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SYSTEM DESIGN SPECIFICATION
FOR THE 1/4-SCALE TANK AND
ANCILLARY EQUIPMENT

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FUNCTIONAL DESIGN CRITERIA

1/4-SCALE TEST FACILITY
A PART OF THE DOUBLE-SHELL TANK
FLUID DYNAMICS TEST FACILITY

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EXECUTIVE SUMMARY

The Fluid Dynamic Test Facility (FDTF) is located in the 336 Building at the 300 Area of the Hanford Site. The FDTF will contain tanks that model the average internal diameter and height of a 3875 m³ (1-million-gal) double-shell tank at both 1/12- and 1/4-scale, as well as ancillary equipment required to store, mix, and transport waste simulants. Experiments to be conducted in this facility will include investigations of sludge mobilization, slurry uniformity, aerosol generation, sludge washing, and instrumentation development to support start-up of the Hanford Waste Vittrification Project. This facility will also be used to model concepts and mitigating strategies to be used in the resolution of tank safety issues and the retrieval of waste from watch-list tanks.

This document presents the functional design criteria for the 1/4-Scale Test Facility portion of the FDTF, which includes:

- the 1/4-scale tank with a removable 1/4-scale dome
- two tanks for preparation of simulant sludge and supernatant
- interconnecting piping and pumps
- instrumentation and process control systems
- data acquisition and analysis systems.

The other portions of the FDTF are either existing equipment to be relocated to the FDTF or planned future additions to the facility. Existing equipment originally located in the 324 Building and to be moved to the FDTF includes:

- solids handling equipment for simulant preparation
- the 1/12-scale tank with its ancillary equipment
- experimental full-scale-diameter, pipe-loop equipment.

Future additions to the FDTF in the 336 Building include:

- long-term simulant storage tanks
- full-scale-diameter, pipe-loop modifications and expansions

- fluid settling columns for sludge washing experiments.

These various components will be interconnected so that all subsystems can share the same simulant preparation equipment, transfer piping, and storage tanks. This will make the FDTF a flexible system that can be readily adapted to test retrieval concepts and to provide scaled testing of strategies to resolve tank safety issues.

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NOMENCLATURE

ALARA	as low as reasonably achievable
DST	double-shell tank
FDC	functional design criteria
FDTF	fluid dynamic test facility
GTF	grout treatment facility
HWVP	Hanford waste vitrification plant
NFPA	National Fire Protection Act
PNL	Pacific Northwest Laboratory
QA	quality assurance
SST	single-shell tank
UBC	Uniform Building Code
$U_0 D_0$	jet exit parameter
WHC	Westinghouse Hanford Company
WISHA	Washington Industrial Safety and Health Act

1.0 INTRODUCTION

The 1/4-Scale Test Facility will be used to conduct experiments that support waste retrieval activities at Hanford via development of correlations describing equipment performance.

1.1 BACKGROUND

The experiments to be conducted in the FDTF will support waste retrieval, resolve tank safety issues, and evaluate mechanisms that influence sludge washing.

1.1.1 Vitrification, Grout, and Waste Retrieval

Radioactive wastes at the Hanford Site are stored in 3875 m³ (1-million gal) double-shell tanks (DSTs) and other older single-shell tanks (SSTs). Disposal of Hanford defense wastes includes conversion of liquids and solids from the DSTs and SSTs into a solid form, either as glass from the Hanford Waste Vitrification Plant (HWVP) or as grout from the Grout Treatment Facility (GTF).

The first step in waste disposal processes is the physical retrieval of the liquids and solids from the tanks. Solids in the waste tanks have been settling for many years, creating sludge layers on the tank bottoms. Jet mixing pumps and other mechanisms are being investigated for use to re-suspend the sludge in the supernatant liquids. The accomplishment of retrieval operations will also allow optimum utilization of existing DST space and will be one step in preparation of the DSTs for final disposition at the end of their service life.

1.1.2 Tank Safety Issues

Tank safety issues at the Hanford Site must be resolved so that the risk of exposure to the public, the worker, and the environment are kept as low as reasonably achievable (ALARA). These tank safety issues include waste tanks that generate hydrogen, contain ferrocyanide and/or organic materials, and

tanks that contain high heat generating wastes. Many methods are being studied to resolve these issues.

1.1.3 In-Tank Sludge Washing

Jet mixing pumps will also be used as the mechanism for suspending and stirring the solids during the in-tank pretreatment process of sludge washing. This pretreatment process is scheduled for some DST wastes.

1.2 EQUIPMENT PERFORMANCE CORRELATION DEVELOPMENT

Prior to operations in waste tanks, correlations to describe equipment performance will be determined via geometrically scaled experiments. For example, scaled experiments to model waste re-suspension have been conducted at bench-scale, laboratory-scale and at 1/12-scale, and scaled experiments to develop correlations of jet static forces impacting tank components have been conducted at 1/6-scale with a partial mockup (Bamberger, Bates and Waters 1990 and 1992).

Some processes, such as maintaining slurry uniformity, cannot be completely modelled in the existing 1/12-scale equipment because fluids with the required physical properties are not available to allow all dimensionless force ratios to be matched simultaneously. The addition of a 1/4-scale facility will allow slurry uniformity experiments to be conducted in a range where all important parameters are adequately scaled. Also, 1/4-scale confirmation of results obtained from smaller-scale sludge mobilization and jet force experiments will increase confidence in scaling relationships to predict behavior in a full-scale waste tank.

1.3 SCOPE

The Fluid Dynamic Test Facility (FDTF) is located in the 336 Building at the 300 Area of the Hanford Site. The FDTF will contain tanks that model the average internal diameter and height of a 3875 m³ (1-million gal) DST at both 1/12- and 1/4-scale, as well as ancillary equipment required to store, mix, and transport waste simulants.

This document presents the functional design criteria (FDC) for the 1/4-Scale Test Facility portion of the FDTF (see Figure 1.1). This portion of the facility will model the major internal dimensions (including vapor space) of a DST at a scale of 1:4 and includes tanks for simulant preparation, pumps for simulant transfer, and other ancillary equipment necessary to support operation of the 1/4-scale tank.

The objectives of this functional design criteria document are to:

- define the criteria and requirements for the 1/4-scale portion of the FDTF
- define the range of operation of the ancillary equipment including piping, pumps, heat exchangers, and process control
- define the instrumentation required to monitor and control facility operation.

Functional requirements are defined in Section 2.0. Equipment design activities are described in Section 3.0. In Section 4.0 existing equipment to be moved and installed in the FDTF and also future equipment to be added to the FDTF are identified. General requirements are summarized in Section 5.0.

FIGURE 1.1 Fluid Dynamics Test Facility and Scope of the Functional Design Criteria

2.0 FUNCTIONAL REQUIREMENTS

The completed 1/4-Scale Test Facility portion of the FDTF shall provide the capabilities to:

- prepare and characterize the properties of waste simulants
- transport simulants between tanks
- conduct experiments at 1/4-scale to model
 - sludge mobilization
 - slurry uniformity
 - dynamic forces on tank components
 - aerosol/vapor generation
 - particulate settling rates
 - sludge washing efficiency
 - thermal effects in waste transfer and storage
- determine performance of developmental instrumentation
- monitor and control the system operating conditions
- evaluate tank safety mitigation strategies.

2.1 LOCATION AND INTERFACES

The 1/4-Scale Test Facility portion of the FDTF shall be located within the 336 Building at the 300 Area of the Hanford Site. Process water and electricity shall be supplied by connections with existing distribution systems within the 336 Building. Other than water and electrical power, the 1/4-Scale Test Facility shall be capable of independent operation.

No discharge to the 300 Area water treatment system is allowed under present permits. To meet this requirement, the FDTF will be connected to two existing storage holding tanks to be located outside the 336 Building.

Simulants will be evaluated to determine whether they are classified as non-hazardous or hazardous waste. Based on this determination, the waste will be disposed of in accordance with established Pacific Northwest Laboratory procedures.

2.2 FACILITY OPERATIONS

Upon completion of installation, testing, and acceptance of the 1/4-scale tank and ancillary equipment, it shall be operated under an approved Safe Operating Procedure prepared by Pacific Northwest Laboratory. Test procedures will be prepared to define exact requirements specific to the objectives of each experiment.

2.3 DESIGN LIFE

The vessels, structural supports, and piping designed specifically for this facility shall be designed for 30 years of operation. Replaceable equipment and components, instrumentation, and specially designed test equipment may be designed for a lesser number of years, but generally not less than 5 years.

2.4 OPERATING ENVIRONMENT

All equipment exposed to synthetic waste simulant shall be compatible with water; a pH range from 6 to 14; the presence of concentrated sodium or calcium carbonate, and/or other chemicals and solutions (such as sodium nitrate, sodium nitrite, sodium silicate, and sodium chloride), and a wet or dry environment. Those in-tank components that are not submerged in chemical solutions may be exposed to vapor at temperatures from 20°C to 80°C.

2.5 SIMULANT PROPERTIES

Simulants with controlled physical properties are required to conduct scaled experiments. Two types of simulants have been used in previous pilot-scale tests.^(a) In Table 2.1 the physical and rheological properties of the target and actual simulant properties are summarized to be used as guidance in design and selection of equipment and controls.

(a) Powell, M. R., C. L. Fow, G. A. Whyatt, P. A. Scott, and C. M. Ruecker. 1990. Proposed Test Strategy for the Evaluation of Double-Shell Tank Sludge Mobilization. (A letter report for Westinghouse Hanford Company). Pacific Northwest Laboratory, Richland, Washington.

TABLE 2.1 Simulant Properties

<u>Property</u>	<u>Target Simulated Waste Properties</u>	<u>Silica Simulant</u>	<u>Clay/Ludox Simulant</u>
Shear strength, Pa	3300 to 3700	500 to 3500 (adjustable)	1000 to 18000 (adjustable)
Sludge density, kg/m ³	1500 to 1800	1800	1500
Slurry density, kg/m ³	1300 to 1400	1300	1300
Slurry viscosity, Pa-s	0.003 to 0.006	0.003 to 0.010	0.003 to 0.040
Sludge weight % solids	< 75		
Slurry weight % solids	0 to 50		
Rheology	near Newtonian or low yield Bingham plastic	near Newtonian	near Newtonian

3.0 EQUIPMENT DESIGN CRITERIA

Design criteria are listed below for equipment included in the 1/4-Scale Test Facility.

3.1 1/4-SCALE TANK

The 1/4-scale tank will model the major internal dimensions of a typical Hanford 3875 m³ (1-million-gal) DST at a scale of 1:4. The full-scale DST and 1/4-scale tank dimensions are defined in Table 3.1. This tank shall be constructed of stainless steel.

TABLE 3.1 Prototype Waste Tank and 1/4-Scale Vessel Dimensions

<u>Parameter</u>	<u>Full-Scale</u>	<u>Quarter-Scale</u>
Nominal diameter	22.9 m (75 ft)	5.73 m (18.75 ft)
Knuckle radius	0.30 m (1.0 ft)	0.075 m (0.25 ft)
Capacity	3875 m ³ (1x10 ⁶ gal)	59 m ³ (15,625 gal)
Vapor space above liquid	~1330 m ³ (~47,000 ft ³)	~20 m ³ (730 ft ³)
Fluid depth		
Minimum working	1.2 m (4 ft)	0.3 m (1 ft)
Nominal working	9.1 m (30 ft)	2.3 m (7.5 ft)
Distance from tank centerline to mixer pump centerline	0 to 6.7 m (0 to 22.0 ft)	0 to 1.7 m (0 to 5.5 ft)

The 1/4-scale tank and support structure shall include the following features:

- accommodate up to four dual-jet oscillatory mixing pumps (the 1/4-scale FDTF will be initially equipped with one dual-jet mixing pump)
- a removable tank cover for use when tank dome is not applied

- crane access provided to the top of the vessel for insertion/removal of mixing pumps and other scaled components
- 3-in.-diameter (7.6-cm) drain and flexible drain line with provision to connect to a transfer pump
- leak tested at ambient pressure and temperature with water for 24 hr
- gratings, walkways, and removable ladders to provide personnel access to the tank perimeter and interior.

3.2 1/4-SCALE TANK DOME

The dome for the 1/4-scale tank must be removable, and the vessel must function with or without the dome in place. The ports in the 1/4-scale tank dome must facilitate the equipment listed in Table 3.2. The dome must mate with the vessel and be able to accept both positive and negative pressure surges of ± 7.6 cm (± 3 in.) H_2O from ambient. It may be constructed of any material that does not corrode in a pH range from 6 to 14, in the presence of concentrated sodium carbonate (Na_2CO_3) solutions and/or a wet, or high salt environment at a temperature range from 20°C to 80°C.

3.3 SLURRY AND SUPERNATANT VESSELS

Two vessels, in addition to the 1/4-scale tank, are required for preparing, separating, and quantifying the simulant supernatant and solids. The supernatant vessel shall be able to contain 45 m³ (12,000 gal) and shall be constructed with a rounded bottom to facilitate supernatant transfer. The slurry vessel shall be able to contain 30 m³ (8,000 gal) and shall be equipped with a materials handling system capable of handling solids and settled sludge. Both secondary vessels shall be constructed of stainless steel.

The vessels and support structure shall include the following features:

- load cells to continuously monitor the weight of tank contents
- a removable flexible cover
- crane access provided to the top of the vessel
- mechanical mixer type agitation for each tank

- gratings, walkways, and removable ladders to provide personnel access to the vessel perimeter and bottom
- leak tested at ambient pressure and temperature with water for 24 hr.

The slurry vessel also requires:

- 15-cm-diameter (6-in.) bottom drain connected to a positive displacement type pump for solids transfer
- steep, approximately 45 degree wall angle, cone-shaped bottom to aid sludge removal
- adjustable dip leg (floating, flexible hose suction line) for settle/decant procedures.

3.4 1/4-SCALE MIXING PUMPS

The principle features of the mixing pumps will be scaled geometrically and dynamically from the proposed full-scale mixing pump design. Each mixing pump is a centrifugal pump with the inlet closely coupled to the outlet. The facility will be designed to accommodate four scaled mixing pumps^(a) operating simultaneously, as desired, located at scaled distances representative of mixing pump locations in the full-scale tank. The specifics of the currently favored mixing pump design and location and orientation in the tank are listed in Table 3.2.

3.5 TRANSFER PUMP

Scaled transfer pumps for use in simulated transfers out of waste tanks will not be installed with the 1/4-Scale Test Facility portion of the FDTF. The transfer pump design criteria will be developed in the future as part of

(a) Mixing pumps will be obtained from the Westinghouse Hanford Company (WHC) equipment pool and modified to suit experimental requirements. If no suitable pumps are available, a request for capital funds will be prepared by WHC.

TABLE 3.2 Full-Scale and 1/4-Scale Mixing Pump Dimensions/Parameters

<u>Mixing Pump Dimensions</u>	<u>Prototype</u>	<u>1/4-Scale</u>
Nozzle diameter	0.15 m (6 in.)	0.0375 m (1.5 in.)
Distance, tank floor to nozzle centerline	0.30 m (12 in.) 0.46 m (18 in.)	0.075 m (3.0 in.) 0.12 m (4.5 in.)
to pump intake	0.15 to 0.20 m (6 to 8 in.)	0.0375 to 0.0508 m (1.5 to 2.0 in.)
Distance, pump centerline to nozzle discharge	0.44 m (17.5 in.)	0.11 m (4.375 in.)
<u>Jet Properties</u>		
100% $U_o D_o$	2.73 m ² /s (29.4 ft ² /s)	0.68 m ² /s (7.35 ft ² /s)
$U_o D_o$ operating range	25% to 100%	5% to 120%
Discharge angle, from vertical	90° +3, -0	90° +3, -0
Rate of oscillation	0.1 rpm	0.1 to 0.6 rpm (adjustable)

other retrieval specific experiments. Non-scaled pumps for waste transfers will be discussed in Section 3.6.

3.6 AUXILIARY PUMPS

A pump for transferring simulants between vessels is required. This pump must be capable of operating over the entire range of rheologies required for testing (see Table 2.1). A progressive cavity (Moyno) pump currently used for powering the mixing pumps in the 1/12-scale facility will be relocated and used for these transfer operations.

3.7 PIPING

The piping system will allow simultaneous mixing, transfer, and transport operations and will facilitate the transfer of water or simulant between any of the 1/4-scale tanks, the 1/12-scale portion of the FDTF, or the

pipe loop. The connecting piping will be constructed of stainless steel, Schedule 40, nominal 7.6-cm-diameter (3-in.) pipe. Lines specified for the transport of water only may be specified at a smaller diameter. All piping will be leak tested as per ANSI/ASME B31.3. A simplified schematic of the tanks, piping, valving, pumps, heating/cooling, control and instrumentation details is shown in Figure 3.1.

3.8 INSTRUMENTATION, MONITORING, AND CONTROL SYSTEMS

System, fluid, and control parameters will be instrumented, monitored, and controlled by an automatic data acquisition and control system. The 1/4-Scale Test Facility portion of the FDTF must be instrumented and controlled to operate unattended. The instrumentation and control system shall include the following capabilities:

- monitor and control mixing pump flow rates ranging from 2.4×10^{-3} to $4.9 \times 10^{-2} \text{ m}^3/\text{s} \pm 2\%$ (38 to 780 gal/min $\pm 2\%$)
- monitor and control fluid temperature
 - in-tank 20 to 80°C $\pm 1^\circ\text{C}$
 - exiting nozzle 20 to 80°C $\pm 1^\circ\text{C}$
- monitor and control fluid viscosity
 - in-tank 0.4 to 4.0 cP $\pm 2\%$
 - exiting nozzle 0.4 to 4.0 cP $\pm 2\%$
- monitor liquid level of all tanks to within $\pm 0.16 \text{ cm}$ ($\pm 1/16 \text{ in.}$)
- monitor weight of all tanks.

Parameters will be automatically controlled with a closed-loop system because of waste disposal restrictions in the 300 Area.

Automatic control elements, such as valves, will be selected so that they may either be operated manually or automatically. Redundant (manual) control of major parameters will be provided in the event of malfunction in the automatic system. Manual control valves will be selected, as appropriate, so that they may be upgraded to automatic operation in the future. The system must include automatic shut down capability for the pump loop if a high pressure or cavitation condition occurs.

FIGURE 3.1 Piping Schematic of 1/4-Scale Facility

FIGURE 3.1 Piping Schematic of 1/4-Scale Facility (condt)

4.0 ADDITIONAL FDTF EQUIPMENT

Equipment to support the 1/4-Scale Test Facility is separated into three categories: equipment included within the scope of this functional design criteria (described in Section 3.0), existing equipment to be transferred in this facility (described in Section 4.0), and planned future facility enhancements (described in Section 4.0).

4.1 EXISTING EQUIPMENT

In addition to the 1/4-Scale Test Facility portion of the FDTF, existing equipment from previous retrieval technology development programs (shown in Figure 1.1) will be installed in the FDTF. This includes, but is not limited to:

- the existing 1/12-scale pilot test tank and auxiliary equipment (see Appendix A)
- the existing Grout Test Facility solids handling equipment (see Appendix B)
- portions of the existing waste transport test loop (see Appendix C)
- the existing MAC-II data acquisition system.

Two existing pumps from the 189D Building will be relocated to support operations in this facility. These are a 500-gpm high-head horizontal pump and a 100-gpm vertical pump. These pumps can be used for water-based experiments and will be investigated for use with dilute mixtures with very small diameter particulate with low solids content.

4.2 FUTURE EQUIPMENT

In addition to the 1/4-Scale Test Facility portion of the FDTF, future equipment shown in Figure 1.1 will be installed in the FDTF. This equipment includes:

- simulant storage tanks to be located outside the 336 Building
- additions to the existing waste transport test loop

- expanded data acquisition and control capabilities.

5.0 GENERAL REQUIREMENTS

Safety, quality assurance, and pertinent regulations that affect the 1/4-Scale Test Facility are summarized.

5.1 SAFETY

Safety analyses shall be performed as appropriate.

5.2 QUALITY ASSURANCE AND IMPACT LEVEL

Quality Assurance (QA) requirements for activities within the defined scope of work shall be in accordance with PNL-MA-70, Quality Assurance Manual (1991). The work scope of this task has been defined as PNL Impact Level III. Final determination of component and subsystem impact levels shall be made as a part of the individual tasks and test plans governing each experiment.

5.3 REGULATIONS, CODES, AND STANDARDS

Project design and construction efforts shall be in accordance with the following standards, codes, and regulations, as applicable:

- NFPA (National Fire Protection Act) Standard 70 (NEC)
- WISHA (Washington Industrial Safety and Health Act)
- UBC (Uniform Building Code) 1988 edition.

6.0 REFERENCES

Bamberger, J. A., J. M. Bates, and E. D. Waters. 1990. Final Report Experimental Characterization of Jet Static Forces Impacting Waste Tank Components. PNL-7394, Pacific Northwest Laboratory, Richland, Washington.

Bamberger, J. A., J. M. Bates, and E. D. Waters. 1992. "Experimental Characterization of Jet Forces on Waste Tank Components." PNL-SA-19999, High Level Radioactive Waste Management, Proceedings of the Third International Conference, Vol 1, pp 628-635, American Nuclear Society, La Grange Park, Illinois.

Pacific Northwest Laboratory. 1991. Quality Assurance Manual. PNL-MA-70, Richland, Washington.

APPENDIX A

1/12-SCALE DST AND ANCILLARY EQUIPMENT

APPENDIX A

1/12-SCALE DST AND ANCILLARY EQUIPMENT

The 1/12-scale double-shell tank facility is used to conduct scaled fluid dynamic experiments to model mobilizing waste and maintaining slurry uniformity using mixer pumps. The facility includes 1/12-scale mixer pumps, simulant preparation equipment, and instrumentation.

The 1/12-scale tank models the major internal dimensions of a Hanford 3875-m³ (1-million-gal) DST, including the tank knuckle (the corner radius connecting the tank wall and floor). The tank is made of 304L stainless steel and can be configured to represent the actual locations of the tank penetrations and internal components.

The 1/12-scale mixer pump simulates the operation of the proposed full-scale jet mixer pump. A centrifugal pump draws simulant up the inside tube of the model pump and through the centrifugal pump. The simulant then discharges through the mixing pump annulus, out two diametrically-opposed nozzles. The 1/12-scale nozzle is designed to simulate the nozzle in the prototype pump and can oscillate or rotate as required.

Simulant preparation equipment includes make-up and holding tanks and a transfer pump. The make-up tank is a 0.684 m² (180 gal) carbon steel tank [0.762-m (30-in.) in diameter by 1.5-m (5-ft) high] equipped with an agitator. Three load cells, one under each support leg, are accurate to ± 0.5 kg (± 1.1 lbm). The tank is used for slurry preparation and for slurry transfers.

The holding tank is a 2.135 m² (564 gal) carbon steel tank [1.22-m (4-ft) in diameter by 1.8-m (6-ft) high]. The holding-tank piping is routed to allow transfer of slurry to or from either the make-up tank or the 1/12-scale tank, or to drain.

The transfer pump is used for transferring slurry to or from any of the tanks, circulating slurry within the tanks, draining the tanks, and flushing the piping. The transfer pump is a centrifugal pump driven by a 1490 W

(2-hp), single-phase, 230-volt motor with a mechanical shaft seal. The pump has a capacity of $0.00317 \text{ m}^3/\text{s}$ (50 gpm) at 15 m (50 ft) of head.

APPENDIX B

MATERIALS HANDLING AND SIMULANT PREPARATION

APPENDIX B

MATERIALS HANDLING AND SIMULANT PREPARATION

The functional requirements associated with the materials handling and simulant preparation equipment to be moved from the 324 Building (Grout Program) to the 336 Building for use with the FDTF are summarized.

The materials handling system has several functions:

- to provide an automated method for metering and mixing materials into the specified simulant
- to transfer the simulant into the test facility
- to transfer the simulant from the test facility for storage or disposal.

The materials handling system may be either a continuous or batch unit. The processing period for simulant preparation may span from several days up to 2 weeks depending upon the simulant specifications. The materials handling may include both pump loop systems for liquid simulants and a screw conveyor or other mechanical handling systems. The facility design will incorporate components of the Grout Test Facility, which include a dry solids vacuum handling system and an air cleaning system for transporting and controlling emissions from the dry solids. The unit is designed to meter dry solids into the rotary mixing in a continuous process.

The simulant preparation portion of the system must include mixers with adequate capacity to produce a uniform simulant from the simulant recipe. Typical simulant recipes used for the sludge mobilization experiments are listed in Table 2.1. Additional information on simulant composition is given by Powell.^{(a),(b)}

-
- (a) M. R. Powell, C. L. Fow, G. A. Whyatt, P. A. Scott, and C. M. Ruecker. 1990. Proposed Test Strategy for the Evaluation of Double-Shell Tank Sludge Mobilization. (A letter report for Westinghouse Hanford Company), Pacific Northwest Laboratory, Richland, Washington.
 - (b) M. R. Powell. 1991. The Current Status of DST Sludge Mobilization Research. (An interim working document for the Double-Shell Tank Retrieval Project), Pacific Northwest Laboratory, Richland, Washington.

APPENDIX C

WASTE TRANSFER FULL-SCALE DIAMETER PIPE LOOP

APPENDIX C

WASTE TRANSFER FULL-SCALE DIAMETER PIPE LOOP

A 7.6 cm-diameter (3-in.) pipe loop will be constructed in the 336 Building. The loop will be used to characterize, at full scale, the transport of double-shell tank slurries through piping networks similar to those on the Hanford Site and to develop operating strategies to resuspend materials that settle in the lines during pump outages. The loop will handle both Newtonian and non-Newtonian simulants.

The test facility requires a pipe flow loop that includes the following components:

- one 60-ft straight horizontal pipe
- one centrifugal pump with a flow rate of 1.3×10^{-3} to 6.3×10^{-3} m³/s (20 to 100 gal/min) capable of handling slurries with physical properties similar to Hanford wastes
- one holding tank of volume adequate to contain loop contents
- special fittings and components including one elbow, one PUREX connector, two ball valves, and one expansion loop
- one flow meter to measure the volume flow rate of fluid in test loop
- in-line density monitor
- two differential pressure transducers for each set of pressure measurements to be performed (18 transducers total)
- two horizontal plug test sections and two vertically oriented elbow test sections.

The pipe loop will be constructed of either stainless steel or carbon steel pipe to be consistent with the materials for the planned cross-site transfer line.

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9	<u>Westinghouse Hanford Company</u>		
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