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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TESTS S-05-6 AND S-05-7 (ALTERNATE ECC INJECTION TESTS)

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IDAHO OPERATIONS OFFICE UNDER CONTRACT EY-76-C-07-1570

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1
TESTS S-05-6 AND S-05-7
(ALTERNATE ECC INJECTION TESTS)

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**EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1
TESTS S-05-6 AND S-05-7
(ALTERNATE ECC INJECTION TESTS)**

By

Edgar M. Feldman
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EG&G IDAHO, INC.

June 1977

PREPARED FOR THE
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ABSTRACT

Recorded test data are presented for Tests S-05-6 and S-05-7 of the Semiscale Mod-1 alternate ECC injection test series. These tests are among several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a pressurized water reactor (PWR) system.

Tests S-05-6 and S-05-7 were conducted from initial conditions of 2263 psia and 550°F and 2253 psia and 551°F, respectively, to investigate the response of the Semiscale Mod-1 system to a depressurization and reflood transient following a simulated double-ended offset shear of the cold leg broken loop piping. The specific objective for these tests was to investigate the effectiveness of low pressure injection system (LPIS) coolant injection into the upper plenum when combined with cold leg intact loop injection. The Semiscale Mod-1 system was modified to represent more closely a two-loop PWR. However, Tests S-05-6 and S-05-7 were not expected to be a demonstration of a two-loop PWR system because of scaling distortions in the Semiscale Mod-1 system relative to a two-loop PWR. Test S-05-6 served as a baseline test for Test S-05-7. Both tests were conducted from similar initial conditions and system configuration with the primary exception that ECC was injected into the upper plenum by the LPIS for Test S-05-7 rather than into the intact and broken loop cold legs as was done for Test S-05-6.

The purpose of this report is to make available the uninterpreted data from Tests S-05-6 and S-05-7 for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to ensure that they are reasonable and consistent.

SUMMARY

Tests S-05-6 and S-05-7 were performed as part of the Semiscale Mod-1 portion of the Semiscale Program conducted by EG&G Idaho, Inc. for the United States Government. These tests were part of the alternate ECC injection test series (Test Series 5), performed to investigate the response of the Semiscale Mod-1 system to specific variations in coolant injection location. The test objective specific to Tests S-05-6 and S-05-7 was to provide data which can be used to assess the influence on core and system response of injecting fluid directly into the upper plenum using the low pressure injection system (LPIS). Test S-05-6 was run with emergency core coolant (ECC) injected by the LPIS into the intact loop and broken loop cold legs to provide baseline data for Test S-05-7. Test S-05-7 differed from Test S-05-6 in that the ECC injection by the LPIS was only into the vessel upper plenum. Hardware configuration and test parameters were selected to simulate more closely the response of a two-loop pressurized water reactor (PWR) to a hypothesized loss-of-coolant accident (LOCA) with subsequent refill and reflood. However, Tests S-05-6 and S-05-7 were not expected to be a demonstration of a two-loop PWR system because of scaling distortions in the Semiscale Mod-1 system relative to a two-loop PWR.

Tests S-05-6 and S-05-7 utilized the Semiscale Mod-1 system, equipped with a pressure vessel with a 40-rod electrically heated core; an intact loop with pump, steam generator, and pressurizer; a broken loop with simulated pump, simulated steam generator, and rupture assemblies; and a pressure suppression system with header, pressure suppression tank, and steam supply system. A coolant injection accumulator was provided for each Semiscale Mod-1 system loop at the cold leg injection points. LPIS pumps were provided for coolant injection into the intact and broken loop cold legs for Test S-05-6 and for coolant injection into the vessel upper plenum for Test S-05-7. The ECC flow rates and total ECC accumulator nitrogen flow were volumetrically scaled to represent more closely a two-loop PWR. In addition, for Tests S-05-6 and S-05-7, four heater rods were intentionally unpowered to simulate the effects of control rod guide tubes, and the power in three heater rods was increased to produce a slightly peaked profile.

Tests S-05-6 and S-05-7 were conducted from initial conditions of 2263 psia and 550°F and 2253 psia and 551°F (temperatures taken at the intact loop cold leg vessel inlet), respectively, by a simulated full-size (200%), double-ended offset shear of the cold leg broken loop piping. The initial core power level was 1.45 MW for Tests S-05-6 and S-05-7 and the initial core inlet flow rate was 175 gpm for both tests. The instantaneous offset shear of the broken loop cold leg piping was simulated by simultaneous (within 10 msec) actuation of the rupture assemblies. After initiation of blowdown, power to the heated core was reduced to simulate the predicted heat flux response of nuclear fuel rods during a LOCA. Blowdown was accompanied by simulated emergency core coolant injection into the intact and broken loop cold legs. ECC was injected by the LPIS into the vessel upper plenum for Test S-05-7 rather than into the intact and broken loop cold legs as done for Test S-05-6.

Tests S-05-6 and S-05-7 were generally conducted as specified. Conditions which did not conform to the specified test configuration were considered acceptable for analysis purposes within the test objectives. The instrumentation used generally functioned as intended. Of 215 measurements taken during Test S-05-6, 212 produced usable data. All 218 measurements taken during Test S-05-7 produced usable data.

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**EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1
TESTS S-05-6 AND S-05-7
(ALTERNATE ECC INJECTION TESTS)**

I. INTRODUCTION

The Semiscale Mod-1 experiments represent the current phase of the Semiscale Program conducted by EG&G Idaho, Inc. for the United States Government. The program, which is sponsored by the Nuclear Regulatory Commission through the Energy Research and Development Administration, is part of the overall program designed to investigate the response of a pressurized water reactor (PWR) system to a hypothesized loss-of-coolant accident (LOCA). The underlying objectives of the Semiscale project are to quantify the physical processes controlling system behavior during a LOCA and to provide an experimental data base for assessing reactor safety evaluation models. The Semiscale Mod-1 program has the further objective of providing support to other experimental programs in the form of instrumentation assessment, optimization of test series, selection of test parameters, and evaluation of test results.

Tests S-05-6 and S-05-7 were conducted March 1st and 10th, 1977, respectively, in the Semiscale Mod-1 system as part of the alternate ECC injection tests series, which was designed to obtain thermal-hydraulic response data from blowdown, refill, and reflood transients in a simulated nuclear reactor with a heated core, to study system response to changes in emergency core coolant (ECC) injection location. The test objective specific to Tests S-05-6 and S-05-7 was to investigate the effectiveness of low pressure injection system (LPIS) coolant injection into the upper plenum when combined with cold leg intact loop coolant injection. The Semiscale Mod-1 system and ECC injection parameters were modified to represent more closely those of a two-loop PWR. However, Tests S-05-6 and S-05-7 were not expected to be a complete demonstration of a two-loop PWR system because of scaling distortions in the Semiscale Mod-1 system relative to a two-loop PWR. Both tests were conducted from similar initial conditions and system configuration with the primary exception that ECC was injected into the upper plenum by the LPIS for Test S-05-7 rather than into the intact loop and broken loop cold legs as was done for Test S-05-6. Test S-05-6 served as a baseline test for Test S-05-7.

The purpose of this report is to present the test data in an uninterpreted but readily usable form for use by the nuclear community in advance of detailed analysis and interpretation. Section II briefly describes the system configuration, procedures, initial test conditions, and events that are applicable to Tests S-05-6 and S-05-7; Section III presents the data graphs and provides comments and supporting information necessary for interpretation of the data. A description of the overall Semiscale program and test series, a more detailed description of the Semiscale Mod-1 system, and a description of the measurement and data processing techniques and uncertainties can be found in Reference 1.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TESTS S-05-6 AND S-05-7

The following system configuration, procedures, initial test conditions, and events are specific to Tests S-05-6 and S-05-7 as indicated.

1. SYSTEM CONFIGURATION AND TEST PROCEDURES

The Semiscale Mod-1 system used for these tests consisted of a pressure vessel with internals, including a 40-rod core with 36 electrically heated rods; an intact loop with steam generator, pump, and pressurizer; a broken loop with simulated steam generator, simulated pump, and two rupture assemblies; coolant injection accumulators for both the intact and broken loops; low pressure injection pumps for the intact and broken loops for Test S-05-6, low pressure injection pump for the vessel upper plenum for Test S-05-7; and a pressure suppression system with a suppression tank, header, and heated steam supply system. The Semiscale Mod-1 experimental system configuration is provided in Reference 1. Figure 1 provides the system configuration for Tests S-05-6 and S-05-7.

For Tests S-05-6 and S-05-7, 33 rods of the 40-rod electrically heated core were operated at a peak power density of approximately 11.5 kW/ft, three rods (Rods D-4, E-4, and E-5) were operated at a peak power density of approximately 12.1 kW/ft to yield a slightly peaked power profile, and four rods (Rods C-3, D-5, F-3, and F-6) were unpowered to simulate the effect of control rod guide tubes. The resulting total core power was approximately 1.45 MW.

In preparation for the tests, the intact and broken loop accumulators were filled with treated demineralized water, drained to the specified initial levels, and pressurized with nitrogen to 700 psig. The system was filled with treated demineralized water and vented at strategic points to ensure a liquid full system. Prior to warmup the system was pressurized to check for leakage, system instrumentation was checked, and transducer readings were initialized. Warmup to initial test conditions was accomplished with the heaters in the vessel core. Heatup of the broken loop piping was accomplished with bypass lines which served to allow circulation through the broken loop. During warmup, the purification and sampling systems were valved into the primary system to maintain water chemistry requirements and to provide a water sample at system conditions for subsequent analysis. At 100-°F temperature intervals during warmup, detector readings were sampled to allow the integrity of the measurement instrumentation and the operability of the data acquisition system to be checked.

Prior to the initial core power level being established, the pressure suppression system was pressurized to 35 psia with saturated steam from the steam supply system. After the core power was increased to the initial test value (1.45 MW for both Tests S-05-6 and

Fig. 1 Semiscale Mod-1 system for cold leg break configuration -- schematic.

S-05-7), initial test conditions were held for 17 minutes and 10 minutes for Test S-05-6 and Test S-05-7, respectively, to establish equilibrium in the system. At the end of this period, all auxiliary systems including the bypass lines were isolated to prevent blowdown through those systems.

During each test, the system was successfully subjected to a simulated 200% double-ended cold leg break through two rupture assemblies and two blowdown nozzles, each having a break area of 0.00508 ft^2 . Pressure to operate the rupture assemblies and initiate blowdown was taken from an accumulator system filled with water and pressurized to 2250 psig with gaseous nitrogen. Immediately (within 0.02 sec) after initiation of blowdown, the lines to the accumulator were again isolated. The effluent from the primary system was ejected into the pressure suppression system which was vented to maintain a constant pressure of 35 psia. At blowdown, power to the primary coolant circulation pump was reduced and the pump was allowed to coast down to speeds of 1530 rpm and 1540 rpm for Tests S-05-6 and S-05-7, respectively. These respective speeds were maintained for the duration of the tests. During the blowdown transient, power to the electrically heated core was automatically controlled to simulate the thermal response of the nuclear-heated fuel rods.

For Tests S-05-6 and S-05-7, coolant injection was initiated from the intact and broken loop accumulators into Spools 14 and 42, respectively, after the system depressurized to 700 psig; injection continued until the accumulators were depleted. Nitrogen flow from the intact loop accumulator was terminated at 100 sec and 103 sec after blowdown initiation for Tests S-05-6 and S-05-7, respectively. Nitrogen flow from the broken loop accumulator continued until depletion for both tests. At approximately 150 psig, the low pressure injection pumps were also started. Low pressure injection for the intact loop was into Spool 14, and in the broken loop it was into Spool 42 for Test S-05-6. Low pressure injection was only made into the vessel upper plenum for Test S-05-7. Coolant injection from the low pressure injection pumps continued until the tests were terminated 300 sec after initiation of blowdown.

2. INITIAL TEST CONDITIONS AND SEQUENCE OF EVENTS

Conditions in the Semiscale Mod-1 system at initiation of blowdown are given in Tables I and II; the primary system water chemistry prior to blowdown is given in Table III; and the sequence of events relative to rupture is given in Table IV.

TABLE I
CONDITIONS AT BLOWDOWN INITIATION

	<u>Measured^[a]</u>		<u>Specified</u>
	<u>Test S-05-6</u>	<u>Test S-05-7</u>	
Core power (MW)	1.454	1.448	1.444 $\pm$ 0.03
Intact loop cold leg fluid temperature (°F)	550	551	552
Hot leg to cold leg temperature differential (°F)	59	58	66 $\pm$ 1
Pressurizer pressure (psia)	2263	2253	2263 $\pm$ 25
Pressurizer water level (in.) ^[b]	19.2 ^[c]	20.5 ^[c]	21.13
Steam generator feedwater temperature (°F)	400	400	400 $\pm$ 10
Steam generator liquid level (from bottom of tube sheet) (in.)	106	109	116 $\pm$ 2
Fluid temperature in broken loop (pump side) (°F)	599	599	605 $\pm$ 5
Fluid temperature in broken loop (vessel side) (°F)	548	550	Not Specified
Intact loop cold leg flow (gpm)	175	175	[d]
Pressure suppression tank water level (in.)	47.5	47.5	47.5 $\pm$ 0.5
Pressure suppression tank pressure (psia)	34.75	35	35.5 $\pm$ 1
Pressure suppression tank water temperature (°F)	60	62	Ambient

[a] Measured initial conditions are taken from process instrumentation read just prior to blowdown. Those measured conditions which did not meet the specified initial conditions were considered acceptable for analysis purposes within the test objectives.

[b] Pressurizer water levels measured down from inside of top head. Levels were specified in terms of differential pressure in the liquid level measuring system.

[c] Levels shown correspond to pressurizer system volumes of 0.74 and 0.71 ft³ (including surge line) for Tests S-05-6 and S-05-7, respectively.

[d] Flow is not specified, since it must be adjusted to achieve the required differential temperature across the core.

TABLE II

PRIMARY COOLANT TEMPERATURE DISTRIBUTION PRIOR TO RUPTURE^[a]

	<u>Detector</u>	<u>Temperature (°F)</u>	
		<u>Test S-05-6</u>	<u>Test S-05-7</u>
Vessel lower plenum (upper portion above filler block)	TFV-LP-7	553	554
Intact loop hot leg (near vessel)	RBU-2	608	609
Intact loop cold leg (near pump inlet)	TFU-10	551	553
Intact loop cold leg (near vessel)	RBU-14A	550	551
Broken loop cold leg (near nozzle)	TFB-23	548	550
Broken loop hot leg (near vessel)	TFB-30	605	606
Broken loop cold leg (near nozzle)	TFB-42	599	599

[a] Data taken from final digital scan 211 and 172 sec prior to rupture for Tests S-05-6 and S-05-7, respectively.

TABLE III
WATER CHEMISTRY PRIOR TO BLOWDOWN^[a]

	<u>Test S-05-6</u>	<u>Test S-05-7</u>
pH	10.80	10.80
Conductivity (μ mho/cm)	196	139
Lithium (ppm)	4.9	3.8
Chlorides (ppm)	<0.1	3.7
Fluorides (ppm) ^[b]	<0.5	<0.4 ^[b]
Oxygen (cc/l)	<0.1	0.65
Total gas (cc/l)	192.0	259.8 ^[c]
Suspended solids (ppm)	0.99	0.41

[a] Water samples taken at a system pressure of about 2250 psia and a system temperature of about 540°F (cold leg).

[b] Present analytical methods prevent accurate determination of fluorides at concentrations of less than 0.4 ppm.

[c] Total STP ml/l may be high due to slow evolution of gas from liquid during collection of gas.

TABLE IV
SEQUENCE OF EVENTS DURING TEST^[a]

	<u>Time Relative to Rupture</u>	
	<u>Test S-05-6</u>	<u>Test S-05-7</u>
Core power level established (min)	-17	-10
Bypass lines valved out of system (sec)	-2.5	-2.5
Blowdown initiated (sec)	0	0
Pump power reduced (sec)	0	0
ECC accumulators valved in (sec) ^[b]	0	0
Steam generator feedwater and discharge valves closed (sec)	1	1
Core power decay transient started (sec)	2.8	2.8
Low pressure injection system pumps started (sec) ^[b]	0	0
Core power tripped off (sec) ^[c]	300	300

[a] A time-controlled sequencer was used to control critical events during the test.

[b] Injection from ECC accumulators and low pressure injection system pumps does not start until system pressure drops below accumulator or pump pressure, respectively.

[c] Core power tripped manually at termination of test.

III. DATA PRESENTATION

The data from Semiscale Mod-1 Tests S-05-6 and S-05-7 are presented with brief comment. Processing analysis has been performed only to the extent necessary to obtain appropriate engineering units and to ensure that the data are reasonable and consistent. In all cases, in converting transducer output to engineering units, a homogeneous fluid was assumed. Further interpretation and analysis should consider that sudden decompression processes, such as those occurring during blowdown, may have subjected the measurement devices to nonhomogeneous fluid conditions.

The performance of the system during Test S-05-6 was monitored by 215 detectors and for Test S-05-7 by 218 detectors. The data obtained were recorded on both digital and analog data acquisition systems. The digital data were recorded at a sample rate of 57.5 points per sec. Long term plots (-20 to 300 sec) were compressed at a 20 to 1 ratio giving an effective sample rate of 2.875 points per sec. Short term plots (-6 to 42 sec) were compressed at a 3 to 1 ratio giving an effective sample rate of 19.17 points per sec. The analog system was used to provide better resolution capability (needed as input to various data analysis codes) and to provide redundancy.

The data are presented, in most instances, in the form of composite graphs to facilitate comparison of the values of given variables between the two tests. The scales selected for the graphs do not reflect the obtainable resolution of the data (the data processing techniques are described further in Reference 1).

Figures 2 through 7 and Table V provide supporting information for interpretation of the data graphs shown in Figures 8 through 555 and provide relative locations of all detectors used during Tests S-05-6 and S-05-7. Table V groups the measurements according to measurement type; identifies the specific measurement location and the range of the detector and actual recording range of the data acquisition system; provides brief comments regarding the data; and references the measurements and comments to the corresponding figure. Figures 8 through 555 present all the blowdown and reflood data obtained. Time zero on the graphs is the time of rupture initiation. Appendix A provides information explaining data adjustments and posttest data processing for data conversion into engineering units.

Fig. 4 Semiscale Mod-1 pressure vessel -- cross section showing instrumentation.

Fig. 5 Semiscale Mod-1 pressure vessel -- isometric showing instrumentation.

Fig. 7 Semiscale Mod-1 heated core -- plan view.

TABLE V

DATA PRESENTATION FOR SEMISCALE MOD-1 TESTS S-05-6 and S-05-7

Range [a]					
Measurement	Location and Comments [a]	Detector	Data Acquisition System	Figure [a]	Measurement Comments [b]
FLUID TEMPERATURE					
Chromel-Alumel thermocouples unless specified otherwise.					
<u>Intact Loop</u>					
		0 to 2300°F	0 to 591°F		
RBU-2	Hot leg, Spool 2, 46 in. from vessel center (platinum resistance bulb).	0 to 1000°F	0 to 1000°F	8, 9-	
TFU-7	Cold leg, Spool 7, 246 in. from vessel center.		0 to 1017°F	10, 11	
TFU-10	Cold leg, Spool 10, 144 in. from vessel center.			12, 13	
RDU-14A	Cold leg, Spool 14, 43 in. from vessel center, upstream of cold leg injection port (platinum resistance bulb).	0 to 1000°F	0 to 1000°F	14, 15	
TFU-14B	Cold leg, Spool 14, 39 in. from vessel center, downstream of cold leg injection port.			16, 17	
<u>Broken Loop</u>					
		0 to 2300°F	0 to 1017°F		
TFB-20	Cold leg, Spool 20, 21 in. from vessel center.			18, 19	
TFB-23	Cold leg, Spool 23, 91 in. from vessel center, upstream of vessel-side nozzle.			20, 21	
TFB-30	Hot leg, Spool 30, 16 in. from vessel center.			22, 23	
TFB-37	Cold leg, Spool 37, 276 in. from vessel center along hot leg, discharge of simulated steam generator.			24, 25	
TFB-42	Cold leg, Spool 42, 414 in. from vessel center along hot leg, upstream of pump-side nozzle.			26, 27	
<u>Inlet Annulus</u>					
	4 in. below cold leg centerline, 0.2 in. from vessel wall, Type J iron-constantan thermocouples.	0 to 1400°F	0 to 803°F		
TFV-ANN-4A	0°.			28, 29	
TFV-ANN-4H	180°.			30, 31	
<u>Downcomer Annulus</u>					
	Centered in annulus, Type J iron-constantan thermocouples.	0 to 1400°F	0 to 803°F		
TFV-ANN-35A	35 in. below cold leg centerline, 0°.			32, 33	
TFV-ANN-70A	70 in. below cold leg centerline, 0°.			34, 35	
TFV-ANN-115A	115 in. below cold leg centerline, 0°.			36, 37	
TFV-ANN-156A	156 in. below cold leg centerline, 0° (Chromel-Alumel Type K).	0 to 2300°F	0 to 601°F	38, 39	
<u>Upper Plenum</u>					
		0 to 2300°F	0 to 1017°F		
TFV-UP-13	In upper plenum, 13.5 in. above cold leg centerline at 180°.			40, 41	
<u>Lower Plenum</u>					
	On fluid thermocouple rack, 1 in. from vessel center, 45°.	0 to 2300°F	0 to 1017°F		
TFV-LP-2	2.0 in. above top of lower plenum filler.			42, 43	
TFV-LP-7	7.0 in. above top of lower plenum filler.			44, 45	
<u>Core Barrel Insulation Gap</u>					
		0 to 1400°F	0 to 803°F		
TFV-CIG-70A	70 in. below cold leg centerline, 0°.			46, 47	
<u>Vessel Filler Insulation Gap</u>					
		0 to 2300°F	0 to 1017°F		
TFV-FIG-156A	156 in. below cold leg centerline, 0°.			48, 49	

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Core Grid Spacers</u>					
<u>Grid Spacer 5</u>	55 in. below cold leg centerline, 21.5 in. above top of heated length.	0 to 2300°F	0 to 2382°F		
TFG-5CD-45	Thermocouple in space defined by Columns C and D, Rows 4 and 5.			50, 51	
<u>Grid Spacer 6</u>	76 in. below cold leg centerline, 1/2 in. above top of heated length.				
TFG-6AB-45	Thermocouple in space defined by Columns A and B, Rows 4 and 5.			52, 53	
TFG-6CD-45	Thermocouple in space defined by Columns C and D, Rows 4 and 5.			54, 55	
<u>ECC System</u>		0 to 2300°F	0 to 591°F		
TFU-ECC-14	In ECC line leading to intact loop Spool 14.			56, 57	
TFB-ECC-42	In ECC line leading to broken loop Spool 42.			58, 59	
TFV-ECC+13	In ECC line leading to vessel 13.5 in. above cold leg centerline.			60, 61	
<u>Steam Generator</u>		0 to 2300°F	0 to 591°F		
TFU-SGFW	In feedwater line leading to steam generator.			62, 63	
TFU-SG1	Secondary side, 12 in. above bottom of tube sheet.			64, 65	
TFU-SG2	Secondary side, 24 in. above bottom of tube sheet.			66, 67	Detector failed for Test S-05-6.
TFU-SG3	Secondary side, 48 in. above bottom of tube sheet.			68, 69	
<u>Pressurizer</u>					
TFU-PRIZE	In surge line, near pressurizer exit, between turbine flowmeter and pressurizer.	0 to 2300°F	0 to 1017°F	70, 71	
<u>Pressure Suppression System</u>		0 to 2300°F	0 to 591°F		
TF-PSS-33	33 in. from bottom of tank.			72, 73	
TF-PSS-130	130 in. from bottom of tank.			74, 75	
<u>MATERIAL TEMPERATURE</u>					
Chromel-Alumel thermocouples unless specified otherwise					
<u>Intact Loop</u>		0 to 2300°F	0 to 591°F		
TMU-1T16	Hot leg, Spool 1, top, 1/16 in. from pipe ID, 29 in. from vessel center.		0 to 1017°F	76, 77	
TMU-15T16	Cold leg, Spool 15, top, 1/16 in. from pipe ID, 17 in. from vessel center.			78, 79	
<u>Broken Loop</u>		0 to 2300°F	0 to 591°F		
TMB-20B16	Cold leg, Spool 20, bottom, 1/16 in. from pipe ID, 21 in. from vessel center.			80, 81	
<u>Vessel Filler</u>		0 to 1400°F	0 to 803°F		
TMV-FI-4M	4 in. below cold leg centerline, 1/16 in. from filler ID, 180°.			82, 83	
TMV-FI-15A	15 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			84, 85	
TMV-FI-35A	35 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			86, 87	
TMV-FI-115A	115 in. below cold leg centerline, 1/16 in. from filler ID, 0°.			88, 89	
TMV-FI-156A	156 in. below cold leg centerline, 0.65 in. from filler ID, 0°.	0 to 2300°F	0 to 1017°F	90, 91	
<u>Vessel Filler Insulator</u>		0 to 1400°F	0 to 803°F		
Outer surface of insulator, Type J iron-constantan thermocouples.					
TIV-FI-35A	35 in. below cold leg centerline, 0°.			92, 93	Data for Test S-05-6 has noise superimposed on it.

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Vessel Filler Insulator</u> (continued)					
TIV-F0-35M				94, 95	
TIV-F0-70A	70 in. below cold leg centerline, 0°.			96, 97	
TIV-F0-115A	115 in. below cold leg centerline, 0°.			98, 99	
<u>Core Barrel</u>	Type J iron-constantan thermocouples	0 to 1400°F	0 to 803°F		
TMV-CI-70A	70 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°.			100, 101	
TMV-CI-115A	115 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°.			102, 103	
TMV-CO-70A	70 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°.			104, 105	
TMV-CO-115A	115 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°.			106, 107	
<u>Core Housing Filler</u>		0 to 2300°F	0 to 1017°F		
TMV-HF-115W	On core housing filler, 115 in. below cold leg centerline, 0.20 in. from outer surface, 315°.			108, 109	
TMV-HF-138W	On core housing filler, 138 in. below cold leg centerline, 0.20 in. from outer surface, 315°.			110, 111	
<u>Steam Generator</u>		0 to 2300°F	0 to 591°F		
TMU-SG1	On a steam generator tube, 12 in. above bottom of tube sheet, on tube OD.			112, 113	
TMU-SG2	On a steam generator tube, 24 in. above bottom of tube sheet, on tube OD.			114, 115	
TMU-SG3	On a steam generator tube, 48 in. above bottom of tube sheet, on tube OD.			116, 117	
<u>CORE HEATER CLADDING TEMPERATURES</u>	Chromel-Alumel thermocouples.				
<u>High Power Heaters</u>		0 to 2300°F	0 to 2382°F		
TH-D4-14 TH-D4-29	Heater at Column D, Row 4. Thermocouples 14 in. (270°) and 29 in. (315°) above bottom of core.			118, 119 120, 121	
TH-D5-29	Heater at Column D, Row 5. Thermocouple 29 in. (225°) above bottom of core.			122, 123	
TH-E4-09 TH-E4-27 TH-E4-55	Heater at Column E, Row 4. Thermocouples 9 in. (180°), 27 in. (90°), and 55 in. (0°) above bottom of core.			124, 125 126, 127 128, 129	
TH-E5-25	Heater at Column E, Row 5. Thermocouple 25 in. (90°) above bottom of core.			130, 131	
<u>Low Power Heaters</u>		0 to 2300°F	0 to 2382°F		
TH-A4-09 TH-A4-29 TH-A4-39	Heater at Column A, Row 4. Thermocouples 9 in. (105°), 29 in. (240°) and 39 in. (300°) above bottom of core.			132, 133 134, 135 136, 137	
TH-A5-29 TH-A5-45	Heater at Column A, Row 5. Thermocouples 29 in. (180°) and 45 in. (255°) above bottom of core.			138, 139 140, 141	
TH-B3-32	Heater at Column B, Row 3. Thermocouple 32 in. (135°) above bottom of core.			142, 143	
TH-B5-29 TH-B5-33	Heater at Column B, Row 5. Thermocouples 29 in. (150°) and 33 in. (45°) above bottom of core.			144, 145 146, 147	
TH-B6-29	Heater at Column B, Row 6. Thermocouple 29 in. (45°) above bottom of core.			148, 149	
TH-C2-38	Heater at Column C, Row 2. Thermocouple 38 in. (225°) above bottom of core.			150, 151	

TABLE V (continued)

Range ^[a]					
Measurement	Location and Comments ^[a]	Detector	Data Acquisition System	Figure ^[a]	Measurement Comments ^[b]
Low Power Heaters (continued)					
TH-C4-26 TH-C4-53	Heater at Column C, Row 4. Thermo-couples 26 in. (75°) and 53 in. (300°) above bottom of core.			152, 153 154, 155	
TH-C5-28	Heater at Column C, Row 5. Thermo-couple 28 in. (315°) above bottom of core.			156, 157	
TH-C7-07 TH-C7-15	Heater at Column C, Row 7. Thermo-couples 7 in. (345°) and 15 in. (255°) above bottom of core.			158, 159 160, 161	
TH-D1-21	Heater at Column D, Row 1. Thermo-couple 21 in. (330°) above bottom of core.			162, 163	
TH-D2-14 TH-D2-61	Heater at Column D, Row 2. Thermo-couple 14 in. (0°) and 61 in. (270°) above bottom of core.			164, 165 166, 167	
TH-D3-29 TH-D3-39	Heater at Column D, Row 3. Thermo-couples 29 in. (150°) and 39 in. (210°) above bottom of core.			168, 169 170, 171	
TH-D6-15 TH-D6-25	Heater at Column D, Row 6. Thermo-couples 15 in. (90°) and 25 in. (255°) above bottom of core.			172, 173 174, 175	
TH-D7-20	Heater at Column D, Row 7. Thermo-couple 20 in. (60°) above bottom of core.			176, 177	
TH-D8-27 TH-D8-57	Heater at Column D, Row 8. Thermo-couples 27 in. (180°) and 57 in. (15°) above bottom of core.			178, 179 180, 181	
TH-E1-33	Heater at Column E, Row 1. Thermo-couple 33 in. (60°) above bottom of core.			182, 183	
TH-E2-20 TH-E2-33	Heater at Column E, Row 2. Thermo-couples 20 in. (210°) and 33 in. (315°) above bottom of core.			184, 185 186, 187	
TH-E3-05 TH-E3-20 TH-E3-24	Heater at Column E, Row 3. Thermo-couples 5 in. (15°), 20 in. (165°), and 24 in. (75°) above bottom of core.			188, 189 190, 191 192, 193	
TH-E6-08 TH-E6-28 TH-E6-37	Heater at Column E, Row 6. Thermo-couples 8 in. (150°), 28 in. (285°), and 37 in. (330°) above bottom of core.			194, 195 196, 197 198, 199	
TH-E7-44	Heater at Column E, Row 7. Thermo-couple 44 in. (195°) above bottom of core.			200, 201	
TH-E8-14 TH-E8-29 TH-E8-45	Heater at Column E, Row 8. Thermo-couples 14 in. (150°), 29 in. (225°), and 45 in. (300°) above bottom of core.			202, 203 204, 205 206, 207	
TH-F2-07 TH-F2-22 TH-F2-25	Heater at Column F, Row 2. Thermo-couples 7 in. (255°), 22 in. (105°), and 25 in. (0°) above bottom of core.			208, 209 210, 211 212, 213	
TH-F4-14 TH-F4-29 TH-F4-44	Heater at Column F, Row 4. Thermo-couples 14 in. (90°), 29 in. (165°), and 44 in. (210°) above bottom of core.			214, 215 216, 217 218, 219	
TH-F5-20 TH-F5-26 TH-F5-33 TH-F5-53	Heater at Column F, Row 5. Thermo-couples 20 in. (255°), 26 in. (165°), 33 in. (315°), and 53 in. (30°) above bottom of core.			220, 221 222, 223 224, 225 226, 227	
TH-G3-13	Heater at Column G, Row 3. Thermo-couple 13 in. (150°) above bottom of core.			228, 229	
TH-G4-29 TH-G4-33 TH-G4-38	Heater at Column G, Row 4. Thermo-couples 29 in. (300°), 33 in. (225°), and 38 in. (30°) above bottom of core.			230, 231 232, 233 234, 235	
TH-G5-14 TH-G5-24	Heater at Column G, Row 5. Thermo-couples 14 in. (45°) and 24 in. (330°) above bottom of core.			236, 237 238, 239	
TH-H5-32	Heater at Column H, Row 5. Thermo-couple 32 in. (45°) above bottom of core.			240, 241	

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
PRESSURE					
<u>Intact Loop</u>		0 to 3000 psi			
PU-13	Cold leg, Spool 13, 54 in. from vessel center.		0 to 4600 psia	242, 243	Failed on Test S-05-6.
PU-15L	Cold leg, Spool 15, 16 in. from vessel center, to atmosphere (low range).	0 to 500 psi	0 to 500 psia	244, 245	
<u>Broken Loop</u>		0 to 3000 psi			
PB-23	Cold leg, Spool 23, 92 in. from vessel center, upstream of nozzle (tee off DP tap).		0 to 4400 psia	246, 247	Failed on Test S-05-6.
PB-27	Cold leg, Spool 27, 202 in. from vessel center along hot leg.		0 to 4700 psia	240, 249	
PD-42	Cold leg, Spool 42, 415 in. from vessel center along hot leg, upstream of pump-side nozzle (tee off DP tap).		0 to 4800 psia	250, 251	
PB-HN1	Pump-side nozzle, nozzle throat, 419 in. from vessel center along hot leg (tee off DP tap).		0 to 4600 psia	252, 253	
PB-CN1	Cold leg, Spool 23, vessel-side nozzle, nozzle throat, 96 in. from vessel center along cold leg, 45°.	0 to 2500 psi	0 to 3100 psia	254, 255	
PB-CN2	Cold leg, Spool 23, vessel-side nozzle, nozzle throat, 96 in. from vessel center along cold leg, 315°.	0 to 2500 psi	0 to 4500 psia	256, 257	
PB-CN3	Cold leg, Spool 23, vessel-side nozzle at beginning of nozzle divergent section, 97 in. from vessel center along cold leg, 0°.		0 to 4700 psia	258, 259	
PB-CN4	Cold leg, Spool 23, vessel-side nozzle, nozzle divergent section, 101 in. from vessel center along cold leg, 0°.		0 to 4800 psia	260, 261	
<u>Vessel</u>					
PV-UP+10	In upper plenum, 10 in. above cold leg centerline, mounted on standoff, 30°.	0 to 3000 psi	0 to 4900 psia	262, 263	
PV-LP-166	In upper part of lower plenum, 166 in. below cold leg centerline, mounted on standoff, 225°.		0 to 4900 psia	264, 265	
<u>ECC System</u>		0 to 1000 psi			
PU-ACC	In intact loop accumulator.		0 to 1200 psia	266, 267	
PB-ACC	In broken loop accumulator.		0 to 1300 psia	268, 269	
<u>Steam Generator</u>					
PU-SGSD	Secondary side steam dome.	0 to 3000 psi	0 to 2000 psia	270, 271	
<u>Pressurizer</u>					
PU-PRIZE	Pressurizer steam dome.	0 to 2500 psi	0 to 3200 psia	272, 273	
<u>Pressure Suppression System</u>					
P-PSS	Suppression tank top.	0 to 250 psi	0 to 340 psia	274, 275	
DIFFERENTIAL PRESSURE					
<u>Intact Loop</u>					
NPIL-IP-3	Upper plenum 10.5 in. above cold leg centerline at 30° to hot leg, Spool 3, 62 in. from vessel center. Upper plenum tap is approximately 2 in. above Spool 3 tap.	+50 in water	+2.5 psia	276, 277	Data acquisition system saturated prior to t=0 sec and intermittently until t=1 sec.

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Intact Loop (continued)</u>					
DPU-3-7	Across steam generator, hot leg Spool 3, 62 in. from vessel center to cold leg Spool 7, 231 in. from vessel center. Spool 3 tap is approximately 18 in. above Spool 7 tap.	+500 in. water	+25 psid	278, 279	Data acquisition system saturated prior to t=2.5 sec.
DPU-6-SGIP	Hot leg, Spool 6, 114 in. from vessel center to steam generator inlet plenum 145 in. from vessel center. Spool 6 tap is 16 in. below SGIP tap.	+500 in. water	+24.6 psid	280, 281	Test S-05-7 only.
DPU-SGOP-7	From steam generator outlet plenum, 269 in. from vessel center along cold leg to cold leg Spool 7, 231 in. from vessel center, including orifice, Spool 7 tap is 35 in. below SGOP tap.	+500 in. water	+24.5 psid	282, 283	Test S-05-7 only. Data acquisition system saturated prior to t=4 sec.
DPU-7-10	Steam generator outlet to pump inlet, cold leg Spool 7, 231 in. from vessel center, to cold leg Spool 10, 141 in. from vessel center.	+50 in. water	+2.5 psid	284, 285	Data acquisition system saturated intermittently between t=0 and t=1.5 sec.
DPU-12-10	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 10, 141 in. from vessel center. Spool 10 tap is 10 in. below Spool 12 tap.	+50 psi	+50 psid	286, 287	Data acquisition system saturated prior to t=2.5 sec for Test S-05-6.
DPU-12-10L	Pump outlet to pump inlet, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 10, 141 in. from vessel center. Spool 10 tap is 10 in. below Spool 12 tap (low range).	+100 in. water	+4.9 psid	288, 289	Data acquisition system saturated prior to 5 sec.
DPU-12-15	Across cold leg injection point, cold leg Spool 12, 75 in. from vessel center, to cold leg Spool 15, 16 in. from vessel center.	+100 in. water	+4.9 psid	290, 291 292, 293	Data acquisition system saturated intermittently between t=0 and t=4 sec for Test S-05-6 and between t=0 and t=5 sec for Test S-05-7.
DPU-15-1	Cold leg to hot leg; cold leg Spool 15, 16 in. from vessel center, to hot leg Spool 1, 31 in. from vessel center. Spool 15 tap is 8.5 in. below Spool 1 tap.	+500 in. water	+25 psid	294, 295	
DPU-15-1L	Cold leg to hot leg, cold leg Spool 15, 16 in. from vessel center, to hot leg Spool 1, 31 in. from vessel center. Spool 15 tap is 8.5 in. below Spool 1 tap (low range).	+100 in. water	+4.9 psid	296, 297 298, 299	Data acquisition system saturated prior to t=0 sec. Apparent malfunction of detector system caused undefined gain resulting in questionable data for Test S-05-6. Data acquisition system also saturated intermittently between t=0 sec and t=95 sec for Test S-05-6.
DPU-15-IANN	Cold leg Spool 15, 16 in. from vessel center, to inlet annulus, 9 in. below cold leg centerline at 225°. Spool 15 tap is 9 in. above inlet annulus tap.	+100 in. water	+4.9 psid	300, 301 302, 303	Data acquisition system saturated between t=0 and t=0.5 sec.
DPU-PRESLL	Pressurizer water level. Elevation difference between taps is 53 in. Lower tap is 3.5 in. above pressurizer exit.	+50 in. water	+2.5 psid	304, 305	
DPU-PR-4	Pressurizer bottom to Spool 4. Elevation difference between taps is 62 in. Spool 4 tap is 55 in. below pressurizer exit.	+1000 psi	+1300 psid	306, 307	
<u>Broken Loop</u>					
DPB-UP-30	Vessel upper plenum, 10.5 in. above cold leg centerline at 30°, to hot leg Spool 30, 18 in. from vessel center. Upper plenum tap is 2 in. above Spool 30 tap.	+100 in. water	+4.8 psid	308, 309 310, 311	
DPB-21-IANN	Cold leg Spool 21, 49 in. from vessel center, to vessel inlet annulus, 9 in. below cold leg centerline at 225°. Inlet annulus tap is 9 in. below Spool 21 tap.	+100 in. water	+4.8 psid	312, 313 314, 315	
DPB-23-CN1	Cold leg, Spool 23, 92 in. from vessel center to vessel-side nozzle throat, 96 in. from vessel center.	+1500 psi	+2000 psid	316, 317	

TABLE V (continued)

Measurement	Location and Comments [a]	Range [a]		Figure [a]	Measurement Comments [b]
		Detector	Data Acquisition System		
Broken Loop (continued)					
DPB-CN1-PSS-63	From vessel-side nozzle throat, 96 in. from vessel center to pressure suppression tank, 353 in. from vessel center along cold leg. Tap is 63 in. above suppression tank bottom.	+1500 psi	+2000 psid	318, 319	
DPB-30-36L	Across entire simulated steam generator assembly, hot leg Spool 30, 18 in. from vessel center, to cold leg Spool 36 lower tap, 242 in. from vessel center. Spool 30 tap is 19 in. below Spool 36 lower tap.	+500 psi	+500 psid	320, 321	
DPB-32U-36L	Across simulated steam generator orifice assembly, hot leg Spool 32 upper tap, 73 in. from vessel center, to Spool 36 lower tap, 242 in. from vessel center. Spool 32 upper tap is 16 in. above Spool 36 lower tap.	+500 psi	+500 psid	322, 323	
DPB-36L-37	Across nozzle assembly, Spool 36 lower tap, 242 in. from vessel center along hot leg, to Spool 37, 282 in. from vessel center along hot leg. Spool 37 tap is 40 in. below Spool 36 lower tap.	+50 psi	+50 psid	324, 325	
DPB-37-38	Across turbine flowmeter and drag disc, cold leg Spool 37, 282 in. from vessel center along hot leg, to cold leg Spool 38, 305 in. from vessel center along hot leg. Spool 37 tap is 23 in. above Spool 38 tap.	+50 in. water	+2.5 psid	326, 327	
DPB-38-40	Across simulated pump, cold leg Spool 38, 305 in. from vessel center along hot leg, to cold leg Spool 40, 365 in. from vessel center along hot leg.	+1000 psi	+1300 psid	328, 329	
DPB-40-42	Across elbow leading to spool upstream of pump-side nozzle. Cold leg Spool 40, 365 in. from vessel center along hot leg, to Spool 42, 415 in. from vessel center along hot leg. Spool 40 tap is 40 in. below Spool 42 tap.	+50 in. water	+2.4 psid	330, 331 332, 333	Data acquisition system saturated between t=0 and t=10.5 sec for Test S-05-6 and saturated intermittently between t=0 and t=23.5 sec for Test S-05-7.
Vessel					
DPV-UP-1ANN	Upper plenum, 10.5 in. above cold leg centerline at 30° to inlet annulus, 9 in. below cold leg centerline at 225°. Elevation difference between taps is 19 in.	+300 in. water	+14.7 psid	334, 335	Data acquisition system saturated between t=0 and t=1 sec.
DPV-0-9GQ	Inlet annulus cold leg centerline at 90°, to 9 in. below cold leg centerline at 225°. Elevation difference between taps is 9 in.	+50 in. water	+2.6 psid	336, 337 338, 339	
DPV-9-26GQ	Inlet annulus, 9 in. below cold leg centerline at 225°, to downcomer gap, 26 in. below cold leg centerline at 225°. Elevation difference between taps is 17 in.	+50 in. water	+2.4 psid	340, 341 342, 343	
DPV-9-166GQ	Inlet annulus, 9 in. below cold leg centerline at 225°, to lower plenum, 166 in. below cold leg centerline at 225°. Elevation difference between taps is 157 in.	+300 in. water	+14.5 psid	344, 345 346, 347	
DPV-26-59UM	Across part of downcomer, 26 in. (225°), to 55 in. (180°), below cold leg centerline. Elevation difference between taps is 29 in.	+50 in. water	+3.0 psid	348, 349 350, 351	
DPV-55-110MM	Across part of downcomer, 55 in. (180°), to 110 in. (180°), below cold leg centerline. Elevation difference between taps is 55 in.	+100 in. water	+4.9 psid	352, 353 354, 355	
DPV-110-156MQ	Across part of downcomer, 110 in. (180°), to 156 in. (225°), below cold leg centerline. Elevation difference between taps is 46 in.	+100 in. water	+4.9 psid	356, 357 358, 359	
DPV-166-173QQ	Across part of lower plenum, 166 in. (225°), to 173 in. (225°), below cold leg centerline. Elevation difference between taps is 7 in.	+20 in. water	+0.98 psid	360, 361	

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Vessel (continued)</u>					
DPV-166Q-UP	Lower plenum, 166 in. below cold leg centerline at 225°, to upper plenum, 10.5 in. above cold leg centerline at 30°. Elevation difference between taps is 177 in.	+300 in. water	+14.7 psid	362, 363	Data acquisition system saturated between t=0 and t-1 sec.
<u>ECC SYSTEM</u>					
DPU-ACC-TB	Top to bottom of intact loop accumulator. Elevation difference between taps is 108 in.	+500 in. Water	+16.0 psid	364, 365	
DPB-ACC-TB	Top to bottom of broken loop accumulator tank. Elevation difference between taps is 84 in.	+300 in. water	+15.0 psid	366, 367	
<u>Steam Generator</u>					
DPU-SG-SEC	Secondary side, differential pressure taps at 45 in. and 126 in. above bottom of tube sheet. Elevation difference between taps is 81 in.	+100 in. water	+5.0 psid	368, 369	
DPU-SG-DISC	Across venturi tube, 66 in. downstream from steam generator discharge.	+100 in. water	+4.9 psid	370, 371	
VOLUMETRIC FLOW RATE	Turbine flowmeter, bidirectional.				Data acquisition system range may exceed rated detector range; however, turbine response is linear to flow rates well beyond the rated range.
<u>Intact Loop</u>					
FTII-1	Hot leg, Spool 1, 18 in. from vessel center.	+20 to +400 gpm	+1800 gpm	372, 373 374, 375	
FTU-9	Cold leg, Spool 9, 154 in. from vessel center.	+80 to +800 gpm	+1800 gpm	376, 377 378, 379	
FTU-13	Cold leg, Spool 13, 64 in. from vessel center.	+20 to +800 gpm	+1800 gpm	380, 381 382, 383	
FTU-15	Cold leg, Spool 15, 29 in. from vessel center.	+20 to +800 gpm	+1500 gpm	384, 385 386, 387	
<u>Broken Loop</u>					
FTB-21	Cold leg, Spool 21, 58 in. from vessel center; 3-in. pipe.	+20 to +400 gpm	+1800 gpm	388, 389	Positive flow indications in the Test S-05-6 data prior to t=0 sec are attributed to noise pickup by the detector system.
FTB-30	Hot leg, Spool 30, 25 in. from vessel center; 3-in. pipe.	+20 to +400 gpm	+1200 gpm	390, 391	Positive flow indications prior to t=0 sec are attributed to noise pickup by the detector system.
FTB-37	Cold leg, Spool 37, 290 in. from vessel center along hot leg; 2-in. pipe.	+20 to +800 gpm	+800 gpm	392, 393	Flow prior to t=0 should not be negative. There was no negative flow prior to t=0 sec in the broken loop.
<u>Core</u>					
FTV-CORE-IN	Entrance to core, ~158 in. below cold leg centerline.	+20 to +200 gpm	+1200 gpm	394, 395	Detectors saturated at -1000 gpm and -1200 gpm for Tests S-05-6 and S-05-7 respectively.
<u>ECC System</u>					
FTU-LPIS	In line leading from LPIS pump for intact loop, 1/2-in. line.	+0.75 to +7.5 gpm	+10 gpm	396, 397	S-05-6 only. Positive flow indicated prior to t=0 sec is attributed to noise pickup by the detector system. Data acquisition system saturated momentarily when flow first started.
FTV-LPIS	In line leading from LPIS pump for vessel upper plenum, 1/2-in. line.	+0.75 to +7.5 gpm	+10 gpm	398, 399	S-05-7 only. Data acquisition system saturated momentarily when flow first started.
FTB-LPIS	In line leading from LPIS pump for broken loop, 3/4-in. line	+0.75 to +7.5 gpm	+4 gpm	400, 401	S-05-6 only. Broken loop LPIS was not used during Test S-05-7.
FTU-ACC	In line leading from intact loop accumulator, 1-in. line.	+5 to +50 gpm	+70 gpm	402, 403	
FTB-ACC	In line leading from broken loop accumulator, 1-in. line.	+5 to +50 gpm	+70 gpm	404, 405	The data acquisition system malfunctioned for flow rates greater than ~40 gpm causing invalid data measurements from t=92 to 116 sec for Test S-05-6 and from t=64 to 129 sec for Test S-05-7.

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Pressurizer</u>					
FTU-PRIZE	1-1/2-in. turbine. Surge line.	+5 to +50 gpm	+100 gpm	406, 407	Positive flow indicated prior to t=0 sec is attributed to noise pickup by the detector system.
FLUID VELOCITY	Turbine flowmeter, bidirectional.				Detectors saturated for negative flow velocities greater than 60 ft/sec.
<u>Downcomer</u>					
FTV-40A	40 in. below cold leg centerline, 0°.	+2.5 to 50 ft/sec	+60 ft/sec	408, 409 410, 411	
FTV-40M	40 in. below cold leg centerline, 180°.	+2.5 to 50 ft/sec	+60 ft/sec	412, 413 414, 415	
MOMENTUM FLUX	Drag disc, bidirectional.				UPAG disc data may exhibit significant temperature dependence. Drag disc data should be used only for short-term transient response.
<u>Intact Loop</u>					
FDU-1	3-in. pipe. Hot leg, Spool 1, 29 in. from vessel center; target size 0.875 in.	+200 to +11,500 lbm/ft-sec ²	+17,800 lbm/ft-sec ²	416, 417	
FDU-5	Hot leg, Spool 5, 100 in. from vessel center; target size 1.0 in.	+1 to +2000 lbm/ft-sec ²	+4700 lbm/ft-sec ²	418, 419	Detector saturated prior to t=1 sec.
FDU-10	Cold leg, Spool 10, 137 in. from vessel center; target size 0.875 in.	+200 to +104,000 lbm/ft-sec ²	+23,750 lbm/ft-sec ²	420, 421	
FDU-13	Cold leg, Spool 13, 54 in. from vessel center; target size 0.875 in.	+200 to +14,800 lbm/ft-sec ²	+19,170 lbm/ft-sec ²	422, 423 424, 425	
FDU-15	Cold leg, Spool 15, 19 in. from vessel center; target size 0.875 in.	+200 to +14,500 lbm/ft-sec ²	+20,700 lbm/ft-sec ²	426, 427 428, 429	
<u>Broken Loop</u>					
FDB-21	Cold leg, Spool 21, 53 in. from vessel center, 3-in. pipe; target size 0.406 in.	+200 to +70,500 lbm/ft-sec ²	+72,912 lbm/ft-sec ²	430, 431	Detector has a nonlinear output for momentum flux values above 16,000 lbm/ft-sec ² .
FDB-23	Cold leg, Spool 23, 93 in. from vessel center, upstream of vessel side nozzle, 2-in. pipe; target size 0.406 in.	+200 to +121,000 lbm/ft-sec ²	+175,860 lbm/ft-sec ²	432, 433	Detector saturates at an indicated measurement of ~170,000 lbm/ft-sec ² and data are also uncertain above ~120,000 lbm/ft-sec ² because the transducer has a nonlinear output above this value.
FDB-30	Hot leg, Spool 30, 21 in. from vessel center, 3-in. pipe; target size 0.406 in.	+200 to +60,000 lbm/ft-sec ²	+90,220 lbm/ft-sec ²	434, 435	
FDB-37	Cold leg, Spool 37, 284 in. from vessel center along hot leg, steam generator outlet, vertical pipe, 2 in. pipe; target size 0.406 in.	+200 to +121,000 lbm/ft-sec ²	+203,210 lbm/ft-sec ²	436, 437	
FDB-42	Cold leg, Spool 42, 416 in. from vessel center along hot leg, upstream of pump-side nozzle, downstream of injection point, 2-in. pipe; target size 0.406 in.	+200 to +116,000 lbm/ft-sec ²	+128,850 lbm/ft-sec ²	438, 439	
<u>Vessel</u>					
FDV-CORE-IN	In core flow mixer box 150 in. below cold leg centerline; target size 0.656 in.	+200 to +131,000 lbm/ft-sec ²	+14,160 lbm/ft-sec ²	440, 441	
DENSITY					
<u>Intact Loop</u>					
GU-1VR	Hot leg, Spool 1, 24 in. from vessel center, vertical.	0.1 to 100 lbm/ft ³	0 to 100 lbm/ft ³	442, 443	For Test S-05-7 the horizontal measured density is greater than the vertical measured density from 260 to 300 sec. These relative densities are not the expected physical system condition and may be the result of detector system drift.

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Intact Loop (continued)</u>					
GU-1HZ	Hot leg, Spool 1, 26 in. from vessel center, horizontal.			444, 445	For Test S-05-7 the horizontal measured density is greater than the vertical measured density from 260 to 300 sec. These relative densities are not the expected physical system condition and may be the result of detector system drift.
GU-5VR	Hot leg, Spool 5, 96 in. from vessel center, vertical.			446, 447	
GU-10VR	Cold leg, Spool 10, 141 in. from vessel center, vertical.			448, 449	
GU-13VR	Cold leg, Spool 13, 59 in. from vessel center, vertical.			450, 451 452, 453	Data values above 62.4 lbm/ft ³ for Test S-05-6 do not reflect actual system density and were the result of detector system nonlinearity.
GU-15VR	Cold leg, Spool 15, 23 in. from vessel center, vertical.			454, 455 456, 457	
GU-15HZ	Cold leg, Spool 15, 20 in. from vessel center, horizontal.			458, 459 460, 461	
<u>Broken Loop</u>		0.1 to 100 lbm/ft ³	0 to 100 lbm/ft ³		
GB-21T	Cold leg, Spool 21, 49 in. from vessel center. T(top) ranges 270 to 360 degrees. B(bottom) ranges 30 to 330 degrees. C, mathematical composite of T and B.			462, 463	
GB-21B				464, 465	
GB-21C				466, 467 468, 469 470, 471 472, 473	
GB-23VR		Cold leg, Spool 23, 92 in. from vessel center, vertical.			474, 475 476, 477
GB-30T	Hot leg, Spool 30, 18 in. from vessel center. T(top) ranges 270 to 360 degrees. B(bottom) ranges 30 to 330 degrees. C, mathematical composite of T and B.			478, 479	
GB-30B				480, 481	
GB-30C				482, 483	
GB-42VR	Cold leg, Spool 42, 415 in. from vessel center along hot leg, vertical.			484, 485	
<u>Vessel</u>		0.1 to 100 lbm/ft ³	0 to 100 lbm/ft ³		
GV-COR-150HZ	Core flow mixer box, 152 in. below cold leg centerline, horizontal, 0 to 180°.			486, 487	
GVLP-165HZ	Upper part of lower plenum, 165 in. below cold leg centerline, 1.724 in. below downcomer exit, horizontal, 0 to 180°.			488, 489	
GVLP-172HZ	Lower plenum, 172 in. below cold leg centerline, 8.729 in. below downcomer exit, horizontal, 90 to 270°.			490, 491	
<u>Pressurizer</u>		0.1 to 100 lbm/ft ³	0 to 100 lbm/ft ³	492, 493	
GU-PRIZE	Surge line.				
<u>MASS FLOW RATE</u>		Range for mass flow is determined from range of individual detectors used in calculation.			
<u>Intact Loop</u>					
FDU-1, GU-1VR FTU-1, GU-1VR	Hot leg, Spool 1.			494, 495 496, 497 498, 499	
FDU-5, GU-5VR	Hot leg, Spool 5.			500, 501 502, 503	The drag disc transducer saturated prior to t=1 sec.
FTU-9, GU-10VR	Cold leg, Spool 9.			504, 505 506, 507	

TABLE V (continued)

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Intact Loop (continued)</u>					
FDU-10, GU-10VR	Cold leg, Spool 10.			508, 509	
FDU-13, GU-13VR	Cold leg, Spool 13.			510, 511 512, 513 514, 515 516, 517	
FTU-13, GU-13VR					
FDU-15, GU-15VR	Cold leg, Spool 15.			518, 519 520, 521 522, 523 524, 525	Nonlinearity in the density detector system caused density data near 62.4 lbm/ft ³ to be greater than 62.4 lb/ft ³ .
FTU-15, GU-15VR					
<u>Broken Loop</u>					
FDB-21, GB-21C	Cold leg, Spool 21.			526, 527	Detector FDB-21 has a nonlinear output for momentum flux values above 45,000 lbm/ft-sec ² .
FTB-21, GB-21C				528, 529	Flow prior to t=0 sec for Test S-05-6 should be zero. Flow indicated by FTB-21 prior to t=0 is not representative of system physical conditions.
FDB-23, GB-23VR	Cold leg, Spool 23			530, 531	Detector FDB-23 has a nonlinear output for momentum flux values above 120,000 lbm/ft-sec ² .
FDB-30, GB-30C FTB-30, GB-30C	Hot leg, Spool 30.			532, 533 534, 535	Flow prior to t=0 sec should be zero. Flow indicated by FTB-30 prior to t=0 is not representative of system physical conditions.
FDB-42, GB-42VR	Cold leg, Spool 42.			536, 537	
<u>Vessel</u>					
FDV-CORE-IN, GV COR 150HZ	Entrance to core.			538, 539	
FTV-CORE-IN, GV COR 150HZ	Entrance to core.			540, 541	Data acquisition for FTV-CORE-IN saturated intermittently from t=20 sec to t=40 sec.
<u>Pressurizer</u>					
FTU-PRIZE GU-PRIZE	Pressurizer surge line.			542, 543	Positive flow indicated prior to t=0 sec is attributed to noise pickup by the detector FTU-PRIZE.
<u>CORE CHARACTERISTICS</u>					
PWRCOR T-1	Core power.		1600 kW	544, 545	
PWRCOR T 2	Core power.		1600 kW	546, 547	
VOLTCOR-T	Core voltage.		0 to 200 Vdc	548, 549	
AMP COR-T	Core current.		0 to 10,000 A	550, 551	
<u>PUMP CHARACTERISTICS</u>					
PUMPU-CUR	Pump current.		0 to 25 A	552, 553	
PUMPU-RPM	Pump speed.		0 to 3600 rpm	554, 555	

[a] Statements at the beginning of a measurement category regarding location and comments, range, and figure apply to all subsequent measurements within the given category unless specified otherwise.

[b] Detectors which were subjected to overrange conditions during portions of the test were capable of withstanding these conditions without change in operating or measuring characteristics when the physical conditions were again within the detector range.

Fig. 8 Fluid temperature in intact loop hot leg (RBU-2), from -20 to 300 sec.

Fig. 9 Fluid temperature in intact loop hot leg (RBU-2), from -6 to 42 sec.

Fig. 10 Fluid temperature in intact loop cold leg (TFU-7), from -20 to 300 sec.

Fig. 11 Fluid temperature in intact loop cold leg (TFU-7), from -6 to 42 sec.

Fig. 12 Fluid temperature in intact loop cold leg (TFU-10), from -20 to 300 sec.

Fig. 13 Fluid temperature in intact loop cold leg (TFU-10), from -6 to 42 sec.

Fig. 14 Fluid temperature in intact loop cold leg (RBU-14A), from -20 to 300 sec.

Fig. 15 Fluid temperature in intact loop cold leg (RBU-14A), from -6 to 42 sec.

Fig. 16 Fluid temperature in intact loop cold leg (TFU-14B), from -20 to 300 sec.

Fig. 17 Fluid temperature in intact loop cold leg (TFU-14B), from -6 to 42 sec.

Fig. 18 Fluid temperature in broken loop, vessel side (TFB-20), from -20 to 300 sec.

Fig. 19 Fluid temperature in broken loop, vessel side (TFB-20), from -6 to 42 sec.

Fig. 20 Fluid temperature in broken loop, vessel side (TFB-23), from -20 to 300 sec.

Fig. 21 Fluid temperature in broken loop, vessel side (TFB-23), from -6 to 42 sec.

Fig. 22 Fluid temperature in broken loop, pump side (TFB-30), from -20 to 300 sec.

Fig. 23 Fluid temperature in broken loop, pump side (TFB-30), from -6 to 42 sec.

Fig. 24 Fluid temperature in broken loop, pump side (TFB-37), from -20 to 300 sec.

Fig. 25 Fluid temperature in broken loop, pump side (TFB-37), from -6 to 42 sec.

Fig. 26 Fluid temperature in broken loop, pump side (TFB-42), from -20 to 300 sec.

Fig. 27 Fluid temperature in broken loop, pump side (TFB-42), from -6 to 42 sec.

Fig. 28 Fluid temperature in inlet annulus (TFV-ANN-4A), from -20 to 300 sec.

Fig. 29 Fluid temperature in inlet annulus (TFV-ANN-4A), from -6 to 42 sec.

Fig. 30 Fluid temperature in inlet annulus (TFV-ANN-4M), from -20 to 300 sec.

Fig. 31 Fluid temperature in inlet annulus (TFV-ANN-4M), from -6 to 42 sec.

Fig. 32 Fluid temperature in downcomer annulus (TFV-ANN-35A), from -20 to 300 sec.

Fig. 33 Fluid temperature in downcomer annulus (TFV-ANN-35A), from -6 to 42 sec.

Fig. 34 Fluid temperature in downcomer annulus (TFV-ANN-70A), from -20 to 300 sec.

Fig. 35 Fluid temperature in downcomer annulus (TFV-ANN-70A), from -6 to 42 sec.

Fig. 36 Fluid temperature in downcomer annulus (TFV-ANN-115A), from -20 to 300 sec.

Fig. 37 Fluid temperature in downcomer annulus (TFV-ANN-115A), from -6 to 42 sec.

Fig. 38 Fluid temperature in downcomer annulus (TFV-ANN-156A), from -20 to 300 sec.

Fig. 39 Fluid temperature in downcomer annulus (TFV-ANN-156A), from -6 to 42 sec.

Fig. 40 Fluid temperature in upper plenum (TFV-UP+13), from -20 to 300 sec.

Fig. 41 Fluid temperature in upper plenum (TFV-UP+13), from -6 to 42 sec.

Fig. 42 Fluid temperature in upper plenum (TFV-LP-2), from -20 to 300 sec.

Fig. 43 Fluid temperature in upper plenum (TFV-LP-2), from -6 to 42 sec.

Fig. 44 Fluid temperature in lower plenum (TFV-LP-7), from -20 to 300 sec.

Fig. 45 Fluid temperature in lower plenum (TFV-LP-7), from -6 to 42 sec.

Fig. 46 Fluid temperature in core insulation gap (TFV-CIG-70A), from -20 to 300 sec.

Fig. 47 Fluid temperature in core insulation gap (TFV-CIG-70A), from -6 to 42 sec.

Fig. 48 Fluid temperature in vessel filler insulation gap (TFV-FIG-156A), from -20 to 300 sec.

Fig. 49 Fluid temperature in vessel filler insulation gap (TFV-FIG-156A), from -6 to 42 sec.

Fig. 50 Fluid temperature in core, Grid Spacer 5 (TFG-5CD-45), from -20 to 300 sec.

Fig. 51 Fluid temperature in core, Grid Spacer 5 (TFG-5CD-45), from -6 to 42 sec.

Fig. 52 Fluid temperature in core, Grid Spacer 6 (TFG-6AB-45), from -20 to 300 sec.

Fig. 53 Fluid temperature in core, Grid Spacer 6 (TFG-6AB-45), from -6 to 42 sec.

Fig. 54 Fluid temperature in core, Grid Spacer 6 (TFG-6CD-45), from -20 to 300 sec.

Fig. 55 Fluid temperature in core, Grid Spacer 6 (TFG-6CD-45), from -6 to 42 sec.

Fig. 56 Fluid temperature in intact loop ECC injection line (TFU-ECC-14), from -20 to 300 sec.

Fig. 57 Fluid temperature in intact loop ECC injection line (TFU-ECC-14), from -6 to 42 sec.

Fig. 58 Fluid temperature in broken loop ECC injection line (TFB-ECC-42), from -20 to 300 sec.

Fig. 59 Fluid temperature in broken loop ECC injection line (TFB-ECC-42), from -6 to 42 sec.

Fig. 60 Fluid temperature in vessel ECC injection line, Test S-05-7 (TFV-ECC+13), from -20 to 300 sec.

Fig. 61 Fluid temperature in vessel ECC injection line, Test S-05-7 (TFV-ECC+13), from -6 to 42 sec.

Fig. 62 Fluid temperature in steam generator (TFU-SGFW), from -20 to 300 sec.

Fig. 63 Fluid temperature in steam generator (TFU-SGFW), from -6 to 42 sec.

Fig. 64 Fluid temperature in steam generator, secondary side (TFU-SG1), from -20 to 300 sec.

Fig. 65 Fluid temperature in steam generator, secondary side (TFU-SG1), from -6 to 42 sec.

Fig. 66 Fluid temperature in steam generator, secondary side, Test S-05-7 (TFU-SG2), from -20 to 300 sec.

Fig. 67 Fluid temperature in steam generator, secondary side, Test S-05-7 (TFU-SG2), from -6 to 42 sec.

Fig. 68 Fluid temperature in steam generator, secondary side (TFU-SG3), from -20 to 300 sec.

Fig. 69 Fluid temperature in steam generator, secondary side (TFU-SG3), from -6 to 42 sec.

Fig. 70 Fluid temperature in pressurizer surge line (TFU-PRIZE), from -20 to 300 sec.

Fig. 71 Fluid temperature in pressurizer surge line (TFU-PRIZE), from -6 to 42 sec.

Fig. 72 Fluid temperature in pressure suppression tank (TF-PSS-33), from -20 to 300 sec.

Fig. 73 Fluid temperature in pressure suppression tank (TF-PSS-33), from -6 to 42 sec.

Fig. 74 Fluid temperature in pressure suppression tank (TF-PSS-130), from -20 to 300 sec.

Fig. 75 Fluid temperature in pressure suppression tank (TF-PSS-130), from -6 to 42 sec.

Fig. 76 Material temperature in intact loop (TMU-1T16), from -20 to 300 sec.

Fig. 77 Material temperature in intact loop (TMU-1T16), from -6 to 42 sec.

Fig. 78 Material temperature in intact loop (TMU-15T16), from -20 to 300 sec.

Fig. 79 Material temperature in intact loop (TMU-15T16), from -6 to 42 sec.

Fig. 80 Material temperature in broken loop (TMB-20B16), from -20 to 300 sec.

Fig. 81 Material temperature in broken loop (TMB-20B16), from -6 to 42 sec.

Fig. 82 Material temperature in vessel filler (TMV-FI-4M), from -20 to 300 sec.

Fig. 83 Material temperature in vessel filler (TMV-FI-4M), from -6 to 42 sec.

Fig. 84 Material temperature in vessel filler (TMV-FI-15A), from -20 to 300 sec.

Fig. 85 Material temperature in vessel filler (TMV-FI-15A), from -6 to 42 sec.

Fig. 86 Material temperature in vessel filler (TMV-FI-35A), from -20 to 300 sec.

Fig. 87 Material temperature in vessel filler (TMV-FI-35A), from -6 to 42 sec.

Fig. 88 Material temperature in vessel filler (TMV-FI-115A), from -20 to 300 sec.

Fig. 89 Material temperature in vessel filler (TMV-FI-115A), from -6 to 42 sec.

Fig. 90 Material temperature in vessel filler (TMV-F0-156A), from -20 to 300 sec.

Fig. 91 Material temperature in vessel filler (TMV-F0-156A), from -6 to 42 sec.

Fig. 92 Material temperature in vessel filler insulator (TIV-F0-35A); from -20 to 300 sec.

Fig. 93 Material temperature in vessel filler insulator (TIV-F0-35A), from -6 to 42 sec.

Fig. 94 Material temperature in vessel filler insulator (TIV-F0-35M), from -20 to 300 sec.

Fig. 95 Material temperature in vessel filler insulator (TIV-F0-35M), from -6 to 42 sec.

Fig. 96 Material temperature in vessel filler insulator (TIV-F0-70A), from -20 to 300 sec.

Fig. 97 Material temperature in vessel filler insulator (TIV-F0-70A), from -6 to 42 sec.

Fig. 98 Material temperature in vessel filler insulator (TIV-F0-115A), from -20 to 300 sec.

Fig. 99 Material temperature in vessel filler insulator (TIV-F0-115A), from -6 to 42 sec.

Fig. 100 Material temperature in core barrel (TMV-CI-70A), from -20 to 300 sec.

Fig. 101 Material temperature in core barrel (TMV-CI-70A), from -6 to 42 sec.

Fig. 102 Material temperature in core barrel (TMV-CI-115A), from -20 to 300 sec.

Fig. 103 Material temperature in core barrel (TMV-CI-115A), from -6 to 42 sec.

Fig. 104 Material temperature in core barrel (TMV-CO-70A), from -20 to 300 sec.

Fig. 105 Material temperature in core barrel (TMV-CO-70A), from -6 to 42 sec.

Fig. 106 Material temperature in core barrel (TMV-CO-115A), from -20 to 300 sec.

Fig. 107 Material temperature in core barrel (TMV-CO-115A), from -6 to 42 sec.

Fig. 108 Material temperature in core housing filler (TMV-HF-115W), from -20 to 300 sec.

Fig. 109 Material temperature in core housing filler (TMV-HF-115W), from -6 to 42 sec.

Fig. 110 Material temperature in core housing filler (TMV-HF-138W), from -20 to 300 sec.

Fig. 111 Material temperature in core housing filler (TMV-HF-138W), from -6 to 42 sec.

Fig. 112 Material temperature in steam generator, secondary side (TMU-SG1), from -20 to 300 sec.

Fig. 113 Material temperature in steam generator, secondary side (TMU-SG1), from -6 to 42 sec.

Fig. 114 Material temperature in steam generator, secondary side (TMU-SG2), from -20 to 300 sec.

Fig. 115 Material temperature in steam generator, secondary side (TMU-SG2), from -6 to 42 sec.

Fig. 116 Material temperature in steam generator, secondary side (TMU-SG3), from -20 to 300 sec.

Fig. 117 Material temperature in steam generator, secondary side (TMU-SG3), from -6 to 42 sec.

Fig. 118 Core heater temperature, Rod D-4 (TH-D4-14), from -20 to 300 sec.

Fig. 119 Core heater temperature, Rod D-4 (TH-D4-14), from -6 to 42 sec.

Fig. 120 Core heater temperature, Rod D-4 (TH-D4-29), from -20 to 300 sec.

Fig. 121 Core heater temperature, Rod D-4 (TH-D4-29), from -6 to 42 sec.

Fig. 122 Core heater temperature, Rod D-5 (TH-D5-29), from -20 to 300 sec.

Fig. 123 Core heater temperature, Rod D-5 (TH-D5-29), from -6 to 42 sec.

Fig. 124 Core heater temperature, Rod E-4 (TH-E4-09), from -20 to 300 sec.

Fig. 125 Core heater temperature, Rod E-4 (TH-E4-09), from -6 to 42 sec.

Fig. 126 Core heater temperature, Rod E-4 (TH-E4-27), from -20 to 300 sec.

Fig. 127 Core heater temperature, Rod E-4 (TH-E4-27), from -6 to 42 sec.

Fig. 128 Core heater temperature, Rod E-4 (TH-E4-55), from -20 to 300 sec.

Fig. 129 Core heater temperature, Rod E-4 (TH-E4-55), from -6 to 42 sec.

Fig. 130 Core heater temperature, Rod E-5 (TH-E5-25), from -20 to 300 sec.

Fig. 131 Core heater temperature, Rod E-5 (TH-E5-25), from -6 to 42 sec.

Fig. 132 Core heater temperature, Rod A-4 (TH-A4-09), from -20 to 300 sec.

Fig. 133 Core heater temperature, Rod A-4 (TH-A4-09), from -6 to 42 sec.

Fig. 134 Core heater temperature, Rod A-4 (TH-A4-29), from -20 to 300 sec.

Fig. 135 Core heater temperature, Rod A-4 (TH-A4-29), from -6 to 42 sec.

Fig. 136 Core heater temperature, Rod A-4 (TH-A4-39), from -20 to 300 sec.

Fig. 137 Core heater temperature, Rod A-4 (TH-A4-39), from -6 to 42 sec.

Fig. 138 Core heater temperature, Rod A-5 (TH-A5-29), from -20 to 300 sec.

Fig. 139 Core heater temperature, Rod A-5 (TH-A5-29), from -6 to 42 sec.

Fig. 140 Core heater temperature, Rod A-5 (TH-A5-45), from -20 to 300 sec.

Fig. 141 Core heater temperature, Rod A-5 (TH-A5-45), from -6 to 42 sec.

Fig. 142 Core heater temperature, Rod B-3 (TH-B3-32), from -20 to 300 sec.

Fig. 143 Core heater temperature, Rod B-3 (TH-B3-32), from -6 to 42 sec.

Fig. 144 Core heater temperature, Rod B-5 (TH-B5-29), from -20 to 300 sec.

Fig. 145 Core heater temperature, Rod B-5 (TH-B5-29), from -6 to 42 sec.

Fig. 146 Core heater temperature, Rod B-5 (TH-B5-33), from -20 to 300 sec.

Fig. 147 Core heater temperature, Rod B-5 (TH-B5-33), from -6 to 42 sec.

Fig. 148 Core heater temperature, Rod B-6 (TH-B6-29), from -20 to 300 sec.

Fig. 149 Core heater temperature, Rod B-6 (TH-B6-29), from -6 to 42 sec.

Fig. 150 Core heater temperature, Rod C-2 (TH-C2-38), from -20 to 300 sec.

Fig. 151 Core heater temperature, Rod C-2 (TH-C2-38), from -6 to 42 sec.

Fig. 152 Core heater temperature, Rod C-4 (TH-C4-26), from -20 to 300 sec.

Fig. 153 Core heater temperature, Rod C-4 (TH-C4-26), from -6 to 42 sec.

Fig. 154 Core heater temperature, Rod C-4 (TH-C4-53), from -20 to 300 sec.

Fig. 155 Core heater temperature, Rod C-4 (TH-C4-53), from -6 to 42 sec.

Fig. 156 Core heater temperature, Rod C-5 (TH-C5-28), from -20 to 300 sec.

Fig. 157 Core heater temperature, Rod C-5 (TH-C5-28), from -6 to 42 sec.

Fig. 158 Core heater temperature, Rod C-7 (TH-C7-07), from -20 to 300 sec.

Fig. 159 Core heater temperature, Rod C-7 (TH-C7-07), from -6 to 42 sec.

Fig. 160 Core heater temperature, Rod C-7 (TH-C7-15), from -20 to 300 sec.

Fig. 161 Core heater temperature, Rod C-7 (TH-C7-15), from -6 to 42 sec.

Fig. 162 Core heater temperature, Rod D-1 (TH-D1-21), from -20 to 300 sec.

Fig. 163 Core heater temperature, Rod D-1 (TH-D1-21), from -6 to 42 sec.

Fig. 164 Core heater temperature, Rod D-2 (TH-D2-14), from -20 to 300 sec.

Fig. 165 Core heater temperature, Rod D-2 (TH-D2-14), from -6 to 42 sec.

Fig. 166 Core heater temperature, Rod D-2 (TH-D2-61), from -20 to 300 sec.

Fig. 167 Core heater temperature, Rod D-2 (TH-D2-61), from -6 to 42 sec.

Fig. 168 Core heater temperature, Rod D-3 (TH-D3-29), from -20 to 300 sec.

Fig. 169 Core heater temperature, Rod D-3 (TH-D3-29), from -6 to 42 sec.

Fig. 170 Core heater temperature, Rod D-3 (TH-D3-39), from -20 to 300 sec.

Fig. 171 Core heater temperature, Rod D-3 (TH-D3-39), from -6 to 42 sec.

Fig. 172 Core heater temperature, Rod D-6 (TH-D6-15), from -20 to 300 sec.

Fig. 173 Core heater temperature, Rod D-6 (TH-D6-15), from -6 to 42 sec.

Fig. 174 Core heater temperature, Rod D-6 (TH-D6-25), from -20 to 300 sec.

Fig. 175 Core heater temperature, Rod D-6 (TH-D6-25), from -6 to 42 sec.

Fig. 176 Core heater temperature, Rod D-7 (TH-D7-20), from -20 to 300 sec.

Fig. 177 Core heater temperature, Rod D-7 (TH-D7-20), from -6 to 42 sec.

Fig. 178 Core heater temperature, Rod D-8 (TH-D8-27), from -20 to 300 sec.

Fig. 179 Core heater temperature, Rod D-8 (TH-D8-27), from -6 to 42 sec.

Fig. 180 Core heater temperature, Rod D-8 (TH-D8-57), from -20 to 300 sec.

Fig. 181 Core heater temperature, Rod D-8 (TH-D8-57), from -6 to 42 sec.

Fig. 182 Core heater temperature, Rod E-1 (TH-E1-33), from -20 to 300 sec.

Fig. 183 Core heater temperature, Rod E-1 (TH-E1-33), from -6 to 42 sec.

Fig. 184 Core heater temperature, Rod E-2 (TH-E2-20), from -20 to 300 sec.

Fig. 185 Core heater temperature, Rod E-2 (TH-E2-20), from -6 to 42 sec.

Fig. 186 Core heater temperature, Rod E-2 (TH-E2-33), from -20 to 300 sec.

Fig. 187 Core heater temperature, Rod E-2 (TH-E2-33), from -6 to 42 sec.

Fig. 188 Core heater temperature, Rod E-3 (TH-E3-05), from -20 to 300 sec.

Fig. 189 Core heater temperature, Rod E-3 (TH-E3-05), from -6 to 42 sec.

Fig. 190 Core heater temperature, Rod E-3 (TH-E3-20), from -20 to 300 sec.

Fig. 191 Core heater temperature, Rod E-3 (TH-E3-20), from -6 to 42 sec.

Fig. 192 Core heater temperature, Rod E-3 (TH-E3-24), from -20 to 300 sec.

Fig. 193 Core heater temperature, Rod E-3 (TH-E3-24), from -6 to 42 sec.

Fig. 194 Core heater temperature, Rod E-6 (TH-E6-08), from -20 to 300 sec.

Fig. 195 Core heater temperature, Rod E-6 (TH-E6-08), from -6 to 42 sec.

Fig. 196 Core heater temperature, Rod E-6 (TH-E6-28), from -20 to 300 sec.

Fig. 197 Core heater temperature, Rod E-6 (TH-E6-28), from -6 to 42 sec.

Fig. 198 Core heater temperature, Rod E-6 (TH-E6-37), from -20 to 300 sec.

Fig. 199 Core heater temperature, Rod E-6 (TH-E6-37), from -6 to 42 sec.

Fig. 200 Core heater temperature, Rod E-7 (TH-E7-44), from -20 to 300 sec.

Fig. 201 Core heater temperature, Rod E-7 (TH-E7-44), from -6 to 42 sec.

Fig. 202 Core heater temperature, Rod E-8 (TH-E8-14), from -20 to 300 sec.

Fig. 203 Core heater temperature, Rod E-8 (TH-E8-14), from -6 to 42 sec.

Fig. 204 Core heater temperature, Rod E-8 (TH-E8-29), from -20 to 300 sec.

Fig. 205 Core heater temperature, Rod E-8 (TH-E8-29), from -6 to 42 sec.

Fig. 206 Core heater temperature, Rod E-8 (TH-E8-45), from -20 to 300 sec.

Fig. 207 Core heater temperature, Rod E-8 (TH-E8-45), from -6 to 42 sec.

Fig. 208 Core heater temperature, Rod F-2 (TH-F2-07), from -20 to 300 sec.

Fig. 209 Core heater temperature, Rod F-2 (TH-F2-07), from -6 to 42 sec.

Fig. 210 Core heater temperature, Rod F-2 (TH-F2-22), from -20 to 300 sec.

Fig. 211 Core heater temperature, Rod F-2 (TH-F2-22), from -6 to 42 sec.

Fig. 212 Core heater temperature, Rod F-2 (TH-F2-25), from -20 to 300 sec.

Fig. 213 Core heater temperature, Rod F-2 (TH-F2-25), from -6 to 42 sec.

Fig. 214 Core heater temperature, Rod F-4 (TH-F4-14), from -20 to 300 sec.

Fig. 215 Core heater temperature, Rod F-4 (TH-F4-14), from -6 to 42 sec.

Fig. 216 Core heater temperature, Rod F-4 (TH-F4-29), from -20 to 300 sec.

Fig. 217 Core heater temperature, Rod F-4 (TH-F4-29), from -6 to 42 sec.

Fig. 218 Core heater temperature, Rod F-4 (TH-F4-44), from -20 to 300 sec.

Fig. 219 Core heater temperature, Rod F-4 (TH-F4-44), from -6 to 42 sec.

Fig. 220 Core heater temperature, Rod F-5 (TH-F5-20), from -20 to 300 sec.

Fig. 221 Core heater temperature, Rod F-5 (TH-F5-20), from -6 to 42 sec.

Fig. 222 Core heater temperature, Rod F-5 (TH-F5-26), from -20 to 300 sec.

Fig. 223 Core heater temperature, Rod F-5 (TH-F5-26), from -6 to 42 sec.

Fig. 224 Core heater temperature, Rod F-5 (TH-F5-33), from -20 to 300 sec.

Fig. 225 Core heater temperature, Rod F-5 (TH-F5-33), from -6 to 42 sec.

Fig. 226 Core heater temperature, Rod F-5 (TH-F5-53), from -20 to 300 sec.

Fig. 227 Core heater temperature, Rod F-5 (TH-F5-53), from -6 to 42 sec.

Fig. 228 Core heater temperature, Rod G-3 (TH-G3-13), from -20 to 300 sec.

Fig. 229 Core heater temperature, Rod G-3 (TH-G3-13), from -6 to 42 sec.

Fig. 230 Core heater temperature, Rod G-4 (TH-G4-29), from -20 to 300 sec.

Fig. 231 Core heater temperature, Rod G-4 (TH-G4-29), from -6 to 42 sec.

Fig. 232 Core heater temperature, Rod G-4 (TH-G4-33), from -20 to 300 sec.

Fig. 233 Core heater temperature, Rod G-4 (TH-G4-33), from -6 to 42 sec.

Fig. 234 Core heater temperature, Rod G-4 (TH-G4-38), from -20 to 300 sec.

Fig. 235 Core heater temperature, Rod G-4 (TH-G4-38), from -6 to 42 sec.

Fig. 236 Core heater temperature, Rod G-5 (TH-G5-14), from -20 to 300 sec.

Fig. 237 Core heater temperature, Rod G-5 (TH-G5-14), from -6 to 42 sec.

Fig. 238 Core heater temperature, Rod G-5 (TH-G5-24), from -20 to 300 sec.

Fig. 239 Core heater temperature, Rod G-5 (TH-G5-24), from -6 to 42 sec.

Fig. 240 Core heater temperature, Rod H-5 (TH-H5-32), from -20 to 300 sec.

Fig. 241 Core heater temperature, Rod H-5 (TH-H5-32), from -6 to 42 sec.

Fig. 242 Pressure in intact loop, Spool 13, Test S-05-7 (PU-13), from -20 to 300 sec.

Fig. 243 Pressure in intact loop, Spool 13, Test S-05-7 (PU-13), from -6 to 42 sec.

Fig. 244 Pressure in intact loop, Spool 15 (PU-15L), from -20 to 300 sec.

Fig. 245 Pressure in intact loop, Spool 15 (PU-15L), from -6 to 42 sec.

Fig. 246 Pressure in broken loop, Spool 23, Test S-05-7 (PB-23), from -20 to 300 sec.

Fig. 247 Pressure in broken loop, Spool 23, Test S-05-7 (PB-23), from -6 to 42 sec.

Fig. 248 Pressure in broken loop, near break (PB-37), from -20 to 300 sec.

Fig. 249 Pressure in broken loop, near break (PB-37), from -6 to 42 sec.

Fig. 250 Pressure in broken loop, near break (PB-42), from -20 to 300 sec.

Fig. 251 Pressure in broken loop, near break (PB-42), from -6 to 42 sec.

Fig. 252 Pressure in broken loop, near break (PB-HN1), from -20 to 300 sec.

Fig. 253 Pressure in broken loop, near break (PB-HN1), from -6 to 42 sec.

Fig. 254 Pressure in broken loop, vessel-side nozzle (PB-CN1), from -20 to 300 sec.

Fig. 255 Pressure in broken loop, vessel-side nozzle (PB-CN1), from -6 to 42 sec.

Fig. 256 Pressure in broken loop, vessel-side nozzle (PB-CN2), from -20 to 300 sec.

Fig. 257 Pressure in broken loop, vessel-side nozzle (PB-CN2), from -6 to 42 sec.

Fig. 258 Pressure in broken loop, vessel-side nozzle (PB-CN3), from -20 to 300 sec.

Fig. 259 Pressure in broken loop, vessel-side nozzle (PB-CN3), from -6 to 42 sec.

Fig. 260 Pressure in broken loop, vessel-side nozzle (PB-CN4), from -20 to 300 sec.

Fig. 261 Pressure in broken loop, vessel-side nozzle (PB-CN4), from -6 to 42 sec.

Fig. 262 Pressure in vessel (PV-UP+10), from -20 to 300 sec.

Fig. 263 Pressure in vessel (PV-UP+10), from -6 to 42 sec.

Fig. 264 Pressure in vessel (PV-LP-166), from -20 to 300 sec.

Fig. 265 Pressure in vessel (PV-LP-166), from -6 to 42 sec.

Fig. 266 Pressure in intact loop accumulator (PU-ACC), from -20 to 300 sec.

Fig. 267 Pressure in intact loop accumulator (PU-ACC), from -6 to 42 sec.

Fig. 268 Pressure in broken loop accumulator (PB-ACC), from -20 to 300 sec.

Fig. 269 Pressure in broken loop accumulator (PB-ACC), from -6 to 42 sec.

Fig. 270 Pressure in steam generator, secondary side (PU-SGSD), from -20 to 300 sec.

Fig. 271 Pressure in steam generator, secondary side (PU-SGSD), from -6 to 42 sec.

Fig. 272 Pressure in pressurizer (PU-PRIZE), from -20 to 300 sec.

Fig. 273 Pressure in pressurizer (PU-PRIZE), from -6 to 42 sec.

Fig. 274 Pressure in pressure suppression tank (P-PSS), from -20 to 300 sec.

Fig. 275 Pressure in pressure suppression tank (P-PSS), from -6 to 42 sec.

Fig. 276 Differential pressure in intact loop (DPU-UP-3), from -20 to 300 sec.

Fig. 277 Differential pressure in intact loop (DPU-UP-3), from -6 to 42 sec.

Fig. 278 Differential pressure in intact loop (DPU-3-7), from -20 to 300 sec.

Fig. 279 Differential pressure in intact loop (DPU-3-7), from -6 to 42 sec.

Fig. 280 Differential pressure in intact loop, Test S-05-7 (DPU-6-SGIP), from -20 to 300 sec.

Fig. 281 Differential pressure in intact loop, Test S-05-7 (DPU-6-SGIP), from -6 to 42 sec.

Fig. 282 Differential pressure in intact loop, Test S-05-7 (DPU-SGOP-7), from -20 to 300 sec.

Fig. 283 Differential pressure in intact loop, Test S-05-7 (DPU-SGOP-7), from -6 to 42 sec.

Fig. 284 Differential pressure in intact loop (DPU-7-10), from -20 to 300 sec.

Fig. 285 Differential pressure in intact loop (DPU-7-10), from -6 to 42 sec.

Fig. 286 Differential pressure in intact loop (DPU-12-10), from -20 to 300 sec.

Fig. 287 Differential pressure in intact loop (DPU-12-10), from -6 to 42 sec.

Fig. 288 Differential pressure in intact loop, low range (DPU-12-10L), from -20 to 300 sec.

Fig. 289 Differential pressure in intact loop, low range (DPU-12-10L), from -6 to 42 sec.

Fig. 290 Differential pressure in intact loop, Test S-05-6 (DPU-12-15), from -20 to 300 sec.

Fig. 291 Differential pressure in intact loop, Test S-05-6 (DPU-12-15), from -6 to 42 sec.

Fig. 292 Differential pressure in intact loop, Test S-05-7 (DPU-12-15), from -20 to 300 sec.

Fig. 293 Differential pressure in intact loop, Test S-05-7 (DPU-12-15), from -6 to 42 sec.

Fig. 294 Differential pressure in intact loop (DPU-15-1), from -20 to 300 sec.

Fig. 295 Differential pressure in intact loop (DPU-15-1), from -6 to 42 sec.

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Fig. 296 Differential pressure in intact loop, low range, Test S-05-6 (DPU-15-1L), from -20 to 300 sec.

Fig. 297 Differential pressure in intact loop, low range, Test S-05-6 (DPU-15-1L), from -6 to 42 sec.

Fig. 298 Differential pressure in intact loop, low range, Test S-05-7 (DPU-15-1L), from -20 to 300 sec.

Fig. 299 Differential pressure in intact loop, low range, Test S-05-7 (DPU-15-1L), from -6 to 42 sec.

Fig. 300 Differential pressure in intact loop, Test S-05-6 (DPU-15-IANN), from -20 to 300 sec.

Fig. 301 Differential pressure in intact loop, Test S-05-6 (DPU-15-IANN), from -6 to 42 sec.

Fig. 302 Differential pressure in intact loop, Test S-05-7 (DPU-15-IANN), from -20 to 300 sec.

Fig. 303 Differential pressure in intact loop, Test S-05-7 (DPU-15-IANN), from -6 to 42 sec.

Fig. 304 Differential pressure in intact loop (DPU-PRESLL), from -20 to 300 sec.

Fig. 305 Differential pressure in intact loop (DPU-PRESLL), from -6 to 42 sec.

Fig. 306 Differential pressure in intact loop (DPU-PR-4), from -20 to 300 sec.

Fig. 307 Differential pressure in intact loop (DPU-PR-4), from -6 to 42 sec.

Fig. 308 Differential pressure in broken loop, Test S-05-6 (DPB-UP-30), from -20 to 300 sec.

Fig. 309 Differential pressure in broken loop, Test S-05-6 (DPB-UP-30), from -6 to 42 sec.

Fig. 310 Differential pressure in broken loop, Test S-05-7 (DPB-UP-30), from -20 to 300 sec.

Fig. 311 Differential pressure in broken loop, Test S-05-7 (DPB-UP-30), from -6 to 42 sec.

Fig. 312 Differential pressure in broken loop, Test S-05-6 (DPB-21-IANN), from -20 to 300 sec.

Fig. 313 Differential pressure in broken loop, Test S-05-6 (DPB-21-IANN), from -6 to 42 sec.

Fig. 314 Differential pressure in broken loop, Test S-05-7 (DPB-21-IANN), from -20 to 300 sec.

Fig. 315 Differential pressure in broken loop, Test S-05-7 (DPB-21-IANN), from -6 to 42 sec.

Fig. 316 Differential pressure in broken loop (DPB-23-CN1), from -20 to 300 sec.

Fig. 317 Differential pressure in broken loop (DPB-23-CN1), from -6 to 42 sec.

Fig. 318 Differential pressure in broken loop (DPB-CN1-PSS-63), from -20 to 300 sec.

Fig. 319 Differential pressure in broken loop (DPB-CN1-PSS-63), from -6 to 42 sec.

Fig. 320 Differential pressure in broken loop (DPB-30-36L), from -20 to 300 sec.

Fig. 321 Differential pressure in broken loop (DPB-30-36L), from -6 to 42 sec.

Fig. 322 Differential pressure in broken loop (DPB-32U-36L), from -20 to 300 sec.

Fig. 323 Differential pressure in broken loop (DPB-32U-36L), from -6 to 42 sec.

Fig. 324 Differential pressure in broken loop (DPB-36L-37), from -20 to 300 sec.

Fig. 325 Differential pressure in broken loop (DPB-36L-37), from -6 to 42 sec.

Fig. 326 Differential pressure in broken loop (DPB-37-38), from -20 to 300 sec.

Fig. 327 Differential pressure in broken loop (DPB-37-38), from -6 to 42 sec.

Fig. 328 Differential pressure in broken loop (DPB-38-40), from -20 to 300 sec.

Fig. 329 Differential pressure in broken loop (DPB-38-40), from -6 to 42 sec.

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Fig. 330 Differential pressure in broken loop, Test S-05-6 (DPB-40-42), from -20 to 300 sec.

Fig. 331 Differential pressure in broken loop, Test S-05-6 (DPB-40-42), from -6 to 42 sec.

Fig. 332 Differential pressure in broken loop, Test S-05-7 (DPB-40-42), from -20 to 300 sec.

Fig. 333 Differential pressure in broken loop, Test S-05-7 (DPB-40-42), from -6 to 42 sec.

Fig. 334 Differential pressure in vessel (DPV-UP-IANN), from -20 to 300 sec.

Fig. 335 Differential pressure in vessel (DPV-UP-IANN), from -6 to 42 sec.

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Fig. 336 Differential pressure in vessel, Test S-05-6 (DPV-0-9GQ), from -20 to 300 sec.

Fig. 337 Differential pressure in vessel, Test S-05-6 (DPV-0-9GQ), from -6 to 42 sec.

Fig. 338 Differential pressure in vessel, Test S-05-7 (DPV-0-9GQ), from -20 to 300 sec.

Fig. 339 Differential pressure in vessel, Test S-05-7 (DPV-0-9GQ), from -6 to 42 sec.

Fig. 340 Differential pressure in vessel, Test S-05-6 (DPV-9-26QQ), from -20 to 300 sec.

Fig. 341 Differential pressure in vessel, Test S-05-6 (DPV-9-26QQ), from -6 to 42 sec.

Fig. 342 Differential pressure in vessel, Test S-05-7 (DPV-9-26QQ), from -20 to 300 sec.

Fig. 343 Differential pressure in vessel, Test S-05-7 (DPV-9-26QQ), from -6 to 42 sec.

Fig. 344 Differential pressure in vessel, Test S-05-6 (DPV-9-166QQ), from -20 to 300 sec.

Fig. 345 Differential pressure in vessel, Test S-05-6 (DPV-9-166QQ), from -6 to 42 sec.

Fig. 346 Differential pressure in vessel, Test S-05-7 (DPV-9-166QQ), from -20 to 300 sec.

Fig. 347 Differential pressure in vessel, Test S-05-7 (DPV-9-166QQ), from -6 to 42 sec.

Fig. 348 Differential pressure in vessel, Test S-05-6 (DPV-26-55QM), from -20 to 300 sec.

Fig. 349 Differential pressure in vessel, Test S-05-6 (DPV-26-55QM), from -6 to 42 sec.

Fig. 350 Differential pressure in vessel, Test S-05-7 (DPV-26-55QM), from -20 to 300 sec.

Fig. 351 Differential pressure in vessel, Test S-05-7 (DPV-26-55QM), from -6 to 42 sec.

Fig. 352 Differential pressure in vessel, Test S-05-6 (DPV-55-110MM), from -20 to 300 sec.

Fig. 353 Differential pressure in vessel, Test S-05-6 (DPV-55-110MM), from -6 to 42 sec.

Fig. 354 Differential pressure in vessel, Test S-05-7 (DPV-55-110MM), from -20 to 300 sec.

Fig. 355 Differential pressure in vessel, Test S-05-7 (DPV-55-110MM), from -6 to 42 sec.

Fig. 356 Differential pressure in vessel, Test S-05-6 (DPV-110-156MQ), from -20 to 300 sec.

Fig. 357 Differential pressure in vessel, Test S-05-6 (DPV-110-156MQ), from -6 to 42 sec.

Fig. 358 Differential pressure in vessel, Test S-05-7 (DPV-110-156MQ), from -20 to 300 sec.

Fig. 359 Differential pressure in vessel, Test S-05-7 (DPV-110-156MQ), from -6 to 42 sec.

Fig. 360 Differential pressure in vessel (DPV-166-173QQ), from -20 to 300 sec.

Fig. 361 Differential pressure in vessel (DPV-166-173QQ), from -6 to 42 sec.

Fig. 362 Differential pressure in vessel (DPV-166Q-UP), from -20 to 300 sec.

Fig. 363 Differential pressure in vessel (DPV-166Q-UP), from -6 to 42 sec.

Fig. 364 Differential pressure in intact loop accumulator (DPU-ACC-TB), from -20 to 300 sec.

Fig. 365 Differential pressure in intact loop accumulator (DPU-ACC-TB), from -6 to 42 sec.

Fig. 366 Differential pressure in broken loop accumulator (DPB-ACC-TB), from -20 to 300 sec.

Fig. 367 Differential pressure in broken loop accumulator (DPB-ACC-TB), from -6 to 42 sec.

Fig. 368 Differential pressure in steam generator secondary (DPU-SG-SEC), from -20 to 300 sec.

Fig. 369 Differential pressure in steam generator secondary (DPU-SG-SEC), from -6 to 42 sec.

Fig. 370 Differential pressure across steam generator outlet orifice (DPU-SG-DISC), from -20 to 300 sec.

Fig. 371 Differential pressure across steam generator outlet orifice (DPU-SG-DISC), from -6 to 42 sec.

Fig. 372 Volumetric flow in intact loop, Test S-05-6 (FTU-1), from -20 to 300 sec.

Fig. 373 Volumetric flow in intact loop, Test S-05-6 (FTU-1), from -6 to 42 sec.

Fig. 374 Volumetric flow in intact loop, Test S-05-7 (FTU-1), from -20 to 300 sec.

Fig. 375 Volumetric flow in intact loop, Test S-05-7 (FTU-1), from -6 to 42 sec.

Fig. 376 Volumetric flow in intact loop, Test S-05-6 (FTU-9), from -20 to 300 sec.

Fig. 377 Volumetric flow in intact loop, Test S-05-6 (FTU-9), from -6 to 42 sec.

Fig. 378 Volumetric flow in intact loop, Test S-05-7 (FTU-9), from -20 to 300 sec.

Fig. 379 Volumetric flow in intact loop, Test S-05-7 (FTU-9), from -6 to 42 sec.

Fig. 380 Volumetric flow in intact loop, Test S-05-6 (FTU-13), from -20 to 300 sec.

Fig. 381 Volumetric flow in intact loop, Test S-05-6 (FTU-13), from -6 to 42 sec.

Fig. 382 Volumetric flow in intact loop, Test S-05-7 (FTU-13), from -20 to 300 sec.

Fig. 383 Volumetric flow in intact loop, Test S-05-7 (FTU-13), from -6 to 42 sec.

Fig. 384 Volumetric flow in intact loop, Test S-05-6 (FTU-15), from -20 to 300 sec.

Fig. 385 Volumetric flow in intact loop, Test S-05-6 (FTU-15), from -6 to 42 sec.

Fig. 386 Volumetric flow in intact loop, Test S-05-7 (FTU-15), from -20 to 300 sec.

Fig. 387 Volumetric flow in intact loop, Test S-05-7 (FTU-15), from -6 to 42 sec.

Fig. 388 Volumetric flow in broken loop (FTB-21), from -20 to 300 sec.

Fig. 389 Volumetric flow in broken loop (FTB-21), from -6 to 42 sec.

Fig. 390 Volumetric flow in broken loop (FTB-30), from -20 to 300 sec.

Fig. 391 Volumetric flow in broken loop (FTB-30), from -6 to 42 sec.

Fig. 392 Volumetric flow in broken loop (FTB-37), from -20 to 300 sec.

Fig. 393 Volumetric flow in broken loop (FTB-37), from -6 to 42 sec.

Fig. 394 Volumetric flow in core entrance (FTV-CORE-IN), from -20 to 300 sec.

Fig. 395 Volumetric flow in core entrance (FTV-CORE-IN), from -6 to 42 sec.

Fig. 396 Volumetric flow in intact loop low pressure injection line, Test S-05-6 (FTU-LPIS), from -20 to 300 sec.

Fig. 397 Volumetric flow in intact loop low pressure injection line, Test S-05-6 (FTU-LPIS), from -6 to 42 sec.

Fig. 398 Volumetric flow in vessel low pressure injection line, Test S-05-7 (FTV-LPIS), from -20 to 300 sec.

Fig. 399 Volumetric flow in vessel low pressure injection line, Test S-05-7 (FTV-LPIS), from -6 to 42 sec.

Fig. 400 Volumetric flow in broken loop low pressure injection line, Test S-05-6 (FTB-LPIS), from -20 to 300 sec.

Fig. 401 Volumetric flow in broken loop low pressure injection line, Test S-05-6 (FTB-LPIS), from -6 to 42 sec.

Fig. 402 Volumetric flow in intact loop accumulator discharge line (FTU-ACC), from -20 to 300 sec.

Fig. 403 Volumetric flow in intact loop accumulator discharge line (FTU-ACC), from -6 to 42 sec.

Fig. 404 Volumetric flow in broken loop accumulator discharge line (FTB-ACC), from -20 to 300 sec.

Fig. 405 Volumetric flow in broken loop accumulator discharge line (FTB-ACC), from -6 to 42 sec.

Fig. 406 Volumetric flow from pressurizer (FTU-PRIZE), from -20 to 300 sec.

Fig. 407 Volumetric flow from pressurizer (FTU-PRIZE), from -6 to 42 sec.

Fig. 408 Fluid velocity in vessel, Test S-05-6 (FTV-40A), from -20 to 300 sec.

Fig. 409 Fluid velocity in vessel, Test S-05-6 (FTV-40A), from -6 to 42 sec.

Fig. 410 Fluid velocity in vessel, Test S-05-7 (FTV-40A), from -20 to 300 sec.

Fig. 411 Fluid velocity in vessel, Test S-05-7 (FTV-40A), from -6 to 42 sec.

Fig. 412 Fluid velocity in vessel, Test S-05-6 (FTV-40M), from -20 to 300 sec.

Fig. 413 Fluid velocity in vessel, Test S-05-6 (FTV-40M), from -6 to 42 sec.

Fig. 414 Fluid velocity in vessel, Test S-05-7 (FTV-40M), from -20 to 300 sec.

Fig. 415 Fluid velocity in vessel, Test S-05-7 (FTV-40M), from -6 to 42 sec.

Fig. 416 Momentum flux in intact loop (FDU-1), from -20 to 300 sec.

Fig. 417 Momentum flux in intact loop (FDU-1), from -6 to 42 sec.

Fig. 418 Momentum flux in intact loop (FDU-5), from -20 to 300 sec.

Fig. 419 Momentum flux in intact loop (FDU-5), from -6 to 42 sec.

Fig. 420 Momentum flux in intact loop (FDU-10), from -20 to 300 sec.

Fig. 421 Momentum flux in intact loop (FDU-10), from -6 to 42 sec.

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Fig. 422 Momentum flux in intact loop, Test S-05-6 (FDU-13), from -20 to 300 sec.

Fig. 423 Momentum flux in intact loop, Test S-05-6 (FDU-13), from -6 to 42 sec.

Fig. 424 Momentum flux in intact loop, Test S-05-7 (FDU-13), from -20 to 300 sec.

Fig. 425 Momentum flux in intact loop, Test S-05-7 (FDU-13), from -6 to 42 sec.

Fig. 426 Momentum flux in intact loop, Test S-05-6 (FDU-15), from -20 to 300 sec.

Fig. 427 Momentum flux in intact loop, Test S-05-6 (FDU-15), from -6 to 42 sec.

Fig. 428 Momentum flux in intact loop, Test S-05-7 (FDU-15), from -20 to 300 sec.

Fig. 429 Momentum flux in intact loop, Test S-05-7 (FDU-15), from -6 to 42 sec.

Fig. 430 Momentum flux in broken loop (FDB-21), from -20 to 300 sec.

Fig. 431 Momentum flux in broken loop (FDB-21), from -6 to 42 sec.

Fig. 432 Momentum flux in broken loop (FDB-23), from -20 to 300 sec.

Fig. 433 Momentum flux in broken loop (FDB-23), from -6 to 42 sec.

Fig. 434 Momentum flux in broken loop (FDB-30), from -20 to 300 sec.

Fig. 435 Momentum flux in broken loop (FDB-30), from -6 to 42 sec.

Fig. 436 Momentum flux in broken loop (FDB-37), from -20 to 300 sec.

Fig. 437 Momentum flux in broken loop (FDB-37), from -6 to 42 sec.

Fig. 438 Momentum flux in broken loop (FDB-42), from -20 to 300 sec.

Fig. 439 Momentum flux in broken loop (FDB-42), from -6 to 42 sec.

Fig. 440 Momentum flux in core entrance (FDV-CORE-IN), from -20 to 300 sec.

Fig. 441 Momentum flux in core entrance (FDV-CORE-IN), from -6 to 42 sec.

Fig. 442 Density in intact loop (GU-1VR), from -20 to 300 sec.

Fig. 443 Density in intact loop (GU-1VR), from -6 to 42 sec.

Fig. 444 Density in intact loop (GU-1HZ), from -20 to 300 sec.

Fig. 445 Density in intact loop (GU-1HZ), from -6 to 42 sec.

Fig. 446 Density in intact loop (GU-5VR), from -20 to 300 sec.

Fig. 447 Density in intact loop (GU-5VR), from -6 to 42 sec.

Fig. 448 Density in intact loop (GU-10VR), from -20 to 300 sec.

Fig. 449 Density in intact loop (GU-10VR), from -6 to 42 sec.

Fig. 450 Density in intact loop, Test S-05-6 (GU-13VR), from -20 to 300 sec.

Fig. 451 Density in intact loop, Test S-05-6 (GU-13VR), from -6 to 42 sec.

Fig. 452 Density in intact loop, Test S-05-7 (GU-13VR), from -20 to 300 sec.

Fig. 453 Density in intact loop, Test S-05-7 (GU-13VR), from -6 to 42 sec.

Fig. 454 Density in intact loop, Test S-05-6 (GU-15VR), from -20 to 300 sec.

Fig. 455 Density in intact loop, Test S-05-6 (GU-15VR), from -6 to 42 sec.

Fig. 456 Density in intact loop, Test S-05-7 (GU-15VR), from -20 to 300 sec.

Fig. 457 Density in intact loop, Test S-05-7 (GU-15VR), from -6 to 42 sec.

Fig. 458 Density in intact loop, Test S-05-6 (GU-15HZ), from -20 to 300 sec.

Fig. 459 Density in intact loop, Test S-05-6 (GU-15HZ), from -6 to 42 sec.

Fig. 460 Density in intact loop, Test S-05-7 (GU-15HZ), from -20 to 300 sec.

Fig. 461 Density in intact loop, Test S-05-7 (GU-15HZ), from -6 to 42 sec.

Fig. 462 Density in broken loop, Test S-05-6 (GB-21T), from -20 to 300 sec.

Fig. 463 Density in broken loop, Test S-05-6 (GB-21T), from -6 to 42 sec.

Fig. 464 Density in broken loop, Test S-05-7 (GB-21T), from -20 to 300 sec.

Fig. 465 Density in broken loop, Test S-05-7 (GB-21T), from -6 to 42 sec.

Fig. 466 Density in broken loop, Test S-05-6 (GB-21B), from -20 to 300 sec.

Fig. 467 Density in broken loop, Test S-05-6 (GB-21B), from -6 to 42 sec.

Fig. 468 Density in broken loop, Test S-05-7 (GB-21B), from -20 to 300 sec.

Fig. 469 Density in broken loop, Test S-05-7 (GB-21B), from -6 to 42 sec.

Fig. 470 Density in broken loop, Test S-05-6 (GB-21C), from -20 to 300 sec.

Fig. 471 Density in broken loop, Test S-05-6 (GB-21C), from -6 to 42 sec.

Fig. 472 Density in broken loop, Test S-05-7 (GB-21C), from -20 to 300 sec.

Fig. 473 Density in broken loop, Test S-05-7 (GB-21C), from -6 to 42 sec.

Fig. 474 Density in broken loop, Test S-05-6 (GB-23VR), from -20 to 300 sec.

Fig. 475 Density in broken loop, Test S-05-6 (GB-23VR), from -6 to 42 sec.

Fig. 476 Density in broken loop, Test S-05-7 (GB-23VR), from -20 to 300 sec.

Fig. 477 Density in broken loop, Test S-05-7 (GB-23VR), from -6 to 42 sec.

Fig. 478 Density in broken loop (GB-30T), from -20 to 300 sec.

Fig. 479 Density in broken loop (GB-30T), from -6 to 42 sec.

Fig. 480 Density in broken loop (GB-30B), from -20 to 300 sec.

Fig. 481 Density in broken loop (GB-30B), from -6 to 42 sec.

Fig. 482 Density in broken loop (GB-30C), from -20 to 300 sec.

Fig. 483 Density in broken loop (GB-30C), from -6 to 42 sec.

Fig. 484 Density in broken loop (GB-42VR), from -20 to 300 sec.

Fig. 485 Density in broken loop (GB-42VR), from -6 to 42 sec.

Fig. 486 Density in vessel (GV-COR-150HZ), from -20 to 300 sec.

Fig. 487 Density in vessel (GV-COR-150HZ), from -6 to 42 sec.

Fig. 488 Density in vessel (GVLP-165HZ), from -20 to 300 sec.

Fig. 489 Density in vessel (GVLP-165HZ), from -6 to 42 sec.

Fig. 490 Density in vessel (GVLP-172HZ), from -20 to 300 sec.

Fig. 491 Density in vessel (GVLP-172HZ), from -6 to 42 sec.

Fig. 492 Density in pressurizer (GU-PRIZE), from -20 to 300 sec.

Fig. 493 Density in pressurizer (GU-PRIZE), from -6 to 42 sec.

Fig. 494 Mass flow in intact loop (FDU-1, GU-1VR), from -20 to 300 sec.

Fig. 495 Mass flow in intact loop (FDU-1, GU-1VR), from -6 to 42 sec.

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Fig. 496 Mass flow in intact loop, Test S-05-6 (FTU-1, GU-1VR), from -20 to 300 sec.

Fig. 497 Mass flow in intact loop, Test S-05-6 (FTU-1, GU-1VR), from -6 to 42 sec.

Fig. 498 Mass flow in intact loop, Test S-05-7 (FTU-1, GU-1VR), from -20 to 300 sec.

Fig. 499 Mass flow in intact loop, Test S-05-7 (FTU-1, GU-1VR), from -6 to 42 sec.

Fig. 500 Mass flow in intact loop, Test S-05-6 (FDU-5, GU-5VR), from -20 to 300 sec.

Fig. 501 Mass flow in intact loop, Test S-05-6 (FDU-5, GU-5VR), from -6 to 42 sec.

Fig. 502 Mass flow in intact loop, Test S-05-7 (FDU-5, GU-5VR), from -20 to 300 sec.

Fig. 503 Mass flow in intact loop, Test S-05-7 (FDU-5, GU-5VR), from -6 to 42 sec.

Fig. 504 Mass flow in intact loop, Test S-05-6 (FTU-9, GU-10VR), from -20 to 300 sec.

Fig. 505 Mass flow in intact loop, Test S-05-6 (FTU-9, GU-10VR), from -6 to 42 sec.

Fig. 506 Mass flow in intact loop, Test S-05-7 (FTU-9, GU-10VR), from -20 to 300 sec.

Fig. 507 Mass flow in intact loop, Test S-05-7 (FTU-9, GU-10VR), from -6 to 42 sec.

Fig. 508 Mass flow in intact loop (FDU-10, GU-10VR), from -20 to 300 sec.

Fig. 509 Mass flow in intact loop (FDU-10, GU-10VR), from -6 to 42 sec.

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Fig. 510 Mass flow in intact loop, Test S-05-6 (FDU-13, GU-13VR), from -20 to 300 sec.

Fig. 511 Mass flow in intact loop, Test S-05-6 (FDU-13, GU-13VR), from -6 to 42 sec.

Fig. 512 Mass flow in intact loop, Test S-05-7 (FDU-13, GU-13VR), from -20 to 300 sec.

Fig. 513 Mass flow in intact loop, Test S-05-7 (FDU-13, GU-13VR), from -6 to 42 sec.

Fig. 514 Mass flow in intact loop, Test S-05-6 (FTU-13, GU-13VR), from -20 to 300 sec.

Fig. 515 Mass flow in intact loop, Test S-05-6 (FTU-13, GU-13VR), from -6 to 42 sec.

Fig. 516 Mass flow in intact loop, Test S-05-7 (FTU-13, GU-13VR), from -20 to 300 sec.

Fig. 517 Mass flow in intact loop, Test S-05-7 (FTU-13, GU-13VR), from -6 to 42 sec.

Fig. 518 Mass flow in intact loop, Test S-05-6 (FDU-15, GU-15VR), from -20 to 300 sec.

Fig. 519 Mass flow in intact loop, Test S-05-6 (FDU-15, GU-15VR), from -6 to 42 sec.

Fig. 520 Mass flow in intact loop, Test S-05-7 (FDU-15, GU-15VR), from -20 to 300 sec.

Fig. 521 Mass flow in intact loop, Test S-05-7 (FDU-15, GU-15VR), from -6 to 42 sec.

Fig. 522 Mass flow in intact loop, Test S-05-6 (FTU-15, GU-15VR), from -20 to 300 sec.

Fig. 523 Mass flow in intact loop, Test S-05-6 (FTU-15, GU-15VR), from -6 to 42 sec.

Fig. 524 Mass flow in intact loop, Test S-05-7 (FTU-15, GU-15VR), from -20 to 300 sec.

Fig. 525 Mass flow in intact loop, Test S-05-7 (FTU-15, GU-15VR), from -6 to 42 sec.

Fig. 526 Mass flow in broken loop (FDB-21, GB-21C), from -20 to 300 sec.

Fig. 527 Mass flow in broken loop (FDB-21, GB-21C), from -6 to 42 sec.

Fig. 528 Mass flow in broken loop (FTB-21, GB-21C), from -20 to 300 sec.

Fig. 529 Mass flow in broken loop (FTB-21, GB-21C), from -6 to 42 sec.

Fig. 530 Mass flow in broken loop (FDB-23, GB-23VR), from -20 to 300 sec.

Fig. 531 Mass flow in broken loop (FDB-23, GB-23VR), from -6 to 42 sec.

Fig. 532 Mass flow in broken loop (FDB-30, GB-30C), from -20 to 300 sec.

Fig. 533 Mass flow in broken loop (FDB-30, GB-30C), from -6 to 42 sec.

Fig. 534 Mass flow in broken loop (FTB-30, GB-30C), from -20 to 300 sec.

Fig. 535 Mass flow in broken loop (FTB-30, GB-30C), from -6 to 42 sec.

Fig. 536 Mass flow in broken loop (FDB-42, GB-42VR), from -20 to 300 sec.

Fig. 537 Mass flow in broken loop (FDB-42, GB-42VR), from -6 to 42 sec.

Fig. 538 Mass flow in vessel (FDV-CORE-IN, GV-COR-150HZ), from -20 to 300 sec.

Fig. 539 Mass flow in vessel (FDV-CORE-IN, GV-COR-150HZ), from -6 to 42 sec.

Fig. 540 Mass flow in vessel (FTV-CORE-IN, GV-COR-150HZ), from -20 to 300 sec.

Fig. 541 Mass flow in vessel (FTV-CORE-IN, GV-COR-150HZ), from -6 to 42 sec.

Fig. 542 Mass flow in pressurizer surge line (FTU-PRIZE, GU-PRIZE), from -20 to 300 sec.

Fig. 543 Mass flow in pressurizer surge line (FTU-PRIZE, GU-PRIZE), from -6 to 42 sec.

Fig. 544 Core heater rod total power (PWRCOR T-1), from -20 to 300 sec.

Fig. 545 Core heater rod total power (PWRCOR T-1), from -6 to 42 sec.

Fig. 546 Core heater rod total power (PWRCOR T-2), from -20 to 300 sec.

Fig. 547 Core heater rod total power (PWRCOR T-2), from -6 to 42 sec.

Fig. 548 Core heater voltage (VOLT COR-T), from -20 to 300 sec.

Fig. 549 Core heater voltage (VOLT COR-T), from -6 to 42 sec.

Fig. 550 Core heater current (AMPCOR-T), from -20 to 300 sec.

Fig. 551 Core heater current (AMPCOR-T), from -6 to 42 sec.

Fig. 552 Primary pump current (PUMPU-CUR), from -20 to 300 sec.

Fig. 553 Primary pump current (PUMPU-CUR), from -6 to 42 sec.

Fig. 554 Primary pump speed (PUMPU-RPM), from -20 to 300 sec.

Fig. 555 Primary pump speed (PUMPU-RPM), from -6 to 42 sec.

IV. REFERENCE

1. E. M. Feldman and D. J. Olson, *Semiscale Mod-1 Program and System Description for the Blowdown Heat Transfer Tests (Test Series 2)*, ANCR-1230 (August 1975).

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APPENDIX A

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-1 TESTS S-05-6 AND S-05-7

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APPENDIX A

POSTTEST ADJUSTMENTS TO DATA FROM SEMISCALE MOD-1 TESTS S-05-6 AND S-05-7

Many of the transducers used in the Semiscale Mod-1 system exhibit significant sensitivity to one or more spurious inputs. Strain gage bridge circuits used in pressure transducers, differential pressure transducers, and drag discs are sensitive to changes in ambient temperature. Differential pressure cells are also sensitive to changes in system pressure. Photomultiplier tubes used as gamma-ray detectors in the density transducers are sensitive to temperature changes, as well as to random variations in the locations of the radiation sources. Core power measurements depend on a calibrated resistor, which changes in value as a function of time and power level as it heats up.

Although the errors introduced into the data by spurious secondary inputs generally do not exceed the specified error ranges of the transducers, significant improvement in measurement accuracy can be achieved if the secondary sensitivity can be identified and removed. In the case of the drag discs, corrections are absolutely necessary since the signal due to temperature fluctuations can exceed that due to flow by several hundred percent. Since the exact values of the spurious inputs to which different transducers might be sensitive cannot often be easily predicted and are sometimes inconvenient to measure, secondary effects have been accounted for by correcting the data after the test rather than by using elaborate real time programs in the data acquisition system computer. The methods and results of the posttest data correction analysis for Tests S-05-6 and S-05-7 are presented in the following paragraphs and tables.

1. PRESSURE MEASUREMENTS

Corrections to pressure transducer measurements in the main system loop are based on data taken from the standard reference (Heise) gauge at Spool 4, taken 15 sec before initiation of blowdown and at 300 sec after initiation of blowdown. The pressure readings are adjusted to account for pressure variations around the main loop, using the readings of nearby differential pressure cells. A linear correction is then applied to the pressure data to match the data to the reference data at the two specified time points.

Correction of the steam generator secondary pressure (PU-SGSD) measurement is done in the same manner as for the main loop pressures using a Heise gauge installed expressly for this purpose.

Pressure measurement corrections are performed using the data acquisition system (DAS) computer using the following equation:

$$F'(t) = C_0 + C_1 [F(t)]$$

where

$F'(t)$ = corrected data

$F(t)$ = raw data

C_0 = offset

C_1 = scaling factor.

The values of the offset and scaling factor are given in Table A-I.

TABLE A-I
CONSTANTS FOR PRESSURE MEASUREMENT CORRECTIONS

<u>Detector Identification</u>	<u>Test S-05-6</u>		<u>Test S-05-7</u>	
	<u>C_0</u>	<u>C_1</u>	<u>C_0</u>	<u>C_1</u>
PU-PRIZE	---	---	-16.0	1.0140
PU-SGSD	-5.9	0.9949	-36.8	1.0579
PB-37	---	---	23.0	0.9955
PB-32	-9.2	0.9512	-91.5	1.0554
PB-HN1	---	---	-12.5	1.0159
PB-CN2	55.5	0.9708	---	---
PB-CN3	75.4	0.9565	---	---
PB-CN4	-11.2	1.0036	-21.4	1.0160
PV-UP-10	35.2	0.9564	-51.8	1.0130
PV-LP-166	---	---	-30.4	1.0187

2. DIFFERENTIAL PRESSURE MEASUREMENTS

Pressure sensitivity in the differential pressure cells in the main system loop is determined from the pretest system pressure check. Digital data are recorded for all measurements at ambient temperature, with no system flow, at pressures of ambient, 200, 500, 1000, 1500, 2000, and 2250 psig. The output of the differential pressure cells is plotted against system pressure, with the resulting plots used to describe the pressure sensitivity of the transducers.

The response of the differential pressure cells due to ambient pressure and temperature is determined from a digital data scan taken at 500°F and 1750 psig, with no system flow. The measured transducer outputs are compared with the values calculated due only to the density difference between the water inside the loop (500°F) and outside the loop in the sense lines (80 to 100°F).

The difference between the measured value and the calculated value is considered to be the result of pressure sensitivity and thermal drift. On-line processing of the data in the computer data acquisition system applies this difference automatically to the measured data. After the data scan at 500°F is made, no more opportunities exist to obtain data with the pump stopped and the system full of liquid; therefore, for lack of later data, the thermal drift calculated from the 500°F data is assumed to be constant throughout the test. However, posttest pressure sensitivity corrections are applied to the data according to system pressure.

In correcting differential pressure data for pressure sensitivity, the data are initially corrected for errors in amplification and ambient offsets. The pressure sensitivity is then subtracted from these corrected data to arrive at the final values. Corrections were made using the following equations:

$$\begin{aligned}F'(t) &= C_1 \left[F(t) \right] + C_0 \\F''(t) &= F'(t) - P_1 \left[P(t) \right]\end{aligned}$$

where

- C_0 = ambient offset
- C_1 = amplification factor
- $F(t)$ = raw data
- $F'(t)$ = first data correction
- $P(t)$ = pressure data

P_1 = pressure sensitivity

$F''(t)$ = final result.

The values for C_0 , C_1 , and P_1 are given in Table A-II.

For some differential pressure measurements, the data scan at 500°F cannot be used as a reference for thermal drift; so other references are used. The liquid level measurements in the intact loop accumulator (DPU-ACC-TB), the broken loop accumulator (DPB-ACC-TB), the pressurizer (DPU-PRESLL), and the intact loop steam generator (DPU-SG-SEC) are referenced to calculated values based on geometrical considerations at the time when gas flow from the respective vessel is first noted, or when the system is completely drained. The reading from the steam generator discharge venturi (DPU-SG-DISC)

TABLE A-II
CONSTANTS FOR DIFFERENTIAL PRESSURE
MEASUREMENT CORRECTIONS

Test S-05-6				
Detector Identification	C_1	C_0	P_1	$P(t)$
DPV-9-166QQ	1.0	0.330	0.0001886	PV-LP-166
DPV-26-55QM	1.0	-0.066	0.0000832	PV-LP-166
DPV-110-156MQ	1.0	0.501	0.0002864	PV-LP-166
Test S-05-7				
Detector Identification	C_1	C_0	P_1	$P(t)$
DPU-UP-3	1	0.0398	0.0000227	PV-UP+10
DPU-SGOP-7	1	0.3980	0.0002274	PU-13
DPU-7-10	1	0.0653	-0.0000373	PU-13
DPB-37-38	1	0.0918	0.0000525	PB-37
DPV-9-166QQ	1	-0.3520	-0.0002012	PV-LP-166
DPV-26-55QM	1	0.0671	0.0000956	PV-UP+10

is shifted to read zero after flow is stopped. For these detectors, and those having nonlinear pressure sensitivities, the corrections are performed according to the following equations:

$$F'(t) = KF(t) + C_1 \text{ for } t < t_1 \text{ or when } t_1 \text{ are listed}$$

for time points t , where $t_1 \leq t \leq t_n$.

$$F'(t) = KF(t) + C_i + \frac{t-t_i}{t_{i+1}-t_i} (C_{i+1} - C_i) \text{ for } t_i \leq t \leq t_{i+1}$$

where i takes on values 1 to $n-1$

$$F'(t) = KF(t) + C_n \text{ for } t > t_n$$

where

t = time

$F'(t)$ = corrected data

$F(t)$ = raw data

K = scaling factor

C_i and t_i = corrections and time points.

The values of the constants are given in Table A-III.

TABLE A-III

CONSTANTS FOR IRREGULAR DIFFERENTIAL
PRESSURE MEASUREMENT CORRECTIONS

Detector Identification	Test S-05-6						
	K	C ₁	t ₁	C ₂	t ₂	C ₃	t ₃
DPU-SG-DISC	1	0.6	---	---	---	---	---
DPU-ACC-TB	1	-0.093	---	---	---	---	---
DPB-23-CN1	100	---	---	---	---	---	---
DPB-32U-36L	1	0.371	0	-0.122	0.01	-3.080	12.00
DPB-37-38	1	0	0.01	0.14	18.0	---	---
DPB-CN1-PSS-63	1	49	---	---	---	---	---
DPB-ACC-TB	1	0.635	---	---	---	---	---
Detector Identification	Test S-05-7						
	K	C ₁	t ₁	C ₂	t ₂	C ₃	t ₃
DPU-PRESLL	1	0.103	---	---	---	---	---
DPU-SG-DISC	1	1.6	---	---	---	---	---
DPU-SG-SEC	1	3.298	---	---	---	---	---
DPU-ACC-TB	1	1.517	---	---	---	---	---
DPB-32U-36	1	0.371	0	-0.380	0.01	-3.080	12.00
DPB-ACC-TB	1	1.025	---	---	---	---	---

3. MOMENTUM FLUX MEASUREMENTS

The temperature sensitivity of drag discs is determined from pretest warmup data taken at 200 and 500°F with no system flow. The temperature sensitivity is removed before the data are converted to momentum flux. The temperature of each transducer is taken from the signal of a nearby fluid or metal temperature thermocouple. Slight corrections for errors in setting the transducer output to zero at ambient conditions are also made at this time. Corrections are made using the following equation:

$$F'(t) = F(t) + D_0 - D_1 T(t)$$

where

$F'(t)$ = corrected data

$F(t)$ = raw data

$T(t)$ = temperature data from the transducer used for temperature correction sensitivity

D_0 = ambient offset

D_1 = temperature sensitivity.

Values of the constants are given in Table A-IV.

TABLE A-IV
CONSTANTS FOR MOMENTUM FLUX
MEASUREMENT CORRECTIONS

Detector Identification	Test S-05-6		
	D_0	D_1	$T(t)$ [a]
FDU-1	-0.065	0.000550	TMU-1T16
FDU-5	-0.016	-0.000247	TMU-1T16
FDU-10	-0.041	0.000223	TMU-1T16
FDU-13	-0.025	0.000942	TMU-15T16
FDU-15	-0.261	0.001194	TMU-15T16
FDB-21	-0.004	-0.000593	TMB-20B16
FDB-23	0.044	0.000582	TMB-20B16
FDB-30 ^[b]	-0.146	-0.000755	TFB-30
FDB-37 ^[b]	-0.048	0.000329	TFB-37
FDB-42	-0.119	0.000831	TFB-42
FDV-CORE-IN	-1.027	-0.002958	TFV-LP-7

Detector Identification	Test S-05-7		
	D_0	D_1	$T(t)$ [a]
FDU-1	-0.064	-0.000562	TMU-1T16
FDU-5	-0.031	-0.000178	TMU-1T16
FDU-10	0.023	0.000250	TMU-1T16
FDU-13	0.195	0.000964	TMU-15T16
FDU-15	-0.258	-0.001275	TMU-15T16
FDB-21	-0.042	-0.000824	TMB-20B16
FDB-23	0.050	0.000616	TMB-20B16
FDB-30 ^[b]	-0.142	-0.000764	TFB-30
FDB-37 ^[b]	-0.120	0.000263	TFB-37
FDB-42	-0.107	-0.000812	TFB-42
FDV-CORE-IN	-0.883	-0.002004	TFV-LP-7

[a] $T(t)$ is the temperature data used for temperature sensitivity correction. The symbols listed identify the thermocouples from which the data were obtained.

[b] FDB-30 and FDB-37 are mounted horizontally and during blowdown were partially filled with subcooled water which affected the temperature sensitivity.

4. DENSITY MEASUREMENTS

Density calculations are based on the voltage output of the photomultiplier tubes in the gamma-attenuation densitometer assemblies. The equation used for converting voltage to density is as follows:

$$\rho = (1/C) \ln \left\{ D / \left[A F(t) + B \right] \right\}$$

where

- ρ = the density in lbm/ft³
- C = a constant based on the length of the gamma beam path
- D = a theoretical voltage for zero attenuation inside the vessel
- A = an amplification factor
- B = a biasing factor
- $F(t)$ = the transducer voltage output.

Constants A and B are adjusted to match the final data to density values calculated from measured pressure and temperature values at the preblowdown and postdrain conditions, effectively giving the data an in-place calibration. The values of the constants for various transducers are given in Table A-V.

An amplifier which precalculates the logarithm function is used for some density measurements and hence, a simpler conversion formula is used:

$$\rho = C_0 + C_1 F(t)$$

where

- C_0 = offset
- C_1 = scaling factor
- $F(t)$ = the transducer voltage output.

The values for constants C_0 and C_1 are given in Table A-VI.

Some density measurements are obtained using a two-beam gamma densitometer which operates on the same basic principle of gamma attenuation as does the single-beam gamma densitometer. Each beam originates from the same gamma source and is allowed to

TABLE A-V

CONSTANTS FOR DENSITY MEASUREMENT
CONVERSIONS TO ENGINEERING UNITS

<u>Detector Identification</u>	<u>Test S-05-6</u>			
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>
GU-1VR	1.093	-0.189	0.0095	3.26
GU-1HZ	1.071	-0.282	0.0095	7.39
GU-5VR	1.168	-0.791	0.0095	6.12
GU-10VR	1.112	-0.542	0.0095	7.02
GU-13VR	1.252	-0.591	0.0095	2.83
GU-15VR	1.147	-0.819	0.0095	7.36
GU-15HZ	1.164	-0.364	0.0095	2.83
GB-21B	1.105	-0.572	0.008	8.28
GB-21T	1.060	-0.174	0.0057	7.89
GU-23VR	1.145	-0.750	0.0095	7.28
GB-30B	1.011	0.181	0.008	8.18
GB-30T	1.159	-0.899	0.0057	7.78
GB-42VR	0.931	0.491	0.006	4.86
GV-COR-150HZ	1.006	0.040	0.014	2.44
GVLP-165HZ	1.034	-0.117	0.024	5.60
GU-PRIZE	1.098	-0.059	0.0095	0.87

TABLE A-V (continued)

Detector Identification	Test S-05-7			
	A	B	C	D
GU-13VR	1.263	-0.632	0.0095	2.82
GU-15VR	1.089	-0.438	0.0095	7.82
GU-15HZ	1.223	-0.524	0.0095	2.70
GB-21B	1.107	-0.582	0.008	8.27
GB-21T	1.061	-0.180	0.0057	7.91
GU-23VR	1.033	0.023	0.0095	7.28
GB-30B	1.006	0.214	0.008	8.17
GB-30T	1.158	-0.892	0.0057	7.77
GB-42VR	0.889	0.656	0.006	4.65
GVLP-165HZ	1.046	-0.181	0.024	5.70
GU-PRIZE	1.082	-0.042	0.0095	0.88

pass through separate portions of the piping cross-sectional flow area to obtain an average density measurement in that particular region. The geometrical relationship of the gamma beam path through the piping and geometrically related variables used for processing of data from a two-beam gamma densitometer are shown in Figure A-1.

The average density measured by each individual gamma beam is obtained using the same equation as is used for the single-beam gamma densitometers:

$$\rho = (1/C) \ln \left\{ D / [A F(t) + B] \right\}.$$

Values for the constants for the single-beam density measurements obtained with the two-beam gamma densitometers are presented in Table A-V along with the constants for single-beam gamma densitometers.

In the Semiscale Mod-1 system, two-beam gamma densitometers provide added information which allows the calculation of a better average density than that obtained from a single beam. A mathematical model is used for processing the two-beam data to obtain the improved average density information. The processing method used is based on a

TABLE A-VI

CONSTANTS FOR DENSITY MEASUREMENT
CONVERSIONS TO ENGINEERING UNITS FOR DETECTORS USING LOG AMPLIFIERS

Detector Identification	Test S-05-6		Test S-05-7	
	C_0	C_1	C_0	C_1
GV-COR-150HZ	--	--	-168.8	-36.26
GULP-172HZ	-26	-1.336	-26.0	-1.327

Fig. A-1 Geometry used for processing of density data obtained from two-beam gamma densitometers.

froth-water model coupled with information from the two individual gamma beams and related beam path and piping cross-sectional geometry. The resulting information is recorded and reported under the density measurement identification ending with a "C", for example, GB-21C.

The use of the froth-water model for obtaining average density from a two-beam gamma densitometer is based on observations indicating that flow regimes in the Semiscale Mod-1 system can be modeled by a layer of water on the bottom of the pipe with a degree of froth on the surface. For homogeneous flow conditions such as all froth or all liquid the model remains valid. At any point in time, slug flow is also modeled. The froth-water model does not model annular or inverted annular flows very well. However, these flows are not expected to exist for significant portions of a Semiscale Mod-1 system blowdown in horizontal piping. Density gradients from the top to the bottom of the pipe may exist showing no distinct location change from water to froth. This flow is neither totally homogeneous nor stratified, but the froth-water model does provide an adequate approximation of the average density characteristic of this flow pattern.

The average density obtained by using the gamma beam geometry shown in Figure A-1 and by applying the froth-water model is given by

$$\bar{\rho} = \alpha_f \rho_1 + (1 - \alpha_f) \rho_w \quad \text{lbm/ft}^3$$

where

$\bar{\rho}$ = average cross-sectional density

ρ_1 = average density measured by the upper gamma beam (measures the froth density)

ρ_w = density of liquid water (at local system conditions)

α_f = $1 + (1/2\pi) (\sin\beta - \beta)$ = froth fraction.

The angle which β represents is shown in Figure A-1. Values for β are obtained as follows:

$$\beta = 2 \cos^{-1} (1 - 2h)$$

where

$$h = \frac{H}{D} = \cos^2 \theta \left(\frac{\rho_2 - \rho_1}{\rho_w - \rho_1} \right)$$

where

H = $\ell_w \cos \theta$ (ℓ_w and θ are defined in Figure A-1)

D = piping inside diameter

ρ_2 = the average density measured by the lower gamma beam.

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