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EXPERIMENT DATA REPORT FOR SEMISCALE
MOD-1 TEST S-01-3
(ISOTHERMAL BLOWDOWN WITH CORE RESISTANCE SIMULATOR)

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Light Water Reactor Safety and Technology – System
Interactions and Effects
TID-4500

EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1

TEST S-01-3

(Isothermal Blowdown with Core Resistance Simulator)

by

S. N. Zender

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ABSTRACT

Recorded test data are presented for Test S-01-3 of the semiscale Mod-1 isothermal blowdown test series. Test S-01-3 is one of several semiscale Mod-1 experiments which are counterparts of the planned Loss-of-Fluid Test (LOFT) nonnuclear experiments. System hardware is of the LOFT design, selected using volumetric scaling methods, and initial conditions duplicate those identified for the LOFT nonnuclear tests.

Test S-01-3 employed an intact loop resistance that was low relative to that of the first test in the series (Test S-01-2) to establish the importance of intact loop resistance on system response during blowdown. An orificed structure was used in the pressure vessel to simulate the LOFT core simulator. The test was initiated at isothermal conditions of 2245 psig and 538°F by a simulated offset shear of the cold-leg broken loop piping. During system depressurization, coolant was injected into the lower plenum of the pressure vessel to provide data on the effects of emergency core cooling on system response. Additionally, to aid in determination of the effects of accumulator gas on pressure suppression system response, the nitrogen used to charge the accumulator systems for Test S-01-3 was allowed to vent into the lower plenum following depletion of the coolant.

The purpose of this report is to make available the uninterpreted data from Test S-01-3 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 assure that they are reasonable and consistent.

SUMMARY

Test S-01-3 was performed as part of the semiscale Mod-1 portion of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project conducted by Aerojet Nuclear Company for the Energy Research and Development Administration. This test was one of the semiscale Mod-1 tests in Test Group 1 performed with hardware configuration and test parameters selected to yield a system response that simulates the Loss-of-Fluid Test (LOFT) system response during the LOFT nonnuclear blowdown experiments. Test S-01-3 which was conducted October 23, 1974, utilized a pressure vessel with internals; an intact loop with active pump, steam generator, and pressurizer; a broken loop with simulated pump, simulated steam generator, and rupture assemblies; a pressure suppression system with header and pressure suppression tank; and a coolant injection system with low-pressure injection pumps, high-pressure injection pumps, and accumulators. An orificed structure was used in the core barrel of the pressure vessel to simulate the flow resistance of the core simulator to be used in the LOFT nonnuclear tests.

The overall objective of the semiscale program is to provide data for use in the development and verification of analytical models that are used to predict the transient thermal-hydraulic response of a water-cooled nuclear reactor system during a hypothetical loss-of-coolant accident (LOCA). The semiscale Mod-1 program has the further general 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.

The areas of interest specific to Test S-01-3 were to determine the effect of intact loop resistance on system response, the effect of injection of emergency core coolant into the lower plenum of the pressure vessel, and the effect of gas flow from the accumulator systems on pressure suppression system behavior. In order to establish the importance of the resistance of the intact loop on system response, this test was conducted with an intact loop resistance that was low relative to that of the first test (Test S-01-2) in the series. Coolant was injected into the lower plenum to establish the effect of coolant injection on system response.

The recorded initial conditions of 2245 psig and 538°F and other initial conditions were within acceptable bounds to allow analysis of the test data. The rupture assemblies were actuated almost simultaneously (within 10 milliseconds) satisfactorily simulating an instantaneous offset cold-leg shear of the broken loop piping. The accumulator coolant injection system functioned as intended. Coolant injection with the low-pressure injection system pump was attempted but without success due to excessive pressure in the injection line caused by inadvertent reopening of the nitrogen supply valve to the accumulator. In general, instrumentation used in Test S-01-3 functioned as intended (of 197 measurements attempted, 189 produced usable data). Data loss during Test S-01-3 was sufficiently low that the test was considered conducted successfully.

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1

TEST S-01-3

(Isothermal Blowdown with Core Resistance Simulator)

I. INTRODUCTION

The semiscale Mod-1 experimental program is part of the Semiscale Blowdown and Emergency Core Cooling (ECC) Project conducted by Aerojet Nuclear Company. The semiscale project in turn is part of the United States Energy Research and Development Administration sponsored research and development program to investigate the response of a water-cooled nuclear reactor 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 an 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.

The semiscale Mod-1 program is conducted with an experimental system designed to simulate the major components of a pressurized water reactor (PWR). Relative to previous experimental systems, the semiscale Mod-1 system advances the representation of a PWR and provides a means of acquiring representative coupled-system response data from which to obtain a more comprehensive understanding of the coupled-system thermal and hydraulic processes during a simulated LOCA.

Test S-01-3, the second test in the semiscale Mod-1 system, was conducted as part of a series of tests (Test Group 1) to provide data for comparison of the isothermal blowdown response of the semiscale system with that of the Loss-of-Fluid Test (LOFT) system. The semiscale Mod-1 experimental configuration for this test utilized hardware components selected to produce a system performance which simulates LOFT system performance during the LOFT nonnuclear tests. An orificed structure was used in the core barrel of the pressure vessel to simulate the flow resistance of the core simulator to be used in the LOFT nonnuclear tests. This test employed an intact loop flow resistance that was low relative to that of the first test (Test S-01-2) in the series in order to establish the importance of intact loop resistance on system response during blowdown. The lower Test S-01-3 resistance was scaled from that of the LOFT system. Water was injected from a pressurized accumulator at a system pressure of 600 psig. Coolant injection by means of the low-pressure injection system was unsuccessfully attempted 35.5 seconds after rupture. Following depletion of the coolant from the accumulator system (at about 70 seconds after rupture), the nitrogen used to charge the accumulator system was allowed to vent into the primary system in order to provide data on the effects of accumulator nitrogen gas flow on system response.

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 Test S-01-3. 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 the test series which includes Test S-01-3, a detailed description of the semiscale Mod-1 system, and a discussion of the measurement and data processing techniques and the data uncertainties are included in Reference 1.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TEST S-01-3

The following system configuration, procedures, initial test conditions, and events are specific to Test S-01-3.

1. SYSTEM CONFIGURATION AND TEST PROCEDURES

The semiscale Mod-1 system used for Test S-01-3 consisted of a pressure vessel with internals; an intact loop with steam generator, pump, and pressurizer; a blowdown loop with simulated steam generator, simulated pump, and two rupture assemblies; a coolant injection system with accumulators and both high- and low-pressure injection pumps; and a pressure suppression system with a suppression tank and header. The semiscale Mod-1 experimental system is described in greater detail in Appendix B of Reference 1.

For Test S-01-3, the intact loop steam generator was maintained in the hot standby condition, in which the steam generator secondary side was valved off and the steam generator primary tubes were completely covered with water (at isothermal system temperature) when blowdown occurred. The system was heated to isothermal conditions with heaters in the bypass lines between the broken and unbroken loops.

In preparation for Test S-01-3, the system was filled with treated demineralized water and vented at strategic points to assure a liquid full system. Prior to warmup the system was pressurized to check for leakage. Warmup to initial test conditions was accomplished with heaters located in the 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. These systems were valved out just prior to initiation of blowdown. At 100-degree 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 initiation of the blowdown test, initial test conditions were held for about 17.5 minutes 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 these systems. However, a posttest review of the temperature data from the hot-leg bypass lines indicated a leak through one block valve had allowed that line to blow down with the rest of the system.

Pressure to operate the rupture assemblies and initiate blowdown was taken from the system through lines connected to the reflood bypass simulators. Immediately following initiation of blowdown (0.02 second after initiation of blowdown), these lines were again isolated.

Power to the primary coolant circulating pump was cut off at blowdown to allow the pump to coast down to a speed of 1300 rpm. This speed was then maintained throughout the remainder of the test. A flywheel mounted on the pump motor shaft provided a simulation of the predicted coastdown of the LOFT pumps.

The system was successfully subjected to a simulated double-ended cold-leg pipe offset shear. The effluent was ejected from the primary system into the pressure suppression system through two blowdown nozzles each having a break area of 0.00262 ft².

Coolant was injected into the lower plenum of the pressure vessel during blowdown. Injection from the accumulator at a system pressure of 600 psig began about 22 seconds after initiation of blowdown and continued for about 48 seconds. Coolant injection by means of the low-pressure injection system pump was attempted 35.5 seconds after rupture but without success because of excessive pressure in the injection line caused by inadvertent reopening of the valve for supplying nitrogen to the accumulator. Nitrogen gas from the accumulator entered the system at about 70 seconds and continued to flow for about 40 seconds.

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

	Measured ^[a]	Specified
System Fluid Temperature (intact loop, vessel outlet)	538°F	540 ± 2°F
System Pressure (vessel upper plenum)	2245 psig	2250 ± 25 psig
Intact Loop Cold Leg Flow	172 gpm	173 ± 2 gpm
Intact Loop Accumulator Pressure	600 psig	600 ± 5 psig
Temperature of Injected Coolant	85°F	85°F[b]
Intact Loop Accumulator Water Volume	1.71 ft ³	1.63 ft ³ [b]
Intact Loop Accumulator Gas Volume	0.99 ft ³	1.11 ft ³ [b]
Pressurizer Water Volume	0.83 ft ³	0.74 ± 0.05 ft ³
Steam Generator Secondary Steam Dome Pressure	950 psig	963 ± 40 psig
Steam Generator Secondary Fluid Temperature	540.5°F	540 ± 5°F
Steam Generator Liquid Level (from bottom of tube sheet)	119 in.	123 ± 2 in.
Pressure Suppression Tank Water Volume	30.15 in.	30[b]
Pressure Suppression Tank Pressure	17.0 psig	17.42 ± 1.0 psig
Pressure Suppression Tank Water Temperature	156°F	156 ± 2°F

[a] Measured initial conditions which did not meet the specified initial conditions were considered acceptable for analysis purposes within the test objectives.

[b] Tolerance not specified.

TABLE II

PRIMARY COOLANT TEMPERATURE DISTRIBUTION AT RUPTURE

Location	Detector	Temperature (°F)
Vessel lower plenum (lower portion)	TFV-LP-1-1/2	534
Vessel lower plenum (upper portion)	TFV-LP-27-1/2	542
Hot leg, intact loop (near vessel)	RBU-2	538
Hot leg, intact loop (104 in. from vessel center)	TFU-5	541
Hot leg, intact loop (near steam generator)	TSU-7	542
Cold leg, intact loop	RBU-14A	541
Cold leg, broken loop (near vessel)	TFB-20	540
Cold leg, broken loop (near nozzle)	TFB-23	540
Hot leg, broken loop (near vessel)	TFB-30	533
Reflood bypass, cold leg	TFB-RFBC	532
Reflood bypass, hot leg	TFB-RFBH	530

TABLE IIIWATER CHEMISTRY PRIOR TO BLOWDOWN^[a]

pH	10.40
Conductivity (μmhos/cm)	69.3
Suspended Solids (ppm)	3.13
Chlorides (ppm)	0.421
H ₂ (cc/l)	1.6
O ₂ (cc/l)	0.06
N ₂ (cc/l)	129.5
CO ₂ (cc/l)	<0.01
Total Gas (cc/l)	132.1

[a] Water sample taken at a system pressure of 2245 psig and a system temperature of 538°F.

TABLE IV
SEQUENCE OF EVENTS FOR TEST S-01-3^[a]

	Time Relative to Rupture (sec)
Heatup bypass lines valved out of system ^[b]	-6
Initiation of blowdown	0
Initiation of ECC injection into lower plenum from accumulator	22
Initiation of ECC injection into lower plenum from low pressure injection system attempted ^[c]	35.5
Termination of coolant injection into lower plenum from accumulator	70
Termination of blowdown and initiation of nitrogen gas flow from accumulator	70
Termination of nitrogen gas flow from accumulator	110

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

[b] The block valves used to isolate the heatup bypass lines from the system leaked and allowed the heatup bypass lines to blow down during the blowdown test.

[c] Low pressure injection system did not function due to inadvertent reopening of the nitrogen supply valve to the accumulator 46 seconds after blowdown. The pressure in the common injection line was too high to allow the low pressure injection system pump to operate.

III. DATA PRESENTATION

The data from semiscale Mod-1 Test S-01-3 are presented with brief comment. Processing analysis has been performed only to the extent necessary to obtain appropriate engineering units and to assure 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 in the isothermal tests may have subjected the measurement devices to nonhomogeneous fluid conditions.

The performance of the semiscale Mod-1 system during Test S-01-3 was monitored by 197 detectors. The data obtained were recorded on a digital data acquisition system and on an analog data acquisition system. The digital system, which is part of the computerized data acquisition system, was used to process the data presented in this report. The analog system was used for redundancy and for better resolution capability for certain detector outputs. The data are presented, in many instances, in the form of composite graphs to facilitate comparison of a given variable at several locations during the test. The scales selected for the graphs were chosen to provide an overview of the test, and do not reflect the obtainable resolution of the data. The conditioning of output signals from the detectors and the system used to process data from these signals is described in Appendix C of Reference 1.

Figures 1 through 5 and Table V provide supporting information for interpretation of the data graphs shown in Figures 6 through 263. Figures 1 through 5 show the locations of all measurements in the isothermal system. Table V groups the measurements taken during Test S-01-3 according to measurement type; identifies the specific measurements, their locations, and the ranges of the detector and the actual recording range of the data acquisition system; provides brief comments regarding the data; and references the measurements and comments to the corresponding figure on which the data are presented. Figures 6 through 263 present the data from the test. Time zero on these graphs is the time of rupture initiation. Even numbered figures present the data for the blowdown portion of the test, that is, from the time of rupture initiation at $t=0$ seconds to $t=70$ seconds. Odd numbered figures extend the presentation to $t=130$ seconds to provide data on the effects of nitrogen entering the primary system from the accumulator following ECC injection.

Fig. 1 Semiscale Mod-1 system and instrumentation -- isometric.

Fig. 2 Semiscale Mod-1 system and instrumentation -- schematic.

Fig. 3 Semiscale Mod-1 pressure vessel -- cross-section showing instrumentation.

Fig. 4 Semiscale Mod-1 pressure vessel -- isometric showing instrumentation.

TABLE V

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
FLUID TEMPERATURE					
Chromel-Alumel thermocouples unless specified otherwise					
<u>Intact Loop</u>					
TFU-1	Hot leg, Spool 1, 31 in. from vessel center	0-2300°F	0-591°F	6, 7	
RBU-2	Hot leg, Spool 2, 46 in. from vessel center bulb)	0-1000°F	0-1000°F		
TFU-5	Hot leg, Spool 5, 104 in. from vessel center				
TSU-7	Cold leg, Spool 7, 243 in. from vessel center (shielded)				
RBU-14A	Cold leg, Spool 14, 43 in. from vessel center, upstream of cold leg injection port (platinum resistance bulb)	0-1000°F	0-1000°F		
TFU-15	Cold leg, Spool 15, 16 in. from vessel center				
<u>Broken Loop</u>					
TFB-20	Cold leg, Spool 20, 21 in. from vessel center	0-2300°F	0-591°F	8, 9	
TFB-23	Cold leg, Spool 23, 91 in. from vessel center, upstream of vessel-side nozzle				
TFB-30	Hot leg, Spool 30, 16 in. from vessel center				
TFB-42	Cold leg, Spool 42, 414 in. from vessel center along hot leg, upstream of pump-side nozzle				
TFB-RFBC	Reflow bypass, near end cap, cold-leg side				Increase in temperature to 560°F at t=76 sec is suspected to be due to leakage from 3/8-in. circulation line between reflow simulators and heatup bypass line
TFB-RFBH	Reflow bypass, near end cap, hot-leg side				Increase in temperature to 545°F at t=76 sec is suspected to be due to leakage from 3/8-in. circulation line between reflow simulators and heatup bypass line
<u>Inlet Annulus</u>					
	4 in. below cold leg centerline, 0.2 in. from vessel wall, Type J iron-constantan thermocouples	0-1400°F	0-692°F	10, 11	
TFV-ANN-4A	0°				
TFV-ANN-4M	180°				
<u>Downcomer Annulus</u>					
	Centered in annulus, Type J iron-constantan thermocouples	0-1400°F	0-692°F	12, 13	
TFV-ANN-15A	15 in. below cold leg centerline, 0°				
TFV-ANN-15M	15 in. below cold leg centerline, 180°				
TFV-ANN-35A	35 in. below cold leg centerline, 0°				
TFV-ANN-35M	35 in. below cold leg centerline, 180°				
TFV-ANN-35T	35 in. below cold leg centerline, 270°				
TFV-ANN-115A	115 in. below cold leg centerline, 0°				
TFV-ANN-156A	156 in. below cold leg centerline, 0°				
<u>Lower Plenum</u>					
	On fluid thermocouple rack, 1 in. from vessel center, 45°	0-2300°F	0-591°F	14, 15	
TFV-LP-1-1/2	1.5 in. from bottom				
TFV-LP-7-1/2	7.5 in. from bottom				
TFV-LP-14-1/2	14.5 in. from bottom				
TFV-LP-21-1/2	21.5 in. from bottom				
TFV-LP-27-1/2	27.5 in. from bottom				
<u>Core</u>					
		0-2300°F	0-591°F	16, 17	
TF-LOFT-COR	Near LOFT core turbine flowmeter, 14 in. below cold leg centerline				

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments {a}	Range {a}		Figure {a}	Measurement Comments {b}
		Detector	Data Acquisition System		
<u>Core Barrel Insulation Gap</u>	Type J iron-constantan thermocouples	0-1400°F	0-692°F	18, 19	
TFV-CIG-70A	70 in. below cold leg centerline, 0°				
TFV-CIG-115A	115 in. below cold leg centerline, 0°				
<u>Vessel Filler - Insulation Gap</u>		0-1400°F	0-692°F	20, 21	
TFV-FIG-70A	70 in. below cold leg centerline, 0°				
TFV-FIG-156A	156 in. below cold leg centerline, 0°				
<u>ECC System</u>		0-2300°F	0-591°F	22, 23	
TFU-ECC-14	On centerline of ECC line at junction with Spool 14				
<u>Steam Generator</u>		0-2300°F	0-591°F	24, 25	
TFU-SG1	Secondary side, 12 in. above bottom of tube sheet				
TFU-SG2	Secondary side, 24 in. above bottom of tube sheet				
TFU-SG3	Secondary side, 48 in. above bottom of tube sheet				
TFU-SG4	Secondary side, 96 in. above bottom of tube sheet				
<u>Pressurizer</u>					
TFU-PR12E	In surge line, near pressurizer exit, between turbine flowmeter and pressurizer	0-2300°F	0-591°F	26, 27	
<u>Pressure Suppression System</u>		0-2300°F	0-591°F	28, 29	
TF-PSS-17	17 in. from bottom of tank				
TF-PSS-33	33 in. from bottom of tank				
TF-PSS-130	130 in. from bottom of tank				
MATERIAL TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise	0-2300°F	0-591°F		
<u>Intact Loop</u>					
TMU-1T4	Hot leg, Spool 1, top, 1/4 in. from pipe ID, 29 in. from vessel center			30, 31	
TMU-1T16	Hot leg, Spool 1, top, 1/16 in. from pipe ID, 29 in. from vessel center			30, 31	
TMU-1B16	Hot leg, Spool 1, bottom, 1/16 in. from pipe ID, 29 in. from vessel center			30, 31	
TMU-7S16	Cold leg, Spool 7, side, 1/16 in. from pipe ID, 242 in. from vessel center (vertical pipe)			30, 31	
TMU-15T4	Cold leg, Spool 15, top, 1/4 in. from pipe ID, 17 in. from vessel center			32, 33	
TMU-15T16	Cold leg, Spool 15, top, 1/16 in. from pipe ID, 17 in. from vessel center			32, 33	
TMU-15B16	Cold leg, Spool 15, bottom, 1/16 in. from pipe ID, 17 in. from vessel center			32, 33	
<u>Broken Loop</u>		0-2300°F	0-591°F	34, 35	
TMB-20B4	Cold leg, Spool 20, bottom, 1/4 in. from pipe ID, 21 in. from vessel center				
TMB-20B16	Cold leg, Spool 20, bottom, 1/16 in. from pipe ID, 21 in. from vessel center				
TMB-40S16	Cold leg, Spool 40, discharge of simulated pump, vertical section, side, 1/16 in. from pipe ID, 368 in. from vessel center along hot leg				

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments [a]	Range [a]		Figure [a]	Measurement Comments [b]
		Detector	Data Acquisition System		
<u>Vessel Wall</u>	1/8 in. from vessel ID	0-2300°F	0-591°F	36, 37	
TMV-VI-35A	35 in. below cold leg centerline, 0°				
TMV-VI-156A	156 in. below cold leg centerline, 0°				
TMV-VI-177M	177 in. below cold leg centerline, 180°				
<u>Cold Filler</u>	Type J iron-constantan thermocouples	0-1400°F	0-692°F		
TMV-FO-35A	35 in. below cold leg centerline, 0.65 in. from filler ID, 0°			38, 39	
TMV-FO-156A	156 in. below cold leg centerline, 0.65 in. from filler ID, 0°			38, 39	
TMV-FO-177M	177 in. below cold leg centerline, 0.65 in. from filler ID, 180°			38, 39	
TMV-FI-4M	4 in. below cold leg centerline, 1/16 in. from filler ID, 180°			40, 41	Thinness of filler at this location exposes metal thermocouple to fluid
TMV-FI-15A	15 in. below cold leg centerline, 1/16 in. from filler ID, 0°			40, 41	
TMV-FI-35A	35 in. below cold leg centerline, 1/16 in. from filler ID, 0°			40, 41	
TMV FI-35M	35 in. below cold leg centerline, 1/16 in. from filler ID, 180°			40, 41	
TMV-FI-70A	70 in. below cold leg centerline, 1/16 in. from filler ID, 0°			40, 41	
TMV-FI-115A	115 in. below cold leg centerline, 1/16 in. from filler ID, 0°			42, 43	
TMV-FI-156A	156 in. below cold leg centerline, 1/16 in. from filler ID, 0°			42, 43	
TMV-FI-156M	156 in. below cold leg centerline, 1/16 in. from filler ID, 180°			42, 43	
TMV-FI-177M	177 in. below cold leg centerline, 1/16 in. from filler ID, 180°			42, 43	
TMV-FI-184M	184 in. below cold leg centerline, 1/16 in. from filler ID, 180°			42, 43	
<u>Vessel Filler Insulator</u>	Outer surface of insulator, Type J iron-constantan thermocouples	0-1400°F	0-692°F	44, 45	
TIV-FO-4A	4 in. below cold leg centerline, 0°				
TIV-FO-35A	35 in. below cold leg centerline, 0°				
TIV-FO-35M	35 in. below cold leg centerline, 180°				
TIV-FO-70A	70 in. below cold leg centerline, 0°				
TIV-FO-115A	115 in. below cold leg centerline, 0°				
TIV-FO-156A	156 in. below cold leg centerline, 0°				
<u>Lower Plenum</u>	Chromel-Alumel thermocouple				
TMV-LH	In vessel bottom head, 1/8 in. from inside surface, 2 in. from vessel centerline, 90°	0-2300°F	0-591°F	46, 47	
<u>Core Barrel</u>	Type J iron-constantan thermocouples	0-1400°F	0-692°F		
TMV-CO-4A	4 in. below cold leg centerline, in inlet annulus region, 1/16 in. from core barrel OD, 0°			48, 49	
TMV-CO-15A	15 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°			48, 49	
TMV-CO-70A	70 in. below cold leg centerline, 1/16 in. from barrel OD, 0°			48, 49	
TMV-CO-115A	115 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°			48, 49	Rapid decrease of temperature at t=47 sec is questionable
TMV-CO-115M	115 in. below cold leg centerline, 1/16 in. from core barrel OD, 180°			48, 49	
TMV-CO-127A	127 in. below cold leg centerline, 1/16 in. from core barrel OD, 0°			48, 49	Rapid decrease of temperature at t=47 sec is questionable

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Core Barrel (Contd.)</u>					
TNV-CI-35A	35 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°			50, 51	
TNV-CI-70A	70 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°			50, 51	
TNV-CI-115A	115 in. below cold leg centerline, 1/16 in. from core barrel ID, 0°			50, 51	
<u>Steam Generator</u>		0-2300°F	0-591°F	52, 53	
TMU-SG1	On steam generator tubes, 12 in. above bottom of tube sheet, on OD of tube				
TMU-SG2	On steam generator tubes, 24 in. above bottom of tube sheet, on OD of tube				
TMU-SG3	On steam generator tubes, 48 in. above bottom of tube sheet, on OD of tube				
TMU-SG4	On steam generator tubes, 96 in. above bottom of tube sheet, on OD of tube				
<u>PRESSURE</u>					
<u>Intact Loop</u>					
PU-13(F)	Cold leg, Spool 13, 54 in. from vessel center (flush mount)	0-3000 psig	0-4000 psig		Data on analog system only. Not digitized because of limited channel availability
<u>Broken Loop</u>					
PB-23	Cold leg, Spool 23, 92 in. from vessel center, upstream of nozzle (tee off DP tap)	0-3000 psig	0-4000 psig	54, 55	
PB-CN1	Vessel-side nozzle, nozzle throat, 96 in. from vessel center, (tee off DP tap)			54, 55	
PB-RUPC	Vessel side of break, between rupture discs			54, 55	
PB-42	Cold leg, Spool 42, 415 in. from vessel center along hot leg, upstream of pump-side nozzle (tee off DP tap)			56, 57	
PB-HN1	Pump-side nozzle, nozzle throat, 419 in. from vessel center along hot leg (tee off DP tap)			56, 57	
PB-RUPH	Pump side of break, between rupture discs			56, 57	
<u>Vessel</u>		0-3000 psig	0-4000 psig	58, 59	
PV-UP+10	In upper plenum, 10 in. above cold leg centerline, mounted on standoff, 30°				
PV-LP-180	In upper part of lower plenum, 180 in. below cold leg centerline, mounted on standoff, 225°				
PV-IANN-9	In vessel inlet annulus, 9 in. below cold leg centerline, mounted on standoff, 225°				
<u>ECC System</u>					
PECC-UL-ACC	In intact loop accumulator	0-750 psig	0-750 psig	60, 61	Decrease of pressure at t=3 sec is due to automatic opening of accumulator valve prior to ECC injection. At t=46 sec, 600-psig nitrogen supply regulator inadvertently opened
<u>Pressurizer</u>					
PU-PRIZE	Steam dome	0-3000 psig	0-4000 psig	62, 63	
<u>Pressure Suppression System</u>					
P-PSS	Suppression tank top	0-100 psig	0-100 psig	64, 65	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments [a]	Range [a]		Figure [a]	Measurement Comments [b]
		Detector	Data Acquisition System		
DIFFERENTIAL PRESSURE					
Elevation difference between transducer taps is zero unless otherwise specified					
Intact Loop					
DPU-UP-1	Upper plenum 10.5 in. above cold leg centerline at 30° to hot leg, Spool 1, 31 in. from vessel center, upper plenum tap approximately 2 in. above Spool 1 tap	+50 in. water	+2.5 psid	66, 67	
DPU-UP-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 approximately 2 in. above Spool 3 tap	+300 in. water	+15 psid	68, 69	
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 approximately 18 in. above Spool 7 tap	+500 in. water	+25 psid	70, 71	
DPU-3-7L	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 approximately 18 in. above Spool 7 tap (low range)	+50 in. water	+2.5 psid	72, 73	Detector range exceeded until t=5 sec
DPU-3-SGIP	Across inlet orifice of steam generator; hot leg, Spool 3, 62 in. from vessel center to steam generator inlet plenum, 145 in. from vessel center, Spool 3 tap is 16 in. below SGIP tap	+500 in. water	+25 psid	74, 75	
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	+25 psid	76, 77	
DPU-SGIP-SG1	Steam generator inlet plenum, 145 in. from vessel center to 12.25 in. above bottom of tube sheet, SG1 tap is 24 in. above SGIP tap	+300 in. water	+15 psid		Detector failed
DPU-SG1-SG2	Across primary side tubes, 12 to 24 in. above bottom of tube sheet, SG1 tap is 12 in. below SG2 tap	+20 in. water	+1.0 psid	78, 79	By 120 sec after rupture a probable measurement system drift of 0.4 psid has occurred
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	+25 psid	80, 81	
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	82, 83	
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 psid	+50 psid	84, 85	
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	+5.0 psid	86, 87	Detector range exceeded until t=4 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	+5.0 psid	88, 89	Detector range exceeded until t=2 sec
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	90, 91	
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)	+50 in. water	+2.5 psid	92, 93	Detector range exceeded and data acquisition system saturated at various times throughout blowdown
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	+5.0 psid	94, 95	
DPU-15-ATH	Cold leg Spool 15, 16 in. from vessel center to atmosphere	+500 psid	+500 psid	96, 97	Data acquisition system saturated until t=23 sec

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
DPB-PRESLL	Pressurizer water level, elevation difference between taps is 34 in., lower tap is approximately 3.5 in. above pressurizer exit	+50 in. water	+2.5 psid	98, 99	Pressurizer liquid level calculated to be 29.1 in. above lower differential pressure transducer tap before blowdown from this measurement. This liquid level provides a liquid volume at blowdown initiation of 0.83 ft ³
Broken Loop					
DPB-IANN-21	Vessel inlet annulus, 9 in. below cold leg centerline at 225° to cold leg Spool 21, 49 in. from vessel center, inlet annulus tap, 9 in. below Spool 21 tap	+100 in. water	+5.0 psid	100, 101	
DPB-21-23	Cold leg Spool 21, 49 in. from vessel center to cold leg Spool 23, 92 in. from vessel center	+800 in. water	+40 psid	102, 103	
DPB-23-CN1	Cold leg Spool 23, 92 in. from vessel center to vessel-side nozzle throat, 96 in. from vessel center	+500 psid	+500 psid	104, 105	
DPB-CN1-CN4	Vessel-side nozzle, nozzle throat, 96 in. from vessel center to nozzle divergent section, 101 in. from vessel center	+1000 psid	+1300 psid	106, 107	
DPB-23-24	Across vessel-side nozzle, Spool 23, 92 in. from vessel center to Spool 24, 104 in. from vessel center	+1000 psid	+1300 psid	108, 109	
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, tap is 2 in. above Spool 30 tap	+100 in. water	+5.0 psid	110, 111	
DPB-30-38	Across entire simulated steam generator assembly and instrument spool downstream of simulated steam generator, hot leg Spool 30, 18 in. from vessel center to cold leg Spool 38, 305 in. from vessel center along hot leg, Spool 30 is 40 in. above Spool 38	+100 psid	+100 psid	112, 113	
DPB-30-32U	Hot leg Spool 30, 18 in. from vessel center to Spool 32 upper tap, 73 in. from vessel center, Spool 30 tap is 30 in. below Spool 32 upper tap	+50 psid	+50 psid	114, 115	
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	+50 psid	+50 psid	116, 117	
DPB-32L-32U	Hot leg Spool 32 lower tap, 63 in. from vessel center to Spool 32 upper tap, 73 in. from vessel center, upper tap is 16 in. above lower tap	+20 in. water	+1.0 psid	118, 119	
DPB-36L-37	Across nozzle assembly Spool 36 lower taps, 242 in. from vessel center along hot leg and Spool 37, 282 in. from vessel center along hot leg, Spool 37 is 40 in. below Spool 36 lower tap	+50 psid	+50 psid	120, 121	By 120 sec after rupture a probable measurement system drift of -1.4 psid has occurred
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 psid	+1300 psid	122, 123	
DPB-38-40L	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 (low range)	+500 in. water	+25 psid	124, 125	Detector range exceeded until t=48 sec and from t=72 sec until t=87 sec
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 psid	+50 psid	126, 127	Data have an apparent -1.6 psid zero offset
DPB-42-43	Across pump-side nozzle, cold leg Spool 42, 415 in. from vessel center along hot leg to cold leg Spool 43, 427 in. from vessel center along hot leg	+1500 psid	+2000 psid	128, 129	
DPB-42-HN1	Spool 42 upstream of pump-side nozzle, 415 in. from vessel center along hot leg to nozzle throat, 419 in. from vessel center along hot leg	+500 psid	+500 psid	130, 131	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments [a]	Detector	Range [a]	Figure [a]	Measurement Comments [b]
			Data Acquisition System		
<u>Broken Loop (Contd.)</u>					
DPB-HN1-HN4	Pump-side nozzle, nozzle throat, 419 in. from vessel center along hot leg to nozzle divergent section, 424 in. from vessel center along hot leg	±1500 psid	±2000 psid	132, 133	
DPB-HN4-43	Pump-side nozzle, divergent section, 424 in. from vessel center along hot leg to downstream Spool 43, 427 in. from vessel center along hot leg	±50 psid	±50 psid	134, 135	
<u>Vessel</u>					
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	±5.0 psid	94, 95	
DPB-IANN-21	Vessel inlet annulus, 9 in. below cold leg centerline at 225° to broken loop cold leg, Spool 21, 49 in. from vessel center, inlet annulus tap is 9 in. below Spool 21 tap	±100 in. water	±5.0 psid	100, 101	
DPV-UP-IANN	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	±14.8 psid	136, 137	
DPV-O-9CQ	Inlet annulus cold leg centerline at 90° to 9 in. below cold leg centerline at 225°, elevation difference between taps is 9 in.	±20 in. water	±1.0 psid	138, 139	Data questionable; probable detector sense line leakage
DPV-9-26QQ	Inlet annulus, 9 in. below cold leg centerline at 225° to downcomer gap approximately 26 in. below cold leg centerline at 225°, elevation difference between taps is 17 in.	±50 in. water	±2.5 psid	140, 141	
DPV-9-180QQ	Inlet annulus, 9 in. below cold leg centerline at 225° to lower plenum, 180 in. below cold leg centerline at 225°, elevation difference between taps is 171 in.	±300 in. water	±14.8 psid	142, 143	Data questionable; posttest review revealed faulty detector
DPV-26-55QM	Across part of downcomer, 26 in. (225°) to 55 in. (180°) below centerline of cold leg, elevation difference between taps is 29 in.	±50 in. water	±2.5 psid		Detector failed
DPV-55-110AM	Across part of downcomer, 55 in. (0°) to 110 in. (180°) below cold leg centerline, elevation difference between taps is 55 in.	±100 in. water	±5.0 psid	144, 145	
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	±5.0 psid	146, 147	
DPV-156-173QQ	Across downcomer exit, 7 in. above exit to 10 in. below exit, taps at 156 in. (225°) and 173 in. (225°) below cold leg centerline, elevation difference between taps is 17 in.	±20 in. water	±1.0 psid	148, 149	
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	±1.0 psid	150, 151	
DPV-173-180QQ	Across part of lower plenum, 173 in. (225°) to 180 in. (225°) below cold leg centerline, elevation difference between taps is 7 in.	±20 in. water	±1.0 psid	152, 153	Data questionable; probable detector sense line leakage
DPV-180-191QT	Across part of lower plenum, 180 in. (225°) to 191 in. (270°) below cold leg centerline, elevation difference between taps is 11 in.	±20 in. water	±1.0 psid	154, 155	Data questionable; probable detector sense line leakage
DPV-166-191QT	Across lower plenum, 166 in. (225°) to 191 in. (270°) below cold leg centerline, elevation difference between taps is 25 in.	±50 in. water	±2.5 psid	156, 157	
DPV-LP-UP	Lower plenum, 180 in. below cold leg centerline at 225° to upper plenum 10.5 in. above cold leg centerline at 30°, elevation difference between taps is 191 in.	±300 in. water	±14.8 psid	158, 159	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments [a]	Range [a]		Figure [a]	Measurement Comments [b]
		Detector	Data Acquisition System		
<u>Vessel (Contd.)</u>					
DPU-UP-1	Upper plenum, 10.5 in. above cold leg centerline at 30° to intact loop hot leg Spool 1, 31 in. from vessel center, upper plenum tap is approximately 2 in. from Spool 1 tap	+50 in. water	+2.5 psid	66, 67	
DPU-UP-3	Vessel upper plenum, 10.5 in. above cold leg centerline at 30° to intact loop hot leg Spool 3, 62 in. from vessel center, upper plenum tap is approximately 2 in. above Spool 3 tap	+300 in. water	+15 psid	68, 69	
DPB-UP-30	Vessel upper plenum, 10.5 in. above cold leg centerline at 30° to broken loop hot leg Spool 30, 18 in. from vessel center, upper plenum tap is 2 in. above Spool 30 tap	+100 in. water	+5.0 psid	110, 111	
<u>Steam Generator</u>					
DPU-3-SGIP	Across inlet orifice, hot leg Spool 3, 62 in. from vessel center to steam generator inlet plenum, 145 in. from vessel center, Spool 3 tap is 16 in. below SGIP tap	+500 in. water	+25 psid	74, 75	
DPU-SGIP-SG1	Steam generator inlet plenum, 145 in. from vessel center to 12.25 in. above bottom of tube sheet, SG1 tap is 24 in. above SGIP tap	+300 in. water	+14.8 psid		Detector failed
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	+800 in. water	+40 psid	76, 77	
DPU-SG1-SG2	Across primary side tubes, 12 to 24 in. above bottom of tube sheet, SG1 tap is 12 in. below SG2 tap	+20 in. water	+1.0 psid	78, 79	By 120 sec after rupture a probable measurement system drift of 0.4 psid has occurred
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	+25 psid	80, 81	
DPU-SG-SEC	Secondary side, differential pressure taps at 45 and 126 in. above bottom of tube sheet, elevation difference between taps is 81 in.	+100 in. water	+5.0 psid	160, 161	Prerupture steam generator secondary liquid level calculated to be 119 in. from this measurement
<u>Pressurizer</u>					
DPU-PRESLL	Pressurizer water level, elevation difference between taps is 34 in., lower tap is approximately 3.5 in. above pressurizer exit	+50 in. water	+2.5 psid	98, 99	Pressurizer liquid level calculated to be 29.1 in. above lower differential pressure transducer tap before blowdown from this measurement. This liquid level provides a liquid volume at blowdown initiation of 0.83 ft ³
<u>VOLUMETRIC FLOW RATE</u>					
<u>Intact Loop</u>					
	3-in. Schedule 160 pipe			162, 163	
FTU-1	Hot leg, Spool 1, 18 in. from vessel center	+20-400 gpm	+655 gpm		
FTU-9	Cold leg, Spool 9, 154 in. from vessel center	+20-400 gpm	+649 gpm		Detector range exceeded at t=69 sec and t=71 sec
FTU-13	Cold leg, Spool 13, 64 in. from vessel center	+20-400 gpm	+649 gpm		Detector range exceeded from t=41 sec to 55 sec and at t=71 sec
FTU-15	Cold leg, Spool 15, 29 in. from vessel center	+10-200 gpm	+389 gpm		Detector range exceeded from t=23 sec to t=73 sec. Data acquisition system saturated at t=44 sec, t=53 sec, t=69 sec, and t=71 sec
<u>Broken Loop</u>					
	All measurements bidirectional, Schedule 160 pipe			164, 165	
FTB-21	Cold leg, Spool 21, 58 in. from vessel center, 3-in. pipe	+20-400 gpm	+600 gpm		Detector range exceeded from t=18 sec to t=71 sec. Data acquisition system saturated from t=24 sec to t=60 sec and from t=68 sec to t=71 sec
FTB-30	Hot leg, Spool 30, 25 in. from vessel center, 3-in. pipe	+20-400 gpm	+408 gpm		
FTB-37	Cold leg, Spool 37, 290 in. from vessel center along hot leg, 2-in. pipe	+10-200 gpm	+657 gpm		Detector range exceeded from t=14 sec to t=54 sec and from t=71 sec to t=93 sec

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments [a]	Range [a]		Figure [a]	Measurement Comments [b]
		Detector	Data Acquisition System		
Core					
FTV-CORE-IN	Entrance to core, approximately 158 in. below cold leg centerline	± 10 -200 gpm	± 405 gpm	166, 167	
FTV-LOFT-COR	In LOFT core simulator, 14 in. below cold leg centerline (LOFT drag-disc, turbine flowmeter combination)				Experimental detector; data not processed for this report
ECC System					
FTU-LPIS	In line leading from LPIS to intact loop, 1/2-in. line	0.5-10 gpm	0-10 gpm		Turbine flowmeter failed
FTU-ACC	In line immediately after intact loop accumulator, 1-in. line	4-75 gpm	0-75 gpm	168, 169	Spike at t=3 sec, caused by air in line being forced through turbine flowmeter during accumulator valve opening
Pressurizer					
FTU-PRIZE	Surge line	5-100 gpm	0-111 gpm	170, 171	
FLUID VELOCITY					
Downcomer Gap					
FTV-22M	22 in. below cold leg centerline, 180°	± 2.5 -50 ft/sec	± 50 ft/sec	172, 173	Data questionable. Posttest inspection revealed worn turbine bearings
FTV-40A	40 in. below cold leg centerline, 0°	± 2.5 -50 ft/sec	± 50 ft/sec	174, 175	
FTV-40M	40 in. below cold leg centerline, 180°	± 2.5 -50 ft/sec	± 50 ft/sec	176, 177	
FTV-83A	83 in. below cold leg centerline, 0°	± 1.8 -36 ft/sec	± 36 ft/sec	178, 179	
FTV-83M	83 in. below cold leg centerline, 180°	± 1.8 -36 ft/sec	± 36 ft/sec	180, 181	
FTV-130M	130 in. below cold leg centerline, 180°	± 0.9 -18 ft/sec	± 18 ft/sec	182, 183	Unidirectional; measured magnitude only
MOMENTUM FLUX					
	Range of drag disc is bidirectional. Computer conversion of voltage output to momentum flux is unidirectional and, therefore, shows magnitude only				
Intact Loop					
FDU-1	Hot leg, Spool 1, 29 in. from vessel center, target size 0.875 in.	± 250 -11,500 lb _m /ft-sec ²	$\pm 15,300$ lb _m /ft-sec ²	184, 185	
FDU-5	Hot leg, Spool 5, 100 in. from vessel center, target size 1.0 in.	± 1 -2000 lb _m /ft-sec ²	± 2000 lb _m /ft-sec ²	186, 187	Data questionable, thermocouple in contact with drag disc
FDU-10	Cold leg, Spool 10, 137 in. from vessel center, target size 0.875 in.	± 200 -104,000 lb _m /ft-sec ²	$\pm 130,000$ lb _m /ft-sec ²	188, 189	
FDU-13	Cold leg, Spool 13, 54 in. from vessel center, target size 0.875 in.	± 200 -11,000 lb _m /ft-sec ²	$\pm 14,800$ lb _m /ft-sec ²	190, 191	
FDU-15	Cold leg, Spool 15, 19 in. from vessel center, target size 0.875 in.	± 200 -11,600 lb _m /ft-sec ²	$\pm 15,500$ lb _m /ft-sec ²	192, 193	
Broken Loop					
FDB-21	Cold leg, Spool 21, 53 in. from vessel center, 3-in. pipe, target size 0.406	± 200 -70,500 lb _m /ft-sec ²	$\pm 94,000$ lb _m /ft-sec ²	194, 195	
FDB-23	Cold leg, Spool 23, 93 in. from vessel center, upstream of vessel-size nozzle 1.5-in. pipe, target size 0.406	± 200 -125,000 lb _m /ft-sec ²	$\pm 167,000$ lb _m /ft-sec ²	196, 197	
FDB-30	Hot leg, Spool 30, 21 in. from vessel center, 3-in. pipe, target size 0.656	± 200 -60,000 lb _m /ft-sec ²	$\pm 80,000$ lb _m /ft-sec ²		Detector failed
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	± 200 -131,000 lb _m /ft-sec ²	$\pm 175,000$ lb _m /ft-sec ²	198, 199	
FDB-42	Cold leg, Spool 42, 416 in. from vessel center along hot leg, upstream of pump-side nozzle, downstream of injection point, 1.5-in. pipe, target size 0.406	± 200 -116,000 lb _m /ft-sec ²	$\pm 155,000$ lb _m /ft-sec ²	200, 201	
Vessel					
FDV-CORE-IN	In core flow mixer box, 150 in. below cold leg centerline, target size 1.0 in.	± 100 -1000 lb _m /ft-sec ²	± 1000 lb _m /ft-sec ²		Detector failed
FDV-LOFT-COR	In LOFT core simulator, 14 in. below cold leg centerline (LOFT drag-disc, turbine flowmeter combination) target size 0.500 in.				Experimental detector; data not processed for this report

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
DENSITY					
<u>Intact Loop</u>					
		0.1-100 lb _m /ft ³	0-100 lb _m /ft ³		
GU-1VR	Hot leg, Spool 1, 24 in. from vessel center, vertical			202, 203	
GU-1HZ	Hot leg, Spool 1, 26 in. from vessel center, horizontal			202, 203	
GU-5VR	Hot leg, Spool 5, 96 in. from vessel center, vertical			204, 205	
GU-10VR	Cold leg, Spool 10, 141 in. from vessel center, vertical			204, 205	
GU-13VR	Cold leg, Spool 13, 59 in. from vessel center, vertical			206, 207	
GU-15HZ	Cold leg, Spool 15, 20 in. from vessel center, horizontal			206, 207	
GU-15VR	Cold leg, Spool 15, 23 in. from vessel center, vertical			206, 207	
<u>Broken Loop</u>					
		0.1-100 lb _m /ft ³	0-100 lb _m /ft ³		
GB-21VR	Cold leg, Spool 21, 49 in. from vessel center, vertical			208, 209	
GB-23VR	Cold leg, Spool 23, 92 in. from vessel center, vertical			208, 209	
GB-30VR	Hot leg, Spool 30, 18 in. from vessel center, vertical			210, 211	
GB-37HZ	Cold leg, Spool 37, 279 in. from vessel center along hot leg, across vertical pipe, simulated steam generator discharge			210, 211	
GB-42VR	Cold leg, Spool 42, 415 in. from vessel center along hot leg, vertical			210, 211	
<u>Vessel</u>					
		0.1-100 lb _m /ft ³	0-100 lb _m /ft ³		
GV-COR-150HZ	Core flow mixer box, 152 in. below cold leg centerline, horizontal, 0-180°			212, 213	
GV-161/192D	Lower plenum 161 in. below cold leg centerline (270°) to 192 in. below cold leg centerline (90°), 31 in. vertical 32.2 in. diagonal			212, 213	
GVL P-165HZ	Upper part of lower plenum, 165 in. below cold leg centerline, 1.724 in. below downcomer exit, horizontal, 0-180°			214, 215	
GVL P-172HZ	Lower plenum, 172 in. below cold leg centerline, 8.729 in. below downcomer exit, horizontal, 90-270°			214, 215	
<u>Pressurizer</u>					
GU-PRIZE	Surge line	0.1-100 lb _m /ft ³	0-100 lb _m /ft ³	216, 217	
LIQUID LEVEL					
<u>Steam Generator</u>					
DPU-SG-SEC	Secondary side, differential pressure taps at 45 and 126 in. above tube sheet, elevation difference between taps is 81 in.	±100 in. water	±5.0 psid	160, 161	Prerupture steam generator secondary liquid level calculated to be 119 in. from this measurement
<u>Pressurizer</u>					
DPU-PRESLL	Pressurizer water level, elevation difference between taps is 34 in., lower tap is approximately 2.5 in. above pressurizer exit	±50 in. water	±2.5 psid	98, 99	Pressurizer liquid level calculated to be 29.1 in. above lower differential pressure transducer tap before blowdown from this measurement. This liquid level provides a liquid volume at blowdown initiation of 0.83 ft ³
MASS FLOW RATE					
	Mass flow rate obtained by combining density (gamma attenuation technique) with volumetric flow rate (turbine flowmeter) or momentum flux (drag disc)	Range for mass flow is determined from range of individual detectors used in calculation			
<u>Intact Loop</u>					
FDU-1 GU-1VR	Hot leg, Spool 1			218, 219	
FTU-1 GU-1VR				220, 221	

TABLE V (Contd.)

DATA PRESENTATION FOR SEMISCALE MOD-1 TEST S-01-3

Measurement	Location and Comments ^[a]	Range ^[a]		Figure ^[a]	Measurement Comments ^[b]
		Detector	Data Acquisition System		
<u>Intact Loop (Contd.)</u>					
FDU-1 GU-1HZ FTU-1 GU-1HZ	Hot leg, Spool 1			222, 223 224, 225	
FDU-5 GU-5VR	Hot leg, Spool 5			226, 227	Data questionable; thermocouple in contact with FDU-5 drag disc
FDU-10 GU-10VR	Cold leg, Spool 10			228, 229	
FDU-13 GU-13VR FTU-13 GU-13VR	Cold leg, Spool 13			230, 231 232, 233	
FDU-15 GU-15VR FTU-15 GU-15VR	Cold leg, Spool 15			234, 235 236, 237	
FDU-15 GU-15HZ FTU-15 GU-15HZ	Cold leg, Spool 15			238, 239 240, 241	
<u>Broken Loop</u>					
FDB-21 GB-21VR FTB-21 GB-21VR	Cold leg, Spool 21			242, 243 244, 245	
FDB-23 GB-23VR	Cold leg, Spool 23			246, 247	
FDB-30 GB-30VR FTB-30 GB-30VR	Hot leg, Spool 30			248, 249	FDB-30 failed
FDB-37 GB-37HZ FTB-37 GB-37HZ	Cold leg, Spool 37			250, 251 252, 253	
FDB-42 GB-42VR	Cold leg, Spool 42			254, 255	
<u>Vessel</u>					
FTV-CORE-IN GV-COR-150HZ	Entrance to core			256, 257	
FDV-CORE-IN GV-COR-150HZ	Entrance to core				FDV-CORE-IN failed
PUMP CHARACTERISTICS					
PUMPU-TORQ	Pump torque		0-500 in.-lb	258, 259	
PUMPU-POW	Pump motor power		0-24.2 kW	260, 261	
PUMPU-RPM	Pump speed		0-3600 rpm	262, 263	
^[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 operation or measuring characteristics and the data are considered valid unless specified otherwise.

Fig. 6 Fluid temperatures in intact loop, -2 to 70 seconds.

Fig. 7 Fluid temperatures in intact loop, 60 to 130 seconds.

Fig. 8 Fluid temperatures in broken loop, -2 to 70 seconds.

Fig. 9 Fluid temperatures in broken loop, 60 to 130 seconds.

Fig. 10 Fluid temperatures in inlet annulus, -2 to 70 seconds.

Fig. 11 Fluid temperatures in inlet annulus, 60 to 130 seconds.

Fig. 12 Fluid temperatures in downcomer annulus, -2 to 70 seconds.

Fig. 13 Fluid temperatures in downcomer annulus, 60 to 130 seconds.

Fig. 14 Fluid temperatures in lower plenum, -2 to 70 seconds.

Fig. 15 Fluid temperatures in lower plenum, 60 to 130 seconds.

Fig. 16 Fluid temperature in core (LOFT), -2 to 70 seconds.

Fig. 17 Fluid temperature in core (LOFT), 60 to 130 seconds.

Fig. 18 Fluid temperatures in core barrel insulation gap, -2 to 70 seconds.

Fig. 19 Fluid temperatures in core barrel insulation gap, 60 to 130 seconds.

Fig. 20 Fluid temperatures in vessel filler insulation gap, -2 to 70 seconds.

Fig. 21 Fluid temperatures in vessel filler insulation gap, 60 to 130 seconds.

Fig. 22 Fluid temperature at cold leg injection point (Spool 14), -2 to 70 seconds.

Fig. 23 Fluid temperature at cold leg injection point (Spool 14), 60 to 130 seconds.

Fig. 24 Fluid temperatures in steam generator, -2 to 70 seconds.

Fig. 25 Fluid temperatures in steam generator, 60 to 130 seconds.

Fig. 26 Fluid temperature in pressurizer, -2 to 70 seconds.

Fig. 27 Fluid temperature in pressurizer, 60 to 130 seconds.

Fig. 28 Fluid temperatures in pressure suppression tank, -2 to 70 seconds.

Fig. 29 Fluid temperatures in pressure suppression tank, 60 to 130 seconds.

Fig. 30 Material temperatures in intact loop (TMU-1T4, TMU-1T16, TMU-1B16, and TMU-7S16), -2 to 70 seconds.

Fig. 31 Material temperatures in intact loop (TMU-1T4, TMU-1T16, TMU-1B16, and TMU-7S16), 60 to 130 seconds.

Fig. 32 Material temperatures in intact loop (TMU-15T4, TMU-15T16, and TMU-15B16), -2 to 70 seconds.

Fig. 33 Material temperatures in intact loop (TMU-15T4, TMU-15T16, and TMU-15B16), 60 to 130 seconds.

Fig. 34 Material temperatures in broken loop, -2 to 70 seconds.

Fig. 35 Material temperatures in broken loop, 60 to 130 seconds.

Fig. 36 Material temperatures in vessel wall, -2 to 70 seconds.

Fig. 37 Material temperatures in vessel wall, 60 to 130 seconds.

Fig. 38 Material temperatures in vessel filler OD, -2 to 70 seconds.

Fig. 39 Material temperatures in vessel filler OD, 60 to 130 seconds.

Fig. 40 Material temperatures in vessel filler ID (TMV-FI-4M, TMV-FI-15A, TMV-FI-35A, TMV-FI-35M, and TMV-FI-70A), -2 to 70 seconds.

Fig. 41 Material temperatures in vessel filler ID (TMV-FI-4M, TMV-FI-15A, TMV-FI-35A, TMV-FI-35M, and TMV-FI-70A), 60 to 130 seconds.

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Fig. 43 Material temperatures in vessel filler ID (TMV-FI-115A, TMV-FI-156A, TMV-FI-156M, TMV-FI-177M and TMV-FI-184M), 60 to 130 seconds.

Fig. 44 Material temperatures in vessel filler insulator, -2 to 70 seconds.

Fig. 45 Material temperatures in vessel filler insulator, 60 to 130 seconds.

Fig. 46 Material temperature in vessel lower head, -2 to 70 seconds.

Fig. 47 Material temperature in vessel lower head, 60 to 130 seconds.

Fig. 48 Material temperatures in core barrel OD, -2 to 70 seconds.

Fig. 49 Material temperatures in core barrel OD, 60 to 130 seconds.

Fig. 50 Material temperatures in core barrel ID, -2 to 70 seconds.

Fig. 51 Material temperatures in core barrel ID, 60 to 130 seconds.

Fig. 52 Material temperatures in steam generator, -2 to 70 seconds.

Fig. 53 Material temperatures in steam generator, 60 to 130 seconds.

Fig. 54 Pressures in broken loop cold leg, -2 to 70 seconds.

Fig. 55 Pressures in broken loop cold leg, 60 to 130 seconds.

Fig. 56 Pressures in broken loop hot leg, -2 to 70 seconds.

Fig. 57 Pressures in broken loop hot leg, 60 to 130 seconds.

Fig. 58 Pressures in vessel, -2 to 70 seconds.

Fig. 59 Pressures in vessel, 60 to 130 seconds.

Fig. 60 Pressure in intact loop ECC accumulator, -2 to 70 seconds.

Fig. 61 Pressure in intact loop ECC accumulator, 60 to 130 seconds.

Fig. 62 Pressure in pressurizer, -2 to 70 seconds.

Fig. 63 Pressure in pressurizer, 60 to 130 seconds.

Fig. 64 Pressure in pressure suppression tank, -2 to 70 seconds.

Fig. 65 Pressure in pressure suppression tank, 60 to 130 seconds.

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Fig. 67 Differential pressure in intact loop (upper plenum to Spool 1), 60 to 130 seconds.

Fig. 68 Differential pressure in intact loop (upper plenum to Spool 3), -2 to 70 seconds.

Fig. 69 Differential pressure in intact loop (upper plenum to Spool 3), 60 to 130 seconds.

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Fig. 71 Differential pressure in intact loop (Spool 3 to Spool 7), 60 to 130 seconds.

Fig. 72 Differential pressure in intact loop, low range (Spool 3 to Spool 7), -2 to 70 seconds.

Fig. 73 Differential pressure in intact loop, low range (Spool 3 to Spool 7), 60 to 130 seconds.

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Fig. 75 Differential pressure in intact loop (Spool 3 to steam generator inlet plenum), 60 to 130 seconds.

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Fig. 85 Differential pressure in intact loop (Spool 12 to Spool 10), 60 to 130 seconds.

Fig. 86 Differential pressure in intact loop, low range (Spool 12 to Spool 10), -2 to 70 seconds.

Fig. 87 Differential pressure in intact loop, low range (Spool 12 to Spool 10), 60 to 130 seconds.

Fig. 88 Differential pressure in intact loop (Spool 12 to Spool 15), -2 to 70 seconds.

Fig. 89 Differential pressure in intact loop (Spool 12 to Spool 15), 60 to 130 seconds.

Fig. 90 Differential pressure in intact loop (Spool 15 to Spool 1), -2 to 70 seconds.

Fig. 91 Differential pressure in intact loop (Spool 15 to Spool 1), 60 to 130 seconds.

Fig. 92 Differential pressure in intact loop, low range (Spool 15 to Spool 1), -2 to 70 seconds.

Fig. 93 Differential pressure in intact loop, low range (Spool 15 to Spool 1), 60 to 130 seconds.

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Fig. 99 Differential pressure in intact loop (pressurizer liquid level), 60 to 130 seconds.

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Fig. 102 Differential pressure in broken loop (Spool 21 to Spool 23), -2 to 70 seconds.

Fig. 103 Differential pressure in broken loop (Spool 21 to Spool 23), 60 to 130 seconds.

Fig. 104 Differential pressure in broken loop (Spool 23 to cold leg nozzle throat), -2 to 70 seconds.

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Fig. 106 Differential pressure in broken loop (cold leg nozzle throat to divergent section), -2 to 70 seconds.

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Fig. 132 Differential pressure in broken loop (hot leg nozzle throat to divergent section), -2 to 70 seconds.

Fig. 133 Differential pressure in broken loop (hot leg nozzle throat to divergent section), 60 to 130 seconds.

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Fig. 153 Differential pressure in vessel (DPV-173-180QQ), 60 to 130 seconds.

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Fig. 155 Differential pressure in vessel (DPV-180-191QT), 60 to 130 seconds.

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Fig. 223 Mass flow in intact loop (FDU-1 and GU-1HZ), 60 to 130 seconds.

Fig. 224 Mass flow in intact loop (FTU-1 and GU-1HZ), -2 to 70 seconds.

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Fig. 227 Mass flow in intact loop (FDU-5 and GU-5VR), 60 to 130 seconds.

Fig. 228 Mass flow in intact loop (FDU-10 and GU-10VR), -2 to 70 seconds.

Fig. 229 Mass flow in intact loop (FDU-10 and GU-10VR), 60 to 130 seconds.

Fig. 230 Mass flow in intact loop (FDU-13 and GU-13VR), -2 to 70 seconds.

Fig. 231 Mass flow in intact loop (FDU-13 and GU-13VR), 60 to 130 seconds.

Fig. 232 Mass flow in intact loop (FTU-13 and GU-13VR), -2 to 70 seconds.

Fig. 233 Mass flow in intact loop (FTU-13 and GU-13VR), 60 to 130 seconds.

Fig. 234 Mass flow in intact loop (FDU-15 and GU-15VR), -2 to 70 seconds.

Fig. 235 Mass flow in intact loop (FDU-15 and GU-15VR), 60 to 130 seconds.

Fig. 236 Mass flow in intact loop (FTU-15 and GU-15VR), -2 to 70 seconds.

Fig. 237 Mass flow in intact loop (FTU-15 and GU-15VR), 60 to 130 seconds.

Fig. 238 Mass flow in intact loop (FDU-15 and GU-15HZ), -2 to 70 seconds.

Fig. 239 Mass flow in intact loop (FDU-15 and GU-15HZ), 60 to 130 seconds.

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Fig. 252 Mass flow in broken loop (FTB-37 and GB-37HZ), -2 to 70 seconds.

Fig. 253 Mass flow in broken loop (FTB-37 and GB-37HZ), 60 to 130 seconds.

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Fig. 259 Primary pump torque; 60 to 130 seconds.

Fig. 260 Primary pump power, -2 to 70 seconds.

Fig. 261 Primary pump power, 60 to 130 seconds.

Fig. 262 Primary pump speed, -2 to 70 seconds.

Fig. 263 Primary pump speed, 60 to 130 seconds.

IV. REFERENCE

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