), a special high-bay mockup was fabricated and "bench calibration experiments" were performed to simulate remote wall-thickness measurements of the A-350 Lift Station Catch Tank. From these validation tests, the measurement precision was judged to be within ±5% of 0.375 in. or ±0.019 in. (see January 18, 2001 Memo from E. B. Schwenk to D. L. Becker).

The A-350 Lift Station Catch Tank is made of Type 309Cb stainless steel and is nominally 3/8-in. thick. The tank is approximately 4 ft 6 in. in diameter and 6 ft 11 in. tall. It is located in an 8-ft-diameter steel caisson that is approximately 29-ft-from the top grade to the bottom of the caisson. A 1/8-in.-thick steel steam jacket surrounds the majority of the stainless tank. Thickness readings of the steam jacket ranged from 0.130 to 0.143 in. However, it was not possible to look through the steam jacket to measure the actual tank wall thickness. Because of the presence of the jacket, only one measurement (0.371 in.) was recorded on the upper exposed portion of the tank. Figure 1 shows a sketch of the tank, the approach for making measurements, and the location of the one measurement.

To make the wall-thickness measurements, a spring-loaded, 5 MHz, 0.5-in. diameter, ultrasonic transducer was mounted on the end of a 40- to 50-ft long pole. Fiducial marks were made on the pole to provide reference positions for establishing the vertical location of the transducer on the side of the tank. The pole was inserted through the seal plug access located above tank and the transducer was positioned normal to the tank wall. Pressurized water to the transducer was used to supply the ultrasonic couplant. A Dupont Quantum ultrasonic thickness measurement instrument, Model-QFT-2, was used to make the wall-thickness measurements.

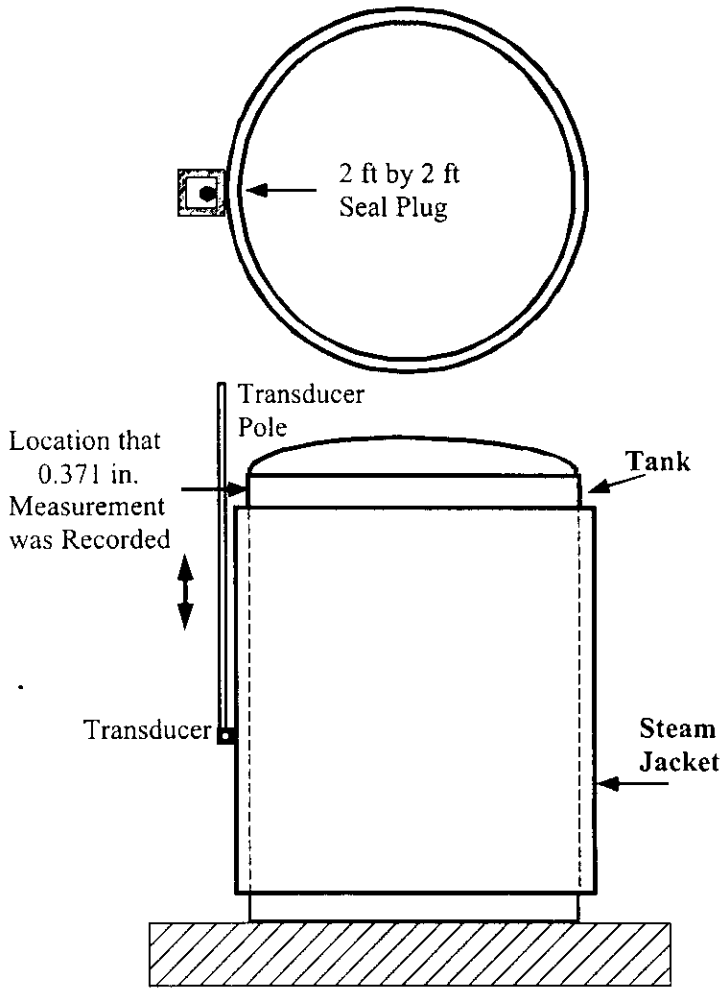

Figure 1. Sketch of A-350 Tank and Technique used for Wall-Thickness Measurements

As a standard practice to assure the quality of the readings, a detailed instrument calibration was performed both before and after each tank examination using the calibration block used to validate the performance and calibration of the system.

SUMMARY

There are several issues to be considered in evaluating the effectiveness of the remote inspection used for the wall-thickness measurements. Namely, personnel qualifications, the procedure followed in making the wall-thickness measurements, and the performance capability of the equipment involved in making the measurements.

- **Personnel Qualifications**—COGEMA personnel involved in making the wall-thickness measurements were all qualified in accordance with the American Society for Nondestructive Testing (ASNT) SNT-TC-1A. The qualification of personnel was current in their certification documentation.

- **Ultrasonic Test Procedure**—The restrictions imposed by the limited access required the development, validation, and deployment of a special procedure. Placing the transducer on a long pole and using a spring-loaded fixture to force the transducer to position itself normally on the tank surface provided a unique solution to a very difficult inspection problem. In addition, a video camera allowed the inspection personnel to view the location and position of the transducer.

  The key feature in the deployment of the system was the development of a mockup that simulated the wall-thickness measurement requirements of the actual tank. This permitted validation of the technique and procedure through demonstration of the performance on a series of mechanically measured thickness calibration blocks. These blocks were then used to calibrate the system before and after each test series to assure the system remained in calibration. The procedure validation on the mockup and the calibration of the system before and after tank examinations is judged to provide as good an approach as could be used for this type of wall-thickness examination.

- **Ultrasonic System**—A DuPont Quantum ultrasonic instrument was used for the wall-thickness measurements. This is a general-purpose instrument that is typically used for measurements of this type. With proper calibration, it has the capability of meeting all the requirements for the wall-thickness measurements. The spring-loaded transducer and the scheme for providing ultrasonic couplant (water) was very effective as demonstrated in both the initial and field calibrations and in the measurements made on the steam jacket surrounding the tank.

RESULTS

The steam jacket surrounding the tank precluded making meaningful thickness measurements of the full vertical wall of the tank. Only one reading was recorded (0.371 in.) at the top of the tank. The remainder of the tank wall could not be measured, as it was not possible to see through the steam jacket annulus to measure thickness of the tank wall itself.

The conclusion from reviewing the data provided is that the procedure and technique employed provided a valid approach to the wall-thickness measurements in the one area above the steam jacket that was accessible. The measurement precision was judged to be ±5%. The technique employed, however, could not penetrate through the steam jacket annulus to provide any wall-thickness measurements of the rest of the catch tank.

APPENDIX K

241-ER-311 CATCH TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
CVI	Certified Vendor Information Files
DOE-RL	U.S. Department of Energy Richland Operations Office
ECN	Engineering Change Notice
ENRAF	Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge)
ER-151	241-ER-151 diversion box
ER-152	241-ER-152 diversion box
ER-311	241-ER-311 catch tank
FIC	Food Instrument Corporation (liquid level gauge)
HDCS	Hanford Data Control System
ID	inside diameter
RHA	Record Holding Area
HLAN	Hanford Local Area Network
LFL	lower flammability limit
OD	outside diameter
PCSACS	Personal Computer Surveillance Analysis Computer System
RMIS	Records Management Information System
SCC	stress-corrosion cracking
SS	stainless steel
VITIS	Video In-Tank Inspection System
WHC	Westinghouse Hanford Company

1.0 INTRODUCTION

The 241-ER-311 catch tank (ER-311) is located in the 200 East Area of the Hanford Site (Figure K1). The catch tank was designed and installed to be used as the secondary containment for diversion box 241-ER-151 (ER-151) and 241-ER-152 (ER-152).

2.0 PURPOSE

The purpose of the design evaluation and examinations is to determine the conditions of the facility, and determine if the ER-311 catch tank components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the ER-311 pump pit and the catch tank. The scope of the examinations includes a visual examination of the ER-311 catch tank internal surface, pump pit, and a leak test of the tank.

4.0 DESCRIPTION

The ER-311 catch tank is a direct-buried underground tank. A pump pit sits directly above the center of the tank at ground level. The original ER-311 tank was carbon steel and was apparently emplaced after 1950. Its stainless steel replacement occurred in 1954. It was later modified in 1980 under Project B-231 primarily by addition of the pump pit and an underground

pump-out capability (Vitro 1980). The location of the facility on the Hanford Site is shown in Figure K1 and a sketch of the facility is shown in Figure K2.

4.1 PUMP PIT

The pump pit has interior dimensions of 5-ft-length by 5-ft-width by 4-ft 4-in.-depth with 1-ft reinforced-concrete walls. Its top is a reinforced concrete, side-tapered cover block that is 20-in.-thick. Internally, it contains a submersible pump assembly, a drain (to its catch tank), a pump-out pipe connection, a leak detector, and ancillary wiring.

4.2 CATCH TANK

The tank is a horizontally-oriented, welded, cylindrical vessel made of 1/2-in.-thick stainless steel plate (equivalent to type 347 stainless steel [SS]). It is 36-ft long, with 9-ft outside diameter, and dished ends. The center of the tank is located 22 ft underground. An 18-in.-flanged connection entrance at the top of the tank reduces to a 12-in. riser that is connected to the underside of the pump pit. There are two ground level 4-in.-diameter access risers to the tank, one located at the west (liquid level gauge) and one at the east end of the tank. The latter riser was used for the visual examination. Three underground drain pipes from diversion boxes ER-151 and ER-152 enter at the top of the tank. The steam jet siphon box connection at the tank was capped, but its tank-internal vertical stainless steel pipe still remains.

5.0 DESIGN EVALUATION

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of ER-311. A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information Files (CVI Files)
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from the Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base
- associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- Interviews with the Tank Farm Engineering personnel.

5.1.1 Tank

The initial review, of a number of documents and drawings of catch tank 241-ER-311, indicated some confusion as to its size, thickness, and material of construction. This was clarified as

follows, and does not affect the evaluation findings, conclusions, and recommendations. It does show, however, that a number of relevant Hanford-Site documents incorrectly note the tank as carbon-steel instead of stainless steel and with differing overall dimensions.

The earliest drawing found H-2-43108 (Drawing 1950), designated "Mild Steel Catch Tank at 241-ER-151," shows that the tank was made of carbon-steel (American Society for Testing and Materials [ASTM] A285-49 Grade B, which could have ASTM A7-49T substituted for it, dated 2/21/1951). Note that ER-151 is a diversion box (which still exists) and that the nomenclature 241-ER-311 does not show up anywhere on the drawing (Drawing 1950). This original tank was 8-ft, 10-in. inside diameter (ID), 35-ft 9.5-in. between the dished end welds, with an overall length of 40-ft.

Around 1954 (or later), the old carbon-steel tank was replaced with a stainless steel tank. The only indication of this work, that was found, is shown in drawings H-2-2537 (Drawing 1954a) and H-2-2542 (Drawing 1954b). Drawing 1954b entitled, "Catch Tank Replacements at 241-TX-155 and 241-ER-151 Tank Removal and Alterations," shows that a 9-ft by 36-ft stainless tank, designated EP 211-B-108, was to be moved to the site of 241-ER-151 (again a diversion box). Also, nowhere in the latter drawing is there any reference to ER-311. The drawing does indicate that the tank is longer than about 32 ft but shows no overall length dimension. LaSalle (LaSalle 1991) says that the replacement tank (211-B-108) was made in 1943 and was constructed of 18-8-SCb. SS.

In Drawing 1954a is the first noted designation to the 241-ER-311 catch tank. Specifically, the drawing is entitled "241-ER-311 Catch Tk. and Piping Replacement at Diversion Box 241-ER-151". Here, on this drawing the term, 'Old 241-ER-311 catch tank' is specifically tied to its (Drawing 1950) reference drawing – the drawing that does not anywhere allude to ER-311. Moreover, Drawing 1954a indicates that all material to be used in the replacement action is to be either type 304L or type 347 SS.

Of the four documents (not including drawings) found, that refer to 241-ER-311, only one indicates that the present tank is made of stainless steel while four incorrectly cite carbon Steel as its material of construction. LaSalle (LaSalle 1991) says that the tank is 1/2-in.-thick, 9-ft-outside diameter (OD), 36.5-ft-long, and is made of type 18-8-SCb SS, which is nearly the same as type 347 SS and reasonably close to type 304L SS. The three other documents (Olander 1990), (Pallit 1996), and HNF-SD WM-BIO-001 (HNF 1998) incorrectly state the material as carbon-steel with a slightly differing thickness (9/16 in. versus 1/2 in.), different diameters (9-ft OD to 9.5-ft ID), and lengths (36 to 40 ft). Dasgupta's Engineering Change Notice (ECN) (Dasgupta 1996), which cites tank volume as a function of waste depth, indicates that the tank is 9-ft OD and 35-ft 9.5-in. between ends.

Regarding design, the initial carbon steel tank (Drawing 1950) was fabricated in accordance with Paragraph U-69 of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. The same Paragraph (U-69) was noted by LaSalle (LaSalle 1991) as being used for fabrication of the replacement 18-8-S Cb stainless steel tank, which had been built in 1943. In 1954, when the latter stainless steel tank (previously called EP-211-B-108) was prepared for

installation as the ER-311 replacement, all welding of the type 304L or type 347 SS ancillary connecting equipment, conformed to Specification HS-4924-S (referenced on Drawing 1954).

5.1.2 Pump Pit

The pump pit and associated piping installed in ER-311 under Project B-231 was built and tested in accordance with construction specification B-231-C1 (Vitro 1980). Additional requirements were found on the construction drawings for ER-311 facility as follows:

Design load (live) surcharge 100 pounds per square foot (Hanford Drawing H-2-71601)

The concrete was J.A. Jones Type A-4, 3,000 pounds per square inch (Hanford Drawing H-2-71601)

All main reinforcing steel used were ASTM A615, Grade 60. Ties and hoops were ASTM A615, Grade 40 (Hanford Drawing H-2-71601).

A structural assessment report (Westinghouse Hanford Company [WHC] 1996) of numerous facilities subjected to various accident-loading conditions was performed for the safety analysis report. This assessment determined that ER-311 tank could fail due to: 1) existing soil load, 2) seismic loads, 3) internal vacuum pressure of –8 psi, and 4) high waste sludge temperature of 600 degrees F.

Review of this document (WHC 1996) indicates that the analysis methods used were crude and simple with very conservative assumptions and unrealistic loadings. The facility has been in operation for 47 years without any incident and a recent internal examination reveals that the tank is in a good condition without any deformations. A recent refined analysis (Julyk 1999) also shows that the tank has adequate structural strength to withstand applicable design loads, therefore the conclusions in the WHC 1996 document are superseded.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

5.2.1 Past Waste Descriptions

ER-311 has served a number of different sites. Its primary function was, and is, to serve as a drain to diversion boxes ER-151, -152, and -153 (Palit 1996, Hanford Drawing. H-2-71633, 1980). U.S. Department of Energy Richland Operations Office (DOE/RL) 92-05, 1993 indicated that it could have received drainage that initiated from 241-B, -BX, and -BY Tank Farms via the 244-BX DCRT and West Area process and decontamination waste from 241-UX-154 diversion box via the 241-EW-151 vent station. Based on Personal Computer Surveillance Analysis Computer System (PCSACS) records, 1980 to present, the primary fluids received by ER-311 were rain water/snowmelt, line flushings, pressure testing water, and some leakage from 244-BX to AW-105 and from ER-151 Diversion box. A recent chemical analysis of the waste in ER-311 (Blaak 1996) showed it to be comprised mainly of diversion box drainage, water and rainwater additions. Analyses of the contents are shown in Table K1.

More recent waste has consisted of rainwater and snowmelt plus traces of diversion box 241-ER-151 and 241-ER-152 drainage. Analysis of the contents are shown in Table K1.

Table K1 Tank Anion Content and Temperatures

	NO_3^- ppm	NO_2^- ppm	pH	Cl^- ppm	T [a] °F
ER-311 [b]	500	520	8.1	90	75

a - estimated maximum for a tank more than 10-ft underground; b - Fuller 1998a

Projected Future Waste

Tank ER-311 still has an active mission to support saltwell pumping at B Complex (by supporting transfers from the 244-BX double-contained receiver tank). In addition, liquids from diversion boxes as well as rainwater will continue to accumulate. It is expected that tank will continue to be pumped every 12 to 18 months as is now the case. According to PCSACS, the tank has been removed from the active receiver list and will only receive rainwater and snowmelt. Tank ER-311 is to be removed from service in 2004.

Safety Considerations

Based on the work of Fuller (Fuller 1998a) and shown in Table K1, the contents of the tank are nominally compatible with the tank - the hazard lies, as discussed below, in the presence of stagnant fluid and, probably, silt. Thus, though the fluid is compatible with the tank, the tank operating conditions leave it susceptible to pitting corrosion and SCC. Further, Fuller (Fuller 1998b) states that because ER-311 is a catch tank, corrosion compatibility rules do not apply; he is correct to the point that the corrosion specifications (Kirch 1984) are not applicable.

Also according to Fuller (Fuller 1998a), there are no flammable or fissionable materials present in excess of safe limits. There is nothing present in sufficient quantity to pose incompatibility with expected wastes.

However, in November 1999 during a vapor-sampling activity under the Flammable Gas Project, the ER-311 catch tank sample identified the presence of flammable gas. The sampling confirmed that the concentration was as high as 400-percent of the lower flammability limit (LFL). Appropriate actions were taken to identify the cause and to mitigate and/or control any future flammable gas problems (Dodd 2000).

In addition to the observed compliance with the safety considerations, including corrosion, a more detailed corrosion evaluation follows.

5.3 CORROSION PROTECTION

Corrosion protection in a catch tank is provided by the combination of good design, appropriate material selection, and corrosion control. The tank liner is made of welded stainless steel, 18-8-SCb, which is close in alloy content to either 304L or 347 SS. It is resistant to uniform corrosion, both from typical Hanford caustic wastes (primarily nitrite, nitrate, and hydroxide) as well as dilute solutions of water.

Regarding the tank interior, the material, however, is susceptible to pitting corrosion and SCC. Both of these corrosion mechanisms are affected primarily by chloride ions in the waste, particularly in a near-neutral (pH ~ 6 to 8) condition. Because flushing water and rain water/snowmelt makeup a significant proportion of the collected waste in ER-311, and because it has a pH around 8, it is near-neutral.

Incubation times for pitting corrosion and SCC often do not exceed one year. Because the tank has been in service over 45-years, there has been ample time to initiate either of the two corrosion conditions.

SCC has the appearance of a brittle fracture, yet it can occur in highly ductile materials (such as type 304L SS), frequently at stresses that are below design levels. Further, SCC is a term describing stressed alloy failures that occur by the propagation of cracks in a liquid environment that is not highly corrosive to the metal overall. SCC requires the simultaneous presence of a tensile stress, either applied or residual (as in the case of weldments) or a combination of both, and the presence of a specific corrodent (like near-neutral water with a very small amount of chloride). The cracks form and grow, in the neighborhood of the weldments, at right angles to the direction of the tensile stress. Because the catch tank has no apparent mechanical loading to contribute to the weld-induced residual stresses, growth of the stress-corrosion cracks will attenuate the driving-force stresses and they will eventually stop growing. Because the tank liner is relatively thin, the small cracks may penetrate its wall before they stop.

In non-welded austenitic stainless steel, the probability of chloride-SCC decreases significantly below 130 degrees F (Smets and Bogaerts 1992). However, in welded austenitic stainless steel, chloride-SCC continues to occur even at room temperature (McIntyre 1990). While the probability of its occurrence is low, it is not eliminated as a damage mechanism.

Pits can also penetrate the tank wall in areas remote from the weldments. Thus, both corrosion mechanisms can act as sources of leakage. Furthermore, pits tend to occur along water lines (the boundary between liquid and vapor phase). Waste depth levels in ER-311 were reviewed and are described later. PCSACS data regarding waste surface level exist only from about 1980 to the present. In general, during that time, there were no long periods when the waste level remained near-constant. During 2000, some near-constant levels occurred for as long as several months. Thus, there is some potential for waterline-induced pitting corrosion to occur. The visual examination, discussed below, did find evidence of some pitting.

Regarding the tank exterior, it was protectively coated with coal tar. The tank is direct buried in the soil. LaSalle (LaSalle 1991) suggests that cathodic protection was present initially but, in 1980, this cathodic protection systems was turned off. Because of low priority, no cathodic protection has been re-applied to the tank. The positive results of the leak test (Section 6.2) however, indicate that the lack of cathodic protection has not yet been detrimental to the tank. Further, the tank interior visual examination (Section 6.1.2) also showed that no significant wall-threatening corrosion has yet occurred.

5.4 AGE OF THE TANK SYSTEM

The current tank went into operation in 1954 (LaSalle 1991). It has been underground for about 47-years though it apparently had been in use above ground from about 1944 to 1954. Details of its prior service are unknown.

6.0 INTEGRITY EXAMINATIONS

The visual integrity examinations were performed in May 2000; the leak-check analysis was performed in June 2000, based on 1999-2000 surface level data. The examinations were conducted to identify possible degradation of the tank system that could have occurred since the tank was put into service about 57-years ago with the last 47-years of that time underground.

6.1 VISUAL EXAMINATIONS

Visual examinations were conducted in the catch tank interior and in the pump pit. The date of examination, for both facilities, was May 25, 2000. Visual examination details and data sheet findings are included in 18 photos (Figures K3 through K20) and two video examination data sheet tables (Table K2 and K3). The 18 individual 'still' photographs, taken from the videotapes and presented below, show the satisfactory status of the facility.

6.1.1 Pump Pit Visual Examination

Entrance to the pit was obtained by removing its floor drain access shield plug (see Hanford Drawing H-2-71601) from the southwest quadrant of its cover block. The Video In-Tank Inspection System (VITIS) II camera and associated lighting (used for viewing the facility components) was lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Azimuthal movement of the camera is provided by manual manipulation of the camera's suspension pole. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or a narrower-angle setting) used to closely view details of interest.

The color videotape showed that the condition of the coated, reinforced concrete walls, floor, joints, and cover block ceiling were in very satisfactory condition. Various pieces of ancillary equipment within the pump pit were also in good condition. Figures K3 through K8 and Table K2 show, and describe, respectively, the satisfactory condition of the ER-311 Pump Pit.

6.1.2 Catch Tank Internal Visual Examination

Entrance to the catch tank interior was provided by opening a 4-in. riser at the east end of the tank (Figure K2). This allowed access for the VITIS II video camera. The tank liquid waste level on the inspection day was at 50.73-in. Essentially the entire tank interior except what was below the water line could be seen.

The color videotape, covering the tank interior, showed that the tank is sound but contains a number of somewhat 'randomly' dispersed corrosion pits, often associated with waterline bands or marks. Furthermore, little uniform (general) corrosion appears to have occurred and thus the tank thickness has not been substantially reduced. Some localized attack occurred in small

portions of the tank weldments. Photographs showing the above conditions are found in Figures K9 through K20, and described in Table K3.

The satisfactory results of all the visual examinations, except for the tank wall corrosion pits, indicate that an additional visual examination of the pump pit and the catch tank should be conducted within the next 10-years.

6.2 LEAK TEST

To assess leak tightness of 241-ER-311, a review of historical fluid level records was conducted. Tank surface level records exist from about August 1980 to present. For ER-311, four types of catch tank liquid level measurement system data are available on the PCSACS: Manual Tape, Manual Food Instrument Corporation (FIC), Auto FIC, and Manual Enraf Nonius Series 854 ATG (Advanced Technology Servo Tank Gauge) (ENRAF). The manual ENRAF data were selected for the leak-check analysis for two reasons: the ENRAF system provides the most sensitive level measurement capability and, the level data cover the most recent time period (1999-2000) when the tank was at its near-highest level (about 63-percent full or approximately 8,000 gallons). Historic level data for the tank are plotted in Figures K21 through K23.

A minimum of 43 hours ($\approx$2 days) is considered the minimum time over which the leak check needs to be conducted to detect a volume change.

Based on the waste level holding at 50.65-in. for 13 days, the tank was assessed as not leaking. Figure K23 is a plot of the constant Manual ENRAF level in the 13-day (April-May 2000) time frame.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The tank has been in service underground for about 47-years without any leaks reported, which indicates that at the time of its construction adequate design controls were used to withstand applicable design loads. Recent analysis performed in 1999 also demonstrates the tank's adequate strength (Julyk 1999).

2. The tank is not leaking at the leak check level of 50.65-in. However, to demonstrate its leak tightness at a higher level, a leak test should be conducted at that higher level.

3. Because the facility is relatively old, but is in relatively good condition, another set of visual examinations (when the tank is empty), and a leak test should be conducted within the next 10-years

4. To avoid continued pitting corrosion at the waste liquid-air interface band, it is recommended that the tank be either pumped-out (and dried), or that the waste waterline be maintained at various different levels, below the mid-plane of the tank.

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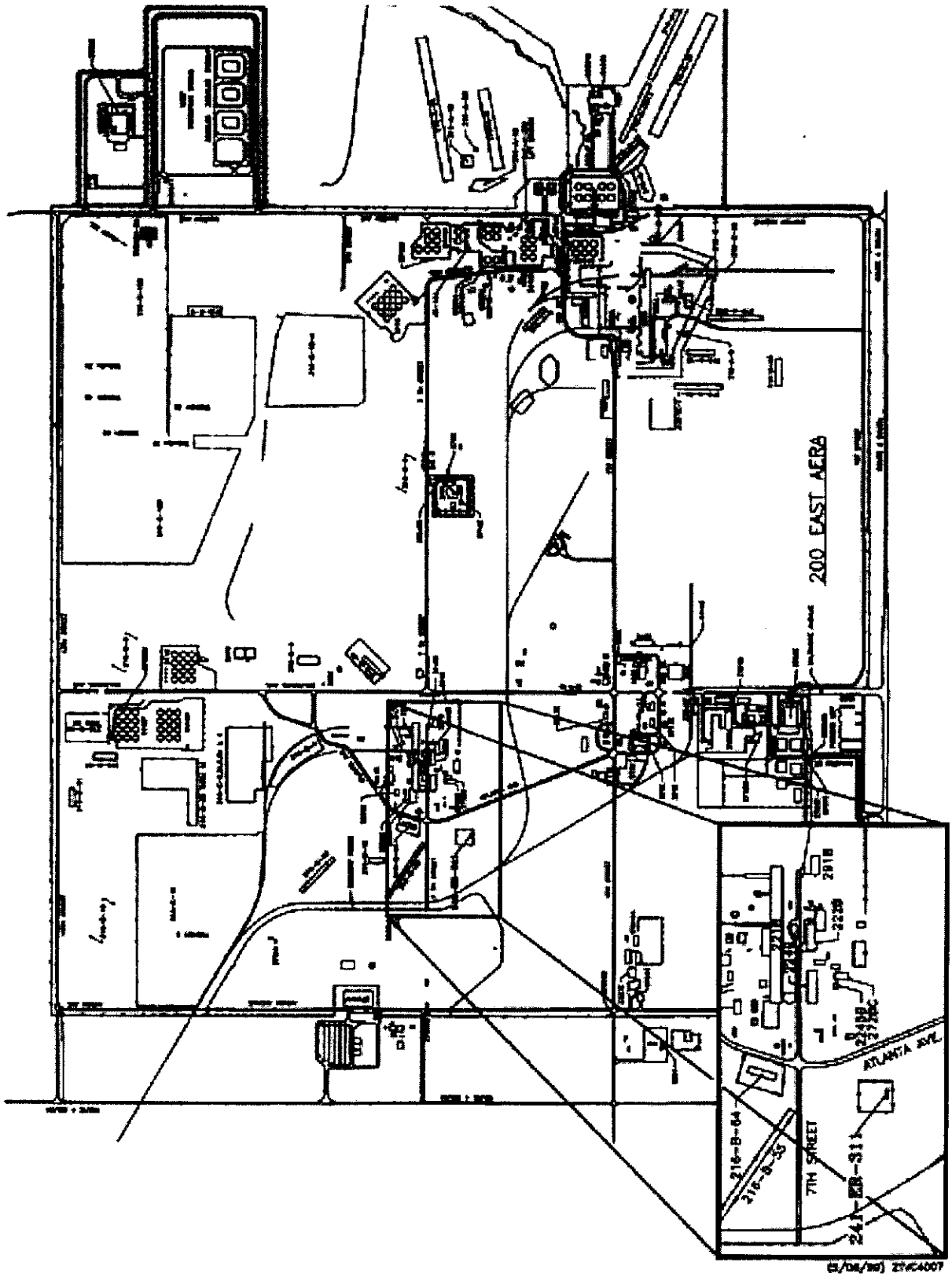

Figure K1 Site Plan

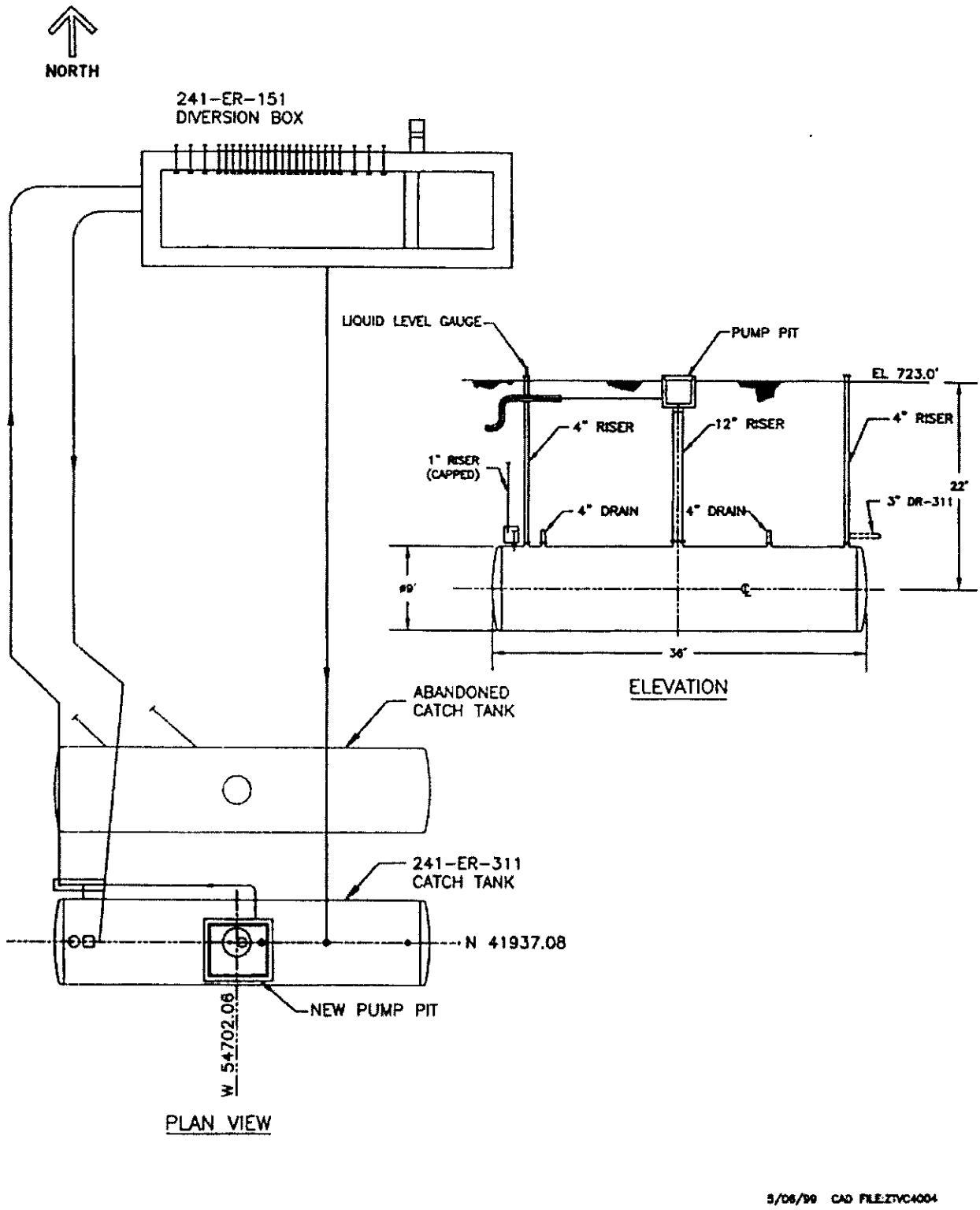

Figure K2 ER-311 Catch Tank

TABLE K2 VIDEO EXAMINATION DATA SHEET, 241-ER-311 PUMP PIT

Examination Date: 5/25/00

Person In Charge: D. P. Niebuhr Camera Operator: J. P. Dunn Video Examiner: T. S. Hundal

Opening: 4-In. Floor Drain Access Hole In Cover Block

Video Tape Reviewer: E. B. Schwenk Date: June 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs and accompanying narrative demonstrate that the approximately 20-year old pump pit is in very satisfactory condition and that it is fit for continued service.
					The interior of the 241-ER-311 pump pit was entered through the floor drain access (see Hanford drawing H-2-71601) in the pump pit cover block. A VITIS II videocamera with attached light and zoom lens were used to visually examine the pit interior. Approximately 25-minutes of the nearly 60-minute long tape was spent in the pump pit.
1031 AM		158	182		Figure K3 is an aboveground view of the catch tank designation.
1039 AM		194	182		In general, the following Figures K4 through K7 show that the integrity of the structure is still intact and adequate and, save for some small amount of dust and light dirt, it appears in very good condition. Figure K4 is a plan view of a portion of the pit floor showing the combined leak detection module and drain, and instrumentation wiring.
1040 AM		349	134		A view of the satisfactory condition of the submersible pump cover plate, nozzle exit and one of the two cover plate lifting yokes is shown in Figure K5.
1041 AM		294	082		The generally satisfactory condition of the reinforced concrete walls and overhead cover block are shown in Figure K6
1048 AM		000	119		Figure K7 provides a view of a nozzle attached to the pump outlet and pit ancillary equipment in the background.
1050 AM		340	164		The generally satisfactory appearance of pit wiring and an electrical connector are shown in Figure K8.

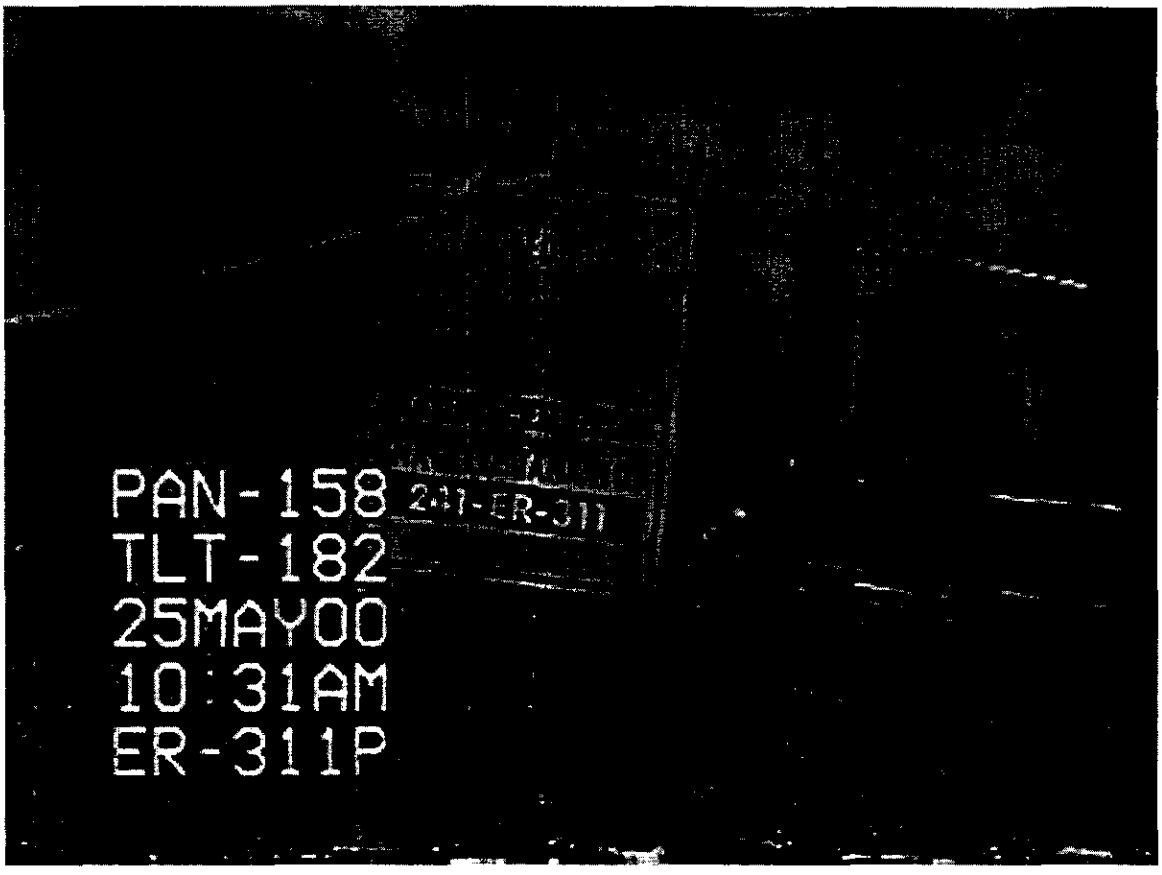

Figure K3
Above Ground, Pump Pit, Catch Tank 241 ER-311

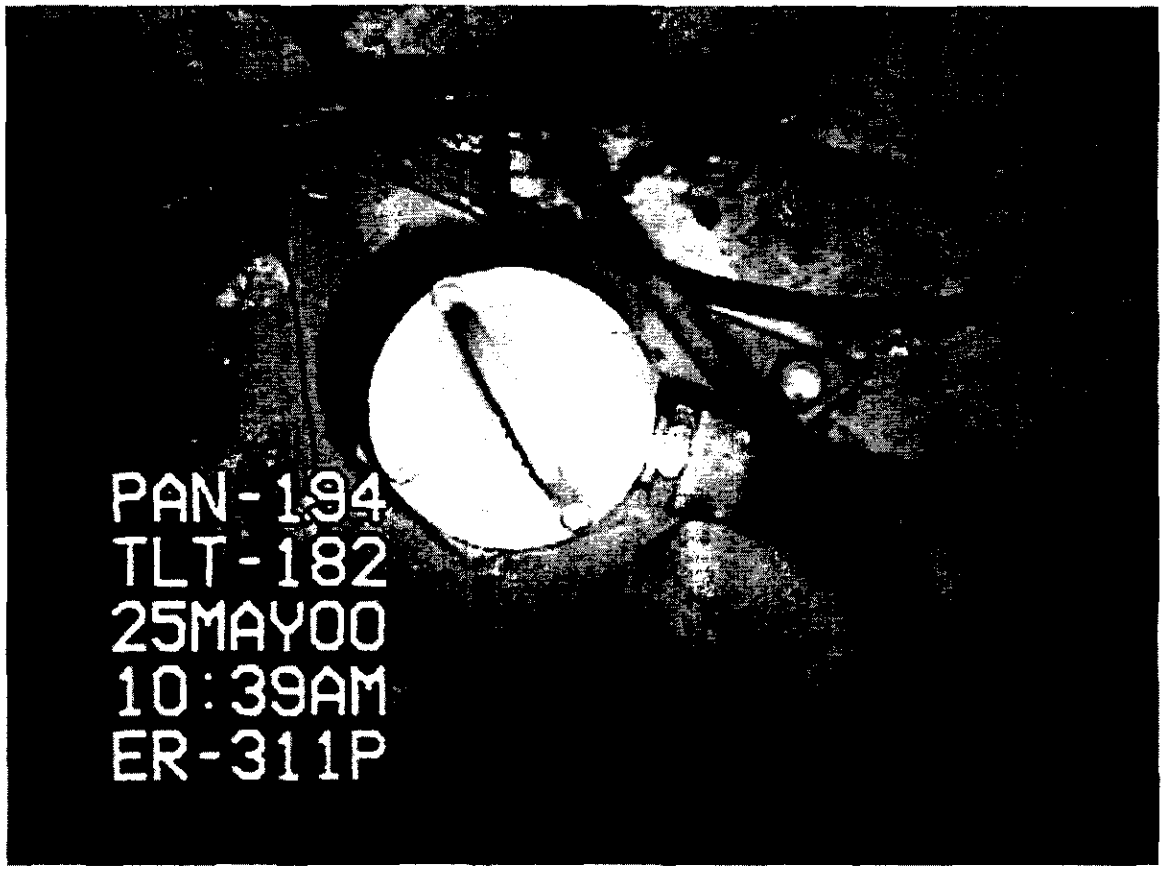

Figure K4
View of Leak Detection Module/Drain in 241-ER-311 Pump Pit.

Figure K5
View of Submersible Pump Cover Plate, Nozzle Exit (Center), and One of Two Lifting Yokes, Pump Pit 241-ER-311B.

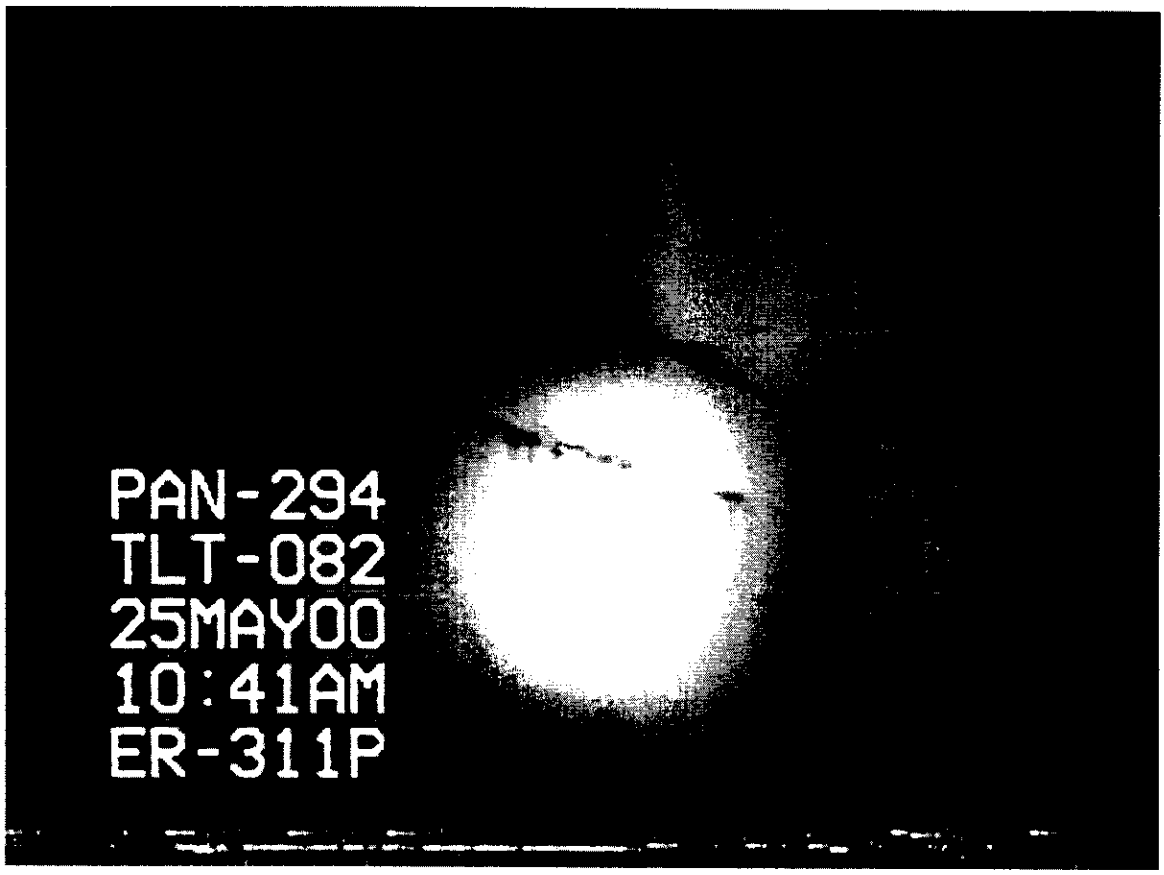

Figure K6
View of Interior of Pump Pit Walls and Reinforced Concrete Cover Plate, 241 ER-311B

Figure K7
View of Pump Nozzle Connection and Ancillary Equipment, Pump Pit 241-ER-311

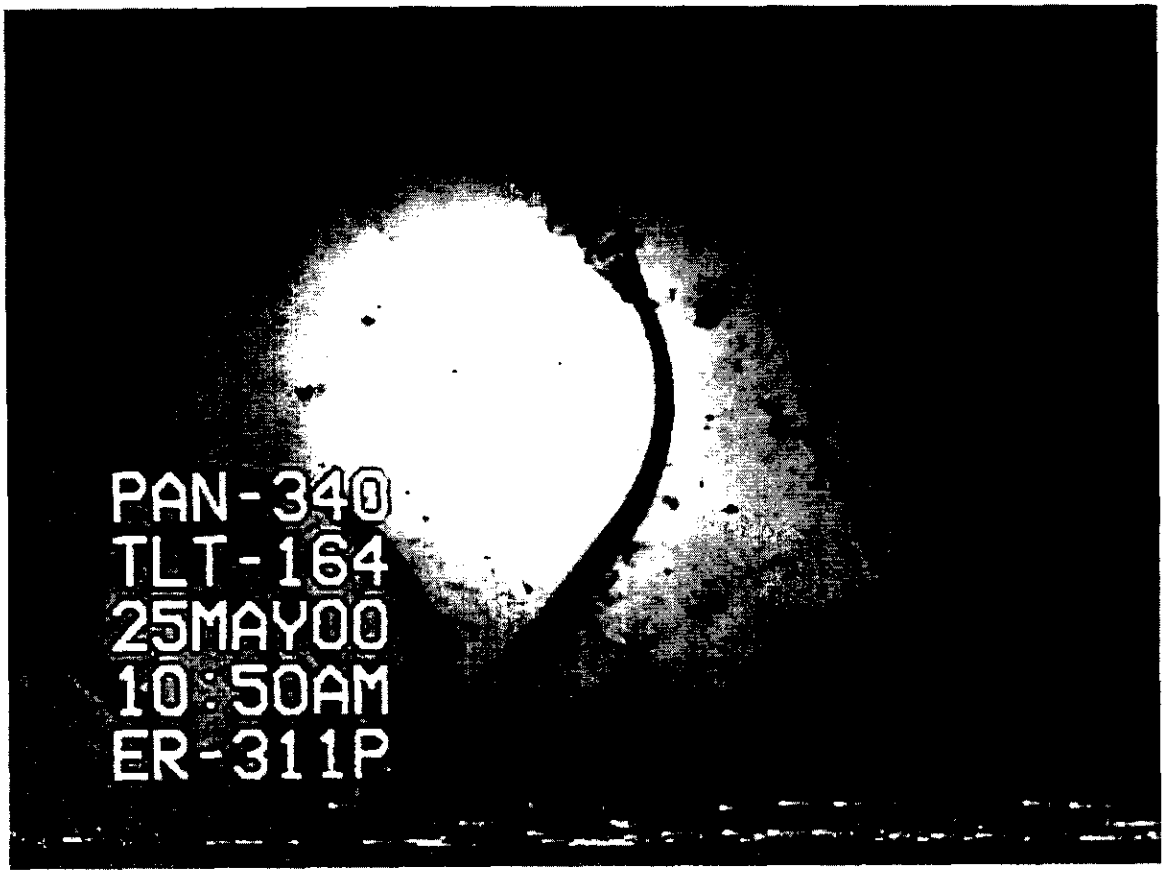

Figure K8
View of Wiring and Connector Associated with Leak Detection Module, Pump Pit 241-ER-311.

TABLE K3 VIDEO EXAMINATION DATA SHEET, 241-ER-311 CATCH TANK

Examination Date: 5/25/00

Person In Charge: D. P. Niebuhr Camera Operator: J. P. Dunn Video Examiner: T.S. **Hundal**

Riser

Video Tape Reviewer: E B. Schwenk Date: June 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following photographs and narrative demonstrate that the stainless steel tank is sound but that it contains corrosion pits, the most severe of which appear to mainly be in a band around the tank's horizontal midplane. Structural loading service is essentially unaffected, because 'randomly' distributed corrosion pits rarely reduce the material's volume (and hence load-carrying capability) more than about 1% or so. The tank is direct-buried, and thus it has no secondary containment and its exterior cannot be accessed for visual leak assessment. Thus, from a pitting corrosion point-of-view, it is recommended that the waste fluid level always either be maintained below the horizontal midplane (about 50-in. deep), or that the waste be completely removed and the tank left in a dry condition. See also the discussion of the leak-check test in Section 6.0. Camera access to the tank was provided through a 4-in. diameter pipe riser at the tank's east end. A VITIS II S-VHS camera, with a zoom lens and attached light, was used to examine the tank interior. Approximately 35-minutes of the nearly 60-minute long videotape was spent in the catch tank.
1103 AM		105	112		Figure K9 is a view of the tank sidewall stained waterlines and stained pitting bands adjacent to the east end of the tank. A wide vertical (or girth) weldment can also be seen, which likely attaches the dished end of the tank to its horizontal cylinder. Because the liquid waste is opaque, it is not possible to see the tank's wall below the present waterline nor to see the likely existing sludge layer.
1103 AM		182	093		Panning the videocamera to the right (westerly direction) multiple waterlines, some vertical blemishes or stains, and the central pitting band can be seen extending toward the west end of the tank (Figure K10).

Table K3 (continued)

1104 AM		202	093		Figure K11 is a view of the west end of the tank, the various waterline corrosion marks and two vertical pipes. The pipe in the foreground is connected to the submersible pump. The one in the background (probably disconnected) is attached to the steam jet siphon that sits atop the west end of the tank.
1105 AM		211	077		Tilting the camera upward (Figure K12) provides a view of the top region of the tank looking toward its west end. Note that the topmost watermark indicates that the tank had been filled to about 90% of its capacity, at one time. White staining at the very top indicates that periodic liquid in-flow, from the (centrally located) pump pit, had also occurred.
1110 AM		215	084		That a floating sludge layer had probably occurred in the past is suggested by the image in Figure K13. A vertical salt buildup is shown in the pitting band along what appears to be a girth weldment.
1112 AM		236	092		Looking toward the west wall of the tank, a somewhat 'random' distribution of pits can be seen (in the pitting band) along with a vertical stain (Figure K14) that appears to emanate from the 4-in. diameter pipe drain. The latter is located at the approximate tank ¼-point opening at the top of the tank.
1112 AM		236	077		Panning upward, above the image in Figure K14, the vertical stain, additional pits, and another girth weldment, in the wall can be seen (Figure K15).
1112 AM		225	068		Figure K16 is a further upward tilt showing the continuation of the vertical stain (noted above) and further light, random pitting.
1117 AM		161	093		Panning further into the east wall, a close-up view of three major pits can be seen, in the midplane pitting band (Figure K17). While these pits are not large in surface diameter, corrosion pits in austenitic stainless steel are notorious for increasing in diameter with depth, and then again narrowing as they approach hole-through.
1119 AM		240	090		Further pitting in both the midplane band and in a girth weldment, on the south side of the tank, are shown in Figure K18.
1119 AM		240	082		Probable corrosion attack on an intersecting horizontal and vertical weldment, including some pitting, can be seen in Figure K19 (image directly above that shown in Figure K18).
1120 AM		317	080		Small corrosion pits plus a relatively wide girth weldment located near the southeast end of the tank (Figure K20).

Figure K9
View of Sidewall Staining and Pitting Bands In Catch Tank 241-ER-311.

Figure K10
Continued View of Sidewall Waterline Staining and Pitting Bands in Catch Tank 241-ER-311

Figure K11
View Of Various Pitted Waterlines And Bands, And Submersible Pump, Looking Toward The West End, Catch Tank 241-ER-311.

Figure K12
Close-up View of West End of Top Region of Catch Tank 241-ER-311, Including a Vertical Submersible Pump Pipe (foreground) and a Steam Siphon Jet Pipe (background).

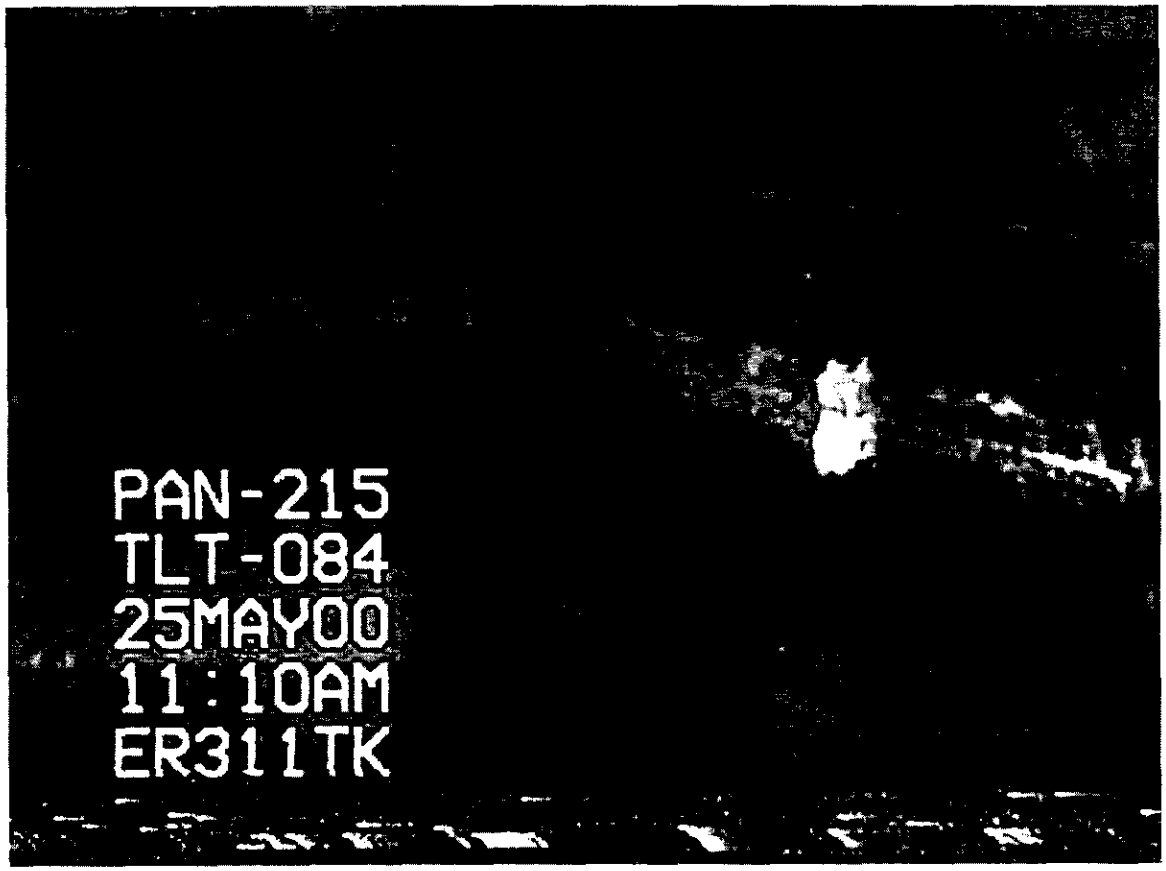

Figure K13
View of Horizontal Pitting Band, Around West End of Tank With Possible Crystalline Waste Buildup, Catch Tank 241-ER-311.

Figure K14
West Wall of Catch Tank 241-ER-311 Showing Pits in Pitting Band and Vertical Stain.

Figure K15
Stains and Additional Pits Directly Above Image in Figure K14, and a Girth Weldment (right), Catch Tank 241-ER-311.

Figure K16
Additional Staining and Light Pitting Located Above View in Figure K15, Catch Tank 241-ER-311.

Figure K17
View of Pits in Pitting Band, Catch Tank 241-ER-311.

Figure K18
Further Pitting in Band, and Girth Weldment, East Side of Catch Tank 241-ER-311.

Figure K19
Possible Corrosive Attack on Intersecting Horizontal and Girth Weldment, Including Pitting; View just Above Figure K18, Catch Tank 241-ER-311.

Figure K20
Small Corrosion Pits plus Relatively Wide Girth Weldment, near Southeast End, Catch Tank 241-ER-311

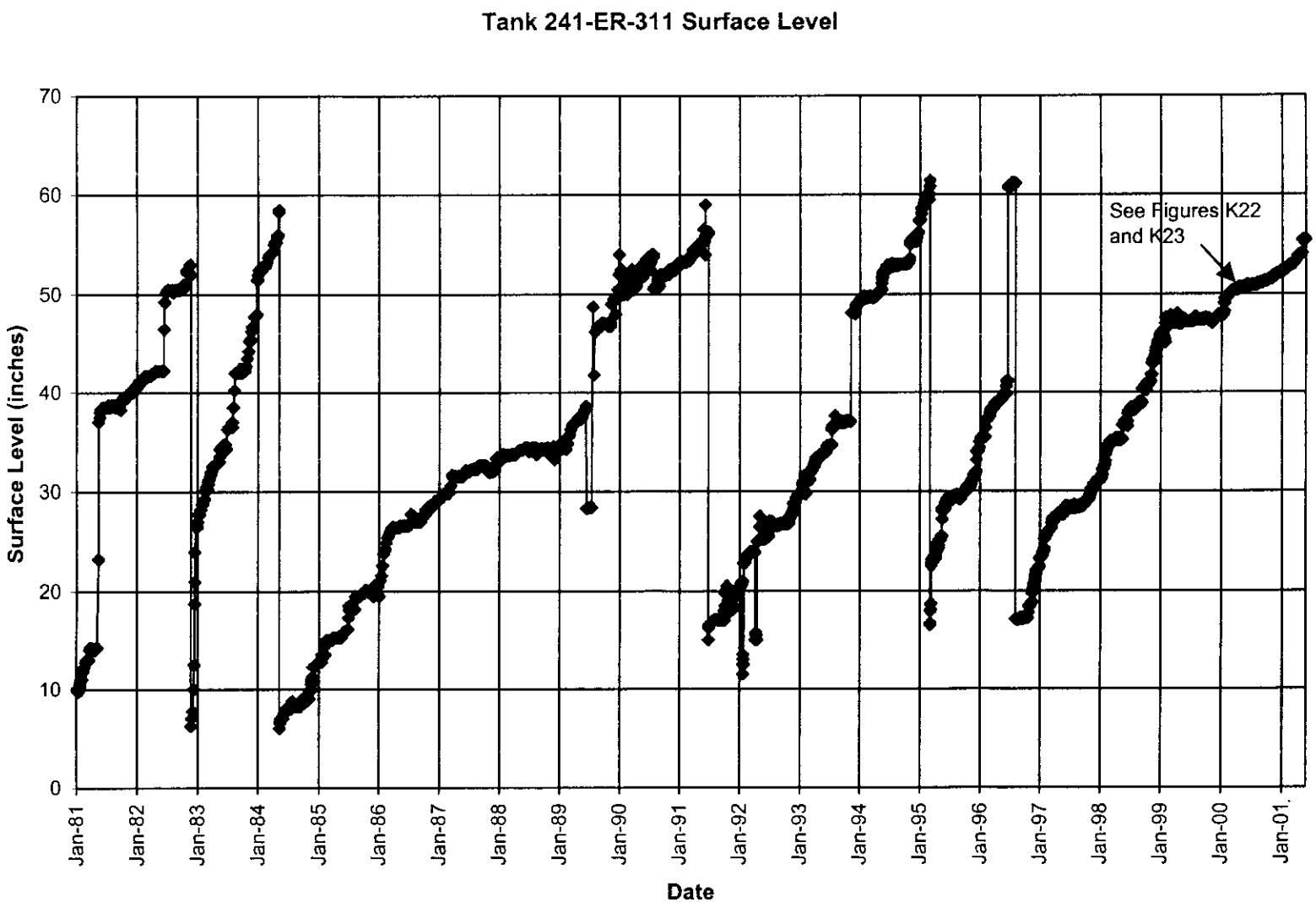

Figure K21 Composite Plot, Surface Level versus Time, 1981-2001, 241-ER-311

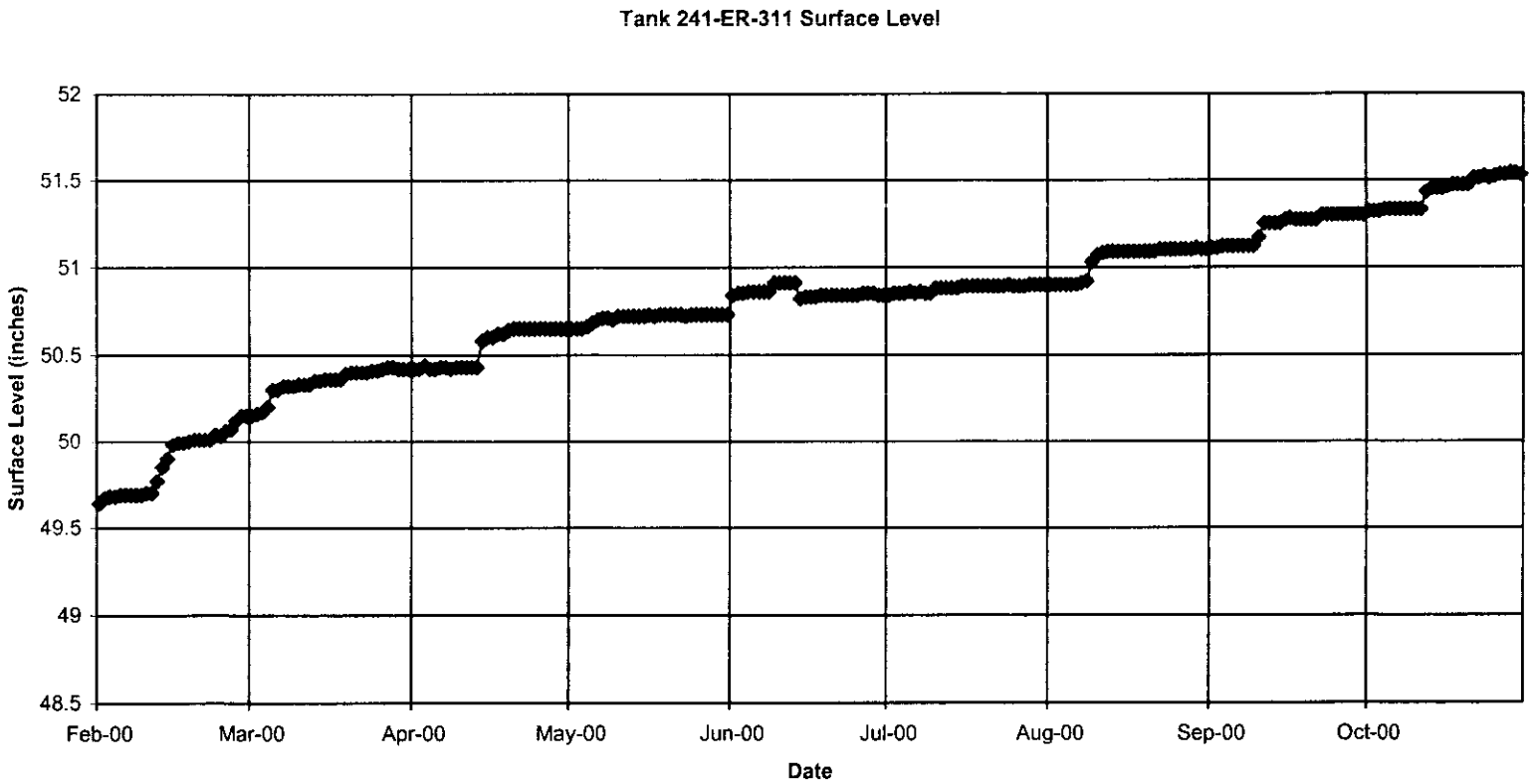

Figure K22 Manual ENRAF Surface Level versus Time, February through October 2000, 241-ER-311

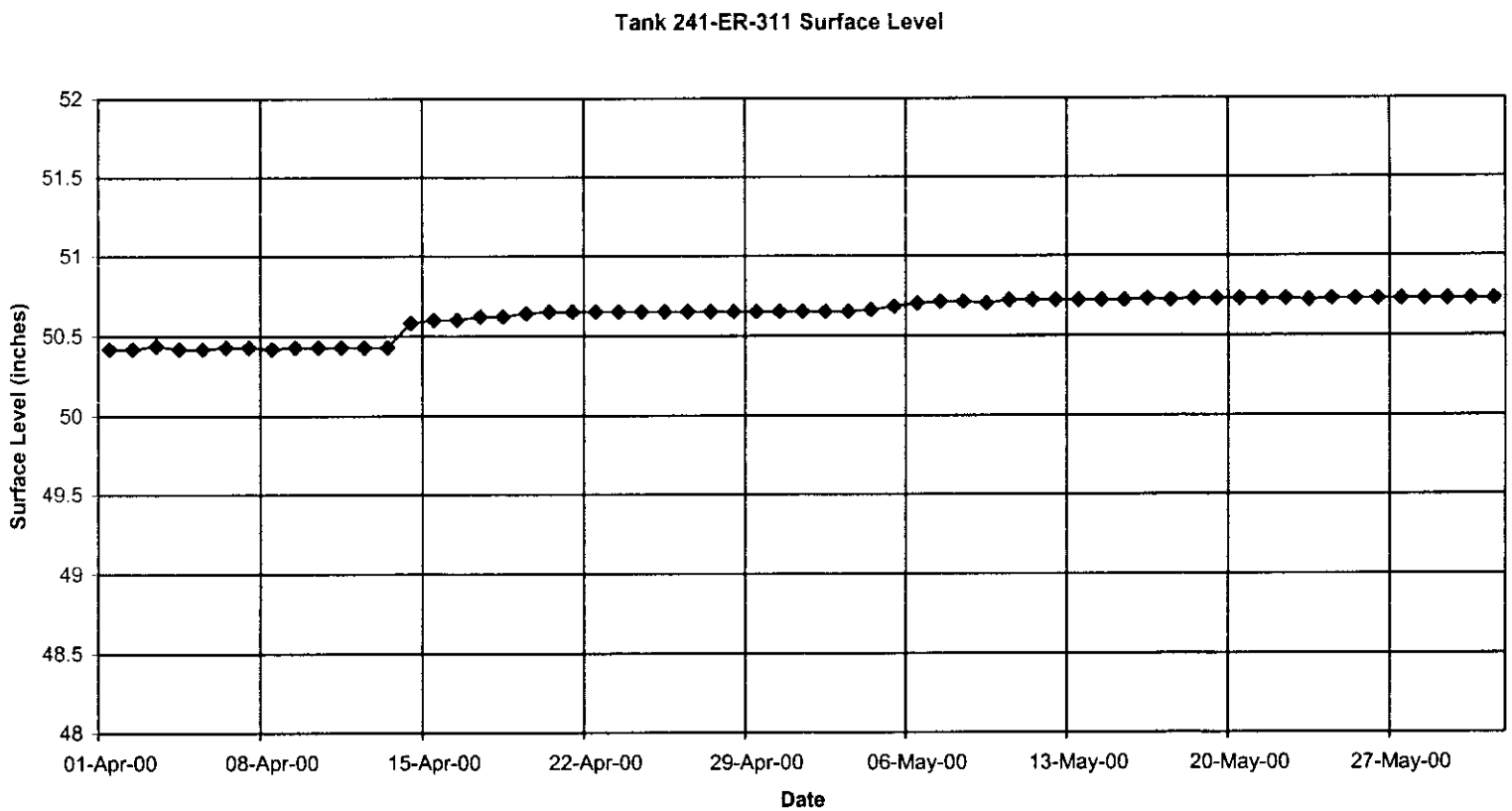

Figure K23 Manual ENRAF Surface Level versus Time, April through May 2000, 241-ER-311

APPENDIX L

244-TX DOUBLE-CONTAINED RECEIVER TANK

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LIST OF TERMS

ASME	American Society of Mechanical Engineers
ASTM	American Society for Test and Materials
CHG	CH2M HILL Hanford Group, Inc.
CT	catch tank
CVI	certified vendor information
DCRT	double-contained receiver tank
DST	double-shell tank
FDC	Functional Design Criteria
FFTF	Fast Flux Test Facility
HDCS	Hanford Data Control System (database)
HEPA	high-efficiency particle air (filter)
HLAN	Hanford Local Area Network
LFL	lower flammability limit
NDE	non-destructive examination
PCSACS	Personal Computer Surveillance Analysis Computer System
RCRA	Resource Conservation and Recovery Act
PFP	Plutonium Finishing Plant
RHA	Records Holding Area
RMIS	Record Management Information System
SST	single-shell tank
TRU	transuranic
TSD	Treatment Storage Disposal
VITIS II	Video In Tank Inspection System

1.0 INTRODUCTION

The 244-TX Double-Contained Receiver Tank (DCRT) facility is located in the 200 West Area of the Hanford Site (Figure L1). This DCRT was designed to provide short-term storage for supernatant liquid waste pumped from T, TX, and TY single-shell tank (SST) farm salt wells, and waste from Plutonium Finishing Plant (PFP) and T Plant. The contents of 244-TX, after dilution with water, are pumped through 241-TX-152, 241-U-152, and 241-U-151 diversion boxes, and 244-S DCRT to SY double-shell tank (DST) farm. The receiver tank also acts as a low collection point for line drainage during jumper change or after the transfer lines are flushed.

The residual liquid contained in the primary carbon steel receiver tank is the waste diluted with flush water, which is further mixed with intruded rainwater. The rainwater or snowmelt enters through removable pump pit cover blocks and passes through the pit floor drain into the tank.

2.0 PURPOSE

The purpose of this design evaluation and examinations is to determine if the 244-TX DCRT facility components are adequately designed with sufficient structural strength and compatibility with the waste that they will not collapse, rupture, or fail during the facility's use.

The following shall be considered:

- Design standards-Identify and evaluate the criteria to which the system was constructed and maintained.
- Waste characteristics-Identify the waste (past and projected) and evaluate the adequacy of the design to handle the waste.
- Corrosion protection measures-Identify the material and evaluate the design and the operational practices for corrosion protection.
- Age-Document, estimate, or otherwise determine the approximate age of the system.
- Integrity Examination-Perform a leak test, internal inspection, or other integrity examination.

3.0 SCOPE

The scope of the design evaluation includes the 244-TX DCRT pump pit, tank vault, and the receiver tank. The scope of the examinations includes a visual examination of the 244-TX DCRT receiver tank internal surface, pump pit, vault, and a leak test of the receiver tank.

The filter pit is excluded as it does not house any dangerous waste or equipment/piping used to handle the waste.

4.0 DESCRIPTION

The 244-TX DCRT facility is an underground reinforced concrete structure consisting of three main compartments that house different facility components (Hanford Drawing H-2- 73796 and H-2-73784). These three compartments described below are: the vault section, the pump pit, and the filter pit. (Figure L2)

4.1 RECEIVER TANK CONTAINMENT VAULT

The vault section is a rectangular reinforced concrete structure, approximately 20-ft wide by 48-ft long by 23-ft high, outside dimensions, with 2-ft-thick walls and a 3-ft to 4-ft-thick bottom floor foundation slab. The vault's entire floor, including sump and walls up to 5-ft height are lined with a 1/4-in.-thick carbon steel plate and the balance of the wall's height is coated with an Amercoat No. 33 liner material as manufactured by Protective Coating Division of Ameron, Brea, California. The vault slab slopes down towards a trench on the eastside, which slopes to a sump to collect liquids. The 6-ft 7-in.-long by 2-ft-wide by 12-in-high sump houses the leak detection devices and a sump pump (when required). The vault houses the primary receiver carbon steel tank. The vault serves as a secondary containment to the receiver tank and is of sufficient volume to hold the total volume of the receiver tank in case of leakage or rupture.

4.2 RECEIVER TANK

The receiver tank is a horizontal tank; 12-ft diameter by 38-ft 6-in. long, built with ASTM A 537, Class 1 carbon steel plates (3/8-in.-thick-cylindrical shell and 1/2-in.-thick dished head on each end). Welk Bros. Fabrication Drawing D59143 Sheets 1-3 show the configuration and fabrication requirements and as-built details of the tank. All longitudinal and circumferential shell and head tank welds received radiographic examination. The tank is supported on two supports. Each support is anchored to the floor slab with ten 2-in.-diameter anchor bolts. The nominal capacity of the receiver tank is 31,000 gallons with a maximum operating capacity of 24,800 gallons (80-percent of capacity) (Dasgupta 1992).

4.3 PUMP PIT AND FILTER PIT

The pump pit section is a 20-ft wide by 22-ft long by 16-ft 2-in.-deep section with 18-in.-thick walls. Its 3-ft-thick floor slab is supported on steel beams and 4 1/2-in. metal decking. The pump pit is located directly above the vault on the west end. The transfer lines come into the pump pit walls at different elevations. The pit has seven 2-ft-thick removable concrete cover block sections at ground level for access into the pit and the receiver tank. These cover blocks also serve as shielding against radiation exposures. The pump pit floor has a drain with a p-trap and other nozzles rising from the receiver tank below. The floor drain directs any waste spillage, and/or rainwater/snowmelt infiltration through the cover blocks, into the receiver tank below.

The pump pit houses the pumps, jumpers, and other ancillary equipment, and serves as secondary containment to the transfer lines.

Adjoining the pump pit on its east side is the third section, the filter pit, also located directly above the vault. The filter pit is a 13-ft-wide by 20-ft-long by 16-ft 2-in.-deep concrete structure with 18-in.-thick walls and a 3-ft-thick floor slab. It also has four 2-ft-thick removable concrete cover block sections at ground level for access. The filter pit houses the high-efficiency particulate air (HEPA) filters for ventilation of the vault, receiver tank, pump pit, and filter pit. The filter pit floor drain with a p-trap directs the condensate or rainwater/snowmelt infiltration from the cover blocks into the receiver tank in the vault.

5.0 DESIGN EVALUATION

The 244-TX DCRT design standards, waste characteristics and compatibility for past and future transfers, corrosion protection, and age of the system are discussed in this section.

5.1 DESIGN STANDARDS

The following paragraphs provide design requirements and other factors used in assessing the integrity of 244-TX DCRT facility. A thorough search was conducted to identify the available design requirements, and design and fabrication documents of the tank. Listed below are the resources searched for tank information.

- Records Management Information System (RMIS)
- Certified Vendor Information Files (CVI Files)
- drawings in the Hanford drawing list at Document Control Center
- INSITE or SOFT REPORTING software (from Hanford Local Area Network [HLAN])
- Hanford Data Control System (HDCS) data base
- all associated project files packed in boxes at Record Holding Area (RHA)
- PROCINFO software at HLAN
- interviews with the Tank Farm Engineering personnel.

The following paragraphs provide design requirements and other factors used the assessment of the 244-TX DCRT facility.

Project B-180 Functional Design Criteria (FDC) (RHO 1981), construction specification (B180 1979), and procurement specification (HWS 1978) provide the design, material, fabrication, inspection, and testing requirements for the 244-TX DCRT facility, which was constructed in approximately 1980.

5.1.1 Waste Receiver Tank Design Standards

The receiver tank was designed, fabricated, inspected, and tested in accordance with the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section VIII, Division 2 (ASME 1977). It was designed for an internal design pressure of 5 psig when

the tank is 100 percent full and also designed for an external pressure of 6 in. of water, when full or empty. The design temperature was 200 degrees F. The receiver tank was successfully tested at a hydrostatic pressure of 8 psig. Overfilling of the tank is avoided administratively by liquid level limit control via operating procedures. Overpressurization is avoided during operations because the tank is vented to the atmosphere. In addition, the tank had cyclic design requirements. Specifically it was required to withstand: a) thermal cycles from 70 degrees F to 200 degrees F weekly for 10 years, and b) concurrent with temperature cycling, pressure cycles by filling from empty to 80 percent full with working fluid plus internal pressure weekly for a period of 10-years. The design corrosion allowance for the receiver tank was 0.001 in. per year for each side for 10-years of minimum intended useful life or 0.02 in. total.

Project B-180 Procurement Specification HWS-10066 (HWS 1978) and Hanford Drawing H-2-73933 describe the design, configuration, and fabrication requirements for the receiver tank. The receiver tank cylindrical shell (3/8 in. thick plate) and end flange and dish heads (1/2 in. thick plate) were fabricated from ASTM A-537 Class 1 (ASTM 1976) welded carbon steel plates (Welk Bros. Fabrication Drawing D 59143 Sheets 1 through 3). The tank's welds were 100-percent visually inspected and non-destructive examination (NDE) was also performed on all welds (i.e. 100 percent radiographic examination) per ASME Section VIII, Division 2 (ASME 1977). The DCRT receiver tank and components were designed to withstand 0.25g horizontal and 0.17g vertical acceleration seismic loads and sloshing forces generated by the contained liquid. These seismic accelerations are equivalent to the Safe Shutdown Earthquake (SSE) design requirements at the time of construction for Class I facilities at the Hanford Site (SDC 1974).

The design standards regarding temperature and pressure cycling were compared with actual conditions that the tank was subjected to. Several sources of information were used. Pressure-cycling was reviewed from two sources: the 244-TX DCRT facility log book (RHO-CD-81-213-TX), covering May 1981 to the first quarter of 1995, and the Personal Computer Surveillance Analysis Computer System (PCSACS) from April 1995 to January 1999. Indirect temperature-cycling data was obtained by reviewing the historic temperature levels of the SST Farms that received waste through the 244-TX DCRT.

The review of the logbook and the PCSACS data indicated that only one pressure-cycle occurred about every 10-weeks, far less than the design limit of one cycle/week. Only during its first year of operation were a relatively large number of small transfers (about 56) made. However, the majority of them represented a level change that was less than half of the tank depth.

A review of the *Maximum Surface Level and Temperature Histories for Hanford Waste Tanks* (WHC 1994) showed that the average temperature of the SST Farms T, TX, and TY, was less than 110 degrees F. Based on the tank temperature levels, it is unlikely that the waste temperature levels in 244-TX DCRT ever reached its design level of 200 degrees F.

Because so few pressure- and temperature-cycles occurred, and because the receiving waste tank temperature levels were low, the 244-TX DCRT facility did not exceed its pressure and temperature design limitations.

5.1.2 Vault, Pump Pit, and Filter Pit Design Standards

Vault: The below ground waste tank vault is a reinforced concrete structure. The FDC (RHO 1981) and Construction Specification (B180 1979) for the 244-TX DCRT structures established requirements for the design and construction of the vault per applicable national codes and standards. The design requirements include a capacity to withstand dead loads, live loads, seismic loads, and lateral soil pressures (Hanford Drawing H-2-73784).

The entire vault's floor, including the sump bottom, and walls up to 5-ft high are lined with a 1/4-in.-thick carbon steel plate and the balance of the walls height is lined with a layer of protective coating material (Amercoat No. 33) for water leak tightness and ease of cleaning any spillage. Water stops are provided at wall construction joints to prevent ground water intrusion through them. The vault floor slopes towards a 6-in.-wide by 5-in.-deep concrete trench, which drains into a 6-ft 7-in.-long by 2-ft-wide by 12-in.-deep sump. A leak detector located in the sump issues an alarm should the liquid waste or water leak into the sump. The vault, which houses the receiver vessel, has more than adequate capacity to contain the maximum capacity of the receiver tank should it leak. The sump pump, P-244-TX-4, is provided (when required) through riser no. 24 through the pump pit floor (Hanford Drawing H-2-73796) for transferring accumulated liquid in the sump to the receiver tank.

Pump and Filter Pits: The reinforced concrete pits are coated with protective paint, (Amercoat No. 33), to mitigate seepage through their walls and floors. Each pit contains a 3-in. floor drain to route any liquid from its floor to the waste receiver tank below. The carbon steel butt-welded drain lines meet the Hanford Pipe Code M-24 per (SDC 1974), and are equipped with p-traps to prevent communication of gas from the tank ullage to the pit environment. Specification B-180-C1 (B180 1979) establishes 5 psig at 200 degrees F as the maximum operating pressure and temperature for these 3-in. drain lines. The pits are closed with 24-in.-thick concrete cover block sections, which also serve as a shield against radiation.

The 244-TX DCRT facility's main structural (vault, pump pit, and filter pit) components, including cover blocks, walls, floor slab, and foundation slab, are designed to withstand design loads described in FDC (RHO 1981), Hanford Drawing H-2-73784, and Construction Specification (B180 1979) for the physical environment around them and for the intended purpose of collecting liquids from transfer lines to be pumped back into a waste tank. All structures were also designed to withstand seismic forces generated due to SSE of 0.25g horizontal and 0.17g vertical ground accelerations acting simultaneously.

A structural assessment report (WHC 1996) of numerous facilities subjected to various accident loading conditions was performed for the safety analysis report. This assessment determined that 244-TX facilities component could fail as follows; 1) vault fails due to internal transient pressure caused by hydrogen deflagration, 2) pump pit walls fail due to seismic event, and 3) cover blocks fail due to impact load of 20,000 lbs.

Review of the (WHC 1996) document indicates that the analysis assumptions are simple and unrealistic and hence its conclusions are unrealistically conservative. A recent refined analysis Julyk (1999) was performed to assess a similar structure (244-A DCRT) components for installation of new equipment. This analysis shows that the 244-A DCRT structure has sufficient

strength to withstand higher loads than the ones determined in WHC 1996 assessment. This kind of refined analysis will also disposition the other conclusions drawn in WHC 1996. The WHC 1996 document should be revised using realistic loading conditions and using refined analyses methods. Failure of the tank due to hydrogen deflagration and cover block impact loads are precluded by administrative controles.

In summary, the 244-TX DCRT system has been in service for about 20 years without any incident and based on the available documentation, it appears to have been adequately designed to withstand applicable design loads.

5.2 WASTE CHARACTERISTICS AND COMPATIBILITY

The 244-TX DCRT saltwell tank provides short-term storage for interstitial liquid wastes pumped from saltwells in the 241-T, -TX, and -TY single-shell tank (SST) farms. It also handles supernatant and other liquid waste pumped from PFP, T Plant, including spills or leaks that could occur in the 241-TX-152 diversion box (Sutherland 1991). Dilute waste solutions from line flushings are also known to enter DCRT 244-TX.

The T, TX, and TY SST farms were constructed between about 1943 and 1952 and were used primarily for past waste storage activities that are not applicable here (See DOE 1992). The three farms contain a total of 36 tanks (12 in T, 18 in TX and 6 in TY) which are interim stabilized. The T farm tanks began receiving waste in mid 1940's from T Plant operations. It consisted of waste from decontamination activities, the bismuth phosphate process, and flush water. Between 1980 and 1985, the applicable period for any subsequent waste transfers, liquid metal reactor safety tests using non-radioactive sodium, lithium and sodium iodide, were conducted in T Plant. However, only residual radioactive contamination, from previous activities, were transferred to DSTs (DOE 1992a).

The PFP began operation in 1945 for plutonium separation and recovery and consists of four major facilities and a number of ancillary structures (see DOE 1992a). The only known facility that produced waste after 1980, that was associated with the 244-TX DCRT, is the 241-Z treatment tank (also noted as Tank D-5 or TK-5) located in the 241-Z building. This tank is a Resource Conservation and Recovery Act (RCRA) Treatment Storage and Disposal (TSD) facility. It receives and treats corrosive liquid waste from the 234-5Z Building. The corrosive liquid waste was treated by addition of caustic soda, to increase the pH of the liquid. After treatment the liquid wastes were transferred to the 244-TX DCRT.

To ensure that the 244-TX DCRT does not exceed its design envelope, certain conditions must be controlled. The design envelope is a maximum fluid pressure of 5 psi, a maximum temperature of 200 degrees F, and a fatigue or cyclic restriction. The latter restriction is a simultaneous maximum of one pressure-cycle (i.e., filling to 80-percent capacity and emptying) and one temperature-cycle (from 70 to 200 to 70 degrees F) per week. In addition to meeting these conditions, tank waste characteristics that could lead to ignitable, reactive, and corrosive conditions must also be controlled.

Prior to a waste transfer, a compatibility assessment is conducted. A description of a typical waste compatibility assessment can be found in Fowler 1998. Here the assessment involves not only DCRT 244-TX, but the controlling downstream, waste-receiving DST 241-SY-102.

Basically the assessment addresses compatibility requirements, waste categories, waste codes, and tank safety concerns that could potentially be created as a result of mixing the subject waste streams. Compatibility compliance centers on requirements noted in five documents: Mulkey (1998), Cox (1997), Mulkey and Miller (1997), Fowler (1995), and HNF (1997). These include: flammable gas (hydrogen, methane and ammonia), nuclear criticality*, organic and energetic reaction, watch list tanks, corrosivity, chemical compatibility, tank waste type, transuranic (TRU) waste segregation, heat generation, complexant waste segregation, phosphate waste, radiological source control, toxic chemical source term controls, and the wastes' Reynolds number. Flammable gas is particularly important in that for any saltwell transfer(s), the DCRT vapor space concentration must remain controlled. Specifically, the minimum time to reach 25 percent of the lower flammability limit (LFL) is required to be ≥7 days, assuming loss of primary tank ventilation.

Generally, the DCRT 244-TX does not accept waste outside of the control limits. An exception is given for single-shell tank waste that is outside the corrosion control limits. In those cases, the waste chemistry either is adjusted in the DCRT or is mixed with a specific amount of another saltwell waste. The mixing process changes the concentrations so that the corrosion control limits are satisfied. An exception to the corrosion control limits is given for small quantities of wastewater from rain and snowmelt and for pipeline flushes.

5.3 CORROSION PROTECTION

Corrosion protection in the 244-TX DCRT is provided primarily by the combination of good design and appropriate corrosion control. Proper design began with selection of a corrosion-resistant material (ASTM A 537 Class 1 steel) for the receiver tank. This was followed by ultrasonic testing before acceptance of the base metal, application of appropriate fabrication/welding requirements, a post-weld heat treatment, and post-fabrication non-destructive weld examination (HWS 1978). Ancillary piping systems are also constructed of corrosion-resistant carbon steel.

When wastes are transferred between storage tanks, standard operating procedures require that the waste first be analyzed, if it is uncharacterized. This procedure is necessary in order to select a tank containing similar waste to receive the transfer. Sampling each waste batch transferred results in a continuing program to characterize the wastes contained in a given storage tank, and to monitor the manner in which they change with time.

Corrosion protection in the DCRT systems is accomplished by controls on composition and concentration limits imposed at the waste generating facilities as well as at downstream tank farms. The primary corrosion control is provided through limits on hydroxide, nitrite, and nitrate

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* DCRT 244-TX also has a neutron monitoring system to detect any plutonium buildup that may occur long before a hazardous situation or criticality could develop.

Kirch (1984). Although the waste contains a large number of other chemical species, these are generally maintained at such low levels that corrosion behavior is not affected. The waste is kept essentially non-corrosive to the tank by addition of sodium hydroxide and sodium nitrite. Maintenance of these corrosion controls ensures that uniform corrosion rates are less then 0.001 in./year and that pitting corrosion and stress-corrosion cracking are inhibited.

Review of the PCSACS comment reports, for 1995 to 1999, indicated that about 50,000 gallons of line flushing water entered the tank during that time period. This could dilute the nitrite and hydroxide corrosion inhibitor levels thereby accelerating corrosion of the tank.

DCRT 244-TX was designed for a maximum waste temperature of 200 degrees F, with a wall thickness of 0.250 in. Its corrosion allowance was 0.001 in./yr., each side, for a total of 10-years or 0.02 in. total corrosion allowance. The working fluid was defined as a highly salted solution of 1.8 specific gravity with a concentration of up to 8.0 Molar caustic.

A further control to the possible escape of waste to the environment is provided by the design and construction of the 244-TX DCRT vault. Specifically, the tank vault floor including sump and walls (up to 5 ft height) are steel lined. The remaining top portions of walls are coated with Amercoat No. 33. A sump pump, with liquid level control, is provided to pump any accumulation of vault liquid back into the receiver tank.

Finally, the 244-TX pit is a below-grade vault where the environment is partially controlled by a ventilation system. Its roof or cover blocks, are made from reinforced concrete. From the above review and recent visual examinations of the facility (Section 6.0) indicate that adequate corrosion protection is provided for the facility.

5.4 AGE OF THE TANK SYSTEM

The 244-TX DCRT receiver tank was fabricated approximately 21-years ago. The facility went into service in early 1980's and since then has been used to transfer saltwell waste from T, TX, and TY farms, Plutonium Finishing Plant (PFP) waste and T Plant waste. No integrity assessment of this facility has been performed between construction and the present.

6.0 INTEGRITY EXAMINATIONS

The integrity examinations (visual and leak test) were performed in 2000. These examinations were done to identify possible degradation, and the extent of that degradation to the tank system, that may have occurred since completion of construction.

6.1 EXAMINATIONS

Visual examinations were conducted in the pump pit, tank vault (also termed annulus or annulus space) and the receiver tank interior. On June 27, 2000 the annulus was visually examined. The pump pit and tank interior were both examined on June 22, 2000.

Visual examination details and data sheet findings are included in 34 photographs (Figures L3 through L37) and four video examination data sheet tables (Tables L1 through L4). The 34 individual 'still photographs, taken from the videotapes, show the very satisfactory status of the facility.

6.1.1 Pump Pit Visual Examination

Access to the pump pit was accomplished through riser number 8. The VITIS II camera and associated lighting (used for viewing all three facility components) was manually lowered into the pit. The camera has the capacity to both pan and tilt while viewing the pit internals. Typically, the overall viewing is done at a wide-angle setting of the zoom lens, with higher-magnification (or lesser-angle setting) used to view details of interest.

The color videotape dedicated to the pump pit showed that the condition of the walls, nozzles, unremoved cover blocks, floor, and various ancillary equipment, appeared very satisfactory. Some normal dust and dirt on parts of the floor prevented the reviewer from seeing the entire coated concrete floor and joints. However, where visible, all appeared very satisfactory.

Satisfactory conditions of the pit walls, roof (cover blocks), walls, nozzles, and pit floor are shown in Figures L3 through L11, and are described in more detail in Table L1.

6.1.2 Annulus Visual Examination

Access to the annulus, or tank vault region, was obtained through riser number 26 (4-in. diameter) and riser number 18 (24-in. diameter). A total of 14 photographs of the vault/tank exterior region were taken. Figures L12 through L20 were taken through riser number 26 (described in Table L2) and Figures L21 through L25 were taken through riser number 18 (described in Table L3). In general, the vault and the tank exterior surfaces appeared to be in very satisfactory condition.

Anecdotal evidence indicated that the tank overflowed in 1993, with about 30 gallons of waste winding up in the annulus sump. Figure L19 shows evidence of leaks through the large riser bellows above the tank top. Light spill markings can be seen on the risers below their respective bellows. But no spill marks appeared above the large bellows. Thus, there may be some through-wall defects in them. These defects are not expected to have any effect on the integrity of the underlying tank.

White circumferential stains appeared on both sides of the tank. None appeared around any of the smaller risers.

6.1.3 Receiver Tank Internal Visual Examination

Access to the tank interior region was accomplished by opening the number 8, 4-in.-diameter pipe riser. In general, the tank, and its internal components (agitator pump piping, recirculation water sluicing system, diptubes) appeared in very satisfactory condition.

A total of twelve photographs of the tank interior were taken, and are shown in Figures L26 through L37. Most of the tank surface could be viewed except, for that below the opaque liquid waste (tank more than half full) and for a vertical strip at the west-end of the tank. That strip,

including the top of the tank, about 10 to 20 degree (est.) wide was obscured by the proximal pump agitator piping. The east-end of the tank (and east-top), however, was clearly visible. No significant corrosion was seen in all the areas visible to the camera.

There is evidence of minor amounts of corrosion pitting and waterline corrosion and waterline marks, some being near the top of the tank. The waterline marks near the top, indicate that the tank had been overfilled, possibly on several occasions well above the 80-percent level. These high-water marks suggest that it would not take much of an increase in volume to fill the tank into its risers.

6.2 LEAK TEST

To assess leak tightness of the 244-TX receiver tank, a review was made of historical fluid level records. The entire 19-year period of recorded surface level data (PCSACS – Figures L38 through L40) was reviewed including a recent time-period (1999-2001). During November 1999 and August 2000, the level was constant for 35 days (72.75 in.) and 14 days (82.25 in.), respectively. The Manual Tape surface level data indicate that the tank is not leaking.

Leakage defects appear to exist in the large riser bellows, which are located about 12 to 16 in. above the top of the tank. Anecdotal evidence indicates that overfilling of the tank sometime early in the 1990's, up into the riser-bellows region, apparently resulted in leakage to the annulus sump of about 30 gallons of waste. These defects are not inimical to the integrity of the tank.

Visual examination of the 244-TX facility indicates that the tank has not leaked and that it is in very satisfactory condition.

7.0 FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Based on the evaluation in Section 5.0 and Section 6.0, the following findings, conclusions, and recommendations are presented:

1. The combination of satisfactory results of the design evaluation and the successful visual examinations, presented in this report, indicate that the facility and its components are adequately designed and the receiver tank has not leaked.

2. The design does not prevent entry of water (rain, snowmelt) intrusion into the pump pit and receiver tank, which adds to the waste inventory and increases the potential corrosion inside the tank and the components in the pump pit. This should be mitigated by effectively sealing the cover block seams.

3. Due to operations' schedule constraints, the visual examination of the tank interior was conducted when it was more than half full (80.75 in.). The visible portions of the tank interior were in good condition, however the bottom portion

of the tank could not be clearly inspected. Therefore it is recommended that a visual examination of the empty tank be conducted within the next 5-years.

4. The structural assessment analysis (WHC 1996) should be revised with refined analysis methods using realistic assumptions and loading conditions to demonstrate and justify the operation of the facility.

5. Tank waste levels should be maintained within the 80-percent fill requirement to ensure that overfilling into the large riser bellows does not occur.

6. The 244-TX facility is in very satisfactory condition. Because the bottom-half of the tank could not be observed, it is recommended that repeat visual examinations of the empty tank (in addition to the one in 5-years in item 3 above) and a leak test be conducted within the next 10-years.

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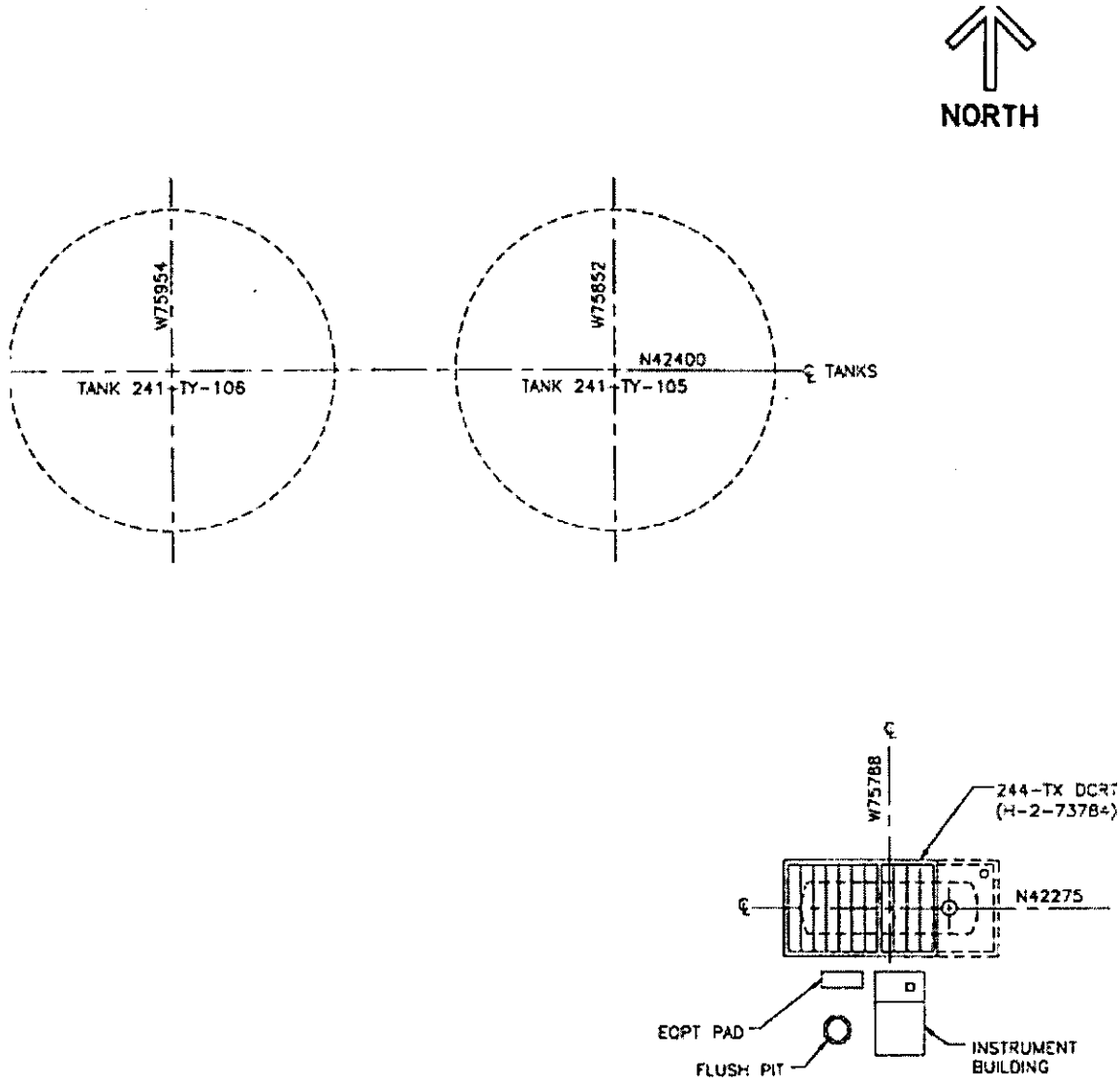

Figure L1 244-TX Site Plan

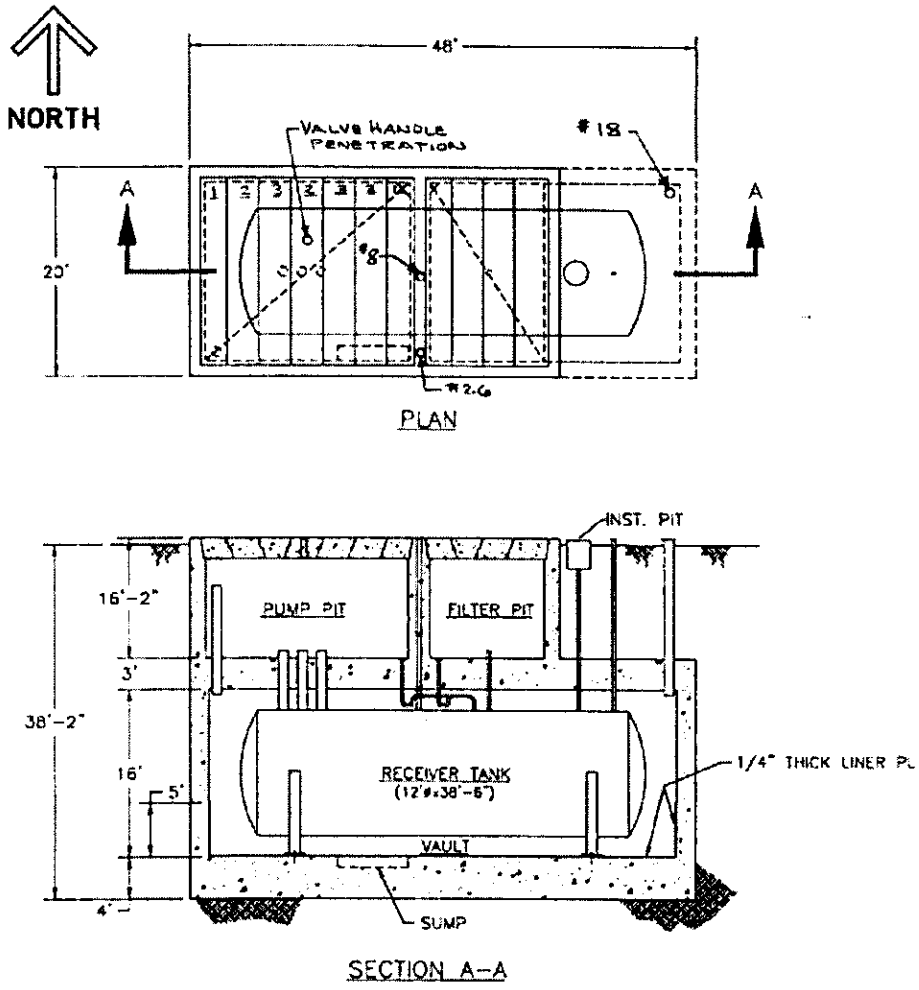

Figure L2 244-TX DCRT

TABLE L1 VIDEO EXAMINATION DATA SHEET, 244-TX PUMP PIT

Examination Date: 6/22/00

Person In Charge: Ken Baird Camera Operator: Mitzi White Video Examiner: T. S. Hundal

Riser: Entrance In Cover Block 2

Video Tape Reviewer: Earl B. Schwenk Date: 8/28/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following information reveals that the pump pit is in very satisfactory condition. All items in the field of view of the camera were observed; essentially the entire pit region was scanned (walls, cover blocks, floor-wall intersections, pump pit components etc.). Comments are made herein confirming the general conditions. Video-based still photographs (nine) are included that show some of the conditions. Pan and tilt refer to the angles of the viewing video camera when a 'still' photograph was taken.
0642 AM		029	099		Fig. L3 is a view of the northwest corner of the pump pit showing six nozzles (A through E) with vapor seal covers. Only nozzle A appears to have leaked, either rainwater/snowmelt or waste, as evinced by the brown wall stain directly below it. Various electrical connecting lines are also seen. No cracks were seen in the coated concrete wall.
0642 AM		000	102		Continuation of the row of nozzles of Fig. L3 above, is shown in Fig. L4 (nozzles F through K). Insulated piping connections and four PUREX nozzles are attached to locations F through I; vapor seals cover nozzles K and J.
0644 AM		044	114		Intersection of the floor with the walls of the northwest corner of the pit floor, are shown in Figure L3. Although some dirt exists on the floor, the joints and the cabling appear satisfactory. The wall stain is the same one shown on the right side of Fig. L3.

Table L1 (continued)					
0700		234	122		The generally satisfactory appearance of pump pit components are shown in Figure L6. They include a waste transfer pump PUREX nozzle connection and piping connections.
0704 AM		330	105		Fig. L7 shows the satisfactory appearance of the southwest corner of the pump pit and several main risers (22 and 23), valve handles and vapor seal covers.
0708 AM		152	110		The satisfactory condition of the southeast corner of the pit-floor intersection region, and ancillary components, are shown in Figure L8.
0824 AM		000	067		Views of the northwest and northeast corner-roof intersections are shown in Figures L9 and L10, respectively. Some minor rusting around the cover block and wall carbon-steel edge angles is apparent. Wall stains are likely due to rainwater/snowmelt in-leakage.
0829 AM		288	148		Fig. L11 shows the central riser (with lid) for the receiver tank below, and the attendant spider piping assemblies entering the periphery of the riser.

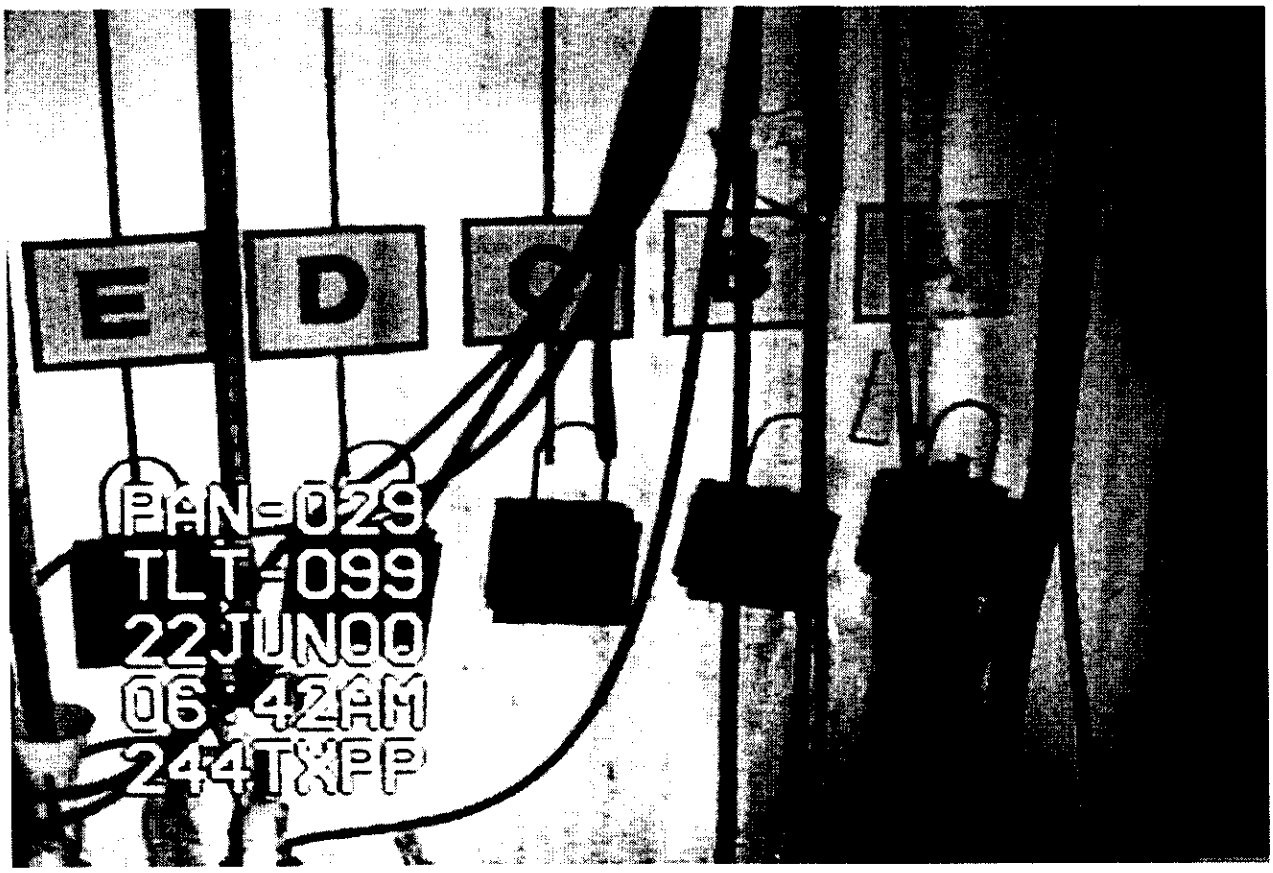

Figure L3
View of Northwest Corner Pump Pit (right) and Nozzles A-E with Vapor Seal Covers. 244-TX DCRT Pump Pit. Camera Entered Through Riser in Cover Block 2, North Side.

Figure L4
View of North Wall Nozzles F-K, with Connections (F to I) and Vapor Seals (E, J and K)

Figure L5
Northwest Corner of Pit Floor, 244-TX DCRT Pump Pit. Riser Cover Block 2.

Figure L6
View of Waste Transfer Pump, 244-TX DCRT. Riser Cover Block 2

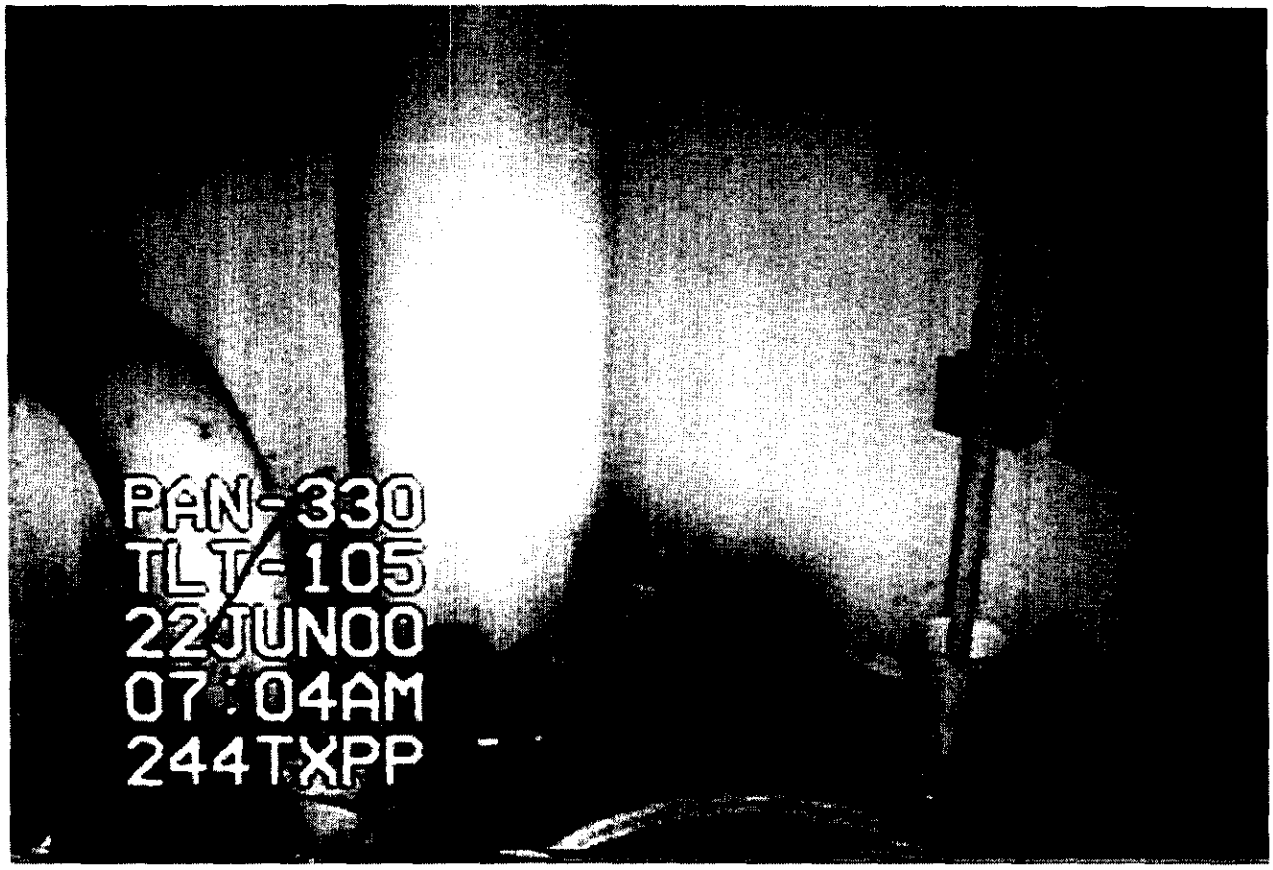

Figure. L7
View of Southwest Corner of Pump Pit, Riser number 23 (left) and number 22 (center), and Valve Handle and Vapor Seal Covers (right). 244-TX DCRT Riser Cover Block 2

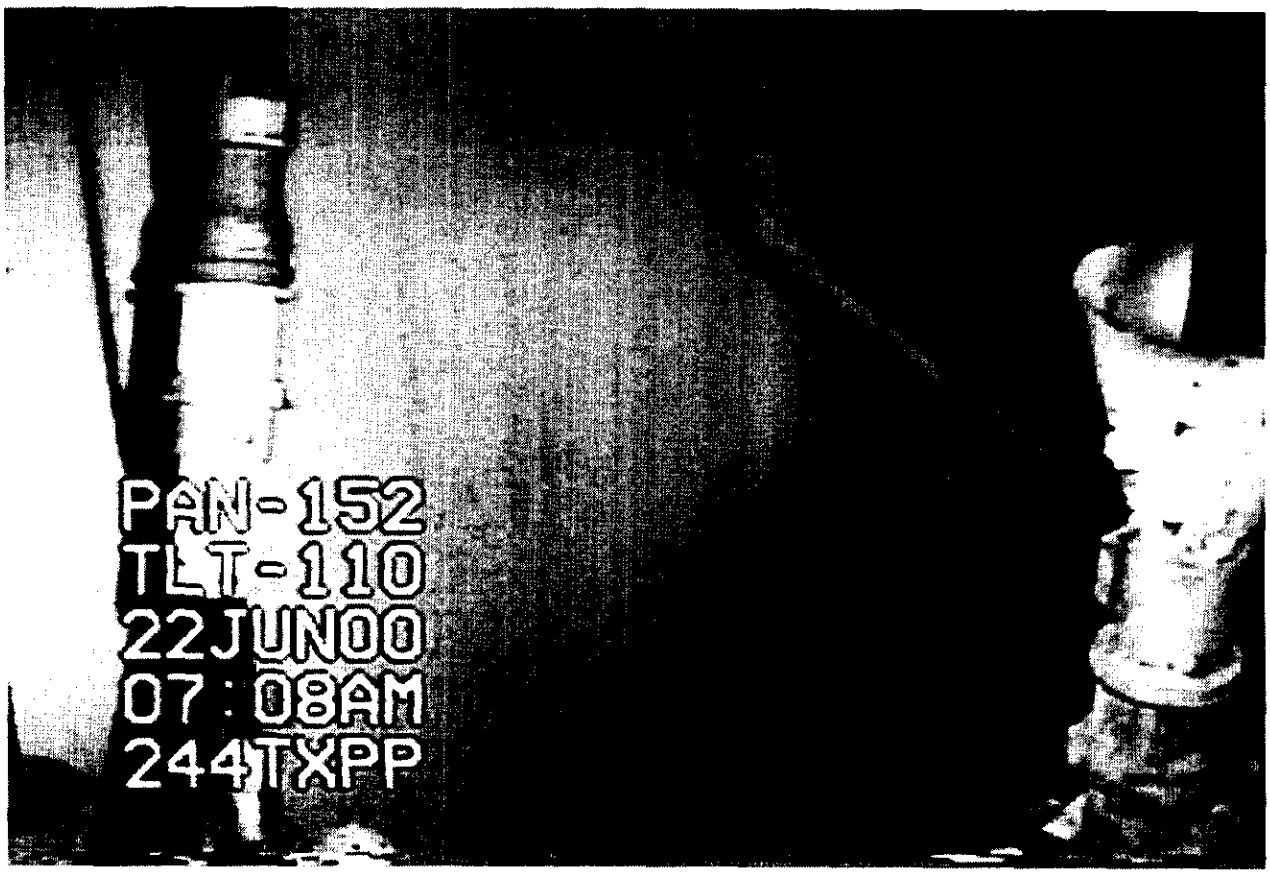

Figure L8
View of Southeast Corner and Floor of Pump Pit, 244-TX DCRT Riser Cover Block 2

Figure L9
View of Northwest Corner and Roof of Pit, Electrical Penetrations on West Wall, 244-TX DCRT. Riser Cover Block 2

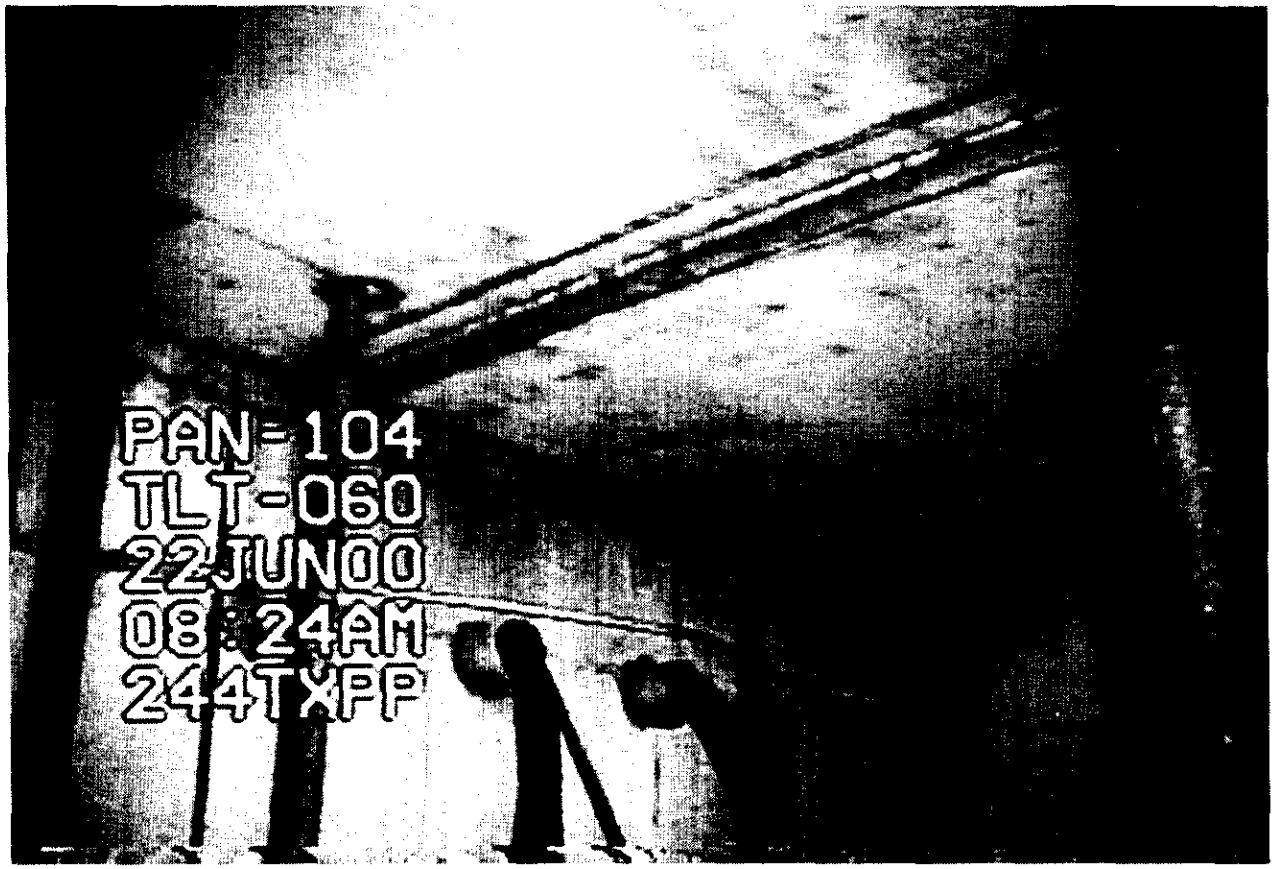

Figure L10
View of Northeast Corner of Pit, Roof and Various Penetrations, 244-TX DCRT.
Riser Cover Block 2

Figure L11
View of Central Riser Opening for Receiver Tank Below, Including Spider Piping Entrances, 244-TX DCRT. Riser Cover Block 2

TABLE L2. VIDEO EXAMINATION DATA SHEET, 244-TX DCRT ANNULUS AREA

Examination Date: 6/27/2000

Person In Charge: Ken Baird Camera Operator: Dave Roberts Examiner: T.S. Hundal

Riser number : 26 (4 in. diameter)

Video Tape Reviewer: E. B. Schwenk Date: 8/28/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following information reveals that the exterior walls and floor of the 244-TX vault, as well as the outside surface of it receiver tank, are in very satisfactory condition. Areas within the field of view of the camera were observed (walls, ceiling, tank exterior, visible tank welds, tank foundation, risers etc). The camera was entered into the annulus of the DCRT vault through riser number 26 (4 in. diameter). The riser is located at near the south face of the vault and is approximately midway between its west and east ends. Comments are made herein at various locations confirming the general satisfactory conditions seen. Nine video/still photographs are included that show some of the noted conditions. Pan and tilt refer to the angles of the viewing video camera either when a comment is made or when a 'still' was taken. A similar write-up is made for entrance of the camera into riser 18 (located at the northeast corner of the vault) with an additional four photographs presented. Hanford Drawing H-2-73908 is helpful for orienting the camera with respect to a given riser entrance and compass directions.
1020 AM		018	181		In the first figure, L12, the camera is looking straight down at the annulus sump. A manual tape, several plummets, and an electrical ground line can be seen. The sump is dry but shows some evidence of having fluid in it at one time as noted by the light layer of rust. The remainder of the area of the carbon-steel annulus remains protectively-coated with Amercoat number 33.
1027 AM		113	144		Figure L13 is a close-up view of the leak detector unit, which is also located on the bottom of the sump.

Table L2 Video Examination Data Sheet, 244-TX DCRT Annulus Area (continued)					
1023 AM		000	127		Progressing upward from the sump, about 5 ft, one can see a horizontal and a vertical intersecting weld, Figure L14. Some typical minor weld porosity can be seen.
1029 AM		109	086		Figure L15 shows a view of the southwest corner, walls and floor of the annulus. The trench leads to the sump; a portion of the support for the south end of the tank is directly to the right. The walls and joints are clean; a small amount of rust particles/dirt resides on the tank floor.
1035 AM		282	088		The cleanliness of the annulus floor and sidewall, toward the southeast corner can be seen in Figure L16. Support structure for the south end of the tank can be seen in the background. Hold-down bolts for the tank are located behind the vertical plate (see also Figure L14 for view of bolts in north tank support).
1038 AM		288	044		A view of the top of the east wall of the annulus, including the roof support decking (for the pump pit above), are shown in Figure L17.
1039 AM		271	044		Evidence of the coating quality on the tank, including one girth weld, can be seen in Figure L18.
1056 AM		179	046		A view of the west end of the top of the receiver tank, including main risers, is shown in Figure L19. Anecdotal evidence indicates that in the past (about 1993) the tank was overfilled, about 30-gallons, resulting in waste spilling down on top of the tank and into the sump. These leaks appear to have come through the large riser bellows. White stains can be seen on the risers, but only below their bellows, and down onto the tank, and along its circumference. Similar white stains were also seen on the opposite side of the tank, but only adjacent to the same larger diameter risers.
1055 AM		158	077		A close-up view of one of the stained areas, below the main riser, is shown in Figure L20. The nature of the waste apparently caused a partial-peeling of the coating.

Figure L12
View of Vault (Annulus) Sump from Riser number 26, 244-TX DCRT Camera Entry Through Riser number 26.

Figure L13
View of Leak Detector Unit in Annulus Sump, Riser number 26, 244-TX DCRT.

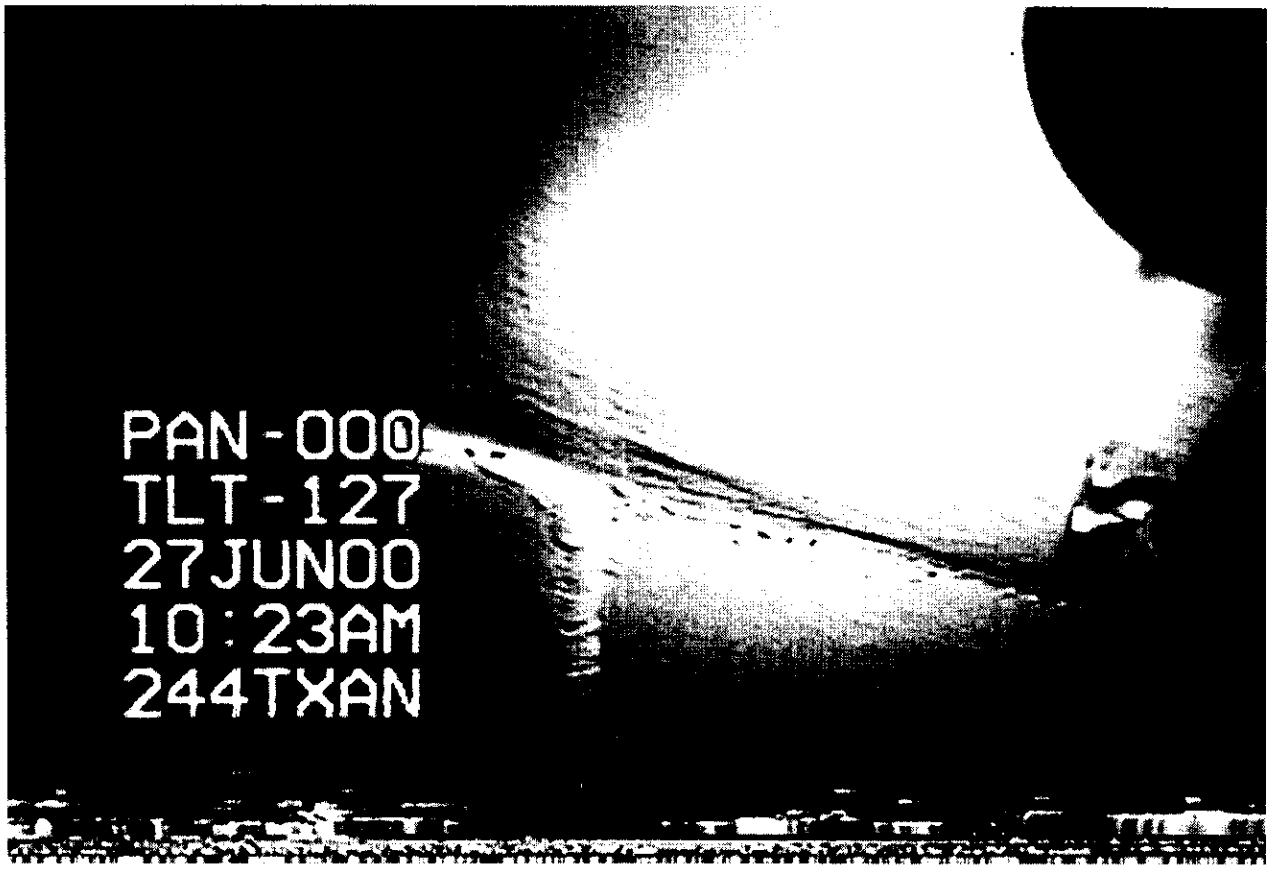

Figure L14
View of Horizontal and Vertical Weld in Carbon-Steel Liner About 4 ft above Annulus Sump. Probable Grounding Cable at Right. 244-TX DCRT. Riser number 26.

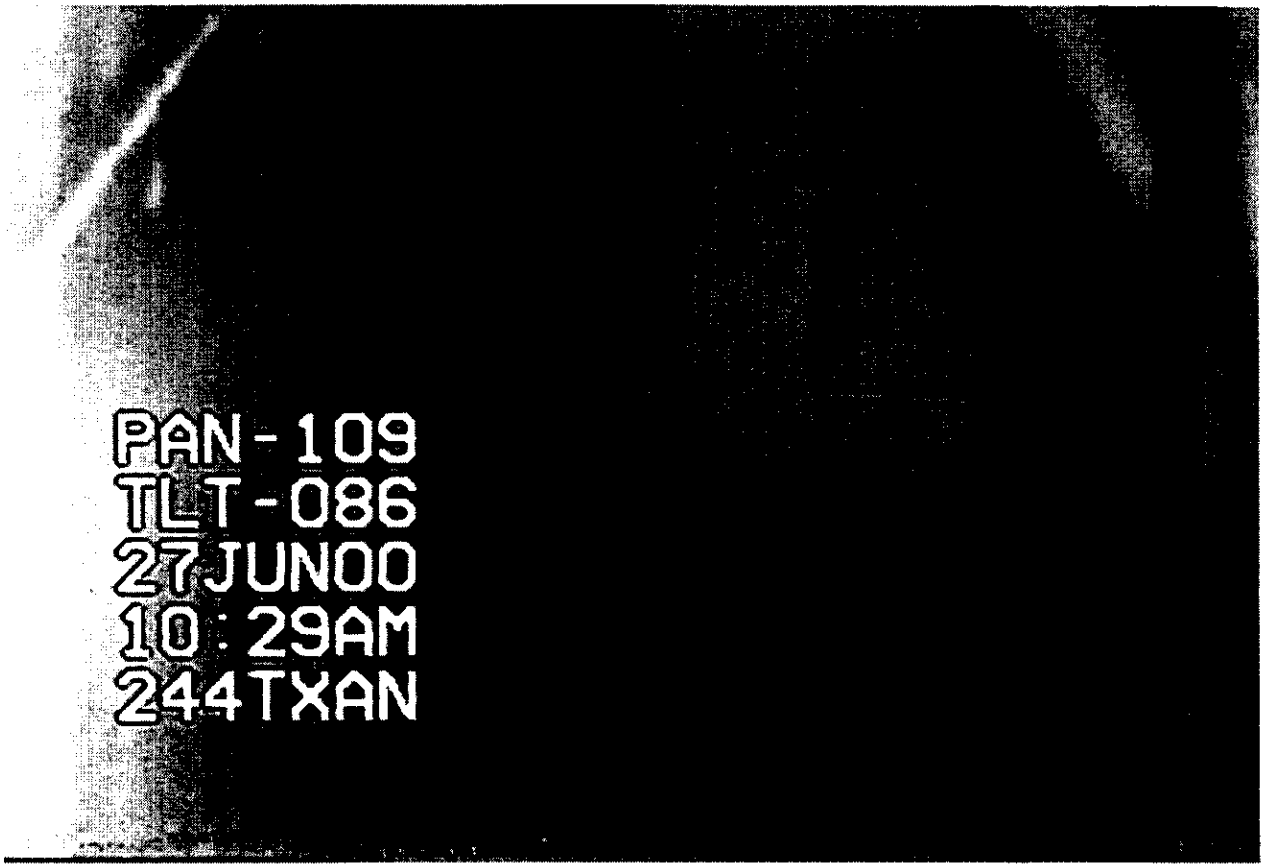

Figure L15
View of Southwest corner of Annulus showing Trench to Sump, Floor, and Tank Support at Right, 244-TX DCRT. Riser number 26.

Figure L16
Southeast Corner, Floor, and Tank Support (right, background) and Receiver Tank (left), Annulus 244-TX DCRT. Riser number 26.

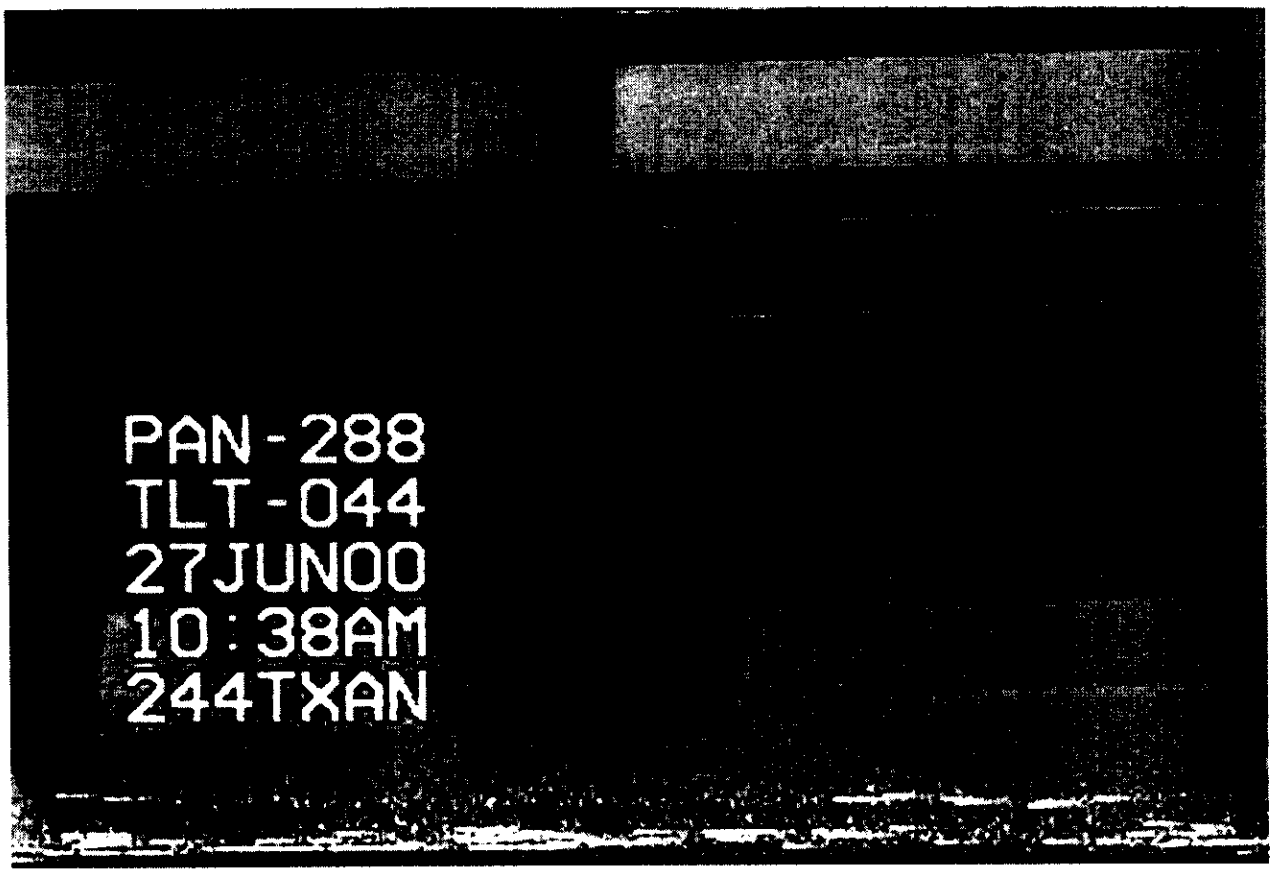

Figure L17
View of East Wall of Annulus (bottom) Including Roof Support Decking for Base of Pump Pit, 244-TX DCRT. Riser number 26

Figure L18
View of Southern Sidewall of Receiver Tank, Girth Weld (far left) and Roof of Annulus, 244-TX DCRT. Riser number 26

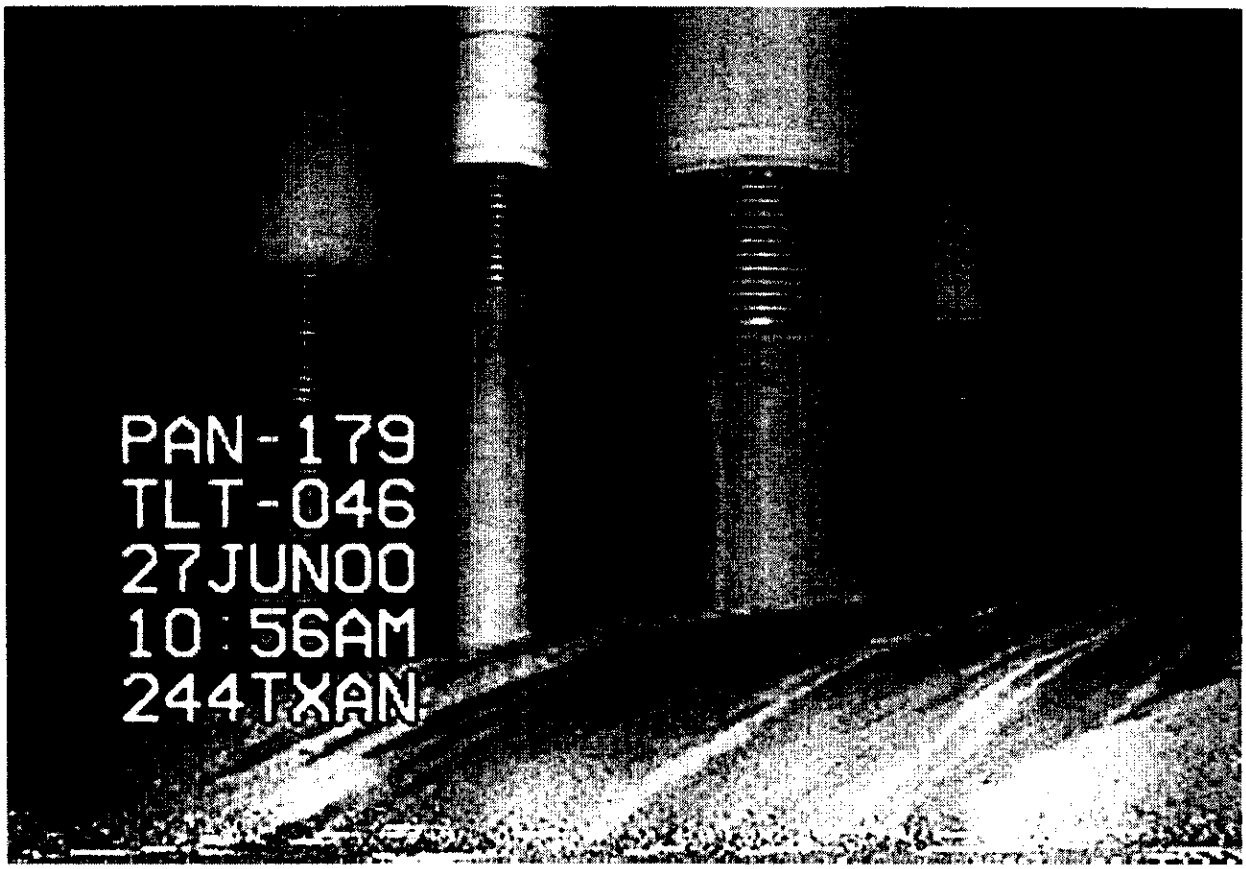

Figure L19
View of Receiver Tank Top and Main Risers, and Stains from a Past Minor Waste Spill Apparently Through the Riser Bellows, 244-TX DCRT. Riser number 26

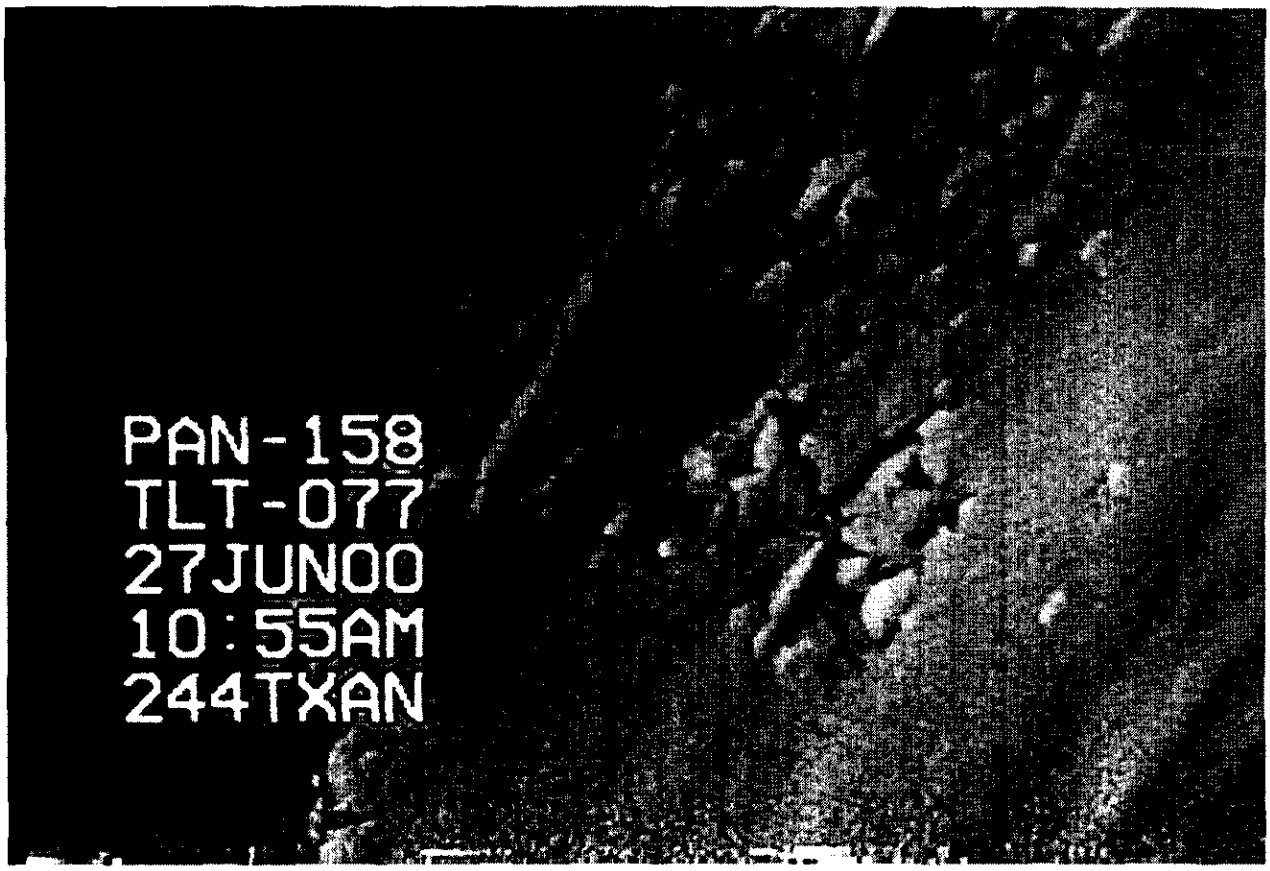

Figure L20
View of Peeling Paint on South Side of Receiver Tank, Apparently Caused by Minor Waste leak Through Tank Riser Bellows, 244-TX DCRT. Riser number 26.

TABLE L3 VIDEO EXAMINATION DATA SHEET, 244-TX DCRT ANNULUS AREA

Examination Date: 6/27/00

Person In Charge: Ken Baird Camera Operator: Dave Roberts Video Examiner: T. S. Hundal

Riser number :18 (24 in. diameter)

Video Tape Reviewer: E. B. Schwenk Date: 8/28/2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					Like the visual exam thru riser number 26 (Table L2), the visual images seen through this riser (number 18) also show that the pit exterior walls, ceiling, floor, receiver tank, and receiver tank foundation are in very satisfactory condition. Hanford Drawing H-2-73908 is helpful for orienting the camera with respect to a given riser entrance and compass directions.
1115 AM		164	072		A view of the very clean southeast corner, bottom and sidewalls of the annulus is shown in Figure L21. The receiver tank can be seen at the right side.
1118 AM		167	052		Like Figure L14, some weld porosity can be seen in the horizontal weld (Fig. L22) in the annulus carbon-steel liner.
1119 AM		241	085		The good quality of the coating on both the tank and its east end support, including hold-down bolts can be seen in Figure L23.
1121 AM		261	061		Figure L24 shows the relatively clean surfaces of the north carbon-steel wall and floor, and the tank/tank support at the left.
1130 AM		314	044		Figure L25 provides a view of the east end/top of the tank and its smaller risers. All surfaces appear clean and undamaged.

Figure L21
View of Southeast Corner of Bottom of Annulus, Receiver Tank on Right, 244-TX DCRT. Entry Through Riser number 18.

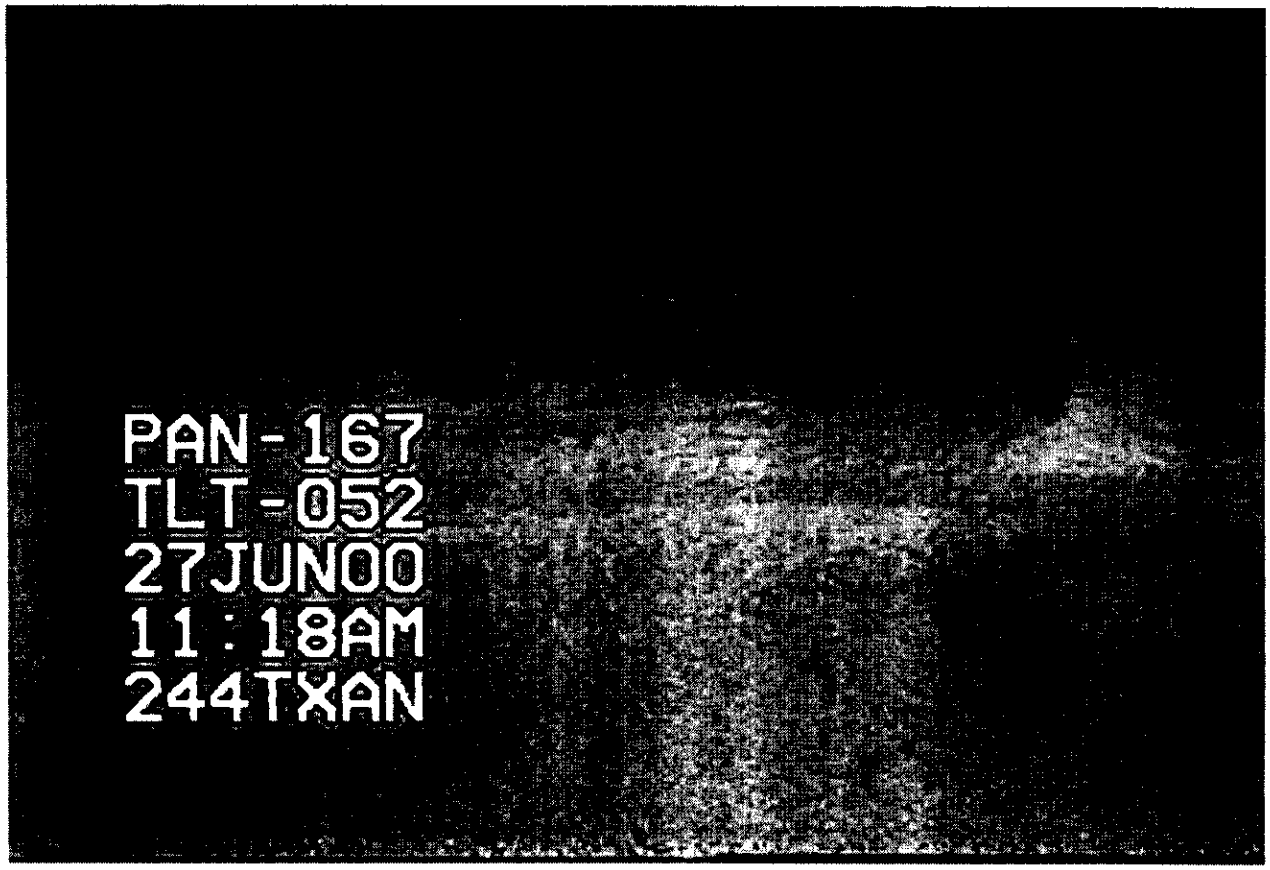

Figure L22
Probable Porosity of Horizontal Weldment in floor liner, near Southeast Corner of Annulus, about 4- to 6 ft above Floor, 244-TX DCRT. Riser number 18.

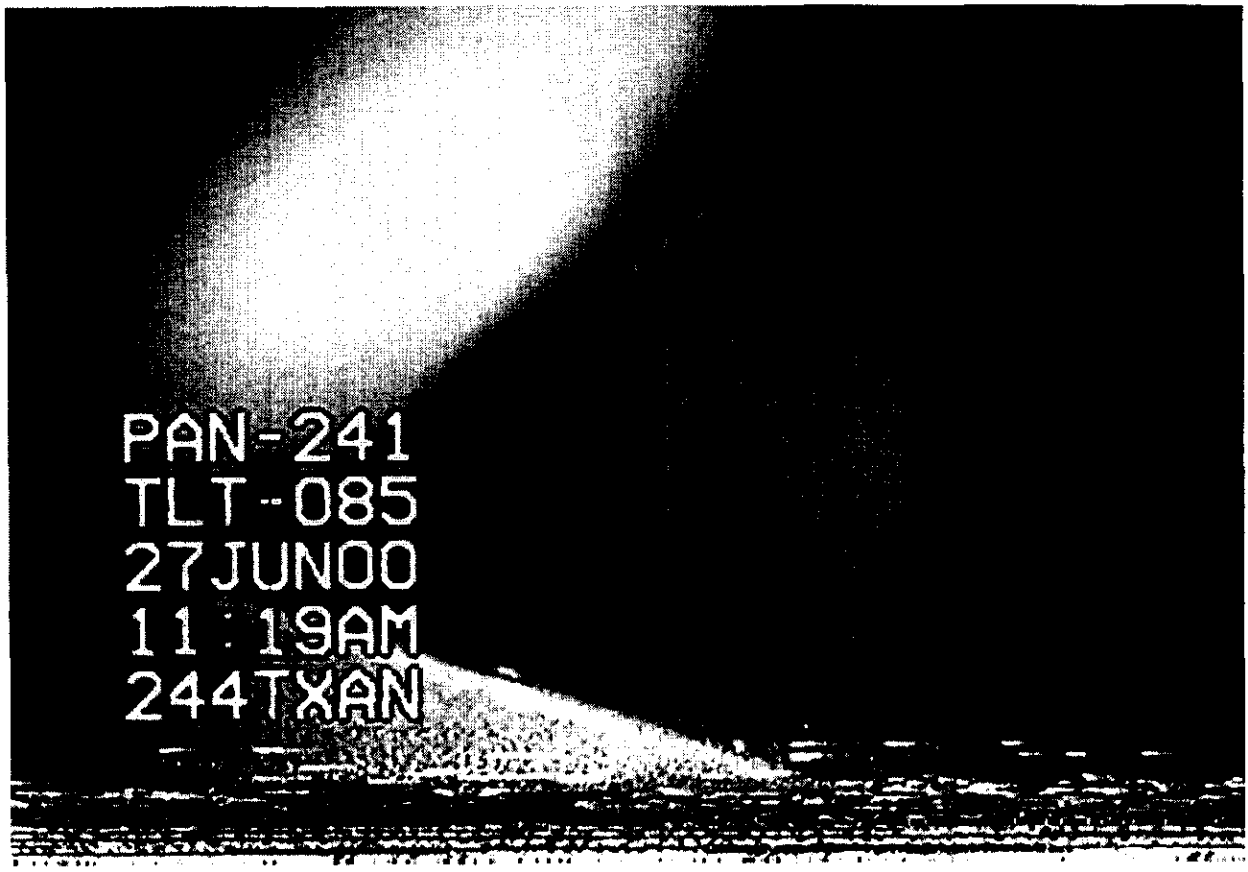

Figure L23
Anchor Bolts on East End Tank Support, 244-TX DCRT. Riser number 18.

Figure L24
View Along North Wall and Floor of Annulus, East End Tank Support at Left, 244-TX DCRT. Riser number 18

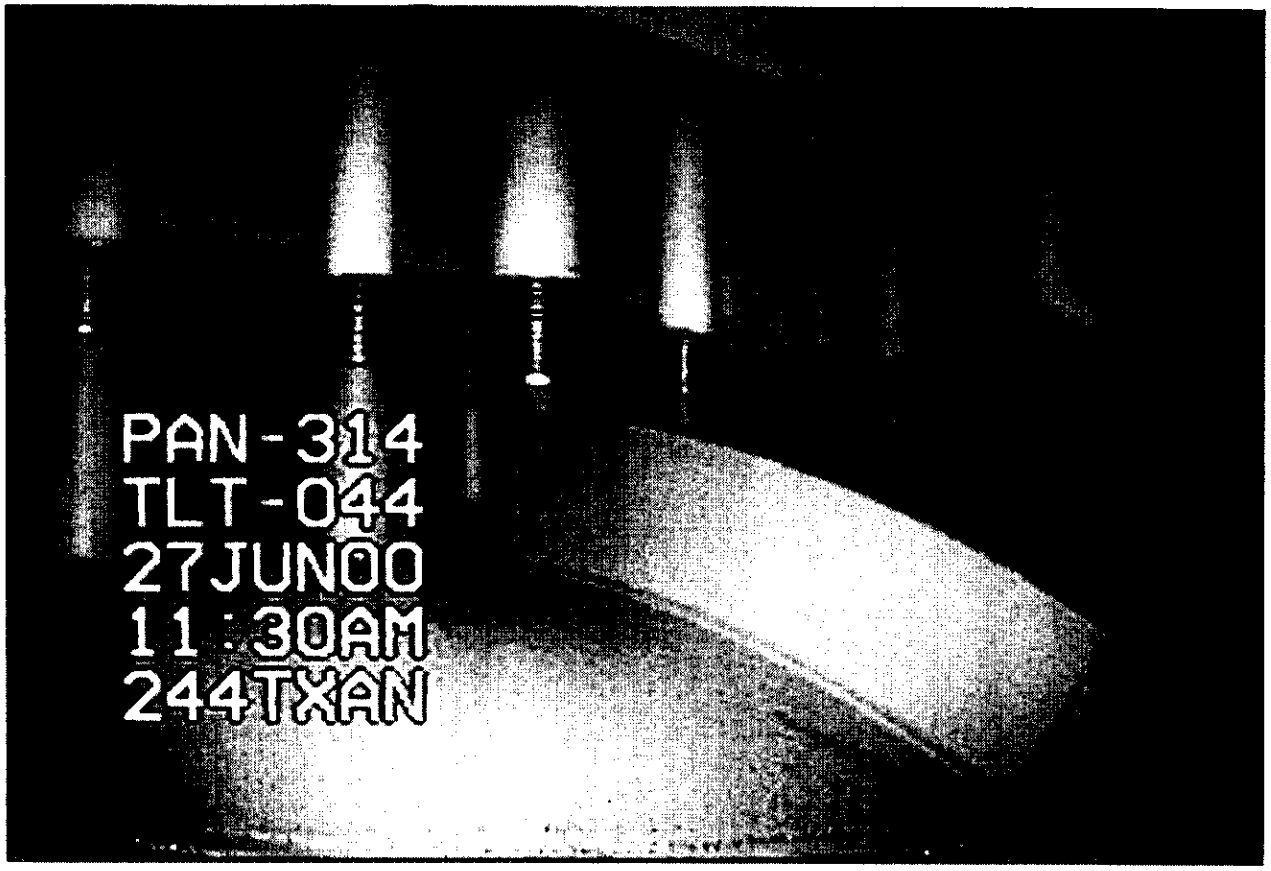

Figure 25
View of East End of Tank and Risers, 244-TX DCRT. Riser number 18

TABLE L4 VIDEO EXAMINATION DATA SHEET, INTERIOR OF 244-TX DCRT

Examination Date: 6/22/00

Person In Charge: Ken Baird Camera Operator: Mitzi White Video Examiners: T. S. Hundal

Riser: number 8, 4 in. diagram

Video Tape Reviewer: E. B. Schwenk Date: August 29, 2000

Tape Time		Complementary Information			Reviewer's Comments
		Pan	Tilt		
					The following narrative and photographs indicate that the nearly 20-year old 244-TX double-contained receiver tank is in very satisfactory condition. Most of the tank surface area could be viewed except for that below the opaque liquid waste (tank about ½-full) and for a vertical strip at the west end of the tank. That strip, about 10 to 20° wide (est.), was obscured by the proximal pump agitator shaft (pipe about 4 in. diameter) that projected vertically down through riser entrance number 7, apparently to the bottom of the tank. The top of the tank, west of the agitator shaft, was also obscured. However, a clear view of the same areas to the east was available to the video camera. The interior of the tank appeared to have been coated with Amercoat number 33 (yellow color) but apparently degraded in the tank ullage (mainly top 1/3rd of tank) to bare metal. After the coating degraded, the tank had been filled nearly to the top, at least several times, as evinced by faint waterlines. This observation appears to match a prior claim that the tank had been overfilled once, which led to a spillage, in the order of 30-gallons, to the annulus sump. A yellowish-white coating (with evidence of many different waterline markings) cover the majority of the tank below approximately the 1/3rd point. Some areas of the coating display black-like blemishes. In some areas, the coating has disappeared with some light general corrosion of the base metal showing. Some minor amounts of pitting corrosion exist in the tank wall vapor space. No significant corrosion was noted in all the areas visible to the camera.

Table L4 Video Examination Data Sheet, Interior of 244-TX DCRT (continued)					
					The terms pan and tilt refer to the angles of the viewing video camera (VITIS II) and attached light that had been lowered through 4 in. pipe riser no. 8. Horizontal panning ranges from about 0 to 359°. Tilt angle ranges from 0 to about 180° (straight down).
0942 AM		181	072		Fig. L26 shows an internal view of the top, east end, and north sidewall of the 244-TX receiver tank.
0939 AM		173	068		A closer view of the diptube assembly (center) and recirculation sluicing piping system is shown in Fig. L27.
0944 AM		179	068		Another closer view of the recirculation piping system, near the top of the tank, shows evidence of light pitting (Fig. L28). This indicates that the pipe had been submerged; note also the light waterlines on both the tank and the upper left recirculation pipe.
0946 AM		203	083		Evidence of the remaining coating of Amercoat is shown in Fig. L-29. Three of the circumferentially oriented recirculation sluicing pipes are visible along with a number of waterlines and black blemishes on the coating. Opacity of the waste is indicated by the mirror-image reflection of the ullage tank wall.
0946 AM		203	083		A closer view of the Fig. L29 sidewall is shown in Fig. L-30. Here, additional small waterlines, blemishes, and some small loss of the coating are apparent.
0948AM		218	093		Fig. L31 is a close-up view of the present waterline, one of the recirculation pipes, and the relative opacity of the liquid waste.
0951 AM		246	086		A major girth weldment is shown in Fig. L32. Some of the coating around the weld has disappeared and minor corrosion is apparent.
0951 AM		246	066		This view (Fig. L33) is an upward continuation of Fig. L32, showing the tank wall and the recirculation pipe. Evidence of original construction chalk markings are apparent behind the recirculation pipe.
0953 AM		250	078		A close-up view of some light pitting corrosion around the major girth weldment is shown in Fig. L34.
0959 AM		325	074		Fig. L35 shows some circumferential stains on the south side of the receiver tank that appear to line up with some of the major riser entrances. Nearly ½ of the west end of the tank is also visible.
0959 AM		345	042		Looking upward (Fig. L36), evidence of the initial tank coating remains around the pump agitator shaft opening (about 18 in. diagram) and the upper reaches of the pipe shaft.
1004 AM		022	070		Rotating the camera, more than 300° shows the same circumferential stains (Fig. L37), but on the opposite side of the tank, to those shown in Fig. L35.

Figure L26
View of Walls, Top and East End of 244-TX Receiver Tank. Diptube System (center) and Recirculation Sluicing Pipe System (right). Camera Entry Through Riser number 8.

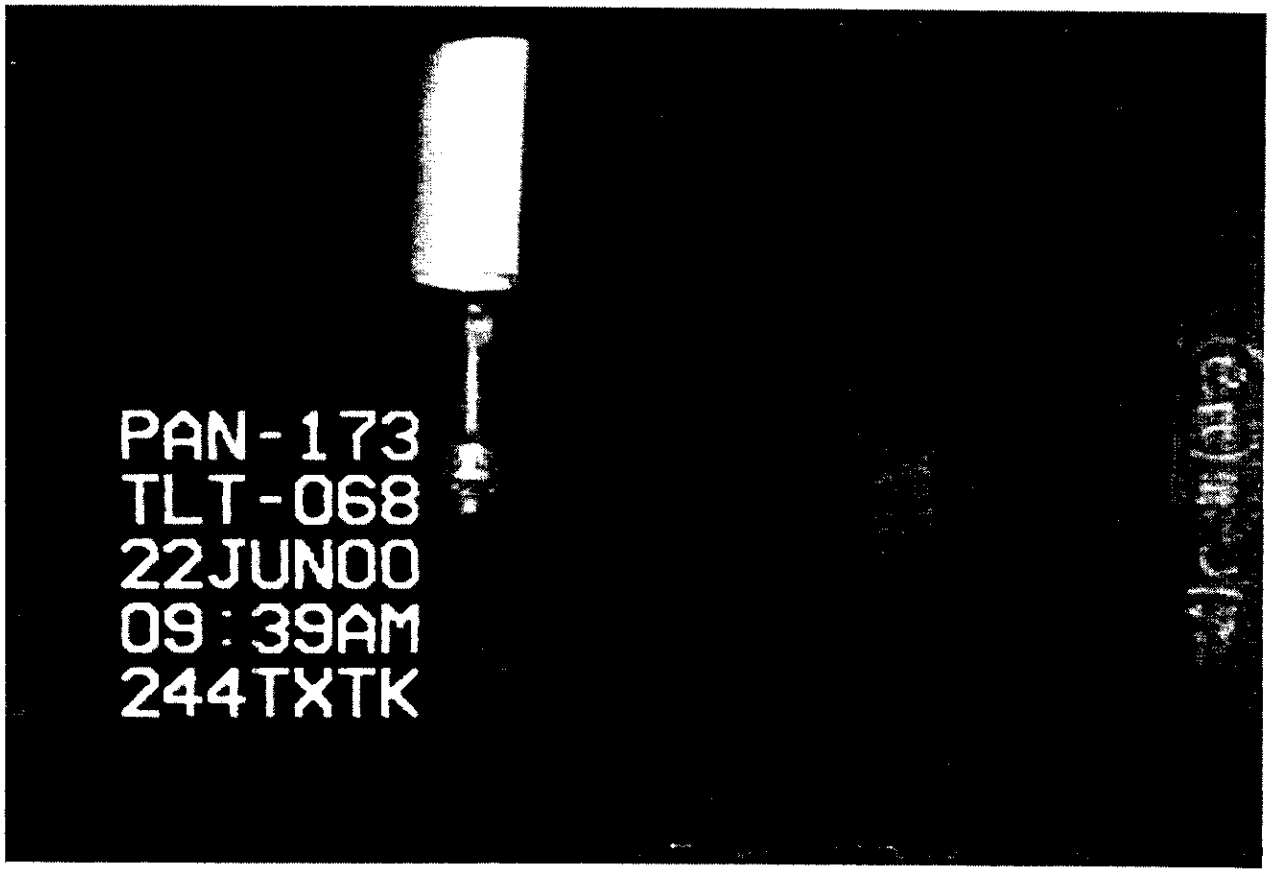

Figure L27
Close-up View of Diptube Assembly (center) and Recirculation Sluicing Piping Entry (right), 244-TX DCRT. Riser number 8.

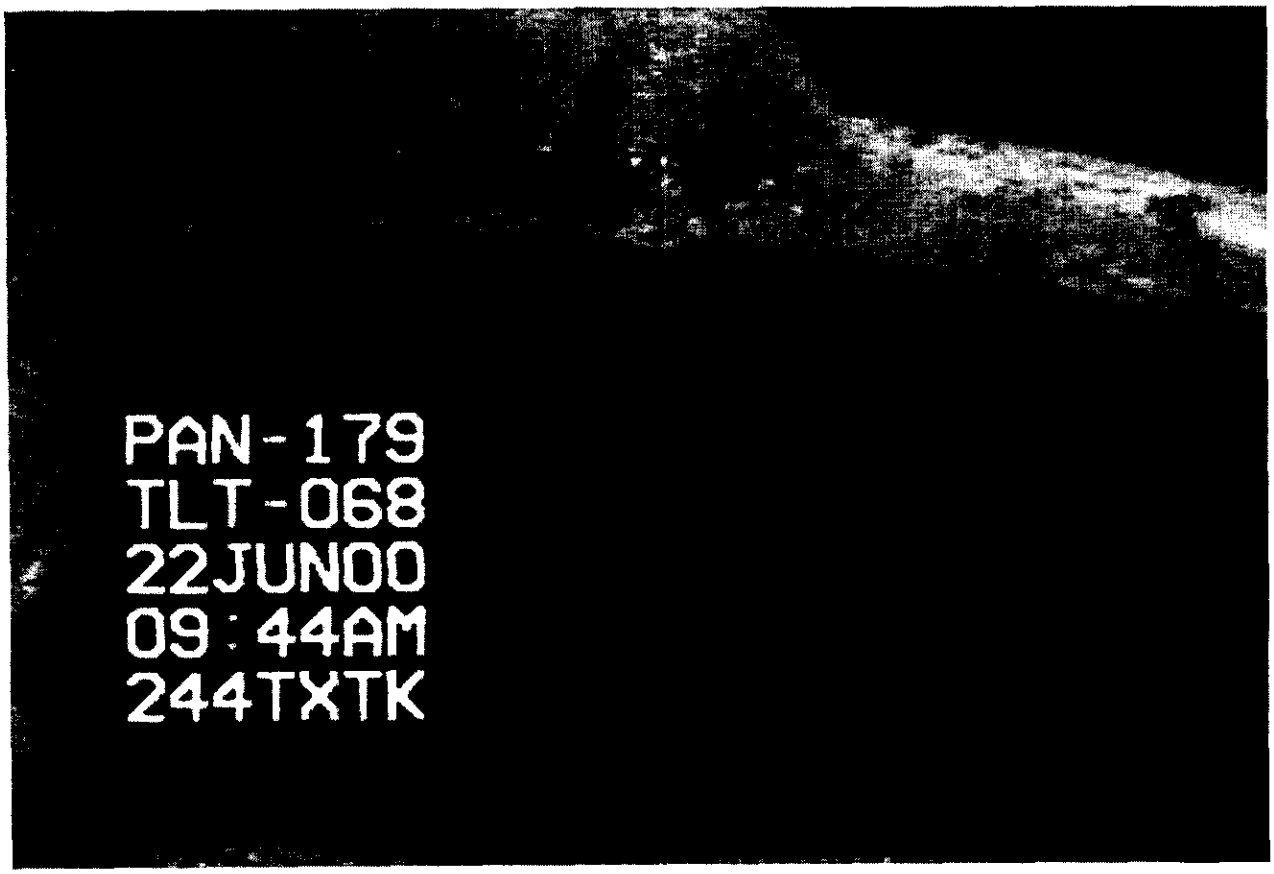

Figure L28
Possible Corrosion Pits in Receiver Tank Recirculation Piping System, 244-TX DCRT.
Riser number 8

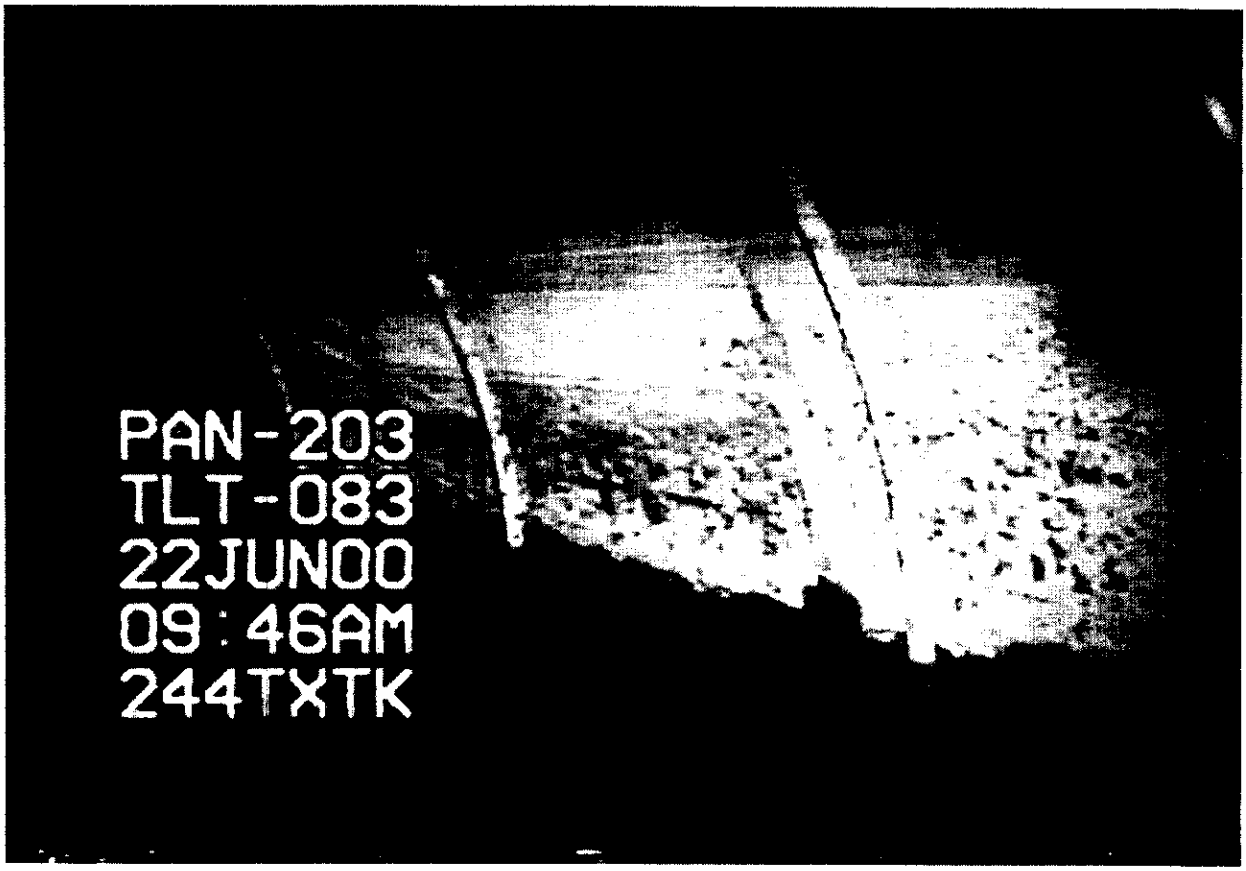

Figure L29
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Riser number 8

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View of North Side of Tank and Vertical Stain Markings; These Appear to Correlate with Stain Markings on South Wall of Tank (See Fig. L-35); Probably Coming From Riser Openings, 244-TX DCRT. Riser number 8

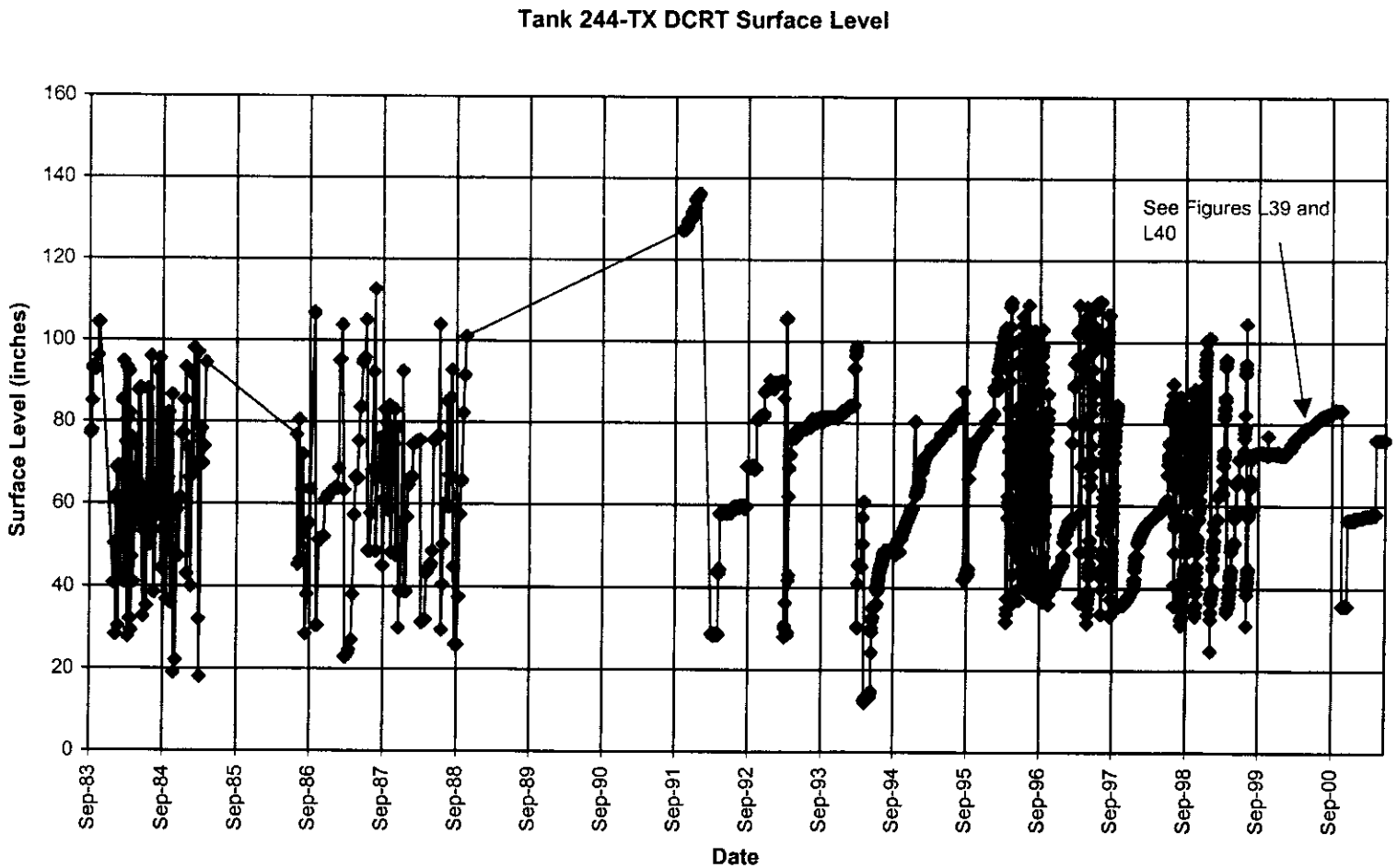

Figure L38 Surface Level versus Time, September 1983 to May 2001, 244-TX DCRT

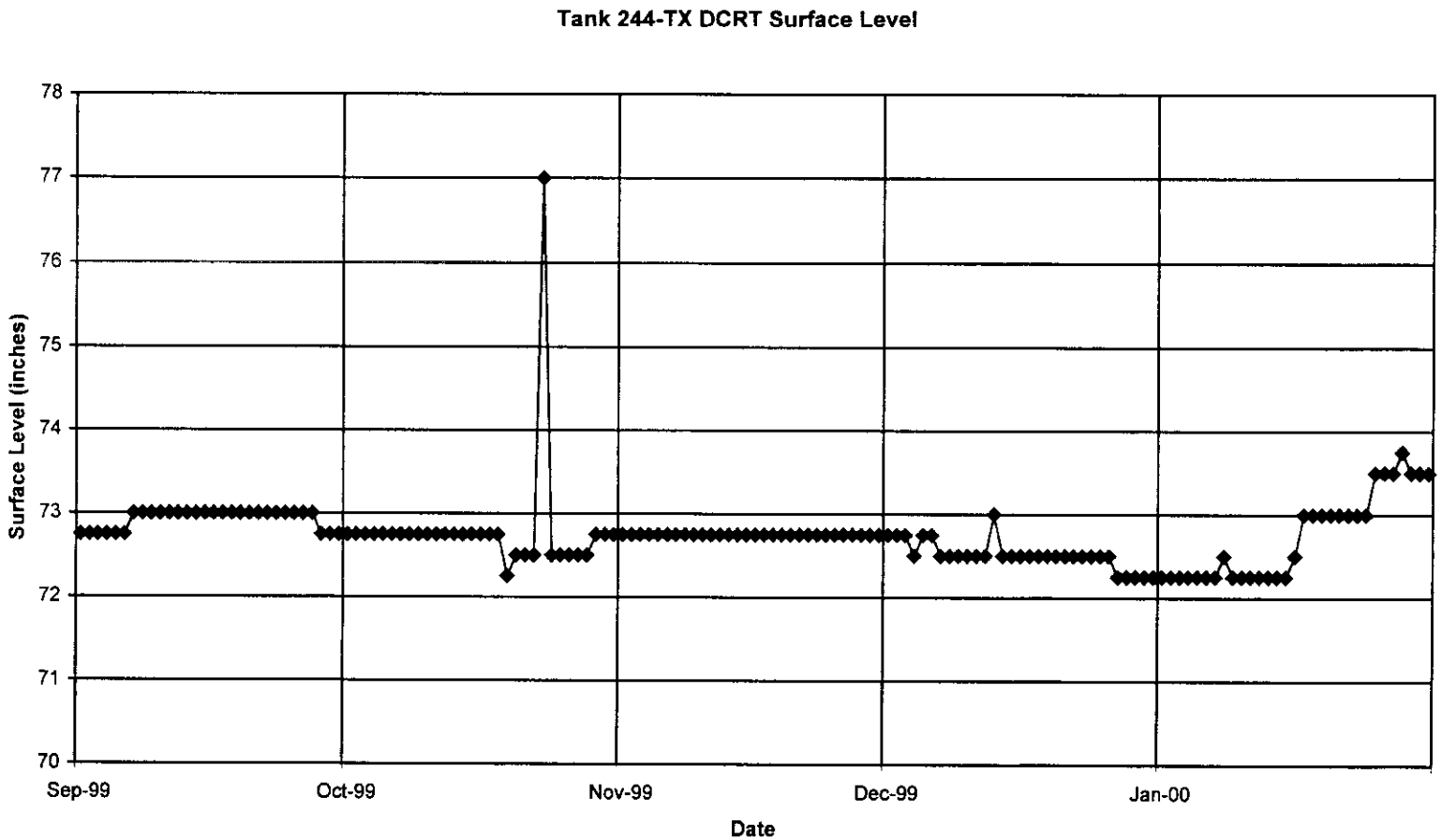

Figure L39 Surface Level versus Time, September 1999 to February 2000, 244-TX DCRT

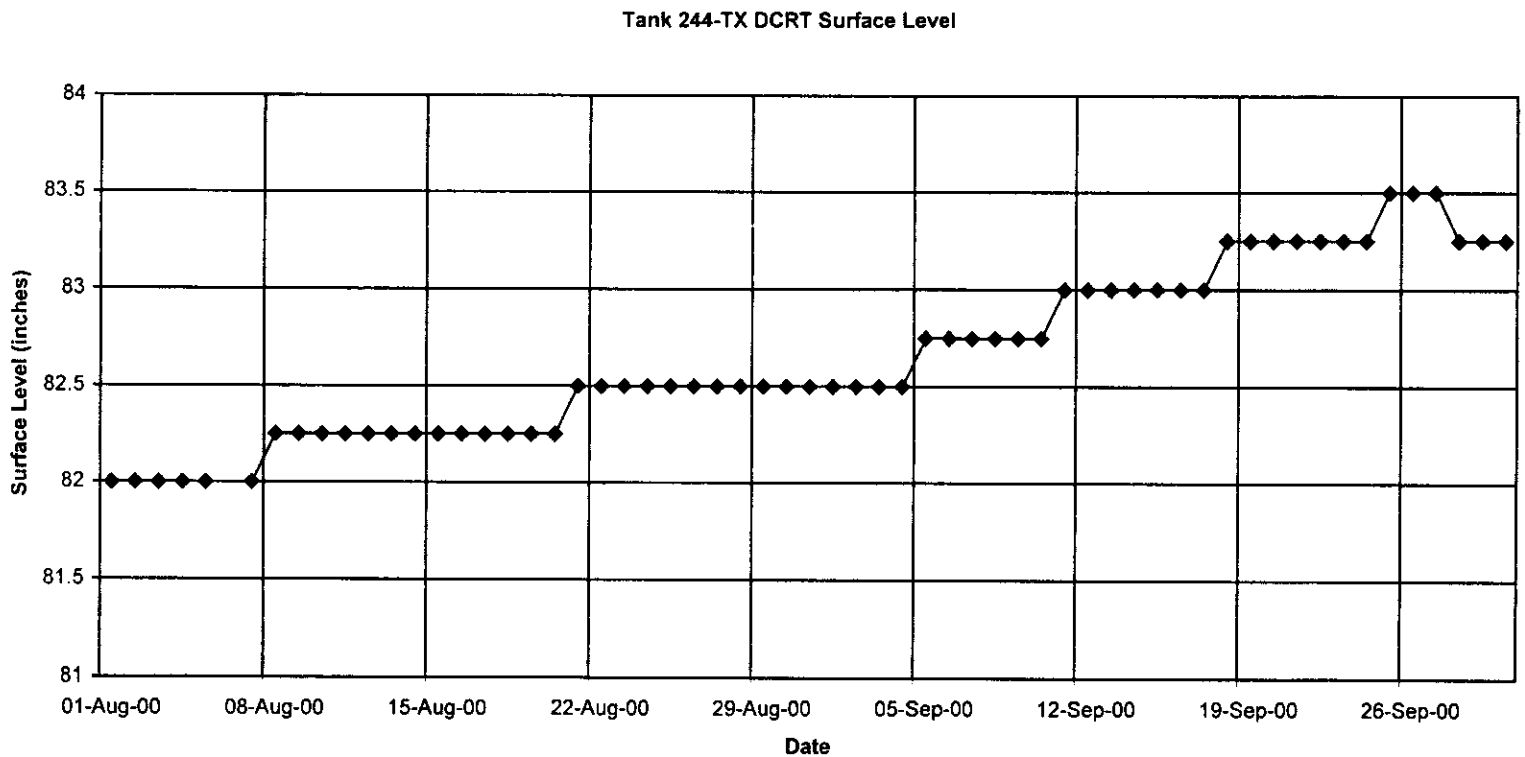

Figure L40 Surface Level versus Time , August 1 to September 26, 2000, 244-TX DCRT

APPENDIX M

244-S DOUBLE-CONTAINED RECEIVER TANK

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LIST OF TERMS

ASNT	American Society for Nondestructive Testing
ASTM	American Society for Testing and Materials
CS	carbon steel
DCRT	double-contained receiver tank
NIST	National Institute of Standards and Technology
PNNL	Pacific Northwest National Laboratories
REDOX	Reduction oxidation (S-Plant)
SS	stainless steel
TOAP	transducer on a pole
UT	ultrasonic
VITIS II	Video In-Tank Inspection System
WAC	Washington Administrative Code

1.0 INTRODUCTION

The 244-S double-contained receiver tank (DCRT) facility is located in the 200 West Area of the Hanford Site (See Figure M1). This DCRT was designed to provide short-term storage for supernatant and interstitial liquid waste pumped from tank farm salt wells (S and SX Farms) and for liquid waste from other storage sites and designated facilities (T Plant, U Plant, Redox Plant, 222-S Laboratory). In addition, it functions as a valve pit to route waste to other storage (SY Farm) tanks or processing facilities in the 200 East Area. Waste is transferred through the pump pit of this facility, via appropriate jumpers.

2.0 PURPOSE AND SCOPE

The purpose of this report is to document the remaining thickness of the carbon-steel tank after about 20 years of service. In accordance with Washington Administrative Code (WAC) 173-303-640(2) (WAC 1998), a detailed integrity assessment of the 244-S facility was performed in 1998 (Hundal and Schwenk 1998). Subsequent to performing the integrity assessment, the requirements for an ultrasonic (UT) wall thickness evaluation of 244-S were added per Administrative Orders 00NWPKW-1250 and 00WPKW-1251 (Silver 2000 a and Silver 2000 b). In this appendix, wall thickness evaluation is limited to 244-S. Additional wall thickness evaluations were required (per Silver) for catch tank 241-AZ-151, the 204-AR Unloading Facility, and the 241-A-350 lift station. The UT wall thickness measurements for the latter noted tanks are presented in Appendices G, I, and J, respectively, in this document. The UT wall thickness data and other information contained in this appendix, supplements the information contained in the aforementioned 1998 report.

3.0 DESCRIPTION OF TANK

The receiver tank is 15-ft in diameter, 18-ft 3-in. high (with a domed top) and is made of 1/4-in. (nominal) carbon-steel plate. The domed top and flat bottom are made of 3/4-in.-thick plate. In addition, the bottom plate was metallurgically formed in the shape of a flat, shallow cup (see Welk Bros. Drawing D57588). As a result, the 3/4-in.-thickness extended upward about 6 to 8 inches where it was subsequently joined (welded) to the 1/4-in-thick-cylindrical shell during fabrication. Dimensions of the surrounding vault are 20-ft in diameter by 21-ft deep, and it is lined with welded 1/4-in-thick carbon steel. Entrance to the tank vault is through an approximate 2-ft x 2-ft-seal plug opening in the floor of the pump pit, which is located directly above the vault. Entrance to the pump pit is provided by removal of as many as five cover blocks.

Further structural and material details, on the entire facility, are presented in the 1998 report (Hundal and Schwenk 1998).

4.0 ULTRASONIC INSPECTION OF TANK WALL

Ultrasonic inspection of the 244-S DCRT was conducted on March 21, 2001.

4.1 UT EQUIPMENT AND APPROACH

Equipment used to conduct the UT examination consisted of a 1/2-in.-diameter spring-loaded UT transducer (5 MHz) mounted at the right angle end of an approximately 40-ft-long, jointed, 1-1/4-in.-diameter aluminum pole. Water couplant was provided to the transducer head by a small pump and flexible plastic waterline. The waterline was secured nearly the full-length of the pole. Fiducial marks, at 6-inch-incremental spacing, were placed on about 20 ft of the upper portion of the pole, to provide a vertical reference point for the location of the UT thickness measurements on the tank sidewall. The top of a hand-railing, located 34 and 3/4 inches above the top of the cover blocks, was used as the point of reference for the pole fiducial marks.

A Model QFT-2, DuPont Quantum™ Nondestructive Examination System was used to condition and readout tank wall thickness values. Attachment 1, "Threefold Calibration of Ultrasonic Testing System for 244-S DCRT Examination," describes how the UT system was calibrated and evaluated for remote thickness measurements. A measurement sensitivity of ± 5% of the nominal ¼-in.-plate thickness (or ± 0.013 in.), was prescribed. Attachment 1 also shows the successful results of the threefold calibration and system evaluation.

The plan to measure tank wall thickness was to lower the pole-transducer system (with a crane) into the ground-level pump pit, and then on through a 2-ft by 2-ft seal-plug opening, leading into the tank pit. Decremental steps, about 4 to 6 in., were planned, starting at the top of the tank's cylindrical shell down to as close as possible to the tank bottom. Viewing of the UT thickness measurements was not possible because of a malfunction of the Video In-Tank Inspection System (VITIS II) camera. As a result, lighting had to be improvised by providing a mirror, using the sun as the primary reflected light source.

At the top of the cylindrical shell, about 32.8 ft down from the top of the railing, UT thickness measurements commenced. The transducer-containing plastic block was pressed against the sidewall by the UT technician applying the necessary force to the upper end of the pole. Water flow was maintained relatively constant to the transducer by pumping water through plastic tubing fastened to the outside wall of the 1-1/4-in.-diameter aluminum pole and through two small holes in the block adjacent to the transducer. The first reading was made toward the left side of the seal plug entrance hole followed by a second, parallel reading, after moving the pole toward the right side of the same seal plug entrance hole. This back-and-forth (left-right, down, then right-left, etc.) measurement approach was maintained until the floor of the pit was contacted.

TM = trademark of the DuPont Corporation.

4.2 RESULTS AND CONCLUSIONS

The successful results of the UT thickness measurements are shown in the UT thickness versus distance (depth) table of Attachment 2. Vertical location of the side-by-side measurements ranged from near the top of the tank, at 32.8 ft down from the railing, to 48 ft, where the transducer block was simultaneously contacting the floor as well as the side of the tank. The UT thickness results were evaluated by the COGEMA Engineering Corporation UT Level III inspector (Attachment 2) and by Pacific Northwest National Laboratory (PNNL) Level III inspectors (Attachment 3). Both evaluations found the process for collection of thickness measurements to be appropriate and the measurements to be valid.

A total of 76 thickness measurements (averaging about one every 5-in.-vertical) were made on both the left and right sides (38 each) of the 1/4-in.-thick (nominal) cylindrical shell. The horizontal separation distance of the two columns of thickness measurements (noted as 'Left' and 'Right' in the Attachment 2 Table) was probably about 24 in. (or more), as horizontal movement of the aluminum pole was restricted by the 24-in.-width of the seal plug opening. The bottom two thickness measurements (not included in Table M1 below) occurred in the vertical 'cup' side of the 3/4-in.-thick bottom plate. The maximum, average, and minimum thickness values for the 'Left' and 'Right' vertical traverses are shown in Table M1.

Table M1 Maximum, Average, and Minimum UT Measured Thickness Values in 1/4-in. (nominal) Thickness 244-S Shell Courses.

Vertical Traverse Location	Thickness (in)		
	Max.	Avg.	Min.
Left Side (38 data points)	0.278	0.261	0.247
Right Side (38 data points)	0.265	0.251	0.238

About half way down the tank, in that given shell course, it is believed that a vertical weld exists between the left and right side measurements columns (in Attachment 2). As a result, the thickness measurements below that point were, almost always, slightly higher on the left side than on the right. Further, it is believed, that this vertical weldment joined two plates of slightly different thickness. The difference in thickness, however, is almost always within normal thickness allowances (-0.010 in. to + 0.030 in.) for 1/4-in.-thick carbon-steel plate as shown in Table A1 in American Society for Testing and Materials (ASTM) A 20 (ASTM 1993). The single measurement that is below 0.240 in. (i.e., 0.238 in.) probably results more from normal point-to-point variations in UT thickness measurement accuracy than the tank actually being below the thickness specification.

The bottom left and right measurement (Attachment 2) confirmed that the 3/4-in.-nominal-thickness bottom plate (with cupped side) had been reached. Its average thickness was 0.764 in., also within specification per ASTM A20 Table A1 (ASTM 1993), as cited above. Attachment 3

provides results of an independent third party review by PNNL of the equipment, procedure, personnel qualifications, and results of the ultrasonic examination of tank 244-S.

All the above UT thickness measurement results indicate that the tank has not undergone any measurable general corrosion.

5.0 REFERENCES

ASTM 1993, *Standard Specification for General Requirements for Steel Plates for Pressure Vessels,* ASTM A20, American Society for Testing and Materials, Philadelphia Pennsylvania.

Hundal T. S. and E. B. Schwenk, 1998, *244-S Double-Contained Receiver Tank Facility Integrity Assessment Report,* HNF-3608, Rev. 0, COGEMA Engineering Corporation, Richland, Washington.

Silver D., 2000a, *Failure to Comply with Major Milestone M-32 of the Tri-Party Agreement; Administrative Order No. U.S. Department of Energy 00NWPKW-1250,* State of Washington Department of Ecology, Olympia, Washington.

Silver, D., 2000b, *Failure to Comply with Major Milestone M-32 of the Tri-Party Agreement; Administrative Order No. CH2M HILL Hanford Group 00NWPKW-1251,* State of Washington Department of Ecology, Olympia, Washington.

WAC 1998, Dangerous Waste Regulations, *Washington Administrative Code*, Chapter 173-303, Washington State Department of Ecology, Olympia, Washington.

Rev. 0

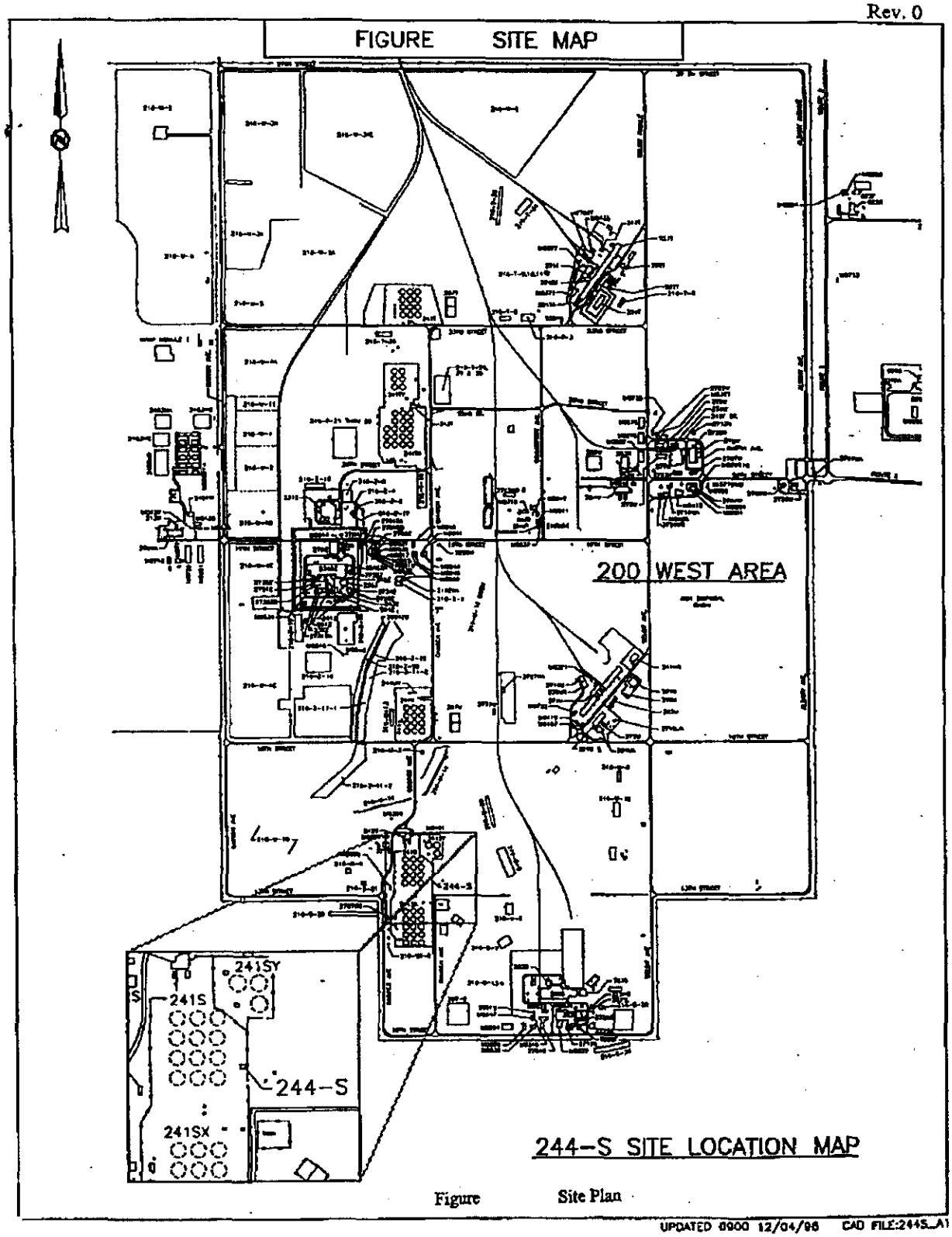

Figure M1 Location of 244-S Site

ATTACHMENT 1

THREEFOLD CALIBRATION OF ULTRASONIC TESTING SYSTEM FOR 244-S DCRT EXAMINATION

THREEFOLD CALIBRATION OF ULTRASONIC TESTING SYSTEM FOR 244-S DCRT EXAMINATION

During the afternoon of February 24, 2001, the subject ultrasonic (UT) testing system was successfully evaluated and calibrated using three, known-thickness mechanical standards. Two of the three calibrations were "bench calibrations." The third calibration involved the use of an approximately 40-ft-long pole to apply the same UT transducer to one of the same standards used in the bench calibration. The intent of the latter was to evaluate the UT transducer-on-a-pole (TOAP) technique under conditions that simulate application of the TOAP technique to remote wall thickness measurement of the 244-S double-contained receiver tank (DCRT). The 244-S tank is made of A 516 Gr 55 carbon steel and it is nominally 1/4 in. thick.

The objective of the forthcoming UT field inspection of the 244-S DCRT is to measure its wall thickness, where feasible, and at no greater than 6-in. vertical intervals, from top to bottom. If feasible, another set of measurements will be made as far as possible in the circumferential direction from the first set. UT measurement precision is prescribed to be $\pm$ 5% of 0.250 in. or $\pm$0.013 in.

The electronic equipment used in this UT system included:

- A Nortec 1/2-in. dia., 5 MHz UT transducer
- A DuPont Quantum Nondestructive Testing System, model QFT-2 with built-in oscilloscope
- A 75-ft-long UT transducer signal cable.

1) UT STEP-BLOCK BENCH CALIBRATION

A. Smith, in conjunction with T. Delucchi and witnessed by F. L. Bolson and E. B. Schwenk (all four COGEMA Engineering employees), made consecutive thickness measurements, usually three times each, on the 0.150 in., 0.250 in., and 0.500 in. steps of a National Institute of Standards and Technology (NIST) traceable stepblock, S/N 584-99-30-135. Table 1 presents the results.

Table 1. Comparison of UT Thickness Measurements with Step-Block Thicknesses

UT Measure-ment No.	Step Thickness – in.		
	0.150	**0.250**	**0.500**
1	0.154	0.250	0.500
2	0.153	0.256	0.502
3	0.153	0.254	0.503
Average	*0.153*	*0.253*	*0.502*
Maximum Variation	*0.004*	*0.006*	*0.003*

2) UNNOTCHED AND NOTCHED PLATE BENCH CALIBRATION

An unnotched carbon-steel (CS) plate and a notched stainless steel (SS) plate were used for bench calibrations. The stainless steel notched plate was used because no equivalent carbon-steel notched plate was available. This required a compensation factor to be applied to the actual measurement based on a different longitudinal wave velocity between CS and SS, and is described below.

A 1/4-in (nominal) unnotched, plain-carbon-steel plate was used for the bench calibration of the same UT transducer system discussed above. The plate was thickness measured with a one-inch micrometer followed by UT measurement of the same region of the plate. The various measured values are shown in Table 2.

TABLE 2 COMPARISON OF UT MEASURED THICKNESS WITH MICROMETER-MEASURED THICKNESS, UNNOTCHED CARBON STEEL PLATE

Measurement No.	Micrometer Measurement (in.)	UT Measurement (in.)
1	0.242	0.246
2	0.242	0.245
3	0.241	0.244
4	0.240	--
Average	*0.241*	*0.245*
Maximum Variation	*0.002*	*0.005*[a]

(a) Compared to the average micrometer-measured value.

The maximum variation of the UT measurement values (0.005-in.) was well within the required ±0.013-in. measurement precision.

The notched plate consists of a single, curved (rolled) ¼-in. (nominal) thickness SS plate (about 1-ft square) with three, rounded-end machined steps (each about 1/2-in. wide and about 2-in. long). The remaining areas of the plate, above, below, and to the sides of the three-notched region, were left as is (unmachined). Average thickness of the plate, in the unmachined region, was 0.249 in.

This particular plate had been machined for UT system calibration before measuring wall thickness in the 204-AR catch tank (1/4-in. nominal thickness). The average thicknesses of the remaining material in the machined steps, were 0.201 in., 0.176 in., and 0.150 in., respectively. This plate was used because no similarly notched mild-steel plate was available.

Longitudinal wave sound velocity in SS is slower than it is in CS. As a result, UT measurements made on a SS plate, with the intent of simulating a CS plate, must be corrected for the velocity difference. According to A Smith, the respective in-metal velocities are 5.66 and 5.85 x 10^5 cm/sec. Further, the correction factor that must be applied to the SS UT measured thickness to provide an equivalent CS UT measured thickness is,

CS thickness = 5.66/5.85 (SS thickness) = 0.968 x SS thickness (a)

Both thickness values are presented in Table 3. The bold-faced thickness values were as-measured SS values. Equation (a) was used to convert them to CS thickness values.

TABLE 3 UT MEASUREMENTS OF REMAINING THICKNESS AT NOTCHES IN CURVED PLATE STAINLESS STEEL SPECIMEN

UT Measurement No.	SS Plate Thickness (0.249-in. Avg.)	Remaining Thickness of Notched SS Plate with Three Steps		
		0.201	0.176	0.150
1	**0.258** (0.250)	**0.214** (0.207)	**0.186** (0.180)	**0.162** (0.157)
2	**0.258** (0.250)	**0.213** (0.207)	**0.187** (0.181)	**0.166** (0.161)
3	**0.262** (0.253)	**0.214** (0.207)	**0.187** (0.181)	**0.164** (0.159)
Average	*0.251*	*0.207*	*0.181*	*0.159*
Maximum Variation	*0.002*	*0.006*	*0.005*	*0.011*

The *italicized* average and maximum variation values for plate thickness and remaining plate thicknesses (last two rows of table), are CS values converted from SS values. In addition, the maximum variation value (bottom row of table) is the difference between the maximum UT measured value and the mechanically measured thickness of the respective step.

The UT measured precision values are within the prescribed ±0.013-in. value. The precision, however, would be expected to worsen if the actual thickness values (in the 244-S DCRT) should become less than 0.150 in. This decreasing precision is a natural consequence of the sonic wavelength becoming a larger and larger fraction of the remaining thickness.

The same staff members identified above, conducted and witnessed the calibration-checks for the two plates.

3) SIMULATED FIELD CALIBRATION OF THE TRANSDUCER-ON-A-POLE, WITH NOTCHED PLATE STANDARD

Calibration of the same UT transducer system, but attached to a 40-ft-long pole, was conducted using the 1/4 in.-nominal-thickness unnotched CS plate used in Table 2, above. The work was conducted and witnessed by the same staff members identified in Sections 1 and 2, with T. Delucchi (COGEMA Engineering) manually operating the TOAP system. Mr. Delucchi also designed and fabricated the very satisfactory jointed, mechanical pole system.

To press the UT transducer against a structure, an operator at the top end of the pole manually pulls a rope. The rope, which is axially attached to the pole through eyebolts, transmits the manual rope force to a hinged-wheel lever arm at the UT transducer end of the approximately

40-ft jointed pole. The lever arm-wheel combination simultaneously rotates and presses out against the simulated 244-S annulus wall thereby reacting the gimbaled UT transducer (and couplant water) against the notched plate standard (or 244-S tank wall).

The simulated field calibration was carried out in the 306 E Building, from the overhead penthouse area, which is as much as 40-ft above the building's floor. The penthouse is an approximate 15-ft square by 10- to 15-ft-high structure located on the top of the 306 E Building and contains a 3-ton capacity crane. The latter was used to support the upper end of the - approximately 40-ft long aluminum pole, thereby allowing Mr. Delucchi (while in the penthouse) freedom to manually apply the UT transducer against the unnotched CS plate standard (see also Table 2) through the hinged-wheel lever rope, at near-floor level. This mock-up arrangement in the 306E Building simulated the 244-S Tank and Pit configuration as shown on engineering drawings. A small flow of water was used as the couplant between the transducer and the plate.

Results of the remote calibration are shown in Table 4.

TABLE 4 UT THICKNESS MEASUREMENT OF UNNOTCHED CS PLATE WITH THE TOAP SYSTEM

UT Measurement No.	Average Micrometer Measurement of Thickness (in.)	Location of UT Measurements	
		Near Plate Center	Moved About 1-in. to Right
1	0.241	0.247	0.249
2		0.245	0.249
3		0.246	0.246
Average		*0.246*	*0.248*
Maximum Variation		*0.005*	*0.007*

The average maximum variation in UT measurement, compared to the average mechanically measured plate thickness, was approximately 0.006 in., which is well within the ±0.013 in. prescribed precision.

4) COMPARISON OF UT MEASUREMENT VARIABILITY LEVELS FOR THREEFOLD CALIBRATION

For the three calibrations presented above, the measurement variability is very satisfactory.

- For the stair-step block bench calibration, the UT measured thicknesses are within a maximum difference of 0.004 in., 0.006 in., and 0.003 in. of the 0.150-in., 0.250-in., and 0.500-in. steps, respectively. This amounts to a corresponding satisfactory maximum variability of about 2.7, 2.4, and 0.7 percent, respectively.

- For the bench check of the full-thickness unnotched plate (1/4-in. nominal) the variability is nominally improved over the step-block. Plate full-thickness values were measured within a maximum variability of 0.005 in. This equates to a maximum 2-percent value.

- For the bench check of the SS notched plate steps (0.201-in., 0.176-in., and 0.150-in.-thick), they were UT measured similarly to maximum variability levels (converted to CS-values) of 0.006 in., 0.005 in., and 0.011 in., respectively. These equate to 3.0-percent, 2.8-percent and 7.3-percent values respectively. The $\pm$ 5% (or $\pm$0.013 in.) prescribed system sensitivity applies to the full-thickness (0.250 in.) of the plate as opposed to a specific reduced thickness at a given notch.

- For the 40+ ft -long TOAP check of the unnotched CS plate, the average maximum variability value was 0.006 in. This corresponds to a 2.4-percent value.

5) SUMMARY

In general the results of the two UT bench calibrations and the over 40-ft-long simulated field TOAP calibration were very satisfactory. All three calibration checks show that a $\pm$ 5-percent precision (or $\pm$ 0.013 in.) for a 1/4-in.-nominal-thickness double-contained receiver tank is feasible.

ATTACHMENT 2

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

COGEMA ENGINEERING CORP.

NDE ULTRASONIC THICKNESS MEASUREMENT PROCEDURE AND TEST REPORT

NONDESTRUCTIVE EXAMINATION
306E BLDG., 300 AREA - TEL. 376-5402

Job No. 01-37

Requester (Client)	Company	MSIN	Bldg.	Area
DAVID L. BECKER	CHG	R1-04	2750	200E

Project/System/Work Package/Traveler No.
INTEGRITY ASSESSMENT OF 244-S CATCH TANK
2W-00-01467
114658/EJ00

Acceptance Std.: BY CLIENT
Section:
Para.:
Date: ☐ NA

PART INFORMATION
Material: carbon STEEL
Wall Thickness: 0.250 NOM. ☐ NA
Diameter: 15 FT. ☐ NA
Schedule: ☒ NA
Size: 18.25 FT TALL ☐ NA
Dwg. No.: ☒ NA
NCR: ☒ NA

PROCEDURE NO.
SVUT-PRC-007 Rev. 1
Appendix B Revision No. 1

Special Technique No. ☐ NA
REMOTE TRANSDUCER

COVERAGE
☐ 100% of Area Requested
☒ Other PER CLIENT DIRECTION

INSTRUMENTATION
Mfg DUPONT Model QET-2
S/N or Standards Lab No
584-31-50-028

CALIBRATION STANDARD(S)
Identification No. 584-99-30-91
Identification No. N/A

TRANSDUCER
Diameter 0.50"
Frequency 5.0 mHz
Mfg. NORTEC
Serial No. 932905
Stand Off NA

Couplant WATER
Batch No. N/A

RESULTS

PRE-EXAMINATION ULTRASONIC READINGS FROM THE CALIBRATON STEP WEDGE: 0.500 (0.500), 0.249 (0.250), 0.101 (0.100) AND 0.069 (0.070)

NOTES: THE PHYSICAL MEASUREMENTS ARE SHOWN IN PARENTHESES.
ALL READINGS ARE IN INCHES.

THE FOLLOWING DATA WAS OBTAINED USING AN ULTRASONIC TRANSDUCER DEPLOYED ON AN ALUMINUM POLE TO REACH DOWN TO THE EXAMINATION AREA.

THE "RIGHT" AND "LEFT" DATA COLUMNS SHOWN ON PAGE 2 OF 2 INDICATE ON WHICH SIDE OF THE SEAL PLUG HOLE THE TRANSDUCER POLE WAS LOCATED WHEN THE READING WAS TAKEN. THE APPROXIMATE DISTANCE FROM THE TOP HAND RAIL AT THE PIT DOWN TO THE TRANSDUCER LOCATION IS SHOWN IN THE "DISTANCE" COLUMN. THE TOP OF THE HAND RAIL IS 34.75 INCHES ABOVE THE COVER BLOCK TOP.

POST-EXAMINATION ULTRASONIC READINGS FROM THE CALIBRATON STEP WEDGE: 0.500 (0.500), 0.249 (0.250), 0.101 (0.100)AND 0.070 (0.070)

Technician	UT Level	Interpreted by	UT Level	Reviewed by
J.N. FURTH	II	J.N. FURTH	II	
A.A.ANDERSON (LIM)	II	A.L. SMITH	II	
Date of examination: 3/21/01		Date of examination: 3/21/01		Date: 3/27/01

A-8000-507 (02/99)

ULTRASONIC DATA ON TANK 244-S

DISTANC (FT)	LEFT	RIGHT
32.8	0.26	0.238
33.33	0.254	0.244
33.75	0.247	0.248
34	0.247	0.249
34.5	0.249	0.25
34.75	0.25	0.249
35.25	0.254	0.25
35.75	0.25	0.254
36.1	0.247	0.246
36.25	0.25	0.251
36.75	0.25	0.247
37.15	0.255	0.249
37.75	0.252	0.251
38.1	0.251	0.25
38.62	0.256	0.252
39	0.248	0.251
39.5	0.25	0.251
39.87	0.258	0.249
40.38	0.26	0.27
40.75	0.27	0.257
41.12	0.269	0.249
41.5	0.27	0.257
41.8	0.27	0.25
42.38	0.276	0.256
42.75	0.273	0.245
43.1	0.276	0.248
43.5	0.275	0.251
44	0.267	0.253
44.5	0.27	0.251
44.75	0.272	0.247
45.38	0.268	0.251
45.6	0.267	0.255
46	0.27	0.251
46.38	0.266	0.255
46.88	0.274	0.249
47.15	0.278	0.25
47.25	0.27	0.263
47.75	0.248	0.257
48 HEAD	0.761	0.767

COGEMA ENGINEERING CORP.

NDE REQUEST/INSTRUCTION FOR NONDESTRUCTIVE TEST SERVICES
Nondestructive Examination
306E Building, 300 Area, Phone No. 376-5402

Requester	MSIN	Bldg.	Area	Phone No.	Company
Robert W. Lysher	S7-12	2704-HV	200E	376-0979	CDC

Project/System Identification
Tank Integrity Assessment (TIA) Project

Work Package/Traveler No.
2W-00-01467

Drawing No.
H-2-71043 Structural
H-2-71049 Tank

CACN/COA
REQUISITION #5788 CACN 114919 / ETD

Acceptance

	Code/Specification	Section	Paragraph	Date
○ NDE	COGEMA-SVUT-007 Thickness Measurements			
◉ Client				

Special Instructions (handling requirements, allowed markings, etc.)
Perform Ultrasonic Testing (UT) of the 244-S DCRT. Starting from either the bottom or top of the tank, take readings at 4 in. intervals or less(spot check) for the full vertical length of the tank. Take readings at two circumferential locations as far apart as possible (movement limited to boundary of entry port). Develop tooling and perform acceptance testing (mock-up) prior to actual field work. Once in-field, perform pre/post cals per procedures.

Safety/Radiological Conditions
Work will be in a radiological zone, see work package and RWP for specific details.

NDE METHOD
- ☐ Penetrant (PT)
- ☐ Magnetic Particle (MT)
- ☐ Leak Testing (LT)
- ☒ Ultrasonic (UT)
- ☐ Radiography (RT)
- ☐ Eddy Current (ET)

Part Location
244-S Double-Contained Receiver Tank (DCRT).

Contact (PIC)
Dan Wiebuhr

Phone No.
373-4639

Bldg./Room
272-AW/8

Part Information
244-S DCRT is made of 1/4 inch thick Type ASTM A-516 Gr. 55 Carbon Steel and is located in a 22 ft. diameter steel caisson approximately 45 ft. from top of grade to bottom of caisson. From grade to pump pit floor is 23 ft. The tank is approximately 15 ft. diameter by 18 ft.-3 in. tall.

RESERVED FOR NDE USE ONLY

Request Accepted By:	NDE Job No.
Blaine Hopkins	01-37

A-6001-036 (02/99)

ATTACHMENT 3

RESULTS FROM THE ULTRASONIC INSPECTION OF 244-S DOUBLE-CONTAINED RECEIVER TANK (DCRT)

RESULTS FROM THE ULTRASONIC INSPECTION OF 244-S DOUBLE-CONTAINED RECEIVER TANK (DCRT)

G. J. Posakony and A. F. Pardini
Pacific Northwest National Laboratory

Introduction

This letter report describes the results of the ultrasonic wall-thickness measurements made on the 244-S Double-Contained Receiver Tank (DCRT). The objective of these measurements was to determine if wall thinning might be present in the sidewall of the tank. Because the tank is radioactive and is buried in the ground, all measurements were made using procedures and techniques that incorporated an ultrasonic transducer mounted on a long pole. Access to the tank was limited to a man-way above the tank.

A procedure was developed that established that:

(a) the transducer could be properly oriented normal to the tank surface,
(b) ultrasonic couplant could be properly applied, and
(c) an effective system calibration could be established.

Procedure Acceptance Tests

To establish the performance capability of the ultrasonic system (electronic, long-pole transducer assembly, and measurement technique planned for wall-thickness measurement), a special high-bay mockup was fabricated. "Bench calibration experiments" were performed that simulated remote wall-thickness measurements of the DCRT. These experiments validated performance of the system. The measurement precision of the system was judged to be ±5% of 0.250 in. or ±0.013 in. (See March 25, Memo from E. B. Schwenk to D. L. Becker.)

To make the wall-thickness measurements, a spring-loaded, 5 MHz, 0.5-in. diameter, ultrasonic transducer was mounted on the end of a long 40- to 50-ft. pole. Pressurized water applied to the transducer was used as the ultrasonic couplant. The pole was inserted through a man-way located above the tank pit. Fiducial marks were placed on the pole to provide vertical reference positions for establishing the transducer location on the side of the tank. Spot measurements were taken at intervals, not exceeding 6 in., down the vertical wall of the tank.

A DuPont Quantum ultrasonic thickness instrument Model-QFT-2 was used to make the measurements. As a standard practice, a detailed instrument calibration was performed both before and after each tank inspection series to assure the system was in calibration.

Thickness Readings for 244-S DCRT

244-S DCRT is made of 0.250-in.-thick Type ASTM A-516 Grade 55 carbon steel. It is located in a 22-ft diameter steel caisson that is approximately 45 ft. from the top of grade to the bottom of the caisson.

Figure 1 is a sketch of the approach used to make wall-thickness measurements on the wall of the tank. Measurements were made at spot intervals for the full vertical height of the tank. Access to the tank was made remotely with the long pole through a man-way that was located above the tank. With the limited access, only two vertical strips (left and right sides of the man-way) on the tank could be made.

Table 1 is a record of the wall-thickness measurements that were taken in the tank.

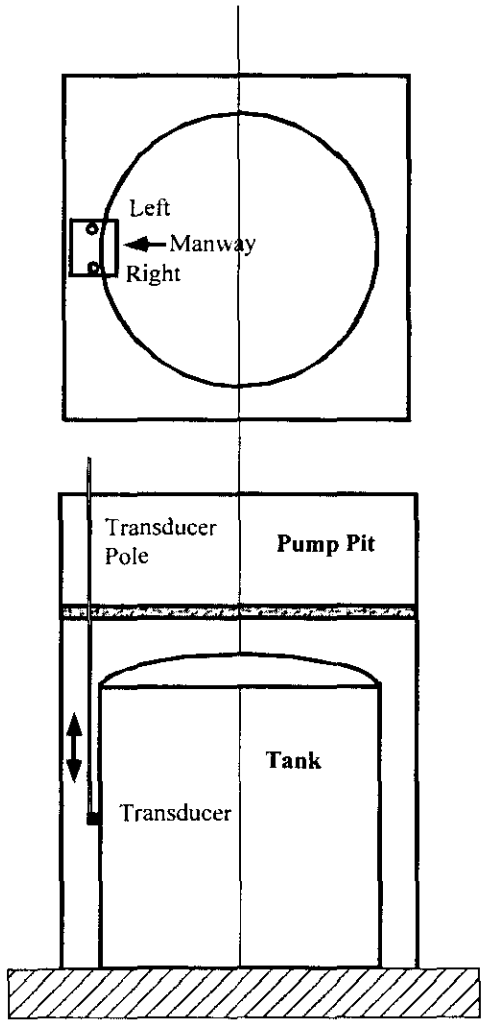

Figure 1. Sketch of the Tank and the Technique for Making Wall-Thickness Measurements

Table 1. Wall-Thickness Measurements from the Vertical Scans

Distance, (ft)	Left Reading, (in.)	Right Reading, (in.)
32.8	0.26	0.238
33.33	0.254	0.244
33.75	0.247	0.248
34	0.247	0.249
34.5	0.249	0.25
34.75	0.25	0.249
35.25	0.254	0.25
35.75	0.25	0.254
36.1	0.247	0.246
36.25	0.25	0.251
36.75	0.25	0.247
37.15	0.255	0.249
37.75	0.252	0.251
38.1	0.251	0.25
38.62	0.256	0.252
39	0.248	0.251
39.5	0.25	0.251
39.87	0.258	0.249
40.38	0.26	0.27
40.75	0.27	0.257
41.12	0.269	0.249
41.5	0.27	0.257
41.9	0.27	0.25
42.38	0.276	0.256
42.75	0.273	0.245
43.1	0.276	0.248
43.5	0.275	0.251
44	0.267	0.253
44.5	0.27	0.251
44.75	0.272	0.247
45.38	0.268	0.251
45.6	0.267	0.255
46	0.27	0.251
46.38	0.266	0.265
46.88	0.274	0.249
47.15	0.278	0.25
47.25	0.27	0.263
47.75	0.248	0.257
48 HEAD*	0.761	0.767

*Measurements of the bottom knuckle plate.

The readings in Table 1 are the digital recordings from the thickness display on the ultrasonic measurement instrument and are calculated mathematically to the third decimal place.

Summary

- **244-S DCRT**—The ultrasonic wall-thickness measurements in Table 1 range from a minimum of 0.238 in. to a maximum of 0.273 in. The precision of these measurements is judged to be ±5%. Because of the access limitations (through the man-way), only the two vertical strip measurements on either side of the man-way could be made. Considering the technique involved and the difficulty of obtaining reproducible measurements with a transducer at the end of a long pole, the data appear to be consistent and reproducible.

  There are several issues to be considered in evaluating the effectiveness of the remote inspection approach used for the wall-thickness measurements. Namely, personnel qualifications, procedure followed in making the wall-thickness measurements and the performance capability of the equipment involved in making the measurements.

- **Personnel Qualifications**—COGEMA personnel involved in making the wall-thickness measurements were qualified in accordance with the American Society for Nondestructive Testing (ASNT) SNT-TC-1A. Personnel certifications were current in their qualification history.

- **Ultrasonic Test Procedure**—The restrictions imposed by the limited access required the development, validation, and deployment of a special procedure. Placing the transducer on a long pole and using a spring-loaded fixture to force the transducer to position itself normal on the tank surface provided a unique solution to a very difficult inspection problem. The key feature in the deployment of the system was the development of a mockup that simulated the wall-thickness measurements requirements of the actual tank. This permitted validation of the procedure and technique through demonstrating system performance on a series of known thickness calibration blocks. These blocks were then used to calibrate the system before and after each ultrasonic tank examination series to assure the system remained in calibration.

- **Ultrasonic System**—A DuPont Quantum ultrasonic instrument was used for the wall-thickness measurements. This is a general-purpose instrument that is typically used for measurements of this type. With proper calibration, it has the capability of meeting all the requirements for the wall-thickness measurements. The spring-loaded transducer and the scheme for providing ultrasonic couplant (water) was very effective as demonstrated in both the initial and field calibrations and in the measurements made on the tank

- **Review**—From our review of the data supplied, the personnel involved in performing the ultrasonic wall-thickness measurements, the ultrasonic equipment associated with the examination and the procedure followed, and the criteria for the examination were equal to or exceeded expectations.