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Engineering Task Plan for the Ultrasonic Inspection of Hanford Double-Shell Tanks – FY2000

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Abstract This document facilitates the ultrasonic examination of Hanford double-shell tanks Included are a plan for engineering activities (individual responsibilities), plan for performance demonstration testing, and a plan for field activities (tank inspection) Also included are a Statement of Work for contractor performance of the work and a protocol to be followed should tank flaws that exceed the acceptance criteria be discovered

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Engineering Task Plan for the Ultrasonic Inspection of Hanford Double-Shell Tanks – FY2000

Prepared by

Chris E Jensen

for the

CH2M HILL HANFORD GROUP, INC
Richland Washington

Engmeerng Task Plan for the Ultrasonic Inspection
of Hanford Double-Shell Tanks – FY2000

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Engineering Task Plan for the Ultrasonic Inspection of Hanford Double-Shell Tanks –FY2000

1 0 INTRODUCTION

In May 1996 the Tank Waste Remediation System (TWRS) Decision Board recommended, and Department of Energy, Richland Lab (RL) agreed, that the condition of the double-shell tanks (DSTs) should be determined by ultrasonic (UT) inspection of a limited area in six of the 28 DSTs The Washington State Department of Ecology (WDOE) has agreed with the strategy of limited ultrasonic inspection of six DSTs Data collected during the UT inspections will be used to assess the condition of the tank, judge the effects of past corrosion control practices, and satisfy a regulatory requirement to periodically assess the integrity of waste tanks

In November 1996, DST 241-AW-103 was inspected to determine if Hanford DST walls could be inspected without removing the existing surface rust and scale Equipment similar to that used to perform routine inspections of oil tanks and large pipelines was used UT sensors were mounted on a remote-controlled crawler that used magnetic wheels to affix itself and move about on the tank walls The crawler was deployed into the tank annulus and vertically traversed the primary and secondary containment walls to collect data on the wall thickness and the size of any pits or cracks The successful completion of this inspection met the requirements of RL milestone T21-97-455 and represented the first UT inspection of a Hanford DST (Leshikar 1997)

Examinations were performed over FY 1998 and FY 1999 of 241-AN-107, 241-AN-106, 241-AN-105, 241-AY-102, and 241-AZ-101 An attempt was made to examine 241-AY-101, but corrosion product on the tank wall prevented reliable examination Based on the results of the examinations, changes were made with respect to the examination of the DSTs

The scope of planned ultrasonic examination of DSTs in FY 2000 is as indicated in the following table

DST	primary tank, vertical strip	primary tank, horiz (20') and vert (20) welds	primary tank knuckle	primary tank bottom
241-AW-103			x	
241-AN-106			x	
241 AZ-101			x	x
241 AY-101	x	x	x	x
241 AY-102			x	
241 AP-107	x	x	x	

The rationale for selection of this work scope is provided in Appendix D, along with a prioritized list of the remaining DSTs yet to be examined in the event it is necessary to select substitute tanks, due to inaccessibility of one or more of the tanks listed in the table above

2 0 OBJECTIVE AND SCOPE

The objective of this Engineering Task Plan (ETP) is to ultrasonically examine selected areas of the tanks listed in the table on Section 1 0, using equipment provided by CH2M HILL HANFORD GROUP, INC (CHG) and operated by a subcontractor

This ETP is an overall plan for task completion that details the roles and responsibilities of individuals involved in the examination process Included herein is the plan for engineering activities, performance demonstration testing of the examination equipment, field activities (tank inspection), the equipment support approach to be used, and the protocol to be followed should tank flaws that exceed the acceptance criteria be discovered

This ETP facilitates the UT examinations of DSTs as described in WHC-SD-WM-AP-017, Rev 1, *Tank System Integrity Assessments Program Plan* (Pfluger 1994), which was submitted to WDOE meeting a Tri-Party Agreement milestone in June, 1994 This ETP was written in compliance with LMH-PRO-283, Rev 2, *Control of Inspections* (Byers 1998)

3 0 EQUIPMENT DESCRIPTION

Generally a UT examination will include a remote-controlled delivery vehicle (i e scanner or crawler) carrying ultrasonic sensors that move across the surface to be inspected A liquid media physically couples the sensors to the surface Data and images are returned to a manned control center that contains the scanner controls, video monitors, and data collection and evaluation hardware Remotely operated cameras observe the operation

Different types of vehicles for delivering the ultrasonic sensors to the tank areas of interest may be required, dependent on the scope of the particular DST examination Each shall be qualified by performance demonstration testing A device or devices for inserting and removing the equipment from the DST riser is also required

A wall-cleaning tool will provide the ability to clean excessive mill scale and corrosion product from the exterior surface of the vertical portion of the primary wall of DSTs in the vertical direction This tool will be capable of cleaning a vertical path at least 15 inches wide and the height of the wall courses

4 0 PLAN FOR ENGINEERING ACTIVITIES

The table below identifies the engineering tasks, by responsible individual, that need to be performed in order to complete the prescribed inspections

RESPONSIBLE INDIVIDUAL/ ORGANIZATION	ENGINEERING TASKS
Project Cognizant Engineer (CHG)	1 Overall activity leader 2 Select tank(s) for inspection 3 Determine scope of inspection (walls, knuckle, welds, and/or tank bottom) 4 Approve inspection detection (sizing) criteria 5 Select UT Inspection Contractor 6 Develop schedule for task completion 7 Approve UT inspection system(s) for use in tank(s) based on the recommendation of Equipment Technical Lead Engineer 8 Approve equipment deployment/retrieval procedures 9 Lead Inspection Review Panel, should flaws be discovered 10 Review/approve Tank Inspection Report 11 Ensure work is performed in accordance with this ETP 12 Approval Authority of examination data/Data Management Plan
Equipment Technical Lead (CHG)	1 Develop and implement equipment support approach 2 Approval Authority, under the Project Cognizant Engineer direction, for all equipment related decisions/issues 3 Review/approve all equipment documentation 4 Technical interface with the UT Inspection Contractor 5 Approve UT equipment navigational capabilities and deployment capability from tank riser per performance demonstration tests
Facility Cognizant Engineer and/or Design Authority (CHG)	1 Review/approve equipment deployment/retrieval procedures 2 Approve work packages
Facility Manager (CHG)	1 Approve scope/schedule/priority of activities 2 Provide personnel to support scope of work (Person-In-Charge (PIC), planners, surveillance crew, crane crew, operators, HPT's, etc)
Planner (FDNW)	1 Develop work package(s) 2 Facilitate resolution of Tank Farm interface requirements/issues (radiological, permits, safety, etc)
Field Engineer (COGEMA)	1 Process engineering documentation supporting field activities (ETP, test plans, USQs, status, etc) 2 Field interface between the inspection contractor and the tank farm facility 3 Coordinate inspection contractor utility needs (control center siting,

RESPONSIBLE INDIVIDUAL/ ORGANIZATION	ENGINEERING TASKS
	power, water, etc) with facility restrictions 4 Facilitate fabrication of special support equipment as required (temporary riser caps, weather protection, etc) 5 Track work package development 4 Provide support during tank inspection 5 Lead status meetings between engineering and facility personnel 7 Process Tank Inspection Report for approval by all required parties
UT Inspection Technical Expert (PNNL)	1 Define and verify examination personnel qualifications 2 Approve calibration procedures, examination procedures, and standards documentation 3 Witness UT system performance demonstration test 4 Evaluate UT system changes for re-test 5 Approve UT system per code and acceptance criteria 6 Qualify UT level II with performance demo results 7 Provide report documenting UT system qualification 8 Review tank inspection data 9 Provide input to and approve Tank Inspection Report
UT Inspection Personnel (COGEMA)	1 Coordinate and lead performance demonstration tests 2 Provide a facility/mock-up for performance demonstration testing 3 Test and operate equipment in tank mock-up 4 Set up and operate equipment in waste tank 5 Interpret and deliver inspection data 6 Maintain CHG-furnished equipment

5 0 PLAN FOR PERFORMANCE DEMONSTRATION TESTING

Equipment not previously qualified shall, prior to deployment of equipment and inspection of a DST, demonstrate the ability of the inspection system to detect and size flaws, and to remotely navigate areas to be examined via a mock-up(s) This shall be performed by UT Inspection Personnel

The performance demonstration test (PDT) is the method chosen to qualify the field and UT Inspection Personnel, procedures, and equipment that will be used to inspect the DST The requirements for the PDT follow practices outlined in Section XI, Appendix VIII of the ASME Code Requirements established in *Personnel Qualification and Certification in Nondestructive Testing*, ASNT-TC-1A, December 1992 Edition, will be followed to assess personnel qualifications ASME Section V outlines the general requirements for inspection procedures, however a specific procedure(s) shall be used to conduct inspection of the DSTs Should this procedure require revision, it shall be prepared by the UT Inspection Personnel that will address how the inspection of the DST is to be performed

If required by CHG, the qualification of the UT system to be used will be based on the successful examination of a series of test plates that will be supplied by CHG The test plates contain stress corrosion cracks simulated pitting, and wall thinning Detection (sizing) criteria are provided the UT Technical Expert and LHMC Project Engineer System acceptance criteria are based on the statistical procedure described in Section XI, Appendix VIII of the ASME Code Once qualified, the system is considered qualified for as long as the personnel, procedure(s), and equipment remain unchanged

If required by CHG the UT Inspection Personnel shall provide a partial mock up of a DST The UT Inspection Personnel shall demonstrate the insertion and retrieval of the inspection equipment into/from the mock-up riser In addition, the following items are to be evaluated subject to the scope of the DST examination

- Ability of equipment to navigate obstacles and obstructions in the mock-up annulus
- Ability of equipment to examine welds and plate areas
- Ability of equipment to navigate mock-up primary and secondary tank knuckles
- Ability of equipment to navigate inside mock-up channels simulating tank bottom air slots

The UT Inspection Technical Expert shall produce a report documenting the results of the UT system qualification The Equipment Technical Lead Engineer shall make a recommendation in the PDT report as to whether navigation capabilities have been adequately demonstrated Final approval of the UT system for use in a Hanford Waste Tank is the responsibility of the Project Cognizant Engineer

6 0 PLAN FOR FIELD ACTIVITIES (TANK INSPECTION)

Individual work packages will be prepared for each DST UT examination Work packages will be the vehicle for performance of the UT examination All work steps, guidelines, procedures, and charters (including the contractors) will be included or referenced in the work package The examination will proceed according to the work instructions in the approved work package The work instructions will point to the applicable guideline, procedure or charter as needed

The Facility Manager will designate an Operations Person-In-Charge (PIC) who has overall authority over the field performance of the inspection This person will work closely with the Field Engineer to ensure that work proceeds per the work instructions

Discovery of a flaw in any Tank that exceeds prescribed limits criteria shall be immediately reported to the Project Cognizant Engineer A second or intermediate level of notification is 12 5% of nominal wall thickness (PNL-10578) This intermediate level notification will also be immediately communicated to the Project Cognizant Engineer The third and final notification occurs after the discovery of a flaw in a Tank that exceeds the prescribed acceptance criteria - Note "*" on page 27 This information will be reported to the Project Cognizant Engineer, who in turn will use the "process for resolution" as stated in Appendix A The inspection is expected to continue after discovery of a flaw, unless the problem is an emergency or immediate safety concern The PIC is required to obtain input from the Project Cognizant Engineer and the UT Inspection Personnel before rendering decisions

Recommendations and findings of the Inspection Review Panel will be processed according to the occurrence reporting procedures by the Facility Manager or his designee

The specific items listed below cover the bulk of the field activities The responsible individual listed under each item has authority and responsibility for that aspect of the inspection work

RESPONSIBLE INDIVIDUAL/ORGANIZATION	FIELD ACTIVITY TASKS
Person-In-Charge (CHG)	- Ensure work packages provide adequate detail to perform the work to CHG requirements - Set-up and operate overview camera and lights inserted in an adjacent riser to the 24 inch inspection riser - Deploy and retrieve examination equipment from the annulus
UT Inspection Personnel (COGEMA)	- Set-up and functional checks of the examination equipment and control center, performance of the UT examination, and data collection - Upon inspection completion, provide the complete set of collected data to the Project Cognizant Engineer
Equipment Technical Lead (CHG)	- Technical interface with the UT Personnel and CHG support groups for troubleshooting, maintenance and repair of the UT examination equipment Oversight of the Equipment Support Approach
I&C Engineer (COGEMA)	- Troubleshooting, repair and maintenance of the examination systems
Field Engineer (COGEMA)	- Provide support during tank inspection

7 0 EQUIPMENT SUPPORT APPROACH

In order to achieve optimal equipment availability of the examination equipment, an equipment support approach will be utilized CHG has chosen to purchase one system to this end with full complements of spare parts Additionally, a contractor Instrument and Electrical Engineer will be tasked to attend the equipment full-time while it is being operated It is anticipated that with this approach, the activity will not be significantly impacted by equipment problems The support approach is a CHG standardized process consisting of the following listed key deliverables The contractor is required to interface with the Equipment Technical Lead for review and approval of the requirements listed below

1) The contractor will provide a complete list of equipment, software and hardware, that is to be used both in the field during actual inspections, and associated data processing equipment that will not be field deployed This list shall contain Manufacturer and Model Number, software versions, as applicable, and description/function This list will be used to track and maintain equipment and location This list should be incorporated into the Spare Parts Requirements document (Item 3 below)
2) The contractor will provide to the Equipment Technical Lead , preventive maintenance recommendations, for review and approval
3) A spare parts recommendations list will be provided by the contractor for review and approval prior to procurements The list will indicate whether the spare is an operational spare or consumable The list will also define the number of spare parts required as well as the Inventory Adjustment Requirements (IAR) The Spare Parts document shall be released as a Supporting Document
4) The contractor shall provide copies of Vendor Information (VI) for all equipment This shall include cut sheets, O&M Manuals, technical specifications, etc An index of the VI data shall be included in the Spare Parts document
5) If applicable, the contractor shall obtain from the manufacturer, registry settings for all programmable instruments The purpose of capturing this data is that, if the equipment should catastrophically fail, the factory setup parameters are available to repair and re-setup the equipment on-site A copy of this data shall be forwarded to the Equipment Technical Lead
6) The contractor shall provide an CHG approved dedicated I&C Engineer This person shall be trained in the troubleshooting, repair and maintenance of the examination systems CHG will fund the training

Because of the uniqueness of this activity and associated equipment, the UT Inspection Personnel shall take responsibility for transport, operation, troubleshooting, spares management and storage until such time as the approach and equipment demonstrate routine reliability At some future date when reliability has been demonstrated, an Acceptance for Beneficial Use (ABU) process will be implemented

Note CHG will provide the equipment for the inspection All equipment used by the contractor is to be removed after the inspection is performed There will be no permanent facility modifications

8 0 RISK MANAGEMENT

Areas of potential risk to equipment deployment/retrieval, collection of data, equipment reliability, etc , are addressed as defined below

1) There is a potential for equipment damage during deployment, operation and retrieval of the system

   Mitigating Actions

   Detailed work packages will be used to control the work Experienced and formally qualified surveillance crews will be used to handle the equipment Trained and qualified UT Personnel will be used to operate and collect data A full complement of spares, and a dedicated and formally trained I&C Engineer will be available should these types of problems arise

2) There is potential for schedule conflicts with other activities slated for work in FY 2000, at the same locations as those scoped within this ETP

   Mitigating Action

   Alternative DSTs may be selected based on the prioritized list of DSTs provided in Appendix D should schedule or resource conflicts occur at the currently scoped Tanks

9 0 TRAINING

<u>CHG</u>

CHG shall ensure that the support teams for the field activity are currently qualified specifically for this activity through Company processes, e g , Surveillance Team Qualification Program, Mock-up participation, Integrated Safety Management Enhanced Work Planning, as appropriate, and Pre-Job briefings Additionally, special on-site training will be provided by the examination equipment manufacturer This training will be given to those CHG personnel directly involved with the equipment handling activities

CONTRACTOR

UT Inspection Personnel - The contractor UT Inspection Personnel shall be certified and qualified to *Personnel Qualification and Certification in Nondestructive Testing*, ASNT-TC-1A, December 1992 Edition, as required for their functions Additionally, special on-site training will be provided to the contractor equipment operators This two week session will be given by the examination equipment manufacturer

Instrument and Electrical Engineer - The contractor I&C Engineer will be provided with a special one-week training session at the manufacturer's facility This training will be focused specifically on troubleshooting, repair and maintenance of the examination system equipment

All involved personnel will additionally be required to participate in the CHG ISMS process, Pre-Job briefings and any other field activity specific requirements

All training shall be documented

10 0 COST AND SCHEDULE

See Appendix B for fiscal year 2000 tank inspection schedules

11 0 RECORDS

The following records will be prepared if not available from previous fiscal year UT examinations or provided, if available, as a result of this work

- Plan for Deployment and Retrieval of UT Equipment from a Double-Shell Tank (Contractor)
- Ultrasonic Examination Procedures (Contractor)
- Performance Demonstration Test Report (UT Technical Expert and Lead Engineer)

- Unreviewed Safety Question screening or determination, as required (Lead Engineer)
- NDE Report (Contractor)
- Final report that presents and explains data from DST examination (Lead Engineer and UT Technical Expert)

The final report will be a supporting document, approved and released in accordance with LMH-PRO-439, Rev 0, *Project Hanford Policy and Procedure System - Supporting Document Requirements*, (Skriba 1997) The final report will also include copies of the above listed records

12 0 REFERENCES

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APPENDIX A

INSPECTION REVIEW PANEL CHARTER

Inspection Review Panel Charter

The Panel is charged with making technical recommendations to the Tank Farm Facility Manager within 24 hours following discovery of flaws that exceed the established acceptance criteria[1] The Panel's recommendations will focus on any immediate actions needed to maintain adequate waste confinement and to gather more data on the discovered flaw At a later time, the Panel will review all the UT inspection data collected for each tank and prepare a summary report with recommendations for future inspections

The Panel will consist of individuals with experience and technical expertise in UT data interpretation, fracture analysis, structural analysis, corrosion, and the tank safety basis One member of the Panel will be the Design Authority for the tank An individual with an overall understanding of the inspection process and the role of the panel will administer the panel The Panel recommendations will be submitted to the tank facility manager and made available to others on request The tank facility manager will determine if the discovered flaws are to be reported as an occurrence Occurrence reporting is described in HNF IP-0842, Volume II, Section 4 6 2, "Occurrence Reporting and Processing of Operations Information

The Panel recommendations will be based on the severity and number of flaws found The Panel will judge the severity of the flaw from the flaw size, flaw location, fracture potential, growth potential, tank failure consequences, and planned use of the tank The recommendations could include re-examination of the same flaw, additional examination of the same tank, examination of other tanks, removing a tank from service, lowering the tank waste level, repairs, periodic monitoring for flaw growth, adjusting the tank chemistry, or no action Westinghouse Hanford Company report WHC-SD-WM-AP-036, Rev 0 *Acceptance Criteria for Non-Destructive Examination of Double-Shell Tanks* (Jensen 1995) and its references are available to assist the panel in their evaluation of flaws Westinghouse Hanford Company report WHC-SD-WM-ER-529, Rev 1, *Description of Double-Shell Tank Selection Criteria for Inspection* (Schwenk and Scott 1996), and its references are available to assist the Panel in determining how representative the inspection results are in relation with other tanks and what additional tanks should be considered for inspection

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[1] Acceptance criteria as used herein refer to sizes of flaws that are larger than are expected to be present and potentially represent significant degradation Flaws of this size or larger will require the consideration of the inspection review panel (See page 23 Reporting criteria * Section 3 2 3 2)

References

TWRS Administration HNF-IP-0842, Fluor Daniel Hanford Inc , Richland, Washington

Jensen, C E , 1995, *Acceptance Criteria for Non-Destructive Examination of Double-Shell Tanks* WHC-SD-WM-AP-036, Rev 0, Westinghouse Hanford Company, Richland Washington

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APPENDIX B

TANKS IDENTIFIED FOR INSPECTION WITH INSPECTION DURATIONS

DST Inspection Tank 241-AY-101,

The primary tank wall, welds, lower knuckle, and bottom (as access allows) of 241-AY-101 are to be examined

Task	Duration
Prepare Work Package/Inspection Equipment	1 Week
Set up equipment at AY tank farm, perform functional checks	1 Week
Perform inspection of tank bottom (as access allows), primary wall, welds and lower knuckle	6 Weeks
Prepare and issue of tank examination report	3 Weeks

DST Inspection Tank 241-AP-107,

The primary tank wall, welds and lower knuckle of 241-AP-107 are to be examined

Task	Duration
Prepare Work Package/Inspection Equipment	1 Week
Set up equipment at AP tank farm, perform functional checks	1 Week
Perform inspection of primary wall, welds and lower knuckle	4 Weeks
Prepare and issue of tank examination report	3 Weeks

DST Inspection Tank 241-AW-103,

The primary tank bottom (if unable to examine 241-AZ-101, and as access allows) and lower knuckle are to be examined

Task	Duration
Prepare Work Package/Inspection Equipment	1 Week
Set up equipment at AW tank farm, perform functional checks	1 Week
Perform inspection of lower knuckle and tank bottom (as a substitute for 241-AZ-101, if required)	2-4 Weeks
Prepare and issue of tank examination report	2 Weeks

DST Inspection Tank 241-AY-102,

The lower knuckle and tank bottom (if 241-AY-101 is not accessible, and as access allows) of 241-AY-102 will be examined

Task	Duration
Prepare Work Package	1 Week
Set up equipment at AY tank farm, perform functional checks	1 Week
Perform of inspection of lower knuckle	2 Weeks
Perform inspection of tank bottom if unable to examine 241-AY-101 tank bottom and as access allows	2 Weeks
Prepare and issue tank examination report	2 Weeks

DST Inspection Tank 241-AZ-101,

The primary tank knuckle and tank bottom of 241-AZ-101 are to be examined

Task	Duration
Prepare Work Package	1 Week
Set up equipment at AZ tank farm, perform functional checks	1 Week
Perform inspection of primary tank knuckle and tank bottom	4 Weeks
Prepare and issue tank examination report	2 Weeks

DST Inspection Tank 241-AN-106,

The primary tank knuckle of 241-AN-106 is to be examined

Task	Duration
Prepare Work Package	1 Week
Set up equipment at AN tank farm, perform functional checks	1 Week
Perform inspection of primary tank knuckle of Tank 241-AN-106	2 Weeks

Task	Duration
Prepare and issue tank examination report	2 Weeks

ALTERNATIVE TANK LIST

In the event examination of tanks listed above are precluded for any reason, alternative tanks can be selected from the prioritized list found in Table 1, Appendix D, Prioritization of Double-Shell Tanks for Ultrasonic Examination

APPENDIX C

ACCEPTANCE CRITERIA AND INSPECTION METHODLOGY

Acceptance Criteria and Selection Methodology

1 0 SCOPE

The objective of this acceptance criteria is to examine ultrasonically the wall, lower knuckle, and bottom of the double-shell waste storage tanks (DSTs) in the Hanford Site 200 Areas using ultrasonic measurement equipment operated and provided by a Contractor An initial performance demonstration of wall thinning, pit, and stress-corrosion crack flaw measurement in test specimens will be followed by the examination of a DST to detect and size wall thinning, pits, and cracks without pre-inspection (except for visual examination of air slots, for tanks slated for examination of tank bottoms) or tank wall preparation (except for surface preparation required for the exterior of the primary wall of 241-AY-101)

There are 28 underground double-shell 1,000,000-gallon waste tanks located in the 200 Areas that are used to store radioactive liquid waste The first tank was placed in service in the 1970s and the last tank was placed in service in the 1980s Vertical, cylindrical pipe risers allow access to the annular space between the inner and outer tanks as shown in the elevation view of a typical tank (Figure 1)

2 0 APPLICABLE DOCUMENTS

2 1 ASNT-TC-1A issued by the American Society of Nondestructive Testing, 1992 Edition

2 2 ASME Boiler and Pressure Vessel Code Section V, Article 4, 1995 Edition

3 0 REQUIREMENTS

The Contractor's work task work description, and requirements are defined in this section

3 1 GENERAL REQUIREMENTS

If the Contractor demonstrates the ability of their measurement system (see 3 2 3 1), the Contractor must successfully perform an ultrasonic examination of a tank wall, tank knuckle, and tank bottom

Primary Tank Wall (see Figure 2) The Contractor will examine a vertical strip (approximately 30 inchs wide x 35 feet long) of the primary wall between the upper haunch transition and the lower knuckle for pits, cracks, and wall thinning Axial cracks on the tank inner surface shall be detected and sized The vertical strip may be comprised of one or more strips whose total width is 30 inches

The Contractor will examine welds for cracks at the following locations (see Figure 2) 20 feet of the circumferential weld joining the cylinder to the lower knuckle, one vertical weld joining the lowest shell course plates (about 10 feet of weld), and one vertical weld joining the next to the lowest shell course plates (about 10 feet of weld) Axial and circumferential cracks on the tank inner surface shall be detected and sized

Primary Tank Knuckle - The Contractor will examine the primary tank lower knuckle to detect the presence of cracks oriented in the tank circumferential direction and for pits and wall thinning The area to be examined is 20 feet long in the circumferential direction and in the meridional direction, is from the weld joining the transition plate with the knuckle to the furthest reach of the transducer assembly that is allowed by the tank geometric constraints The 20-foot dimension is not required to be a continuous length Examination segments that add up to a 20-foot-long area are acceptable

Secondary Tank Knuckle and Bottom - The Contractor must also successfully perform an ultrasonic examination of the secondary tank lower knuckle and bottom A 20-foot length of the knuckle will be examined over the entire area of the knuckle for the presence of circumferential cracks The tank bottom will be examined between the primary and secondary tank walls over an area 10 ft^2 to detect and measure thickness and pits The tank bottom examination shall be at the location between the nearest two air supply pipes that appears to have the most surface corrosion

Primary Tank Bottom -The Contractor will examine the primary tank bottom for pits, wall thinning, and cracks following any necessary performance demonstration Crack detection is limited to cracks oriented perpendicular to the air channels The tank bottom is accessible for examination through straight-sided channels in the foundation directly below the tank The channels are cut or formed in the insulating concrete that supports the tank eight inches above the secondary tank floor The details of the channel shape and size are as shown in Figure 3 In each of 16 channels, the tank directly above the channels, the width of the channel and for a distance of 12 feet towards the tank center beginning seven inches inboard of the outside radius of the tank cylindrical section will be examined In addition, the Contractor's examination equipment shall be capable of navigating around an air supply pipe (except in AP tank farm) and inspecting the tank bottom

Access to the tank annulus is through inspection risers There are two large risers, 24 inch in diameter, and one or two smaller risers, 12 inch in diameter The risers are at 90-degree intervals around the tank Each is approximately 20 feet long The risers are constructed of schedule 40 ASTM A53 pipe, with a 150-pound, raised face, slip-on flange The surface area surrounding the access riser, which terminates a few inches above grade, is gravel, with no immediate obstructions, except other risers The radiation dose rate at any tank location is low for the workers except for radiation shine through the riser The annual radiation dose limit for an individual is 0 5 rem (the unit of dose equivalent) The expected accumulated individual dose is far below this limit

There are several locations in the annulus that may pose obstacles to inspections There are groups of one half-inch conduits that run vertically along the secondary tank wall and cross the secondary tank bottom Also in the annulus space, there are 4 inch diameter air supply pipes that run vertically to the secondary tank bottom and then cross to the primary tank insulating pad The position and number of air supply pipes varies by tank farm as shown in Table 1 From visual examinations in the annulus space, obstructions have been observed in the air channels under the tank The obstructions are pieces of insulating concrete, instrumentation wires, and metal bars The Contractor shall provide a means of clearing the minor obstructions to inspections, such as the pieces of concrete Additional channels may be examined to achieve an equivalent area of examination A video of the annulus area and of the air vent slots, of limited clarity, is available to the prospective Contractors upon request Tanks in farms AY, AZ, and SY have leak detection probe assemblies at three azimuthal locations that obstruct inspections The assemblies are all similar and for AY farm tanks are shown on drawing H-2-64369

Upon completion of the initial tank examination, Contractor may be requested to examine additional tanks as described above

3 2 SPECIFIC REQUIREMENTS

General tank information typical of all double-shell tanks follows

1 Primary tank lower knuckle plate thickness ranges from 7/8-15/16 inch
2 Primary tank bottom thickness ranges from 3/8-7/8 inch
3 Secondary tank plate thickness ranges from 1/4-9/16 inch
4 Tank surfaces are in the "as welded" condition The welds have not been ground
5 Annulus air temperature varies up to 130° F
6 Annulus beta-gamma radiation rates up to 1000 R/hr

The condition of the tank surface to be examined varies from mill scale to the coating of rust that follows in the normal weathering of steel plate The surface is nearly equally divided between mill scale, transition from mill scale to a rust coating, and rust coating areas A few laitance streaks from pouring the concrete structure over the dome, chalk used in the welds areas during the tank hydrostatic test, and miscellaneous marks used to identify materials during construction remain on the tank surface

A video of the annulus area and the air vent slots, of limited clarity, is available to the prospective Contractors upon request

Workers will likely be restricted from occupying the space immediately above the riser because of the radiation shine from the waste below Actual restriction parameters will not be known until the shielding plug is removed and a radiation survey is completed immediately prior to the examination

It will be necessary for the Contractor to lower the ultrasonic measurement equipment through a riser to perform the examination Personnel must operate the ultrasonic equipment from grade elevation An annular space approximately two and a half feet wide is available for ultrasonic equipment operation between the outer surface of the primary tank and the inner surface of the secondary tank There should be no obstruction to movement of the ultrasonic equipment in the annular space immediately below the access riser

The tanks are grouped in tank farms Each farm is a controlled access area and is enclosed by a chain link fence The riser flange cover and radiation shielding will be removed by the Hanford facility personnel Raw water and electrical power for data acquisition equipment are available at the tank farm The Contractor must provide compressed air if needed

3 2 1 LIMITATIONS AND APPROVAL REQUIREMENTS

Vehicles or equipment having a gross weight exceeding 10 000 lbs are subject to restriction to specific areas inside the tank farm The degree of restrictions depends upon the configuration and utilization of the vehicles or equipment Plans describing the activities of personnel, vehicles, and equipment inside the tank farm shall be provided by the Contractor for Lockheed Martin Hanford Corporation (CHG) approval prior to the examination

All required weather and dust protection structures or facilities for the Contractor's workers or equipment in the tank farm shall be provided by the Contractor and must be approved by CHG before use to ensure compliance with safety and operational policy

Unless otherwise noted herein, the Contractor shall provide all design, materials, services, equipment, labor, and documents necessary to safely perform the examination in accordance with this specification All equipment deployed in the tank and all couplant remaining in the tank in excess of 20 gallons must be removed upon completion of the examination without damaging the tank Each worker entering the tank farm, which is a controlled access area is required to have radiation worker training, hazardous waste worker training (24 hour) and training unique to the facility, as applicable in section 3 2 6 All personnel and equipment are surveyed for radiation contamination upon each departure from the tank farm Specific training details are described in Section 3 2 6

3 2 2 Qualifications

Nondestructive examination (NDE) personnel shall be qualified and certified in accordance with the recommended guidelines of the American Society of Nondestructive Testing SNT-TC-1A-92

Prior to the examination the Contractor must provide the following documentation to CHG for approval NDE qualification and certification procedures, Level I, II, and III qualifications and certifications, which include objective evidence of NDE training, formal education, examinations, experience, date of hire, and current eye examination for personnel, and NDE method/examination procedures that are in accordance with the applicable codes/standards

3 2 3 Ultrasonic Examination

3 2 3 1 Performance Demonstration

An ultrasonic examination of test specimens shall be performed by the Contractor at the Contractor's facility to demonstrate performance of their measurement system The Contractor shall provide a mockup of the tanks for this purpose The following are specific requirements for the mock-up

A Deployment and Retrieval

The mock-up shall have an access riser of the diameter the Contractor plans to use to gain access to the Hanford tanks (minimum inside diameter of the 24-inch riser is 22 6 inches) The riser shall be 20 feet long or at least twice the length of the Contractor's deployment equipment The lower end of the vertical riser shall open to vertical tank walls The vertical tank walls and riser shall be of a material, strength, and size required to support the deployment equipment, deploy the inspection equipment, and retrieve the inspection and deployment equipment

B Flaw Detection (demonstration plates will be provided by CHG)

1 At least one vertical steel plate shall be positioned for ultrasonic scanning The plate will have no surface preparation

2 A cut-out in the vertical plate shall be made to allow insertion of flat demonstration plates that are 14 5 inches by 21 6 inches and of different thickness (3/8 and 7/8 inches) Appropriate brackets shall firmly hold the demonstration plates in the cut-out and the brackets shall not interfere with the inspection of the demonstration plate The long dimension of the cut-out and demonstration plate shall be horizontal

3 The primary tank knuckle (see Figure 1) shall be simulated with a straight knuckle section (nominal thickness of ½-inch, in the shape of 1/4 section of a steel pipe) and sufficient plate attached to the pipe section to allow the inspection tool to be demonstrated for its ability to inspect the knuckle as described in Section 3 1 The steel will have no surface preparation

The secondary tank knuckle shall be simulated in the same manner as the primary tank knuckle

4 The secondary and primary tank bottom inspection mock-up shall include the area between the primary and secondary tank (annulus) The area shall be simulated with a straight section having the following obstacles included that must be overcome to perform the inspections of the tank bottoms, one vertical four-inch pipe attached such that each of the air pipe spacings (radial) can be simulated with the exception of the spacing for AP tank farm (see Table 1) and four 1/2 inch conduits, adjacent to each other, attached to the secondary wall oriented vertically, running to the tank floor, and fanning out across the annulus space at 30 degree separation and terminating at the base of the tank foundation The mock-up annulus shall be of adequate length to properly demonstrate the inspection equipment's capability to overcome the obstacles to the inspection

Each of the air vent geometries shall be simulated (see Figure 3) and each shall be 13 feet long The insulating concrete may be simulated with Portland cement and the height of the insulating concrete shall be accurately represented (eight inches) The plate in front of the vents in details 4 and 5 of Figure 3 shall also be included for those particular vent geometries The primary and secondary tank knuckles shall be included in the mock-up (see item 3 above) A 3/8-inch thick flat steel plate, 11 feet long, shall simulate the primary tank bottom and cover the air vents or be designed to be moved over each vent type individually A curved section (pipe section) shall be welded to the flat plate to simulate the primary tank knuckle The primary tank bottom and knuckle shall be positioned over the air vents as shown in Figure 3 There will be approximately two feet of insulating concrete and vents not covered by the primary tank bottom plate This area shall be used to place demonstration plates for testing the inspection equipment

A single mock-up or multiple mock-ups may be made as long as they meet the characteristics described above (mock-up requirements A and B)

CHG will provide test specimens containing crack, pit, and thinning flaws to allow demonstration of the Contractor's ability to detect and size the flaws as follows (all accuracy requirements are RMS values)

Pits - Contractor to size the depth dimension within 0 050-inch accuracy

Thinning - variable thickness Contractor to size the thickness within 020 inch accuracy

Cracks - Contractor to detect the existence of a crack at the inner wall surface on the primary tank and size the crack depth within 0 1-inch accuracy The crack orientation will be provided by CHG For the secondary knuckle, the Contractor is to detect cracks at both the inner and outer surface and size the crack depth within 0 1 inch

As part of the performance demonstration, the Contractor shall examine eighteen test specimens, six for a wall examination demonstration, six for a weld examination demonstration, and six for a primary tank bottom examination demonstration If the knuckle examination transducers are not the same as the wall examination transducers, another six plates shall be examined

3232 Tank Examination

Upon successful completion of the performance demonstration, the Contractor shall perform the ultrasonic examination of the tank The Contractor shall provide a calibration block to verify proper function of the examination system immediately before and after the examination

The examination goal is to determine whether the tank owner is required to take special action (see "*" below) The ultrasonic examination shall detect any pit whose depth exceeds 25% of the wall thickness and wall thinning that exceeds 10% of the wall thickness and cracks exceeding a depth of 0 18 inches Hemisphere configuration is assumed for the pit Differentiation between laminations and corrosion shall be provided by the Contractor The examination data shall identify the location of any anomalous indications within ± 1 inch

* NOTE Pit depth that exceeds 50% of the wall thickness, thinning that exceeds 20% of the wall thickness, and surface crack depths that exceed 0 18 inches are considered significant and will cause the tank owner to take special action

3233 Foreign Material

The Contractor shall provide a chemical description and identify the quantities of couplant and any other substance introduced into the annulus that remains in the annulus following the examination

3234 Visual Information

The Contractor shall provide a closed circuit television system to continuously view the ultrasonic examination process The Contractor and CHG shall provide a monitor for viewing during the examination process The examination image shall be recorded on videotape and provided to CHG at the completion of the examination, it shall also contain the tank designation, the riser designation, time, and date

3235 Ultrasonic Examination Procedure

The ultrasonic examination shall be conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section V, Article 4, 1995 edition, and the requirements identified herein In addition, the Contractor shall provide a copy of the calibration block certification

3 2 4 Sequence of Contractor Performance

1 Performance demonstration in accordance with the requirements herein
2 Ultrasonic examination of the tank wall, lower knuckle, and tank bottom as described herein
3 Ultrasonic examination of additional tanks as described herein

Item #2 and #3 will include videotape of the examination, an examination evaluation report and a report and record of the examination in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section V Article 4 or the equivalent The contractor shall also provide hard copy records (B or C-scan) and the electronic records of the areas inspected The hard copy and electronic records shall include samples of A-scans (amplitude of front and back wall echoes) for the performance demonstration plate, calibration plate and for each of the areas inspected

3 2 5 Acceptance Criteria

Completion of the ultrasonic examination in accordance with the requirements set herein

3 2 6 Training Requirements

The following training will be required for each person performing work in the 200 area All worker training is available at the Hanford site at the expense of CHG excluding worker salary and sustenance

3 2 6 1 Training for Workers Inside the Tank Farm

3 2 6 1 1 **Radworker 1,**
Course #020001, two and a half days or one day test

3 2 6 1 2 **24 hour Hazworker Training,**
Course #031110, two days or previous qualification

3 2 6 1 3 **Hazworker Physical**, HEHF Lisa M Whitemore, 376-4122

3 2 6 1 4 **Buildıng Emergency Plan Revıew**
Course #03E060 scheduled by appoıntment, approxımately two hours

3 2 6 1 6 **Tank Facılıty Orıentatıon**
Course #350710, scheduled by appoıntment, approxımately two hours

3 2 6 2 Traınıng for Workers or Vısitors Outsıde the Tank Farm

3 2 6 2 1 **Buildıng Emergency Plan Revıew**
Course #03E060, scheduled by appoıntment, approxımately two hours

3 2 6 2 2 **Tank Facılıty Orıentatıon**
Course #350710, scheduled by appoıntment, approxımately two hours

4 0 SCHEDULE

The Contractor shall be avaılable and prepared to begın the performance demonstratıon wıthın 60 calendar days followıng the receıpt of order The demonstratıon actıvıty and the ınıtıal tank measurement shall be completed wıthın 30 days Inspectıon of addıtıonal tanks wıll commence after October 1, 1999

A tentatıve schedule of the events to be done ın the 30 days ıs as follows

1 Demonstratıon measurement of test specımens – five days

2 Evaluatıon of the demonstratıon measurement by CHG – one day

3 Travel to Rıchland followed by one week of Traınıng – eıght days

4 Set up at tank farm – one day

5 Perform prımary tank bottom examınatıon – sıx days

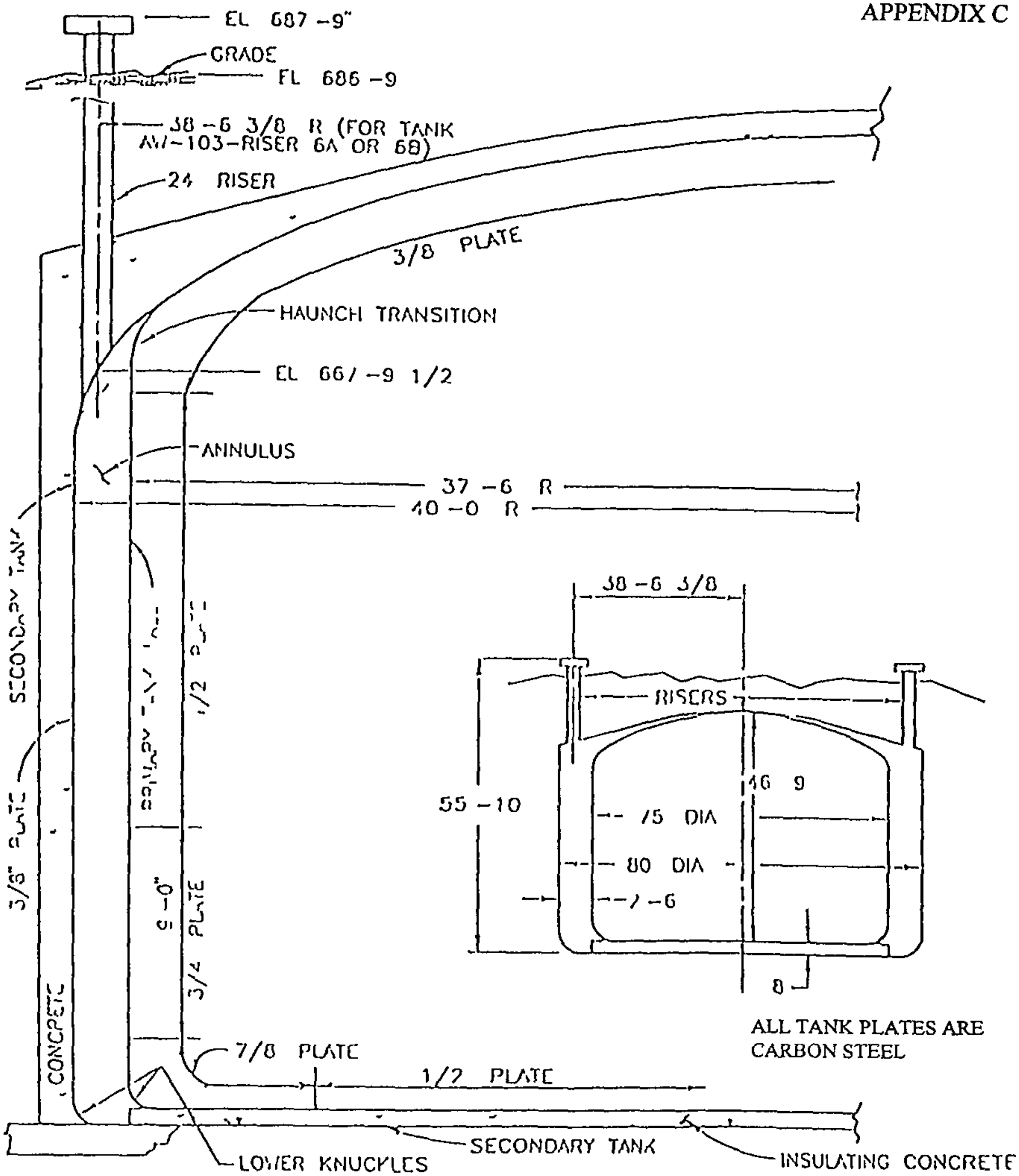
6 Perform the prımary tank wall, prımary tank knuckle, secondary tank knuckle, and secondary tank bottom examınatıon – eıght days

7 Remove the equıpment from the tank farm – one day

The demonstratıon measurement of the test specımen does not requıre specıal traınıng

Table 1 Tank Air Slot Arrangement Details

Tank Farm	4 inch Dia Air Supply Pipes	No of Air Vent Slots at Annulus	Reference Drawing
AN	8 @ 45 deg At 37'-11" Radius	64	H-2-71906
AP	8 @ 45 deg At 39'-3 Radius	64	H-2-90440
AW	8 @ 45 deg At 37'-11" Radius	64	H-2-70304
AY	4 @ 90 deg At 38'-4" Radius	72	H-2-64307
AZ	4 @ 90 deg At 37'-11" Radius	64	H-2-67244
SY	4 @ 90 deg at 37'-11" Radius	64	H-2-37705



ALL TANK PLATES ARE CARBON STEEL

FIGURE 1
TYPICAL ELEVATION VIEW
(NO SCALE)

Wall Examination of Welds and 30 Inch Wide Area

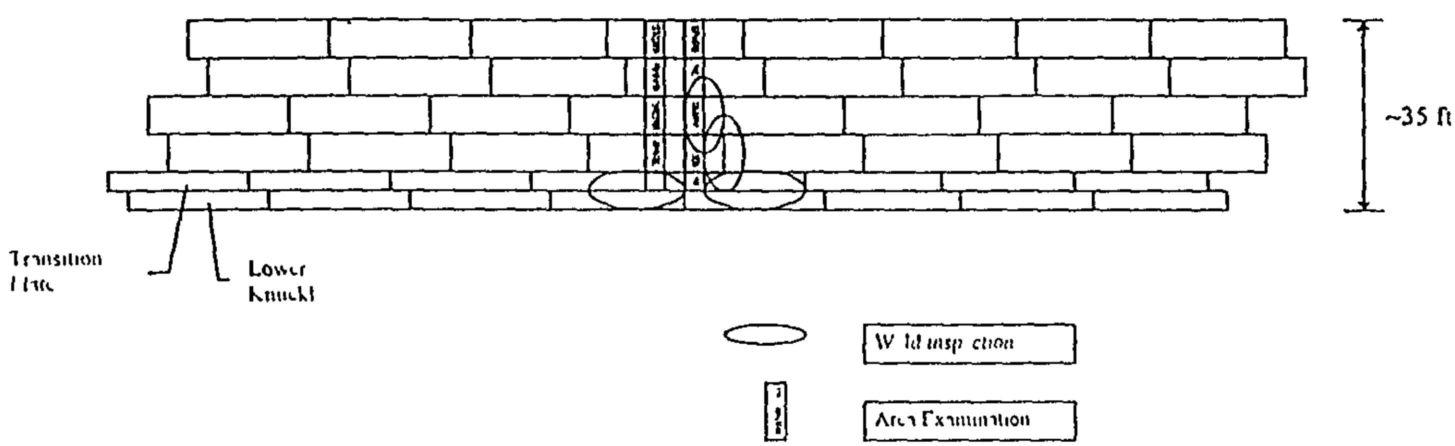
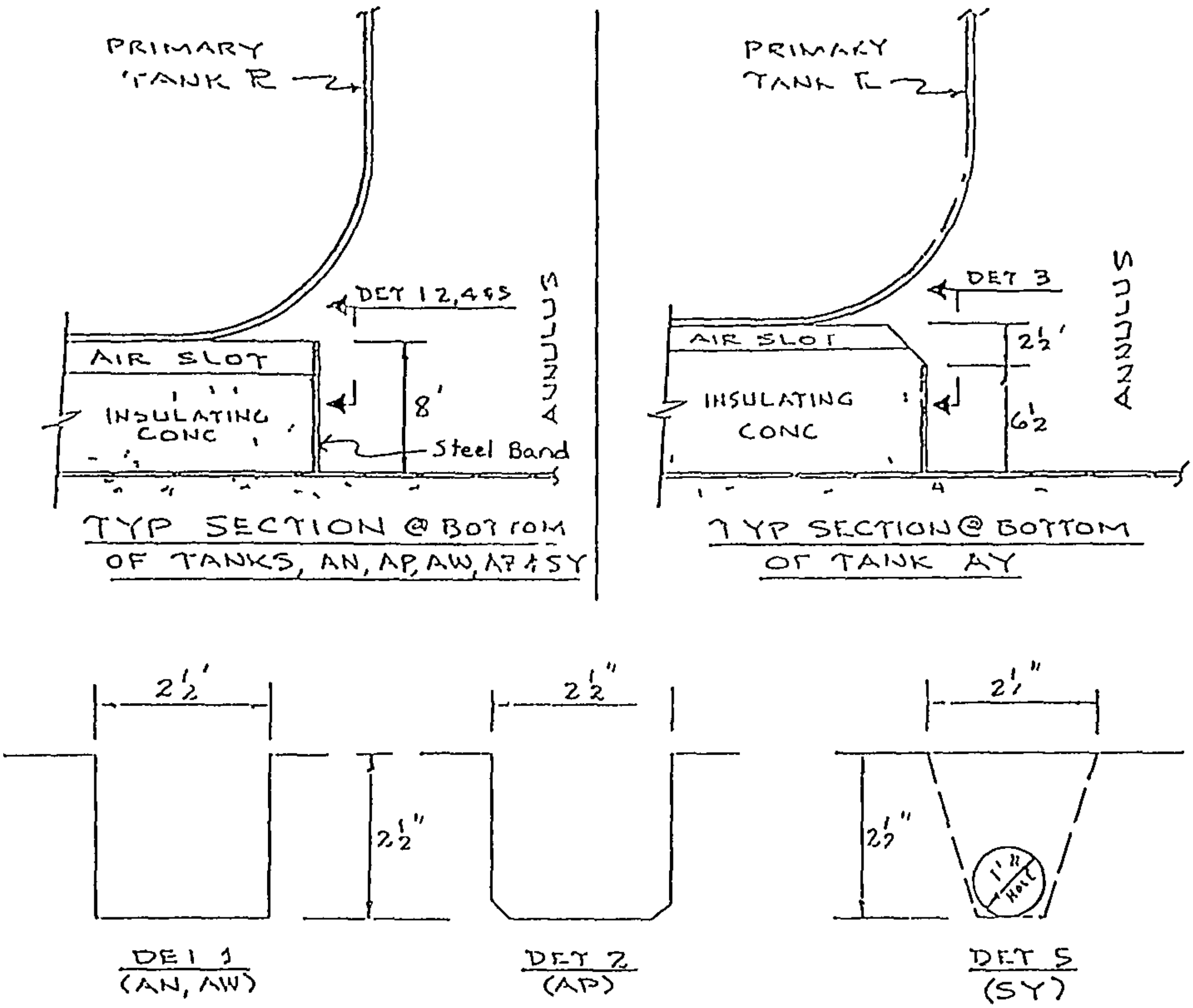
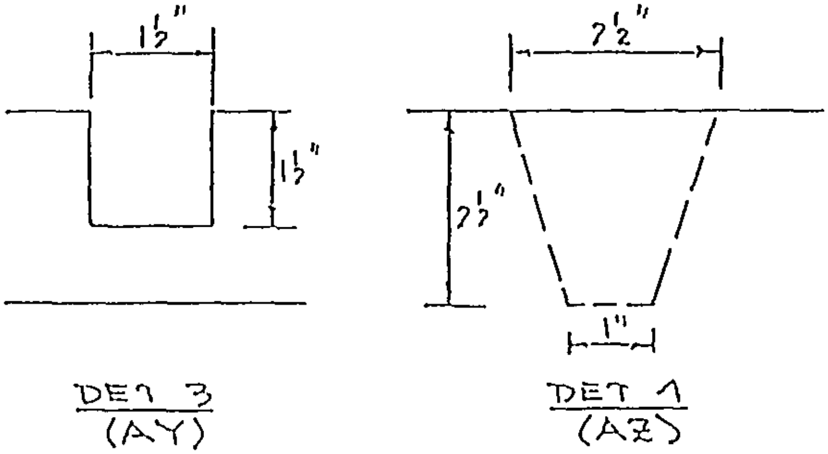


Figure 2 Tank Layout

Tanks are constructed of three or four major shell courses, approximately 30 feet long and eight to ten feet wide. The lower knuckle is one foot high and there is a transition plate of about one foot height between the knuckle and the lower shell course





NOTE
Det 4 and Det 5 slot shape may be rectangular 1 ¾ wide x 2 ½ ' deep

FIGURE 5
RETURN AIR VENT SLOTS

APPENDIX D

PRIORITIZATION OF DOUBLE-SHELL TANKS FOR ULTRASONIC EXAMINATION

PRIORITIZATION OF DOUBLE-SHELL TANKS FOR ULTRASONIC EXAMINATION

The first group of six double-shell tanks (DSTs) were selected at the Hanford Site in 1994 for inspection using the ultrasonic (UT) examination technique (Pfluger 1994a, b) The six DSTs selected were AY-101, AZ-101, AN 106, AN 107, AW-103, and AN-103 The selection was made on the basis of longest service history (AY-101), highest sustained temperature (AZ-101), high phosphate waste content (AN-106), low corrosion inhibitor (AN-107), high sludge level (AW-103), and flammable gas watch list tank (AN-103) The selection of these tanks is consistent with the Tank Structural Integrity Panel (TSIP) guidelines (Bandyopadhyay et al 1994) The TSIP, however, recommended that tank AY-101 be replaced with AY-102 In 1996, selection criteria were developed for UT examination of DSTs (Schwenk and Scott 1996) These criteria were consistent with TSIP guidelines and previous selection criteria (Pfluger 1994b) Six tanks were again selected in 1997 (Schwenk and Anantatmula 1997) on the basis of criteria similar to those of Schwenk and Scott (1996) for the first group of six tanks for UT examination This time the criteria were weighted relative to each other and the tanks were ranked for each criterion The tanks selected were AW-103, AN-107, AY-102, SY-101, AY-101 and AZ-101 The criteria used for these tanks were 1) years of service 2) temperature, 3) inhibitor levels, 4) sludge height, 5) hydrogen release, 6) number of waste transfers to and from a given tank, 7) least weight depth fluctuation, and 8) type of steel used for construction Four of these tanks, viz , AW-103, AN-107 AY-101 and AZ 101, are the same as those selected on the basis of the 1994 criteria

Tank AW-103 was selected as the first of six tanks to be examined The tank was selected primarily on the basis of its sludge level for possibilities of under-deposit corrosion The examination was limited to two vertical strips of the tank wall which revealed no corrosion indications Ultrasonic examination of tank AN-107 was completed Similar to tank AW-103, the UT examination results of tank AN-107 did not reveal any corrosion indications outside the established criteria although the waste had been outside the DST waste specifications for several years

Tank AN-106 (which was on the 1994 selection list) was subsequently added to the current list to replace tank AY-101 because of the inability of the crawler to maintain contact with the primary wall of tank AY-101 due to rust buildup on the primary wall in the annulus Because of the unavailability of tank SY-101 (which is on the flammable gas watch list similar to tank AN-103 of the 1994 selection list) due to a heavy work schedule in FY 1999, tank AN-105 was selected as its replacement The selection was based on the fact that tank AN-105 is also on the flammable gas watch list similar to tank SY-101 The UT examination of tank AN-105 was completed and it revealed that some regions of tank wall experienced wall thinning outside the established criteria Although the exact cause for the unusual wall thinning is not known at the present time the reduction in the wall thickness was attributed to corrosion from condensation of moisture on the tank walls as a result of low levels of waste stored at the start of tank operations It has been recommended to reexamine this tank in 2-5 years to determine the rate at which the thinned areas are corroding Little or no corrosion was noted in the bottom knuckle area of tank AN-105

Because of the possible corrosion implications of low level waste storage in tank AN-105, more recently tank AP-107 has been added to the list of tanks for UT examination on the basis of low levels of waste water stored in the tank for an extended period of time The reason for selection can also be attributed to the results of a visual examination performed on the tank interior in 1997 (Anantatmula 1997a) during which some shallow pitting of the tank wall was observed in the vapor space of tanks AP-107 and AP 104

The current objective of the Integrity Assessment Panel for the UT examinations of the DSTs is to examine, as a minimum, the vertical wall, lower knuckle, and the welds, viz , lower knuckle weld, and the two lowest vertical welds Because of the difficulty in examining the tank bottoms due to obstacles created by concrete splashing in some tanks, the Integrity Assessment Panel recommended to examine tank bottoms of at least three tanks The first tank bottom examined was that of tank AN-107 It is recommended that one of the remaining two tank bottoms to be examined should be that of tank AY-101 or its alternate AY 102 This is because the AY Farm tanks are the oldest of the DSTs are aging waste tanks, and the bottom design wall thickness is only 3/8-inch compared to ½-inch for all the other DSTs The third tank bottom should be that of tank AZ-101 (preferred) or AW 103 (alternate) depending on the ease of accessibility

It is also recommended to complete the UT examination work started on tanks AW-103, AN-106, AZ-101 and AY-102 The UT examination of these tanks should be performed in no particular order except it should be based on schedule constraints and the ease with which the UT equipment can be installed It is also deemed important to examine tank AY-101 to determine the remaining in-tact wall thickness of the primary wall because of the unusual amount of rust observed on the outside of the primary wall, at the earliest opportunity

Based on the foregoing, the immediate plans for UT examination of DSTs should be the following

AW-103 – Knuckle (and tank bottom if AZ-101 is not accessible)
AN-106 – Knuckle
AZ-101 – Knuckle and tank bottom
AY-101 – Accessible corroded wall and welds knuckle and tank bottom
AY-102 – Knuckle (and tank bottom if AY-101 is not accessible)
AP-107 – Tank wall, welds, and knuckle

The DST selection criteria developed previously (Anantatmula 1997b) have been modified to reflect the possible corrosion implications of low level waste storage The remaining tanks have been prioritized based on these modified selection criteria and presented in Table 1 If, for some unforeseen reason, UT examination of tanks AW-103, AN-106, AZ-101, AY-101, AY-102, and AP-107 cannot be performed, it is recommended to examine the remaining tanks in the order of priority indicated in Table 1 The DST selection criteria (and consequently the DST prioritization) for UT examination will be updated periodically as more information becomes available

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Pfluger, D C 1994a *Tank Waste Remediation System Tank System Integrity Assessments Program Plan*, WHC-SD-WM-AP-017, Rev 1, Westinghouse Hanford Company, Richland, Washington

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TABLE 1

ORDER OF PRIORITY OF REMAINING DOUBLE-SHELL TANKS*

Tank	Age Factor	Temperature Factor	Composition Factor	Least Waste Ht Factor	Material Factor	Low Waste Level Factor	Overall Factor
108-AP	4	5	2	4	5	10	173 5
101-SY	8	7	2	10	9	2	149 5
104-AN	6	6	2	9	5	4	148 5
105-AN	6	6	2	9	5	4	148 5
101-AW	6	7	2	8	5	4	147 5
103-AN	6	7	2	7	5	4	142 5
106-AP	4	6	2	4	5	6	137 5
101-AP	4	5	2	4	5	6	133 5
102-AZ	9	9	2	4	10	2	132
102-AW	6	7	2	4	5	4	127 5
105-AW	6	6	2	4	5	4	123 5
103-SY	8	7	2	4	9	2	119 5
102-SY	8	7	2	4	9	2	119 5
101-AN	6	5	2	4	5	4	119 5
102-AN	6	6	4	4	5	2	117 5
105-AP	4	5	2	4	5	4	113 5
103-AP	4	5	2	4	5	4	113 5
102-AP	4	5	2	4	5	4	113 5
104-AW	6	7	2	4	5	2	107 5
106-AW	6	6	2	4	5	2	103 5
104-AP	4	5	2	4	5	2	93 5

The weights used are 3, 4, 7, 5, 1 5 and 10 respectively for aging factor, temperature factor, composition factor, least waste height factor, material factor and low waste level factor The overall factor for a given tank was calculated by multiplying each factor for the tank by its weight and summing