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Document #: SD-WM-FDC-042

Title/Desc:

FDC FOR THE SELF INSTALLING LIQUID OBSERVATION WELL

Pages: 24

COMPLETE

ENGINEERING CHANGE NOTICE

1. ECN 186715

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	3a. USQ Required?	4. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	S. A. Parra, Nuclear Analysis and Characterization, H0-38, 373-3379	[] Yes [X] No	January 4, 1996
	5. Project Title/No./Work Order No. Liquid Observation Wells/N2208	6. Bldg./Sys./Fac. No. 200-G	7. Approval Designator S,Q
	8. Document Numbers Changed by this ECN (includes sheet no. and rev.) WHC-SD-WM-FDC-042, REV. 2	9. Related ECN No(s). N/A	10. Related PO No. N/A

11a. Modification Work	11b. Work Package No.	11c. Modification Work Complete	11d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 11b) [X] No (NA Blks. 11b, 11c, 11d)	N/A	N/A Cog. Engineer Signature & Date	N/A Cog. Engineer Signature & Date

12. Description of Change

Tolerance of dimensions change due to fabricator's request.

ECN 621855
Superceded in its entirety.

13a. Justification (mark one)

Criteria Change	[]	Design Improvement	[X]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

13b. Justification Details

Tolerance dimensions changed to industry standards to reduce fabrication costs.
Informal Review per EP-4.1 by J. H. Huber.

14. Distribution (include name, MSIN, and no. of copies)

See distribution page.

RELEASE STAMP

JAN 05 1996

DATE:

STA: 21

HANFORD RELEASE

ID:

A-7900-013-2 (11/94) GEF095

A-7900-013-1 (11/88)

ENGINEERING CHANGE NOTICE	Page 2 of 2	1. ECN (use no. from pg. 1) 186715

15. Design Verification Required	16. Cost Impact				17. Schedule Impact (days)
	ENGINEERING		CONSTRUCTION		N/A
[] Yes	Additional	[] $	Additional	[] $	Improvement []
[X] No	Savings	[] $	Savings	[X] $	Delay []

18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[X]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

19. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
Drawing H-14-100509 Rev. 0 Self-Installing Liquid Observation Well Assy & Instl.		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. S.A. Parra	Jan 4, 1996	PE	
Cog. Mgr. A. E. Waltar	1/9/96	QA	
QA M. S. Bhangoo	1/5/96	Safety	
Safety L. E. Thomas	1/5/96	Design	
Environ.		Environ.	
Other G. T. Dukelow	1/5/96	Other	
J. H. Huber Informal Review	1/4/96		
K. J. Hull	1/5/96		
		DEPARTMENT OF ENERGY	
		Signature or a Control Number that tracks the Approval Signature	
		ADDITIONAL	

Functional Design Criteria for the Self-Installing Liquid Observation Well

Santiago A. Parra
Westinghouse Hanford Company, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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Key Words: liquid observation well, LOW, organic, S-type, fiberglass, EMI probe, neutron probe

Abstract:

This document presents the functional design criteria for installing liquid observation wells (LOWs) into single-shell tanks containing ferrocyanide and organic wastes. The LOWs will be designed to accommodate the deployment of gamma, neutron, and electromagnetic induction probes and to interface with the existing tank structure and environment.

RECORD OF REVISION

(1) Document Number: WHC-SD-WM-FDC-042

Page 1

(2) Title

Functional Design Criteria for the Self-Installing Liquid Observation Well

CHANGE CONTROL RECORD

(3) Revision	(4) Description of Change - Replace, Add, and Delete Pages	Authorized for Release (5) Cog. Engr.	(6) Cog. Mgr. Date
0	(7) EDT-701453, 1/4/95	SA Parra	H. Toffer
1	Completely replaces Rev. 0 ECN-615171 6/16/95	SA Parra	H. Toffer
2	Completely replaces Rev. 1 ECN-621851 8/28/95	SA Parra	H. Toffer
3 RS	Completely replaces Rev. 2 ECN-186715 1/5/96 SS ECN-621855	SA Parra	A. E. Walter 1/4/96

CONTENTS

1.0 INTRODUCTION

Installation of in-tank liquid observation wells (LOWs) was implemented in the early 1980's to provide a reliable leak detection system for the Hanford 200 East and 200 West Tank Farms. The LOWs are made from E-type fiberglass, Tefzel, or Carbon Steel materials. They are tubes closed at one end, inserted vertically into the tank waste, and suspended from tank risers. Different surveillance probes are deployed inside the LOWs to detect the liquid interface in the surrounding waste. This system has proven to be a reliable method for monitoring the tank waste liquid levels (Kelly 1982, Jones 1983).

Currently, 57 of the 149 single-shell tanks have an installed functional LOW. Some of the tanks that do not have a LOW are suspected of containing potentially reactive wastes and have been placed on a ferrocyanide watch list. Maintaining an adequate waste moisture concentration in these tanks is important to prevent the occurrence of exothermic chemical reactions. It has been proposed that LOWs be installed in these tanks to allow for moisture concentration monitoring. Moisture monitoring will provide a means to determine if the waste is stored in an intrinsically safe condition. Moisture monitoring probes that can be deployed inside the LOWs are currently being developed. New materials for the LOW casing have been suggested to enhance the performance of these probes (Toffer 1994). The present LOW casing materials are not acceptable because E-type fiberglass contains neutron absorbing borosilicate glass which hinders the moisture monitoring probes, Tefzel material is not structurally strong enough to withstand the waste environment in the tanks, and carbon steel prevents the deployment of the electromagnetic induction probe for monitoring moisture.

1.1 SCOPE

This document provides the criteria for the design, construction, and installation of S-type fiberglass LOWs into ferrocyanide-bearing waste tanks that currently do not contain LOWs. Two types of S-type fiberglass material have been approved for the LOW casing. They are a filament wound S-glass fiber with Dow Epoxy Resin 331[1] and a bi-directional S-glass cloth with Derakane 411-C-40 Vinyl Ester Resin[1]. These S-type fiberglass materials were chosen because they satisfy the conditions imposed by the moisture monitoring probes related to strength, nonconductive, nonmagnetic, and lack of thermal neutron absorbers (Parra 1995).

A new method of installing the LOWs has been developed. Instead of water lancing a hole through the salt cake waste material and then inserting the LOW, the LOW will be inserted into the waste using an ultra-high pressure water (UHPW) borehead attached to the bottom of the LOW tube. It will utilize the same UHPW borehead design presently used in the insertion of the Thermocouple Trees with the exception that the water feed line shall be removable and reusable (Hertelendy 1994). The UHPW borehead method of installation was chosen to minimize the disturbance of the surrounding waste and minimize the water usage during installation of the LOWs.

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[1]Trademark of the Dow Chemical Company.

1.2 PROJECT INTERFACES

The project will interface with tank waste sampling efforts. Waste sampling requires a free riser to collect core samples. During conceptual design, a list of tanks with only one uncommitted riser will need to be produced (Brown 1994). This will help avoid any scheduling conflicts between the LOW installation and waste sampling.

2.0 PROJECT CRITERIA

The general functional, performance, and design requirements for the Self-Installing LOW Project are provided in the following paragraphs.

2.1 LIQUID OBSERVATION WELL SPECIFICATIONS

The LOW shall maintain an effective barrier against the tank waste and prevent contamination of the monitoring probes. Any flexing of the LOW during service should not interfere with the passage of the probes. The following sections define the design characteristics of the Self-Installing LOW Project.

2.1.1 LOW Interfaces

It is anticipated that a gamma probe and/or a neutron probe will be used to measure the liquid interstitial level in the waste tanks. In addition, a thermal neutron moisture probe, epithermal neutron moisture probe, and an electromagnetic induction moisture probe will be inserted into the LOWs for monitoring the moisture concentration in the waste. These probes are designed to fit into a 7.937 cm (3.125 in.) inner diameter LOW tube. Furthermore, the LOW tube will be required to fit within a 4-inch schedule 40 riser (10.2 cm inner diameter). The top end of the LOW tube will interface with the riser flange. A plug consisting of an UHPW borehead shall be connected to the bottom end of the tube for installation of the LOW. This UHPW borehead shall facilitate penetration of the salt cake and sludge. After installation, this UHPW borehead shall seal and act as a plug. The UHPW borehead incorporates a check valve which seals the borehead. The crack pressure of the check valve shall be sufficiently high to prevent liquid waste intrusion after installation of the LOW. The LOW interface connections must accommodate the different rates of thermal expansion of the stainless steel UHPW borehead, the steel riser flange, and the LOW fiberglass material.

Due to manufacturing methods, the LOW will be manufactured from several sections to produce the required length. The design must permit a variation in length of the LOW tube from 1219 cm (40 ft) to 1676 cm (55 ft). It is desirable that the number of joints be minimized in the LOW design. Most important, there shall be no joint connection in the bottom 762 cm (25 ft) of the LOW.

2.1.2 LOW Dimensions

(1) Length:
The LOW shall reach within 5.1 ± 1.3 cm (2.0 ± 0.5 in.) of the bottom. The length of the LOWs shall range from 1219 cm (40 ft) to 1676 cm (55 ft). There shall not be any joint connection in the bottom 762 cm (25 ft) of the LOW tube.

(2) Inner diameter (minimum):
The inner diameter shall be 7.937 ± 0.127 cm (3.125 ± 0.050 in.), including the tube to tube connections.

(3) Outer diameter (maximum):
The maximum outer diameter shall be less than 9.525 cm (3.750 in.), including the tube to tube connections and the LOW adaptor ring connection. This shall permit the installation of the LOWs in 4-inch schedule 40 risers (10.2 cm inner diameter).

(4) Bottom Connection:
The unusable length at the bottom of the LOW, UHPW borehead connection and LOW adaptor ring, shall be less than 15.24 ± 1.27 cm (6.0 ± 0.5 in.) measured from the bottom of the LOW.

(5) Tube Straightness:
The LOW shall allow passage of a cylinder with an outside diameter of 7.303 cm (2.875 in.) and length of 165 cm (65 in.). Dimensional deformation due to radiation exposure or chemical corrosion should not interfere with the passage of the cylinder.

(6) Inner Wall Surface:
The inside surface shall range from glazed to a maximum of 160 μcm (63 μin.) Root Mean Square.

2.1.3 Material Properties

The LOW casing material shall contain minimal amounts of thermal neutron absorbers, be nonmagnetic, be nonconductive, and have sufficient structural strength to survive the waste tank environment for 20 years. The LOW casing material shall also be homogeneous; 70% free of air bubbles and voids with no air bubble or void diameter greater than 1.3 cm (0.5 in.).

The composition of S-type fiberglass shall be approximately 60% S-glass and 40% resin/epoxy by weight. The composition of S-glass, disregarding minor impurities, is (Lubin 1969):

SiO_2	65%
Al_2O_3	25%
MgO	10%

The tensile strength and modulus of elasticity for S-type fiberglass is 33% and 20% greater than that of E-type fiberglass, respectively.

The LOW material and the joints shall be able to support three times the weight of a 16.8 m (55 ft) long LOW and the borehead plug. The LOW material shall also be flexible enough to withstand some impact from waste movement, and yet be rigid enough to prevent large deformation caused by buoyancy forces (approximately 20 N). These properties shall not vary greatly over the life expectancy of the LOW. The material shall have a minimum apparent elastic modulus of 4.8 GPa (700 kpsi) during service conditions (Deichelbohrer 1982). A system of two materials joined end to end may be necessary to withstand the forces present in the waste tank. Extra weight shall not be added to the plug/borehead for any reason. Finally, the LOW material shall have a resistivity above 1000 Ω-cm with the total resistance of the LOW being less than 10^6 Ω.

2.1.4 Chemical Resistance

The LOW casing material including joints and the UHPW borehead must maintain its integrity when in contact with the following solutions at 80 °C:

3.0 M NaOH
2.0 M $NaNO_2$
5.0 M $NaNO_3$
2.5 M $NaAlO_2$
0.5 M Na_2CO_3
0.1 M $Na_2Cr_2O_7$

The outside surface of the LOW casing shall have a resin/epoxy rich surface to provide added protection against chemical corrosion.

2.1.5 Radiation Resistance

Cumulative gamma radiation exposure of 10^6 Gy (10^8 rad) which simulates a dose rate of 5 Gy/h (500 rad/h) for 20 years should not compromise the integrity of the LOW nor the UHPW borehead. The dimensional variations of the LOW due to radiation exposure shall not interfere with use.

2.1.6 Pressure Requirements

The LOW joints shall withstand an external positive hydrostatic test to 275 kPa (40 psi) for 15 minutes without any leaks. This test shall be performed at a temperature of 95 °C (200 °F). This test shall be performed by the manufacturer after completion of fabrication of the entire LOW. The pressure shall be cycled five times. The LOW shall also be pressure tested in the field, prior to installation, at 275 kPa (40 psi) using tap water. The LOWs shall be visually inspected during hydrostatic testing. The actual operating pressure of the LOW shall be approximately 220 kPa (32 psi).

2.1.7 Interface Connections Requirements

The LOW tube shall be joined by means of a butt and strap connection (wrapped and cured during assembly) between the tube to tube sections. This will insure a smooth inner surface transition at the butt and strap connection. The thickness of the strap shall be a minimum of 0.317 cm (0.125 in.) with a maximum thickness of 0.413 cm (0.162 in.) for the LOW tube to fit inside a 10.2 cm (4 in.) riser. The length of the strap shall be 15.2 ± 1.3 cm (6.0 ± 0.5 in.).

The LOW shall be joined with the UHPW borehead by means of an adaptor ring. The adaptor ring will be joined with the LOW by filament winding the fibers onto the adaptor ring or by hand laying the bi-directional cloth onto the adaptor ring surface during the manufacturing process. This process will require a special type of mandrel that can accommodate the adaptor ring without damaging the internal surface of the LOW. The mandrel may need to be disconnected into two parts to aid in removing it after the curing process is completed. The wall thickness should increase around the adaptor ring to provide extra strength in that region. To avoid any sharp edges, the outside diameter should gradually increase in size. This larger diameter shall not interfere with the installation of the LOW. The outer surface of the adaptor ring will be knurled to increase the bonding area. The UHPW borehead shall then be welded to the adaptor ring. The unusable inside diameter of the UHPW borehead and adaptor ring shall be less than 15.24 cm (6 in.) measured from the bottom of the LOW.

Methods of joining the tube sections, the UHPW borehead, and the riser flange should not interfere with the operation of the monitoring probes or the installation of the LOWs into the tank risers. The joints must support three times the weight of a 1676 cm (55 ft) long LOW tube with the UHPW borehead attached to it. The joints shall also be strong enough to withstand a collision caused by a probe being lowered to an incorrect well depth and impacting the bottom of the LOW. A worst case impact scenario would be equivalent to a 23 kg (50 lbs) mass dropping at a rate of 61 cm/s (2 ft/s).

2.1.8 Ultra-High Pressure Water Borehead Requirements

The check valve located inside the UHPW borehead must prevent waste from entering the LOW for 20 years under waste tank environment conditions. It must have a minimum crack pressure of 620 kPa (90 psi) and be able to operate at 207 ± 21 MPa (30,000 ± 3,000 psi). The check valve associated with the quick disconnect system prevents water from leaking after disconnecting the system from the UHPW borehead. It should be mechanically held open when the system is connected to the UHPW borehead. This check valve must have a minimum crack pressure of 206 kPa (30 psi) and be able to operate at 207 ± 21 MPa (30,000 ± 3,000 psi). The minimum crack pressure of the check valves shall be tested using clean air and the operating pressure shall be tested using purified water for 5 cycles at 5 minutes per cycle. The assembled UHPW borehead with the quick disconnect system shall also be tested using purified water at 207 ± 21 MPa (30,000 ± 3,000 psi) for 5 minutes and 5 cycles.

2.1.9 Waterproof Requirements

The LOW including all joints should be fabricated to be leak proof. The LOW casing material shall also prevent liquid absorption through the walls.

2.1.10 Thermal Requirements

The maximum temperature that the LOWs must withstand is 80 °C (176 °F). The maximum temperature expected in the ferrocyanide-bearing waste tanks is 53 °C (127 °F), corresponding to tank BY-106 (Hanlon 1995)

2.2 TANK RISER INTERFACE

The LOW shall be compatible with the existing tank riser interface. Existing 10.2 cm (4 in.) uncommitted risers will be preferentially chosen for installation of the LOWs. This will allow larger risers to remain uncommitted and available for future applications requiring a larger riser. If necessary, risers that are larger than 10.2 cm (4 in.) in diameter shall be modified to accept the LOWs. Location of risers should be as close as practical to the center of the tank.

The tank risers are made from 4-inch schedule 40 pipe which have an inner diameter of 10.24 cm (4.03 in.). Over time, these risers have experienced swelling and warping of the tubes. To account for this, the maximum outer diameter of the LOW should be less than 9.525 cm (3.750 in.). This should insure that the LOW will fit into all of the 10.2 cm (4 in.) risers located on top of the waste tanks. To confirm the inner diameter dimensions of the 10.2 cm (4 in.) risers, a Go/No-Go Gauge may be used to measure the inner diameter of the risers. The vertical length of the risers should also be measured to detect any bending or warping that may have occurred in the tubes over time.

2.3 IDENTIFICATION AND MARKING

Identification and marking on the LOWs shall be in accordance with WHC identification standards. The flange connection shall be marked on the outer diametrical surface per HS-BS-0015, type 2 (die-stamping) with 0.0635 cm sized characters. The fiberglass tubing shall be marked per HS-BS-0015, type 8 (painting) using 0.127 cm high yellow characters. Both forms of identification shall include drawing number, part number, and drawing revision. The part number must correspond to a specific LOW assembly, i.e., the flange connection and tube sections of one LOW shall either have linked part numbers or the same part number assigned to them.

2.4 DESIGN LIFE

The LOWs will be expected to have a useful life of 20 years.

3.0 PROCESS CRITERIA

The installation and operational procedure requirements will remain the same as currently installed LOW's procedures because similar conditions exist (RHO 1983). The installation requirements may need revision due to the use of an UHPW borehead for installation of the LOW.

3.1 FREQUENCY OF USE

The schedule for use of the LOW could be as often as once a week.

3.2 TRANSPORTABILITY AND STORAGE

The need for additional testing of the complete LOW assembly upon acceptance may be required due to any damage incurred during shipment, handling, and storage. The adaptor ring, LOW tube, or tube joints may become damaged during movement of the LOW due to rough handling or unclean conditions. Problems may also be encountered in trying to perform on-site tests on a 1676 cm (55 ft) LOW tube including the borehead system. There may also not be an adequate facilities at WHC for performing the acceptance testing. Testing of the complete assembly should be arranged at the supplier's facility to insure that the LOWs function properly before shipment.

If any damage is incurred during shipment from the supplier to WHC, then the damaged LOW should not be accepted. Acceptance should be determined according to the extent of any damage attained during shipment and handling. The extend of the damage can only be determined from careful visual inspection of the LOW assembly and during pressure testing of the LOW. If there is no obvious considerable damage to the LOW surface or interfaces then the LOW should be accepted. If there is extensive damage or noticeable abnormalities on the LOW surface or interfaces then the complete assembly should be returned to the supplier for repair. The supplier of the LOWs should provide documentation of test results on the assembled and operational LOW and borehead to insure adequate functionality.

3.3 INSTALLATION CONSIDERATIONS

During installation, water will be added to the tank by the UHPW borehead. Tank farm operating specifications shall be maintained during installation. Since some of the ferrocyanide-bearing waste tanks are also on the organic watch list, the installation of the LOWs shall take into consideration any requirements set forth for organic-bearing waste tanks.

The quick disconnect system must detach from the UHPW borehead remotely from the inside of the LOW after installation has been completed and be reusable. The method of removal shall not impose any torque on the LOW casing material or the adaptor ring and shall not leak any water into the LOW upon disconnection and removal. The quick disconnect system consists of the water feed line, the reverse check valve, and the disconnecting joint attached to the UHPW borehead. The UHPW borehead shall act as the bottom plug at the conclusion of the installation and seal against waste intrusion. Finally, the design of the quick disconnect system shall permit the variation in length of the LOWs from 914 cm (30 ft) to 1829 cm (60 ft) from order to order.

4.0 FACILITY CRITERIA

The LOW will be installed inside the underground waste tanks located in the 200 East and 200 West Tank Farms. There will be no facility requirements for installation maintenance or operational of the LOW.

4.1 UTILITY REQUIREMENTS

None

4.2 COMMUNICATION REQUIREMENTS

None

4.3 MAINTENANCE REQUIREMENTS

Periodic inspection and repair of the risers and riser covers will be required.

5.0 GENERAL REQUIREMENTS

The safety evaluation shall be based upon the previous LOW Installation Project and the Thermocouple Trees Project. Because similar conditions are expected to exist during this project, the required compliances and procedures will be modeled on the current LOW installation process. Additional safety assessments may be needed due to the operation of the UHPW borehead.

5.1 SAFETY

The installation and operation of the self-installing LOW shall be performed in accordance with the radiation safety requirements specified in HSRCM-1, *Hanford Site Radiological Control Manual*. A formal safety analysis and evaluation is not required because the installation and operation of the LOWs are the same as specified in the safety analysis evaluation for the Thermocouple Trees with the exception that the water feed system shall be removable and reusable (Hertelendy 1994, Farley 1994). Safety reviews performed during the normal planning, design, and execution of the project will mitigate identified hazards associated with installation and operations. An Unreviewed Safety Question (USQ) Safety Evaluation was performed to show that installation of the Self-Installing LOWs using an UHPW borehead in organic-bearing or ferrocyanide-bearing waste tanks are considered safe activities (Farley 1995).

5.2 ENVIRONMENTAL PROTECTION AND COMPLIANCE

The environmental assessment document DOE/EA-0915, Section 3, *Environmental Assessment: Waste Tank Safety Program*, supports the installation, operation, maintenance, and removal of in-tank monitoring devices. In performing this work, installation of the LOWs into the waste tanks in the 200 East Area and 200 West Area Tank Farms is accepted.

The applicable environmental requirements for new and modified facilities, as defined in WHC-CM-7-5, Section 9, *Environmental Compliance Manual*, shall be identified and followed. Applicable permits will be identified and obtained before installation.

5.3 SAFEGUARDS AND SECURITY

No additional requirements are needed to those currently in place at the tank farms as defined in WHC-CM-4-33, *Security Manual*.

5.4 NATURAL FORCE CRITERIA

The requirements of DOE 5480.28, *Natural Phenomena Hazards Mitigation*, shall be complied with in the design of the LOW whenever possible. The requirements for designing, installing, and using the LOWs are:

1. Providing for a safe work condition.
2. Protecting against property loss or damage.
3. Protecting the public health, property, and environment against exposure to hazardous materials.

Because the scope of this project does not include any alteration to the existing tank structure, it may not be possible to meet all of these requirements.

5.5 DESIGN FORMAT

Two-way traceability shall be provided between the tank farm installation drawings and the reference drawings from which they were developed. Tank farm installation drawings shall identify existing drawings that will be affected by the project and identify vendor part and drawing numbers. Design drawing formats will be in accordance with WHC-CM-6-1, Section EP 1.3, *Preparation of Engineering Drawings*.

5.6 QUALITY ASSURANCE

The Quality Assurance (QA) activities for all contractors involved in the design, construction, and acceptance testing shall be executed in accordance with DOE 5700.6C, *Quality Assurance*, to provide the following assurances:

1. Design data and design decisions are documented and traceable.
2. The design and design criteria are adequately supported by the prepared plans, specifications and analyses.

3. The design meets the baseline design criteria.

4. Construction is performed in accordance with the definitive design documents.

5. Testing or modeling, as applicable, confirms the adequacy of the design, the quality of the construction and manufactured components, operability and maintainability, and reliability. The QA activities are formulated and executed through the use of the project specific quality assurance plan in accordance with WHC-CM-4-2, Section QI 2.1, *Quality Assurance Manual*.

5.7 DECONTAMINATION AND DECOMMISSIONING

The LOW design shall facilitate future decontamination as prescribed in WHC-CM-7-5, Section 6.4, *Environmental Compliance*. The LOWs will be decontaminated and decommissioned after serving their design life. The LOWs shall have a smooth exterior (i.e., contain no crevices that can trap waste) that will be easy to clean during removal. The project will also minimize hazardous waste generation and use of hazardous materials during construction, installation, and operation. By using an UHPW borehead for installing the LOW, the amount of water added to the waste tanks will be greatly reduced. Present installation methods require 379 L - 1893 L (100 gal - 500 gal) of water while the UHPW borehead will utilize less than 189 L (50 gal) of water.

5.8 OPERATING PERSONNEL AND SERVICES

Additional trained and certified operating personnel will be required during installation.

5.9 TESTING

Testing of the proposed LOW casing materials and joints shall be performed to establish the durability of the material and the quality of construction in the working environment. The material testing shall include exposing the LOW materials to expected gamma radiation while embedded in a corrosive solution and standard destructive tests to establish material properties before and after irradiation. The joint testing shall include bending, pulling, leakage, and impact testing to establish that the LOW joints can withstand worst case expected conditions (Parra 1995).

6.0 CODES AND STANDARDS

The codes and standards that will be utilized in the design and testing of the self-installing LOW are given in the following subparagraphs. These standards should be followed and any deviations from these standards should be stated in WHC-SD-WM-TD-008, *Test Results for Qualification of the Self-Installing Liquid Observation Well*.

6.1 AMERICAN SOCIETY FOR TESTING AND MATERIALS

The American Society for Testing and Materials (ASTM) testing standards should be used as a reference during the testing of the materials. The most current revision should be used.

ASTM D3039-76, *Standard Test Method for Tensile Properties of Fiber-Resin Composites*, American National Standard, Washington, D.C.

ASTM D790-92, *Standard Test Method of Unreinforced and Reinforced Plastics and Electrical Insulating Materials*, American National Standard, Washington, D.C.

ASTM E329-93, *Standard Practice for Use in the Evaluation of Testing and Inspection Agencies as Used in Construction*, American National Standard, Washington, D.C.

ASTM E548-91, *Standard Guide for General Criteria Used for Evaluating Laboratory Competence*, American National Standard, Washington, D.C.

6.2 U.S. DEPARTMENT OF ENERGY HEADQUARTERS

DOE 5480.28, *Natural Phenomena Hazards Mitigation*, Washington, D.C. "Interim Guidance for Preparing Safety Assessments," Rev. 2, March 6, 1992.

DOE 5700.6C, *Quality Assurance*, Washington, D.C.

DOE 6430.1A, *General Design Criteria*, Washington, D.C.

DOE EA-0915, *Environmental Assessment: Waste Tank Safety Program*, Hanford Site, Richland, Washington.

6.3 WESTINGHOUSE HANFORD COMPANY

HSRCM-1, *Hanford Site Radiological Control Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-2, *Quality Assurance Manual*, Section QI 2.1, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-3, *Industrial Safety Manual*, Volumes 1, 2, and 4, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-11, *ALARA Program Manual*, Westinghouse Hanford Company, Richland, Washington.

WHC-CM-4-33, *Security Manual*, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX A

SINGLE-SHELLED TANKS WITH LIQUID OBSERVATION WELLS

APPENDIX IS FOR ARCHITECT-ENGINEER INFORMATION ONLY

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Single-Shelled Tanks with Liquid Observation Wells[1,2]

Tank Number	LOW Material	Date Installed	Riser Size (in)	Riser Number	Watchlist Status	LOW Status
1. A-101	FG	08/13/84	4	19	H,ORG	
2. A-103	FG	08/13/84	4	19		
3. AX-101	FG	08/15/84	6	9A	H	
4. B-104	FG	07/24/84	12	6		
5. B-105	FG	07/23/84	4	5		
6. BX-111	FG	08/09/84	4	5		
7. BY-101	FG	07/18/84	4	9A		
8. BY-102	FG	07/17/84	4	1		
9. BY-103	FG	07/16/84	4	10A	FeCN	
10. BY-104	FG	07/19/84	4	10C	FeCN	
11. BY-105	FG	07/19/84	4	10B	FeCN	
12. BY-106	FG	07/13/84	4	10B	FeCN	
13. BY-107	FG	09/13/83	12	7	FeCN	
14. BY-109	FG	07/11/84	12	12B		
15. BY-110	FG	06/25/84	4	3	FeCN	
16. BY-111	FG	06/27/84	4	1	FeCN	
17. BY-112	FG	06/28/84	6	15	FeCN	
18. S-101	FG	05/14/84	4	2		
19. S-102	FG	05/03/84	12	5	H,ORG	
20. S-103	FG	05/04/84	4	2		
21. S-105	FG	05/17/84	4	14		
22. S-106	FG	05/04/84	4	4		
23. S-108	FG	09/13/83	4	16		
24. S-109	FG	05/07/84	12	8		
25. S-110	FG	05/16/84	4	2		
26. S-111	FG	05/16/84	4	16	H,ORG	
27. S-112	FG	05/07/84	12	8	H	
28. SX-101	FG	05/22/84	4	14	H	
29. SX-102	FG	05/22/84	4	14	H,ORG	
30. SX-103	FG	05/21/84	4	14	H	
31. SX-104	TZ,FG	05/22/84	4,4	14,16	H	TZ and FG LOWs failed
32. SX-105	FG	05/25/84	4	16	H	
33. SX-106	FG	05/21/84	4	14	H,ORG	

Tank Number	LOW Material	Date Installed	Riser Size (in)	Riser Number	Watchlist Status	LOW Status
34. T-104	FG	08/23/84	4	1		
35. T-110	FG	08/23/84	4	5	H	
36. T-111	FG	06/01/84	12	7	ORG	
37. TX-102	FG	08/17/84	4	11A		
38. TX-105	FG	08/16/84	4	9B	ORG	Riser hit by truck
39. TX-106	FG	08/16/84	4	11A		
40. TX-108	FG	08/17/84	4	9A	ORG	
41. TX-109	FG	06/03/84	4	3		
42. TX-110	FG	06/13/84	4	13B		
43. TX-111	FG	06/15/84	4	11B		
44. TX-112	FG	07/25/84	4	12A		
45. TX-113	FG	06/11/84	4	4		
46. TX-114	FG,CS,CS	06/14/84	12,4,4	7,12A,9A		Riser 7 Monitored
47. TX-115	FG	06/14/84	4	9A		
48. TX-117	FG	07/19/84	12	7		
49. TX-118	FG	07/16/84	12	5	FeCN,ORG	
50. TY-103	CS	08/21/86	4	3	FeCN	Endplug failed-LOW replaced
51. U-102	FG	08/23/84	12	2		
52. U-103	FG	08/21/84	4	19	H,ORG	
53. U-105	FG	08/21/84	4	19	H,ORG	
54. U-106	FG	08/21/84	4	9	ORG	
55. U-107	FG	08/22/84	4	19	ORG	
56. U-108	FG	08/21/84	4	19	H	
57. U-109	FG	08/22/84	4	9	H	
58. U-111	FG	08/22/84	4	19	ORG	

TOTAL Number of Tanks with LOW: 58
(SX-104 LOW is inoperable)

FG = E-Type Fiberglass
TZ = Tefzel
CS = Carbon Steel
FeCN = Ferrocyanide watchlist tank
ORG = Organic salts watchlist tank
H = Hydrogen watchlist tank

[1] Watson, W.T., 1994, Survey for New Liquid Observation Well and Liquid Observation Well Material Considerations for Neutron Probe Applications, Westinghouse Hanford Company, Richland, Washington.

[2] Some of the FG LOWs have been replaced with carbon steel LOWs. The location and number of carbon steel LOWs are unknown.

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