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Document #: SD-WM-PTP-027

Title/Desc:
MIXER PUMP TEST PLAN FOR DST AZ101

Pages: 30

COMPLETE

ENGINEERING CHANGE NOTICE

Page 1 of 2

1. ECN 164966

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 []	G. A. Symons, Retrieval Engineering, H5-61, 372-0384	[] Yes [X] No	2/22/96
	5. Project Title/No./Work Order No.	6. Bldg./Sys./Fac. No.	7. Approval Designator
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12. Description of Change

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13a. Justification (mark one)

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ENGINEERING CHANGE NOTICE

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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	[]	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.

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~~WHC-SD-WM-PTP-027, Rev 0~~ (GAS) N/A		

20. Approvals

Signature	Date	Signature	Date
OPERATIONS AND ENGINEERING		ARCHITECT-ENGINEER	
Cog. Eng. GA Symons [signature]	2-22-96	PE	
Cog. Mgr. EJ Kosiancic [signature]	2-28-96	QA	
QA RE Clayton [signature]	2-22-96	Safety	
Safety H. Aguirre [signature]	2/23/96	Design	
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Mixer Pump Test Plan for Double-Shell Tank AZ-101

Gina A. Symons
Westinghouse Hanford Company, Richland, WA 99352
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Abstract: Westinghouse Hanford Company has undertaken the task to develop and demonstrate a method of retrieval for double-shell tank waste. Mixer pumps were chosen as the planned method of retrieval for DSTs, based on engineering technology studies, past experience with hydraulic sluicing at the Hanford Site, and experience with mixer pumps at the Westinghouse Savannah River Site.

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RECORD OF REVISION	(1) Document Number WHC-SD-WM-PTP-027	Page 1

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Mixer Pump Test Plan for Double-Shell Tank AZ-101

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MIXER PUMP TEST PLAN FOR DOUBLE-SHELL TANK AZ-101

February 1996

G. A. Symons

Westinghouse Hanford Company
Richland, Washington

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TABLES

FIGURES

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MIXER PUMP TEST PLAN FOR DOUBLE-SHELL TANK AZ-101

1.0 INTRODUCTION

Westinghouse Hanford Company has undertaken the task to develop and demonstrate a method of retrieval for double-shell tank (DST) waste. Mixer pumps were chosen as the planned method of retrieval for DSTs based on engineering technology studies, past experience with hydraulic sluicing at the Hanford Site, and experience with mixer pumps at the Westinghouse Savannah River Site (WSRS).

1.1 BACKGROUND

Although some tests of mixer pumps have been performed in actual waste tanks at the Hanford Site, those tests have been of limited scope, using only one mixer pump at a time. Retrieval work at WSRS, and at West Valley Nuclear Services has shown that more than one mixer pump must be used in a tank to achieve mobilization of a large fraction of the settled solids. The Hanford Site DST waste is thought to be similar to the WSRS waste, and thus it is probable that multiple mixer pumps will be required.

Tank AZ-101 has been selected as the first full-scale demonstration testing of a retrieval system. Tank AZ-101 is located in the AZ Tank Farm in the 200 East Area. The tank is a 3,785,400-liter, (1 million- gal), 23-meter (75-ft) diameter double-shell underground storage tank. The tank currently holds over 900,000 gal of neutralized current acid waste, including approximately 45.7 cm (18 in) of settled solids (sludge) at the bottom of the tank.

Project W-151 will provide two mixer pumps of the largest practical size which can be installed and safely operated within the DST, along with certain ancillary equipment. Existing instrumentation installed in the tank, as well as additional instrumentation being installed for sludge-washing and waste consolidation, will also be utilized during the test of the retrieval system following the Project W-151 completion. The test will be performed by Tank Farm Operations.

Prior to performing the mixer pump test, the existing supernate in AZ-101 will be decanted to another tank, and the AZ-101 tank will be refilled with AY-102 liquid. The operation of the mixer pumps during the test will function to wash the mobilized sludge (MacLean 1995).

This test is an integral part of the DST Waste Consolidation and Retrieval Planning Base Case (Bacon 1995) and in providing an initial feed for the privatized vitrification facilities.

1.2 PURPOSE

The test goals of the mixer pump system is to effectively mobilize solids within the supernate, provide actual in-tank operation of mixer pumps, validate empirical data from the effective cleaning radius (ECR) equation, to provide further justification for use of mixer pumps on the other DSTs (Project W-211), and verify that sludge-washing can be effectively accomplished in-tank.

The operational goal of the test is to achieve 90% mobilization of the approximately 46 cm (18 in) of solids, which have settled to the tank bottom, in preparation for retrieval. The information and experience gained during this test is expected to:

- Demonstrate the capability of two 300-hp mixer pumps to mobilize sludge at the tank bottom.

- Confirm the mobilization properties of the AZ-101 waste sludge to validate the empirical data from the ECR equation, as projected from simulated wastes studied by the Pacific National Northwest Laboratory (PNNL) in laboratory tests, and from actual tank waste samples. The ECR formula is

$$ECR = K U_0 D \tau_s^{\,n}$$

  ECR = Effective cleaning radius
  K = 17.3
  U_0 = distance velocity
  D = nozzle diameter
  τ_s = shear stress
  n = -.67

- Provide a base to optimize the number and location of mixer pumps, and the cleanout time cycles needed for various other Hanford Site waste tanks.

- Provide verification of models and laboratory data used to project forces on in-tank components, and verification of effects of mixer pump operation on other DST operating parameters, including the ventilation system.

- Identify worthwhile design of operational improvements for future in-tank mixing of retrieval systems at the Hanford Site.

- Determine the sludge-washing efficiency with the mixing pump system.

This test plan will provide the testing and evaluation of the mixer pump architectural solution for mobilization of double-shell tank sludges. The planned demonstration of mixer pump technology will provide verification and validation of the predictive model for estimating mixer pump performance.

Although no sludge will be transferred from the tank during the test, the performance of the equipment will provide a basis for determining if the delivered neutralized current acid waste (NCAW) sludge will meet the pretreatment process feed requirements.

1.3 TEST OBJECTIVES

Table 1 shows a relationship between the numbered test objectives listed below and the instrumentation to be used to support each test objective. The objectives of this test are to operate the mixer pumps and make the measurements necessary to accomplish the following.

1. Determine the degree of solids mobilization for several pump speeds as a function of operating time (for individual pumps and both pumps).
2. Determine the rate of sludge interface settling after the pumps are turned off.
3. Determine mixer pump jet force on selected in-tank components.
4. Determine the effects of possible waste entrainment in the ventilation exhaust stream as a function of the mixer pump operating conditions.
5. Monitor mixer pump instrumentation and equipment; evaluate their adequacy and determine the minimum need to be applied to future retrieval systems to monitor the mixer pump system operation.
6. Determine the sludge-washing efficiency by sampling and analyzing the supernate for dissolved solids before and after mixing.
7. Determine the minimum pump speed required to maintain the mobilized solids in suspension.
8. Provide a correlation between waste shear strength and the ECR equation as developed by PNNL (PNNL 1995).
9. Evaluate the accuracy of the simplified DST heat removal program (Crea 1995) to predict DST waste temperature increase during mixer pump operation.

Table 1. Summary of Instrumentation.

Instrument	Sampling interval	Data recording system	Test objective number	When instrument used?
CCTV[a] w/ VCR capabilities	Continuously Monitoring CCTV Recorded Intervals - VCR	CCTV- continuously VCR- Manually	3,5	During entire mixer pump test
ENRAF liquid level	continuously	OPC	5	Pumps Off
Gamma reading[b]	5 readings	Manually	1,5,7	Pumps On and Off
All thermocouples	continuously	OPC	1,5,7,8,9	Pumps On and Off
Strain gauge	continuously	OPC	3,5	Pumps On and Off
Suspended solids profiler	continuously	OPC	2,5,	Pumps Off
Ultrasonic interface level analyzer	continuously	OPC	1,2,5,7,8	Pumps On and Off
Mixer pump instrumentation			5	See Table 2[c]

[a]For CCTV sampling intervals, see Section 4.1.1
[b]For gamma reading sampling intervals, see Section 4.1.3
[c]For Table 2 see Section 4.1.8

CCTV = closed-circuit television
ENRAF® = Trademark of ENRAF, Inc.
OPC = operator personal computer (2 are located in AZ-156 Building)
PLC = programmable logic controller
VCR = video cassette recorder

1.4 EXPECTED RESULTS

The following are the goals that reflect the test objectives.

1. The mixer pump test has a retrieval operational goal to mobilize 90% of the solids that have settled to the tank bottom.

2. The estimated initial rate of sludge interface settling after the mixer pumps are turned off will be determined. Settling rate of about 2 cm/h (0.79 in/h) is expected based on laboratory tests with simulants and actual waste.

3. The maximum force predicted from the jet force of the two mixer pumps on selected in-tank components is 76 Kg (167 lb).

4. The beta/gamma continuous air monitoring (CAM) and iodine reaction located after primary exhauster will be monitored to determine the mixer pump system contribution to increased effluent emissions. No effect is predicted. If Project W-030 is completed before the test there will be a tritium detector installed to provide additional data.

5. The instruments and equipment to monitor the mixer pump test shall evaluate the adequacy and determine the minimum need to be applied to future retrieval systems to monitor the mixer pump system operation. Instrumentation and equipment operations will be reviewed for reliability and operability.

6. The amount of total dissolved solids in previous supernate samples and the amount of solution in the sludge previously taken core samples will be used to estimate the amount of total dissolved solids in the sludge. After the mixer pump operation a supernate sample will be taken and analyzed for total dissolved solids. The difference in the total dissolved solids in the supernate before and after the mixer pump operation will determine the sludge-washing efficiency, which is expected to be 90%.

7. The predicted minimum speed for maintaining sludge mobilization is 700 rpm once the maximum amount of sludge has been mobilized at full-pump operation.

8. The expected sludge shear strength is 10,000 dyn/cm^2. Sampled results have predicted that the sludge shear ranges from 2,300 to 15,000 dyn/cm^2. Based on the sludge shear strength of 10,000 dyn/cm^2, the expected ECR will be approximately 9.8 m (32 ft).

9. At full-flow from the two mixer pumps the predicted waste temperature increase is less than -17.7°C/hr (0.15°F/hr).

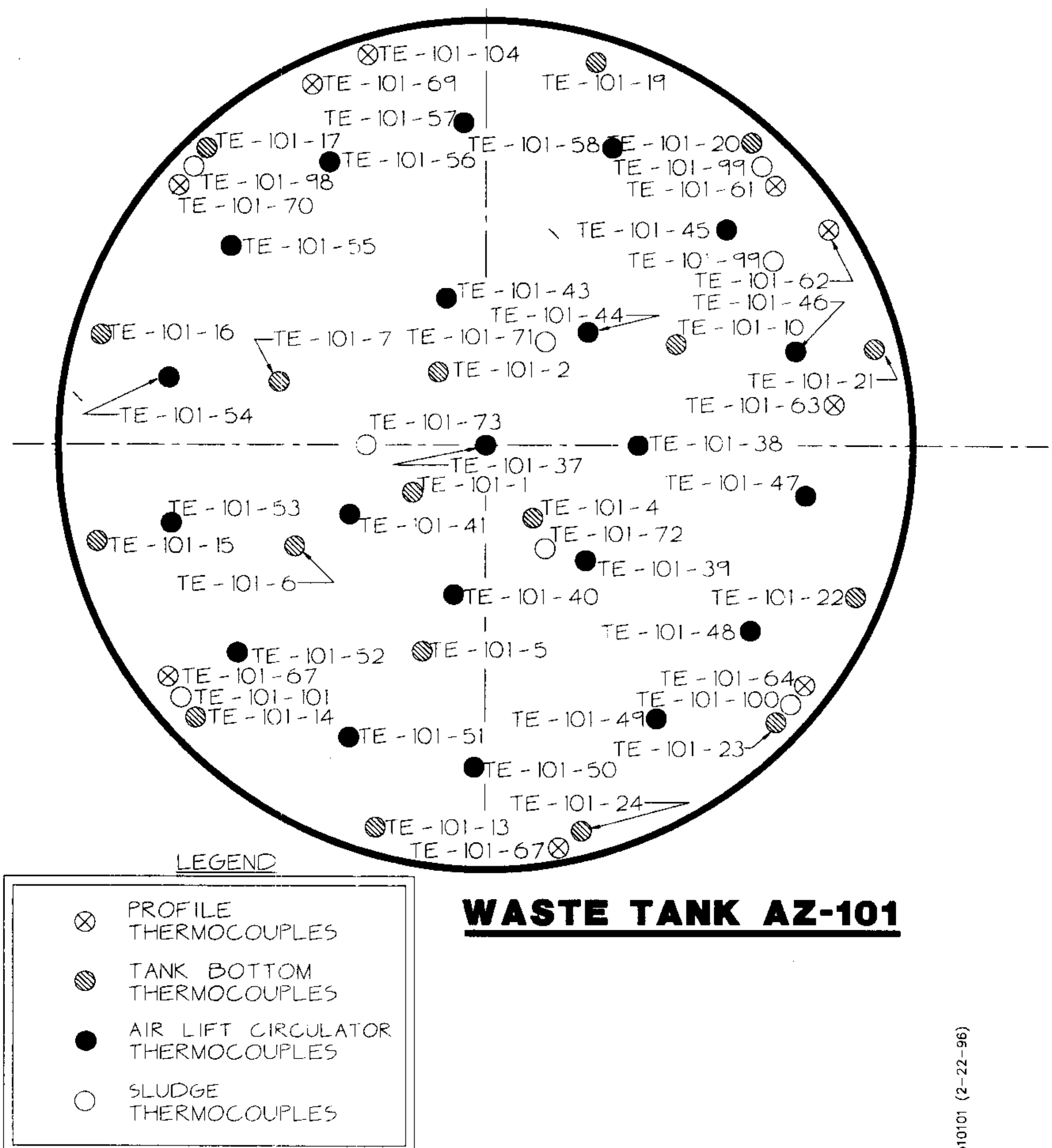
2.0 TEST DATA ANALYSIS

Double-shell Tank Retrieval Engineering will analyze the test data as summarized below. This test data analysis reflects how the test objectives listed above will be evaluated.

1. Calculate the percent of sludge mobilization. Compile temperature data from the in-tank thermocouples (see Figure 1), ultrasonic interface level analyzer (URSILLA), and the gamma probe are used to calculate the estimated percentage of sludge mobilized.

2. Data from the URSILLA and the suspended solids profiler (SSP) will be used to determine the rate of sludge particles settling after mixer pumps have been turned off (for individual and both pumps).

Figure 1. Operational thermocouples which will monitor sludge mobilization.



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3. Estimate the force caused by the mixer pump jets on in-tank components. The stress from the mixer pump jets will be determined by the measurements taken from the strain gauges.

4. Estimate the effects of possible waste entrainment conditions in the ventilation system. The CAM and iodine reactor will be measured during the test.

5. Recommend design or operational improvements for future in-tank mixing or retrieval systems. When the mixer pump test has been completed, the compiled data shall determine which equipment and/or instrumentation was most effective, as well as aid in determining what is needed for follow-on retrieval tanks.

6. The "grab" sample taken after completion of the mixer pump test will estimate the sludge-washing efficiency. These samples will be analyzed (MacLean 1995).

7. After the tank is mobilized, both pumps will be operated to determine the minimum pump speed required to maintain the mobilized solids in suspension.

8. The operational thermocouples, which monitor sludge mobilization, assume that the sludge at that location has been mobilized and the ECR is determined at, or beyond, that approximate location.

9. The operating profile (pump versus time) of the mixer pump will be evaluated with the simplified DST heat removal program (Crea 1995) to determine the accuracy and applicability of the program.

3.0 MIXER PUMP DESCRIPTION

The major test items are two mixer pumps installed in the tank, operated to mobilize settled sludge, and mix sludge with supernate. Mixer pumps will be installed on opposite sides of the tank in risers 1C (south 107-cm [42-in] riser) and 1A (north 107-cm [42-in] riser). A brief list of the characteristics of each pump is provided in Table 2.

Table 2. Project W-151 Provided Mixer Pump Characteristics.

Pump type	Vertical Line Shaft Drive Mixer Pump
Motor type	300 hp, 1,200 rpm, 480V/3PH/60HZ weather-protected enclosure
Total pump weight	12,247 kg (27,000 lb) (water column filled)
Number of jet nozzles	(2) 180° opposed
Diameter of each nozzle	15 cm (6 in)
Flow rate of each nozzle	19,680 L/min (5,200 gal/min)
U_0D each nozzle	2.7 m^2/s (29.4 ft^2/s)
Jet flow direction	horizontal
Nozzle centerline distribution above floor	38 to 46 cm (15 to 18 in)
Pump rotation	180° oscillating at 0.05 to 0.2 rpm

4.0 TEST INSTRUMENTATION

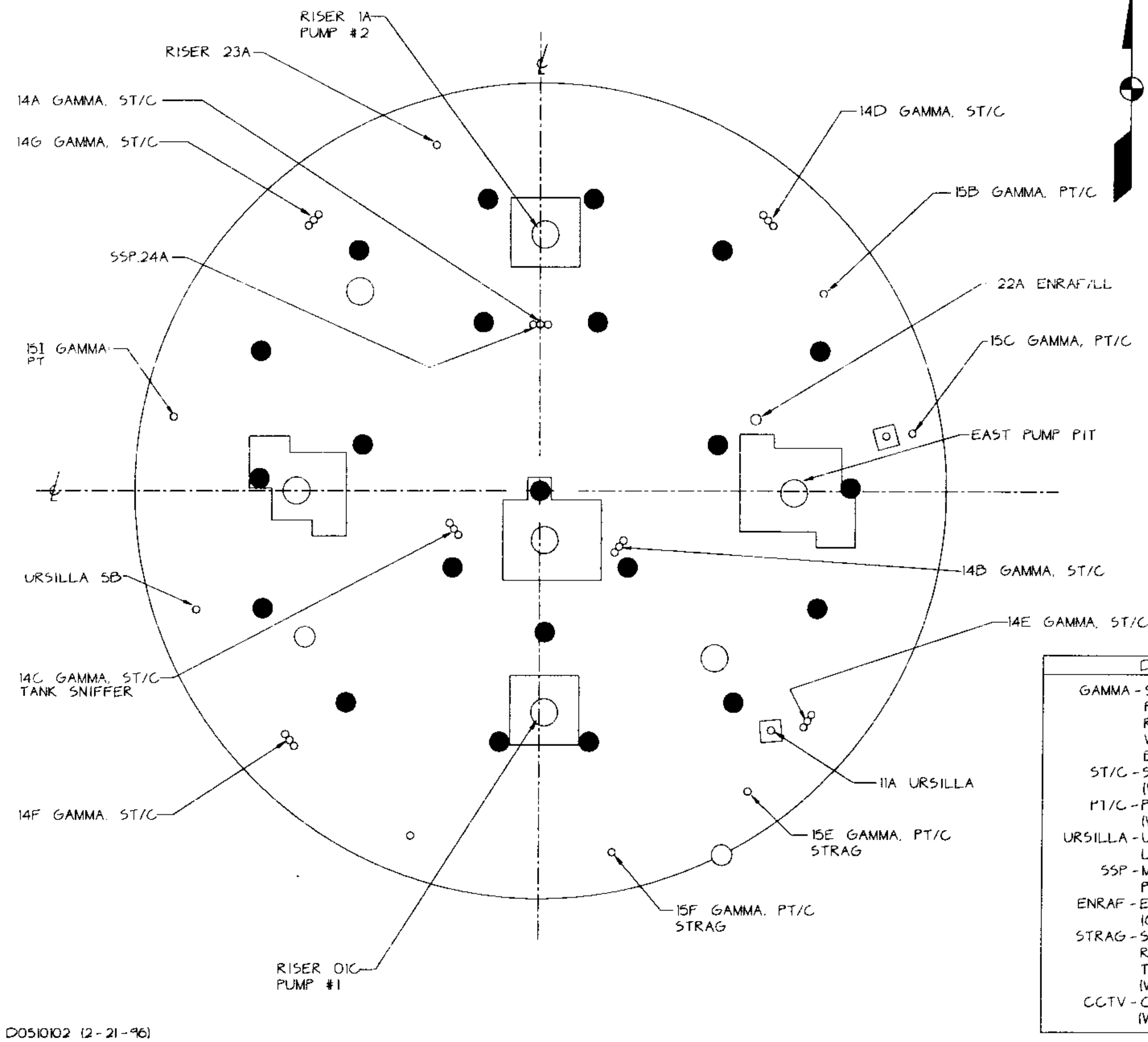
Test instrumentation installed in the tank is described in Section 4.1. All of the AZ-101 operational thermocouples used to monitor sludge mobilization are shown in Figure 1.

The location of in-tank instruments and equipment will either be supplied by Project W-151, the Decant Pump Project U-101, or they are already present in Tank AZ-101, as shown in Figure 2. The only instrumentation that the Decant Project is supplying is the SSP. The new instrumentation and equipment supplied by Project W-151 are:

- CCTV with VCR capabilities
- Gamma profiler
- 12 thermocouples
- Strain gauges
- URSILLA (proposed)
- Pump thermocouples
- Pump pressure transducer
- Variable frequency drive (VFD)
- Pump rotary position indicator

The existing instrumentation and equipment are the ENRAF liquid level, suspended solids profiler, tank bottom thermocouples, airlift circulator thermocouples, sludge thermocouples, and pump displacement (vibration).

Figure 2. Location of instrumentation to monitor AZ-101 process test.



DEFINITION OF TERMS

GAMMA - SLUDGE MOBILIZATION PROBE (W-151) RADIATION WELL LOCATION, WHERE GAMMA PROBE CAN BE INSTALLED
ST/C - SLUDGE THERMOCOUPLE (W-151)
PT/C - PROFILE THERMOCOUPLE (W-151)
URSILLA - UNTRASONIC INTERFACE LEVEL. (SLUDGE WASH)
SSP - MT. FURY SUSPEND SOLIDS PROFILER (SLUDGE WASH)
ENRAF - ENRAF LIQUID LEVEL (OPERATIONS)
STRAG - STRAIN GAGE INSTRUMENTED RISER AND PROFILE THERMOCOUPLE TREE/WELL (W-151)
CCTV - CLOSED CIRCUIT TELEVISION (W-151) LOCATION T.B.D.

4.1 DESCRIPTION OF INSTRUMENTATION

4.1.1 Closed-Circuit Television

The CCTV monitor will visually display any bending or moving of any in-tank hardware. The CCTV will be monitored during the mixer pump test to assist in the handling of any developing problems. This equipment will have VCR capabilities. The CCTV will be operated during the entire mixer pump test.

The VCR will not run for the entire duration of the mixer pump test. The CCTV recording will occur 1 hour before pump speed change, during pump speed change, when the URSILLA and thermocouples stabilizes, and for 1 hour during continuous minimum speed operation. The only time this specific schedule will be overridden is when an instrumentation and equipment alarm indicates off-normal conditions, at which time the VCR will be manually started.

4.1.2 ENRAF Liquid Level

The ENRAF liquid level is a microprocessor-controlled tank gauge which accurately measures the liquid level. The ENRAF data will be measured and stored on the OPC. This measurement will be taken when the pump is off.

4.1.3 Gamma Profiler

The sludge mobilization monitoring equipment is designed to monitor the dispersion of total gamma activity at energies above Cesium-137 during mixer pump operation. The system consists of a portable utility cart and a cadmium tellurium gamma detector. The utility cart contains a motorized cable spool and boom, position indicator, above-tank electronics, and power connections. Gamma monitoring can be accomplished through the entire tank depth by raising or lowering the probe within a drywell. The drywell position and detector elevation are determined by the requirements of the process test. This instrument is manually operated and the readings may be taken during the mixer pump test. At a minimum, the sampling interval of the gamma profiler will be as follows.

1. One hour before the start of the test,
2. As mixer pump No. 1 is turned on,
3. One hour after the pump is turned off,
4. As both mixer pumps are turned on, and
5. One hour after both mixer pumps are turned off.

4.1.4 Thermocouples

The sludge thermocouples, profile thermocouples, tank bottom thermocouples, and airlift circulator thermocouples will be used to monitor sludge mobilization (see Figure 1). The thermocouples will monitor the growth of the ECR area when the mixer pumps are operating. The thermocouple data will be measured and stored in the OPC. All thermocouples will be monitored before and during pump operation.

4.1.5 Strain Gauge

Strain gauge will monitor the impinging jet force from the mixer pump. This instrument is used while the mixer pumps are in operation and when they are shut off. This instrument data will be measured and stored in the OPC.

4.1.6 Suspended Solids Profiler

The SSP lowers a probe into the tank waste and obtains readings at 20 elevations over a 4-minute period. The initial SSP reading shall be taken as quickly as possible after the mixer pumps have been shut off. This instrument cannot be used during pump operation. The data will be measured and stored in the OPC.

4.1.7 Ultrasonic Interface Level Analyzer

The URSILLA Model 2511 uses an ultrasonic ranging technique, sound, navigation, and ranging (SONAR), to measure the depth of the sludge interfaces within the settling tanks. The sensor is mounted approximately 5 m (15 feet) off the tank bottom. One of the two crystals in the sensor assembly acts as a transmitter and generates short bursts of ultrasonic energy which travels in a narrow beam towards the tank bottom. The other crystal acts as a receiver to detect any resulting echoes. The analyzer measures the time delay and magnitude of these returning signals and stores this information in its memory in the form of a tank profile. The URSILLA will be operated continuously during pump operation and measurements will be taken and stored in the OPC.

4.1.8 Instrumentation for Mixer Pump Operation Monitoring

Table 3 provides a summary of pump instrumentation location, sampling interval, and data recording system. Various measurements can be taken by the following types of instruments used for monitoring mixer pump operation. The mixer pump instruments listed below, except for the pump displacement and its sampling interval, are installed in the OPC.

- Mixer pump motor bearing temperature
- Pressure transducer readings on pump bearing/seal lubrication water pressure

- Displacement readings for vibration of the mixer pump assembly is recorded locally at the pump. At a minimum, the sampling interval is as follows:
  - during the start of the first mixer pump
  - during any pump speed change of the first mixer pump
  - during the start of both mixer pumps
  - during any pump speed of both mixer pump
- The VFD will have a readout for electrical parameters including current, voltage, and frequency. The pump speed is controlled by the frequency output of the VFD.
- Rotary position indicator can determine pump orientation.

Table 3. Summary of Pump Instrumentation Location, Sampling Interval, and Data Recording System.

Parameter	Location	Sampling interval	Data recording system
Pump thermocouples	Pump motor bearing	continuously	OPC
Pump pressure transducer	Pump bearing/seal	continuously	OPC
Pump displacement	Vibration	2 readings*	Manually
Variable frequency drive	Pump speed, electric power frequency, current, voltage	continuously	OPC
Pump rotary position indicator	Pump orientation	continuously	OPC

*For Pump displacement (vibration) sampling intervals, see bulleted items in Section 4.1.8.

OPC = Operator Personal Computer

5.0 SAMPLING AND ANALYSES

Grab samples of tank AZ-101 supernate will be obtained as follows.

- Before the start of the mixing pump test,
- As soon as possible, after testing of the first mixer pump,
- As soon as possible, after testing of the first and second mixer pumps, and
- From 7 to 30 days after test completion.

The samples should be taken from the supernate at the top, middle, and near the sludge interface, and from the sludge if possible. The detailed analyses will be performed (MacLean 1995).

6.0 MONITORING AND CONTROL SYSTEM

The control system consists of a local programmable logic controller (PLC) and two remote OPCs. The PLC and OPCs communicate over a spread spectrum radio link. The PLC is located near the center pit of AZ-101 in an environmentally controlled portable enclosure. The OPC is located in Building AZ-156 in the AZ Tank Farm. A plan is in place to install a second PLC at the AY-801 Instrument Building, located in the AY Tank Farm, to collect existing thermocouple data and send this information to the AZ-156 Building, also by radio link/modems.

The OPCs are 486/33MHZ computers with a Super VGA 43-cm (17-in) monitor and sits on a table in the control room located in Building AZ-156. The two OPCs will be connected via an RS-232 link to a spread spectrum radio transceiver. The radio transceiver is connected to an antenna mounted on the roof.

Tables 4 and 5 show the alarm control logic for the mixer pump, tank temperatures, liquid level, and tank pressure. The mixer pump motor vibration will not be connected to the system logic. This reading will be taken with a hand-held monitor instrument during the mixer pump test (see Section 4.1.8 for sampling intervals). The "Action" column in the tables indicates that the alarm is at the operator station located in AZ-156 Building in the two OPCs, unless otherwise noted.

Table 4. Mixer Pump System Control Logic.

	Range	Variable	Action
Pump temperature:	10°C to 130°C (50°F to 266°F)		
• High temperature		Hi-WW	Alarm
• Maximum temperature		HiHi-WW	Pump off, alarm
Motor winding temperature:	TBD		
• High temperature		Hi-WW	Alarm
• Maximum temperature		HiHi-WW	Pump off, alarm
Pump current:	50 to 360 A		
• High current		Hi-WW	Alarm
• Maximum current		HiHi-WW	Pump off, alarm
Pump motor speed:	700 to 1,200 rpm		
• Low speed		Lo-WW	Indicator
• Minimum speed		LoLo-WW	Indicator
Pump Column H_2O Pressure	60 to 100 psig		
• High		Hi-WW	
• Low		Lo-WW	
• Minimum		LoLo-WW	
• Maximum		HiHi-WW	
Pump Column Supply Filter	TBD		
• Filled		Hi-WW	Alarm
Pump Discharge pressure	40 to 50 psig		
• Pump loss pressure		Lo-WW	Alarm

Hi-WW and HiHi-WW = Programmed in Wonder Ware Software.

Table 5. Tank Vapor, Temperature, and Liquid Level System Control Logic.

	Range	Variable	Action
Tank vapor pressure	.6 to 2.5 cm (.25 to 1 in) vacuum		
• High		Hi-PLC	
• Low		Lo-PLC	
• Minimum		LoLo-PLC	
• Maximum		HiHi-PLC	
Tank temperatures:	39°C to 100°C (102°F to 212°F)		
• High		Hi-WW	Alarm
• Maximum		HiHi-WW	Pump off, alarm
Tank liquid level:	0 to 914 cm (0 to 360 in)		
• High		Hi-PLC	Alarm
• Maximum		HiHi-PLC	Alarm

Hi-PLC, HiHi-PLC, = Programmed in the register of the PLC
Hi-WW, HiHi-WW = Programmed in the Wonder Ware Software

7.0 PROCEDURE

7.1 GENERAL SEQUENCE FOR MOBILIZATION OF SOLIDS

The general sequence of testing and data analysis is outlined below. A detailed test procedure will be prepared by operations. The test procedure will contain the step by step instructions of the mixer pump test. Grab samples of the supernate will be taken before and after the test stated in the Decant and Refill Test Plan (MacLean 1995). The general mixer pump test sequence is as follows.

1. Before pump operation, measure and record the following: liquid level, all thermocouple temperatures, gamma profiler, strain gauges, SSP, CCTV, and URSILLA.

2. Operate mixer pump No. 1 at 700 rpm. Mixer pump No. 1 is located in riser 01C (south riser). During operation, monitor and record readings from all thermocouple temperatures, gamma profiler, strain gauges, CCTV, URSILLA, and all pump instrumentation and equipment.

3. Increase mixer pump No. 1 to 1,000 rpm. During operation, monitor and record readings from all thermocouple temperatures, gamma profiler, strain gauges, CCTV, URSILLA, and all pump instrumentation and equipment.

4. Increase mixer pump No. 1 to 1,200 rpm (100%). During operation, monitor and record readings from all thermocouple temperatures, gamma profiler, strain gauges, CCTV, URSILLA, and all pump instrumentation and equipment.

5. Stop mixer pump. Take readings from all thermocouple temperatures, gamma profiler, strain gauges, CCTV, and URSILLA. Wait one minute before taking readings from ENRAF liquid level and SSP.

6. Take a grab sample as soon as possible after the pumps are shut off.

7. Increase mixer pumps No. 1 and No. 2 to 700 rpm. Mixer pump No. 2 is in riser 01A (north riser).

8. Increase mixer pumps No. 1 and No. 2 to 1,000 rpm. During operation, monitor and record readings from all thermocouples, gamma profiler, strain gauges, CCTV, URSILLA, and all pump instrumentation. If unmobilized sludge banks are detected, perform step 11, otherwise proceed to step 12.

9. Increase mixer pumps No. 1 and No. 2 to 1,200 rpm (100%). During operation, monitor and record readings from all thermocouples, gamma profiler, strain gauges, CCTV, URSILLA, and all pump instrumentation and equipment.

10. Stop mixer pumps No. 1 and No. 2. Take readings of thermocouple temperatures, strain gauges, CCTV, and URSILLA. Wait one minute before taking readings from the ENRAF liquid level and SSP.

11. After the pumps have been shut off, obtain a grab sample as soon as possible.

7.2 GENERAL SEQUENCE FOR MAINTAINING MOBILIZED SOLIDS IN SUSPENSION

This sequence will start immediately after the last step in Section 7.1, which is taking a grab sample after pumps have been shut off. Ramp the pumps up to full speed until instruments indicate sludge is mobilized. Lower the speed until instruments indicate sludge settling. At that point, raise speed until remobilized and record.

8.0 MODE OF MIXER PUMP OPERATION FOR SLUDGE MOBILIZATION

There are two types of pump operation for the mixer pumps that can be considered: continuous-oscillation mode (COM), and the indexed-fixed-direction mode (IFDM). The mixer pumps will be continuously rotated 180° during the test.

The mixer pump design operational speed varies between 700 and 1,200 rpm. The design of the lower mechanical seal limits low speed operation of the mixer pumps to 700 rpm. The pump design speed is 1,000 rpm.

9.0 SAFETY

Unreviewed Safety Question (USQ) Evaluation (Kidder 1994) is currently being resolved to attempt to close all yes/maybe responses. The resolution of the USQ Evaluation may require changes in the Tank Waste Remediation System (TWRS) Safety Authorization Basis to include the case of the operation of two mixer pumps within the safety envelope. Concurrently, the distribution of fissile material by mixer pumps is not addressed in the Criticality Safety Evaluation Report (CSER) for AZ Tank Farms and the disposition of this issue will be determined by the TWRS Criticality Safety Representative. All issues will be resolved prior to mixer pump operations, and these actions will be documented in readiness review activities and documents.

Any safety issues resolution necessary for mixer pump operations will be included in closure documents for both the USQ Evaluation and the CSER.

10.0 QUALITY ASSURANCE

This test plan and other documentation and aspects of the test will be reviewed by Quality Assurance, as necessary.

10.1 INSTRUMENT CALIBRATION

Instruments will be calibrated in a manner appropriate to their use in the test. The ASTM testing and calibration standards, that apply to the instruments used during the test, will be reviewed and modified, as necessary.

For instruments which are not addressed by ASTM standards, calibration procedures will be prepared consistent with the general principles that guide the formulation of acceptable calibration and operating procedures, taking into account limitations that may be imposed by operation in a nuclear waste tank.

Instruments will be calibrated outside of the waste tank, using standards traceable to the National Bureau of Standards, where possible.

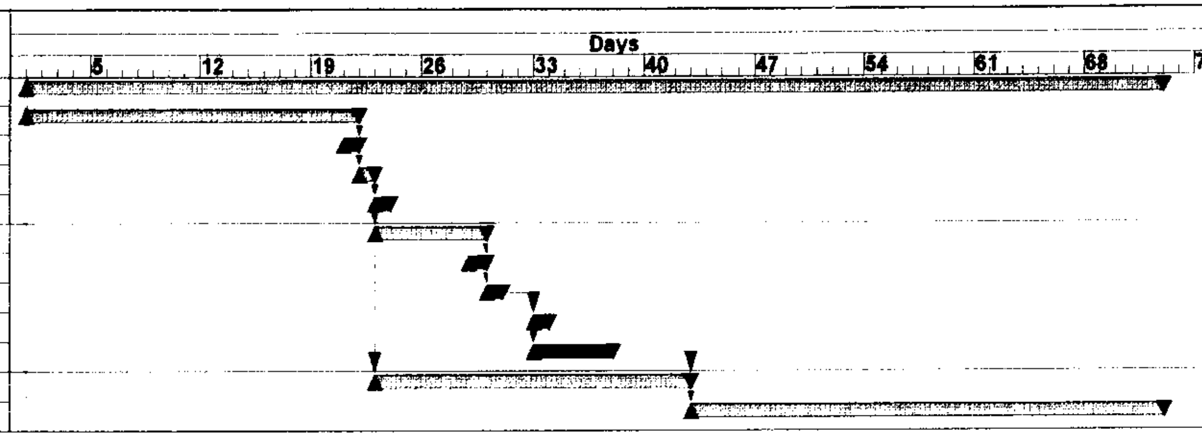
10.2 WITNESSING TESTS

Quality Assurance personnel will witness the test procedure, as necessary.

11.0 SCHEDULE

See the attached schedule for the AZ-101 Mixer Pump Test Plan.

Activity ID	Activity description
001	MIXER PUMP TEST 101-AZ
010	MP #1 MOBIZE SOLIDS
020	SAMPLING SET UP
030	OBTAIN SAMPLE
040	SAMPLING MOVE
050	MP #1 & #2 MOBIZE SOLIDS
060	SAMPLING SET UP
070	OBTAIN SAMPLE
080	SAMPLING MOVE
090	MP #1 & #2 MAINTAIN SOLIDS
100	ISSUE PRELIMINARY MIXER PUMP TEST RESULTS
110	ISSUE FINAL MIXER PUMP TEST REPORT



Project Start 01AUG96
Project Finish 11OCT96
Data Date 01AUG96
Plot Date 26FEB96
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Early Bar
Progress Bar
Critical Activity

MIXR

Sheet 1A of 1B

MIXER PUMP TEST 101-AZ
AS OF 26FEB96

12.0 FUNCTIONAL RESPONSIBILITIES

To support this process test, the following responsibilities have been, or will be, conducted:

Retrieval Equipment and Basic Instrumentation: To be provided by Project W-151 and the Decant Pump Project U-101

Mixer Pump Test Plan: Prepared by DST Retrieval Engineering

Mixer Pump Test Procedure: To be prepared by DST Retrieval Engineering

Technical Test Direction: Preparation of mixer pump test procedures, such as the operating power level of a mixer pump, will be under the direction and control of the technical test director who will be supplied by DST Retrieval Engineering

Predictions and Data Analysis: To be provided by DST Retrieval Engineering

Mixer Pump Test Report: To be prepared by DST Retrieval Engineering

Actual Performance of Testing: Tank Farm Operations and Plant Engineering

Data Collection: Tank Farm Operations and Plant Engineering.

Sample Collection and Analysis: The Characterization Process Management

13.0 REFERENCES

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15.0 GLOSSARY

ABBREVIATIONS AND ACRONYMS

ASTM	American Society for Testing Materials
CCTV	closed-circuit television
CAM	continuous air monitoring
COM	continuously-oscillation mode
DST	double-shell tank
ECR	effective cleaning radius
IFDM	indexed-fixed-direction mode
NCAW	neutralized current acid waste
OPC	operator personal computer
OPCs	operator personal computers
PLC	programmable logic controller
PNNL	the Pacific Northwest National Laboratories
PUREX	plutonium uranium extraction (Facility)
SONAR	sound, navigation, and ranging
SSP	suspended solids profiler
TWRS	Tank Waste Remediation System
URSILLA	ultrasonic interface level analyzer
USQ	unreviewed safety question
VCR	video cassette recorder
VFD	variable frequency drive
WSRS	the Westinghouse Savannah River Site