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Experiment Data Report For Semiscale MOD-2A Natural Circulation Test Series (Test S-NC-1)

Thomas M. O'Connell

November 1981

Prepared for the
U.S. Nuclear Regulatory Commission
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ABSTRACT

This report presents test data recorded for Test S-NC-1 (ANC1 and BNC1) of the Semiscale Mod-2A Natural Circulation Test Series. This is one of several Semiscale tests that investigate the thermal-hydraulic phenomena resulting from operational transients involving loss of mechanical primary coolant circulation in a pressurized water reactor. These tests give experimental data used to develop and assess the analytical capability of computer models predicting the results of small-break loss-of-coolant accidents or operational transients involving the loss of primary pumping ability.

The primary objective of Test S-NC-1 was to experimentally characterize the thermal-hydraulic behavior of a system during single-phase (subcooled) steady-state natural circulation flow conditions. Of special interest were the effects on single-phase natural circulation flow promoted by changes in core power, primary pressure, and external heater power.

This report presents the uninterpreted data from Test S-NC-1 (ANC1 and BNC1) for future data analysis. The data, presented by graphs in engineering units, have been analyzed only to the extent necessary to ensure that they are reasonable and consistent.

SUMMARY

Test S-NC-1 is one in the Semiscale Mod-2A Natural Circulation Test Series conducted by EG&G Idaho, Inc., for the United States Government. The NC Series investigates the thermal-hydraulic phenomena resulting from operational transients involving the loss of mechanical primary coolant circulation in a pressurized water reactor, and provides experimental data that can be used to develop and assess the analytical capability of computer models designed to predict and analyze such transients. The objective of Test S-NC-1 was to experimentally characterize the thermal-hydraulic behavior of a system during single-phase (subcooled), steady-state, natural circulation flow conditions. Of special interest were the effects on single-phase, natural circulation flow promoted by changes in core power, primary pressure, and external heater power.

The Mod-2A system is equipped with a pressure vessel that contains an electrically heated core and other simulated reactor internals and an external downcomer assembly; an intact loop with steam generator, pump, and pressurizer; and a broken loop with steam generator, pump, and rupture assembly. For this test, the broken loop and vessel upper head were removed and replaced with end caps, leaving the intact loop, vessel with downcomer, and intact loop steam generator. The intact loop pump was removed to eliminate leakage, and replaced with a spool piece designed to have a hydraulic resistance scaled for a locked rotor condition.

Natural circulation of the primary fluid was established at a variety of primary system pressures and core power levels, using the core as a heat source and steam generator secondary as a heat sink: low pressure, 0.48 MPa; intermediate pressure, 3.5 MPa; high pressures, 9.1 MPa, 10.1 MPa, and 11.2 MPa; and core power between 30 and 100 kW, 1-1/2% to 5% decay power. The primary pressure was changed as noted above to ensure sufficient subcooling in the primary for single-phase conditions. Secondary pressure was maintained constant during each case.

Generally, Test S-NC-1 proceeded as specified. Conditions that did not conform to the specified test configuration were considered acceptable for analysis within the test objectives.

Test S-NC-1 data are available from the NRC/RSR Data Bank at the Idaho National Engineering Laboratory. Address inquiries to EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415.

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NOTE: The appendix to this report is presented on microfiche sheet 003 attached to the inside of the back cover.

FIGURES

NOTE: Figures 9 through 416 are presented on microfiche attached to the inside of the back cover.

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EXPERIMENT DATA REPORT FOR SEMISCALE MOD-2A NATURAL CIRCULATION TEST SERIES (TEST S-NC-1)

I. INTRODUCTION

The Semiscale Mod-2A experiments represent the current phase of the Semiscale Program conducted by EG&G Idaho, Inc., for the United States Government. The program, sponsored by the Nuclear Regulatory Commission (NRC) through the Department of Energy (DOE), is part of the overall NRC water reactor research program to investigate the response of a pressurized water reactor (PWR) system to hypothesized loss-of-coolant accidents (LOCAs) and to operational transients involving the loss of mechanical primary coolant circulation. The underlying objectives of the Semiscale Program are to quantify the physical processes that control system behavior during operational transients or a LOCA, and to provide an experimental data base for assessing reactor safety evaluation models. The Semiscale Mod-2A Program has the further objective of providing support to other experimental programs in the forms of instrumentation assessment, test series time optimization, selection of test parameters, and comparative evaluation of test results.

Test S-NC-1, consisting of two parts, ANC1 and BNC1, was conducted June 24, 1981, in the Semiscale Mod-2A system, as part of the Mod-2A Natural Circulation Test Series (Test Series NC). This series investigates the thermal and hydraulic phenomena of natural circulation as a principal core heat rejection mechanism during small-break loss-of-coolant accidents (LOCAs) and operational transients involving the loss of mechanical primary coolant circulation in a PWR. The series also provides thermal-hydraulic data that can be used to assess and develop computer codes that predict PWR system behavior resulting from a loss of mechanical coolant circulation. Additional objectives for this test series include evaluation of low flow, natural circulation-type measurement techniques, identification of system thermal-hydraulic and measurement response during transitions between different modes of natural circulation, examination of the effect of noncondensible gas on natural circulation, and comparison of data to natural circulation tests performed in other facilities. Results will also aid in assessing the capability of conventional PWR process instrumentation to detect natural circulation. Due to scaling compromises in the Mod-2A system, test results may not be directly applicable to PWRs, but rather, may help identify dominant parameters for quantifying PWR natural circulation characteristics and limitations.

The primary objective of Test S-NC-1 was to investigate the effect of core power on single-phase natural circulation flow at a variety of system pressures, and with this data, to assess the code capability to calculate single-phase natural circulation and to predict system sensitivity to changes in core power and primary pressure. In particular, modeling of the steam generator and system hydraulic resistances and heat transfer models were key features for evaluation. Other objectives were to evaluate instrumentation capability to detect and quantify low, natural circulation type, flow rates and small differential temperatures and pressures, and to examine Semiscale system typicality (scaling) by comparing results in the Mod-2A system with those obtained in other systems.

Test S-NC-1 is a steady-state experiment designed to produce data that are independent of loop-to-loop instabilities that could occur during transients. It is also a separate effects test, which uses only a subsystem of the Mod-2A system so that important system parameters during natural circulation can be better examined. Hardware configuration and test parameters were scaled from, and representative of, typical PWR systems and operating conditions.

This report presents 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, and sequence of events for Test S-NC-1; Section III gives the data graphs, comments, and supporting information necessary for interpretation of the data. A description of the overall Semiscale Program and test series, and a more detailed description of the Natural Circulation Test Series, are in References 1 and 2. Preliminary analysis and interpretation of S-NC-1 data are presented in Reference 3. Additional information describing the data acquisition system capabilities, posttest adjustments made to the data, and the methodology used to establish uncertainty limits for the data are given in Appendix A.

II. SYSTEM, PROCEDURES, CONDITIONS, AND EVENTS FOR TEST S-NC-1

The following system configuration, procedures, conditions, and events are specific to Test S-NC-1.

System Configuration

For Semiscale Natural Circulation Test S-NC-1, only part of the Mod-2A system was used, as shown in Figures 1 and 2. The test configuration consisted of the vessel with electrically heated core and external downcomer, intact loop tube-and-shell steam generator, and loop piping. The broken loop was removed and the vessel/downcomer penetrations for the broken loop hot and cold legs were capped. Normally, the Mod-2A system includes an intact loop pump; however, this was removed and replaced with a special instrumented spool piece, as shown in Figure 3. This spool piece was orificed to represent the scaled hydraulic resistance of a pressurized water reactor primary pump in the locked rotor (stopped) configuration. The vessel was modified from the normal Mod-2A configuration for these tests by removing the vessel upper head as shown in Figure 4. This was necessary to ensure a uniform heatup of the entire system and to avoid condensation on upper head structures. The vessel core consists of a 5 x 5 array of internally heated electric rods, 23 of which were powered. The rods are geometrically similar to nuclear rods with a heated length of 3.66 m and an outside diameter of 1.072 cm. All 23 heated rods were powered equally. Figure 5 shows a plan view of the vessel core.

The intact loop steam generator is a two-pass, tube-and-shell design. Primary fluid flows through vertical, inverted, U-shaped tubes, and secondary coolant passes through the shell side. The steam generator has 2 short, 2 medium, and 2 long tubes representative of the range of bend elevations in a PWR steam generator. A horizontal cross section of the intact loop steam generator tubes is shown in Figure 6. The "off center" arrangement of tubes was required to provide better volume scaling of the secondary. The same tube stock (2.22 cm OD x O.124 cm wall) and tube spacing (3.175-cm triangular pitch) used for PWR U-tubes were used in the steam generator. Since the heat transfer area was specified by the ratio of PWR-to-Semiscale core power, the number of tubes was thereby fixed by the specified tube diameter and lengths. Fillers were installed in the shell side to provide a more properly scaled secondary fluid volume.

Elevations of steam generator nozzles, plenums, and tubes are similar to those of a PWR; however, the steam dome is shorter than a PWR's steam dome. The steam drying equipment is of a simpler and less efficient design, but this is of little importance at the low steaming rates used in the NC test series.

Basically, the system was configured as a heat source (represented by the vessel core) and a heat sink (represented by the steam generator secondary) all connected by loop piping. External heaters were installed on the vessel and loop piping to offset environmental heat loss. The heaters are controlled by four independent, variable power supplies.

The Natural Circulation Test Series presents unique ranges of hydraulic conditions relative to the majority of previous Semiscale testing. Low flow rates are the main measurement challenge. For this purpose, turbine meters and drag screens throughout the system have been ranged as low as presently possible. The steam generator primary and secondary sides have been extensively instrumented with thermocouples. At several axial locations throughout the steam generators, pairs of primary and secondary fluid thermocouples, along with primary tube wall metal thermocouples have been attached to the primary tube walls, as shown in Figure 7. One long tube and one short tube is extensively instrumented; the middle tubes have no thermocouples installed. Tubes that are instrumented are identified on Figure 6.

Depiction of a typical fluid thermocouple installation is shown in Figure 8. The thermocouple leads are attached to the OD of the primary tubes. Penetrations of the primary tube wall by fluid thermocouples are sealed with a gold braze. The metal thermocouples are attached to the OD of the primary tube wall. A groove in the primary tube wall accepts a special thermocouple that has had the tip flattened for a distance of 0.017 cm. The thermocouple is secured in the groove with a braze. In addition to tube thermocouples, the steam dome has several fluid thermocouples, and

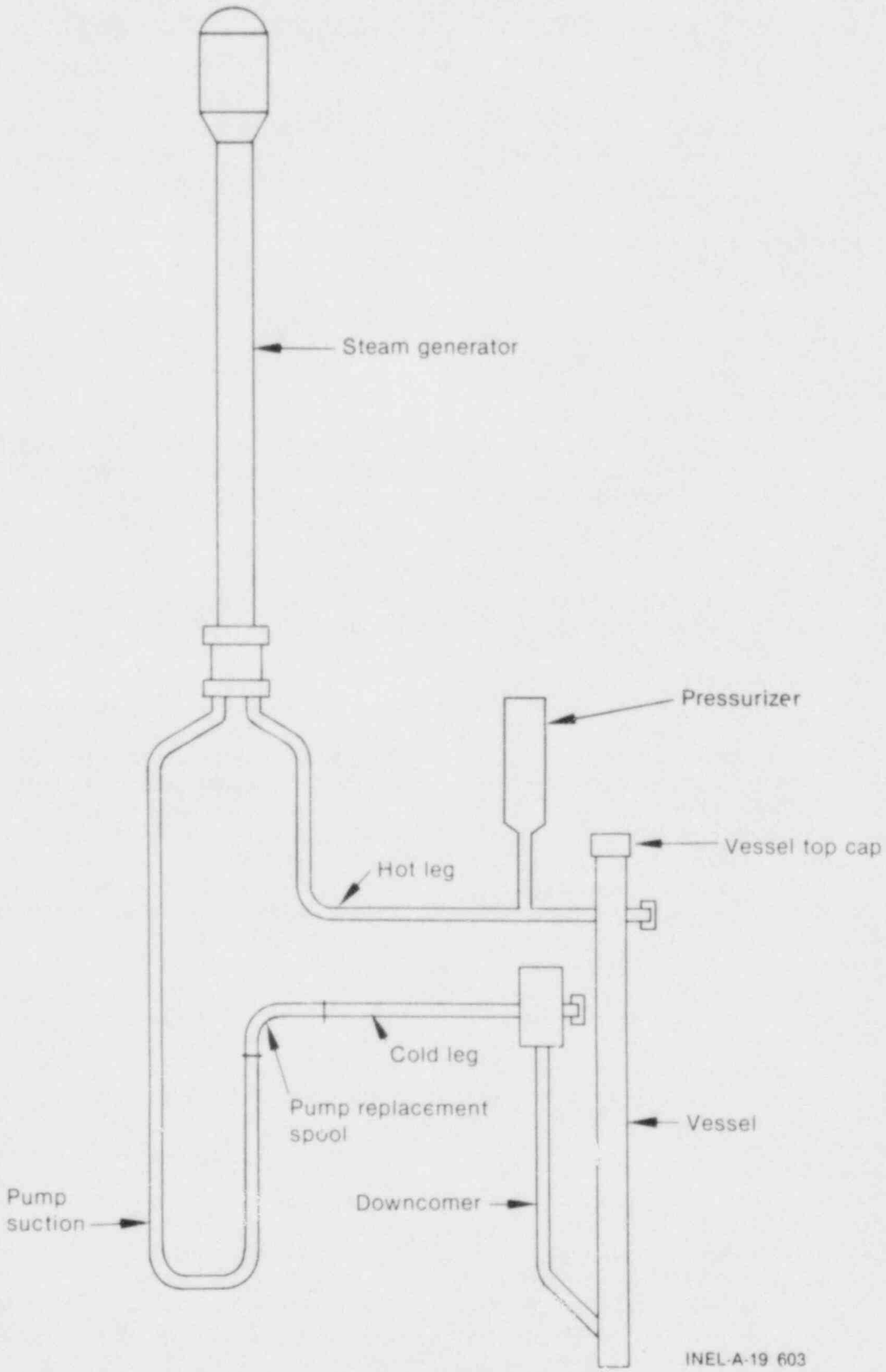

Figure 1. Semiscale Mod-2A system configuration for separate effect natural circulation—isometric.

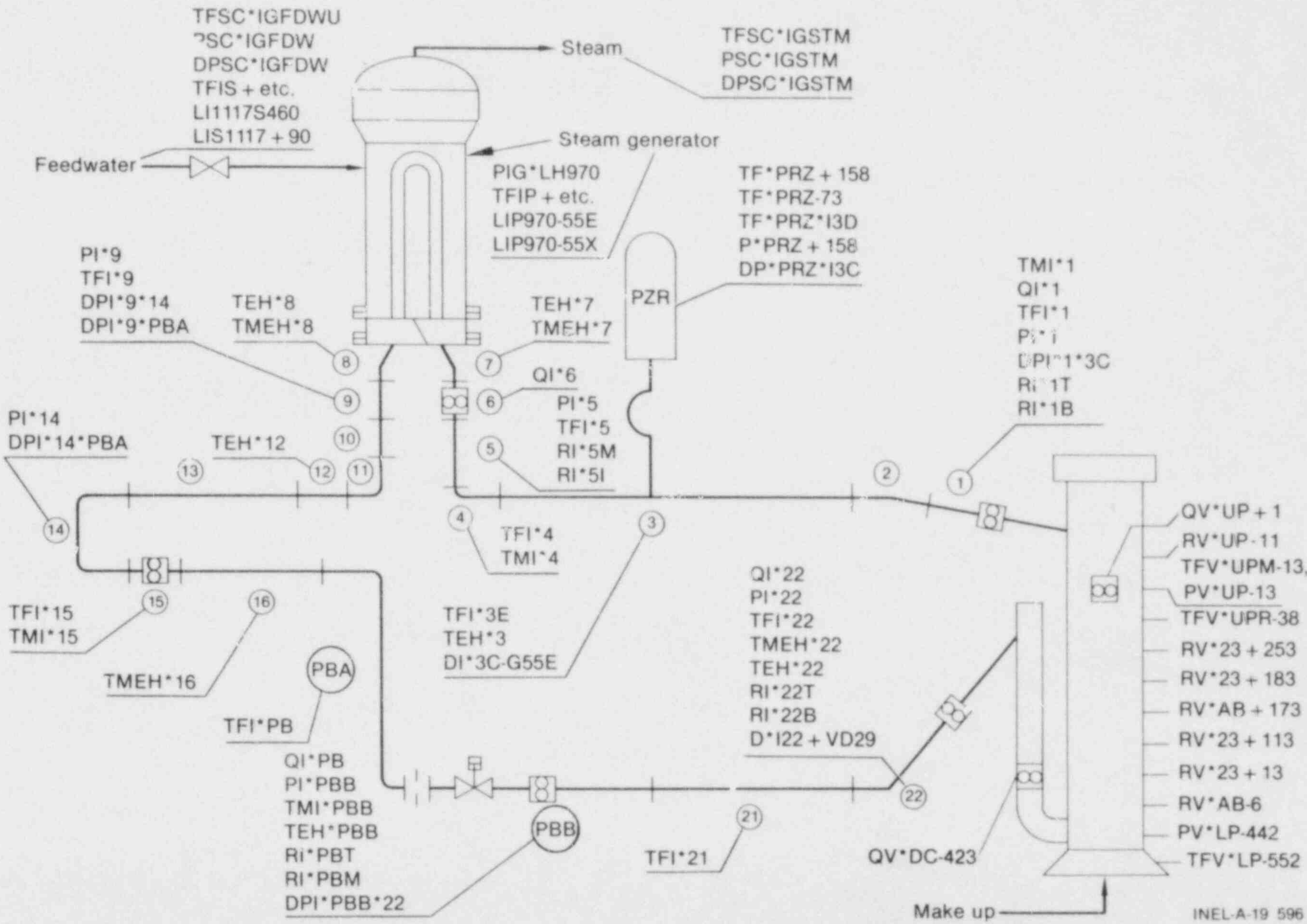

Figure 2 Semiscale Mod-2A system configuration for separate effect natural circulation—schematic.

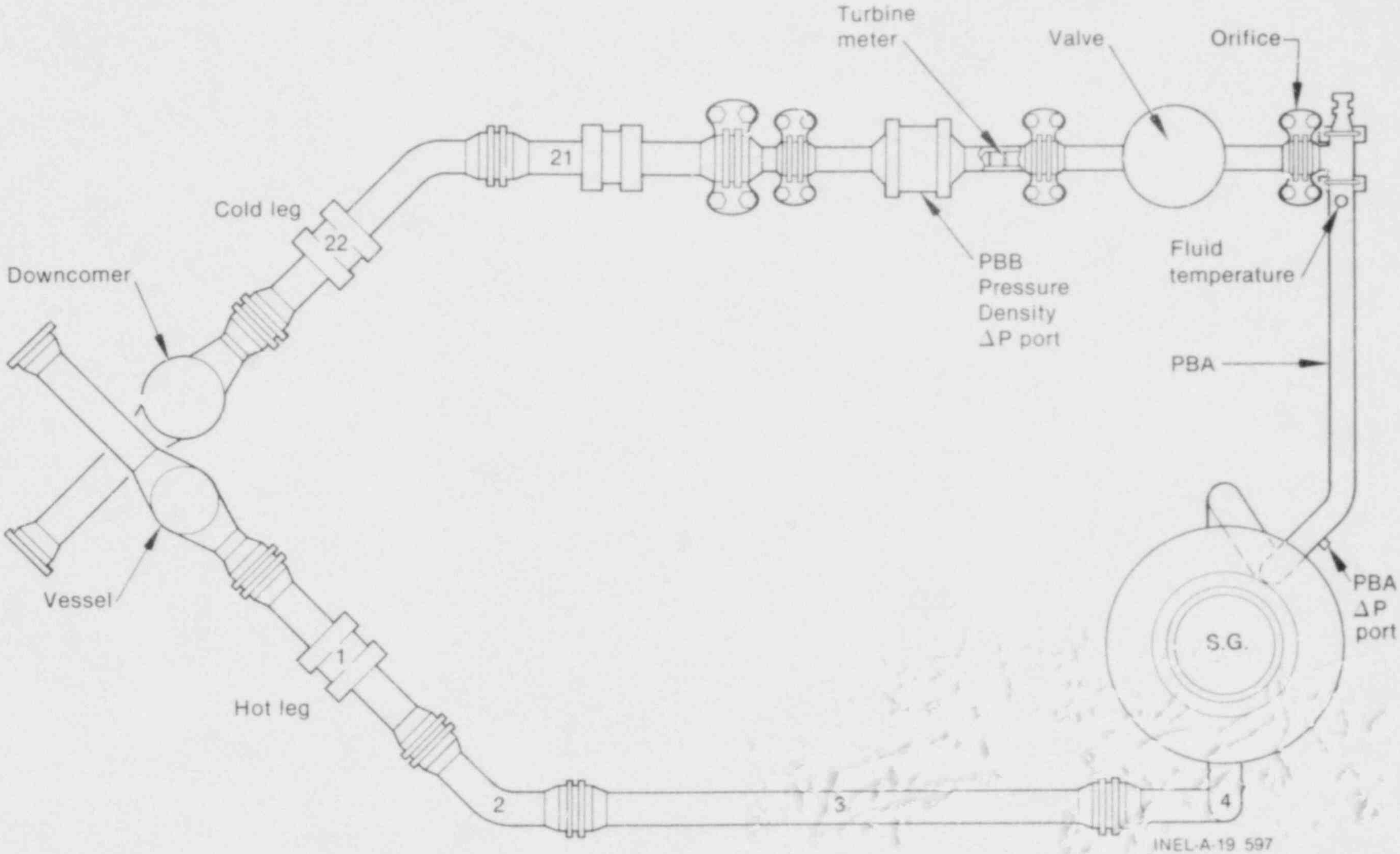

Figure 3. Semiscale Mod-2A intact loop pump bypass assembly—isometric.

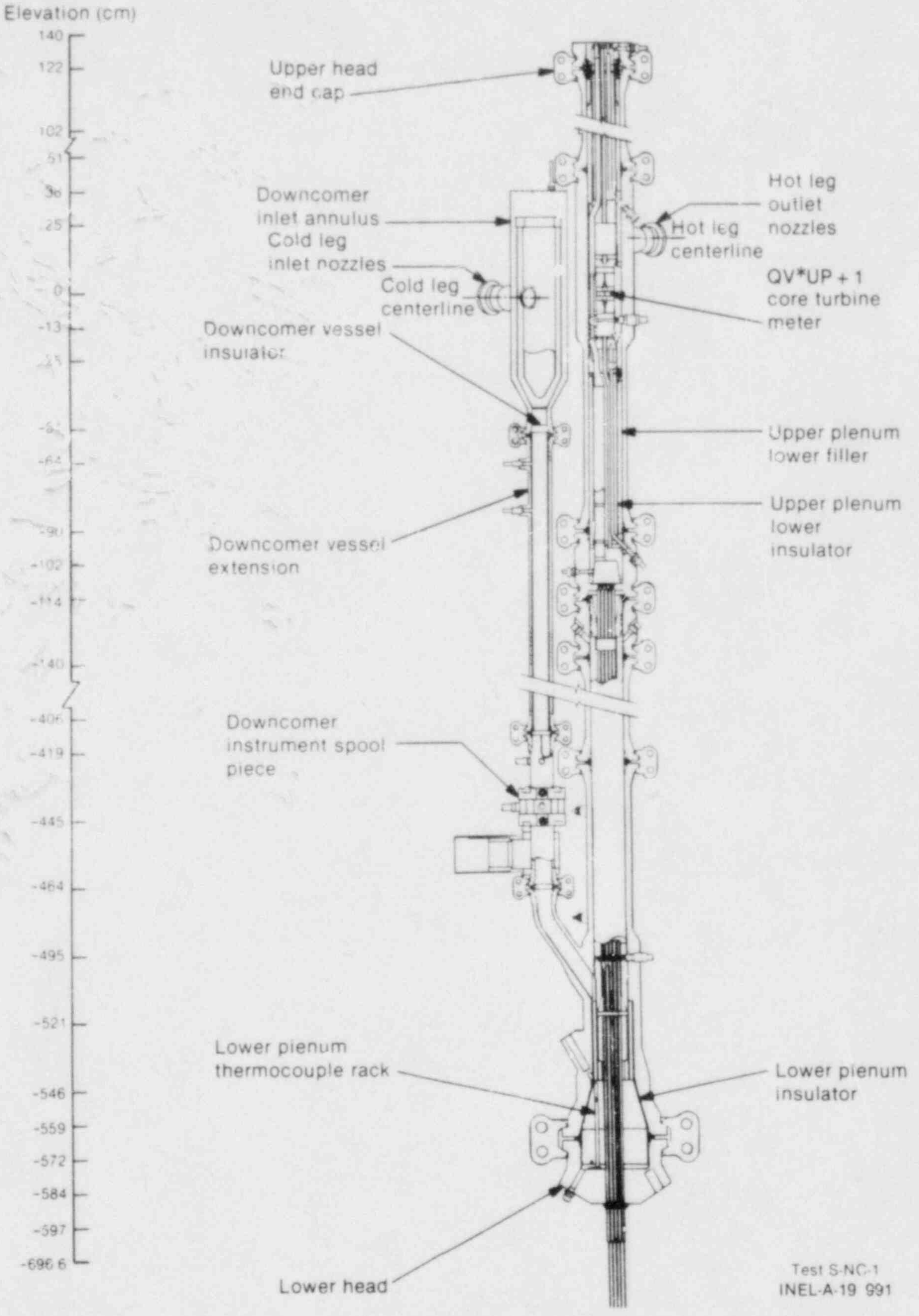

Figure 4. Semiscale Mod-2A core vessel and downcomer—Test S-NC-1 cross section.

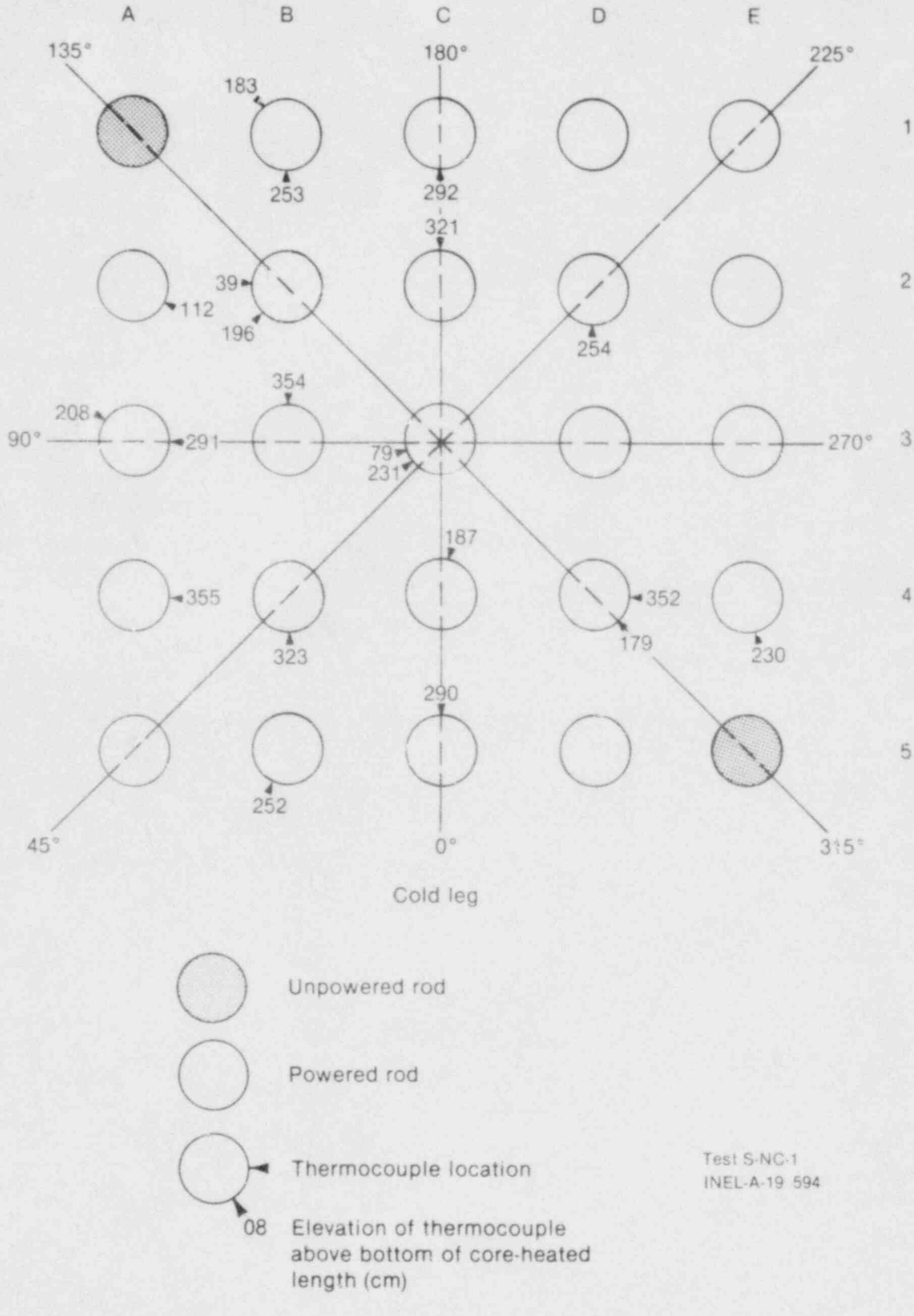

Figure 5. Semiscale Mod-2A heated core plan view.

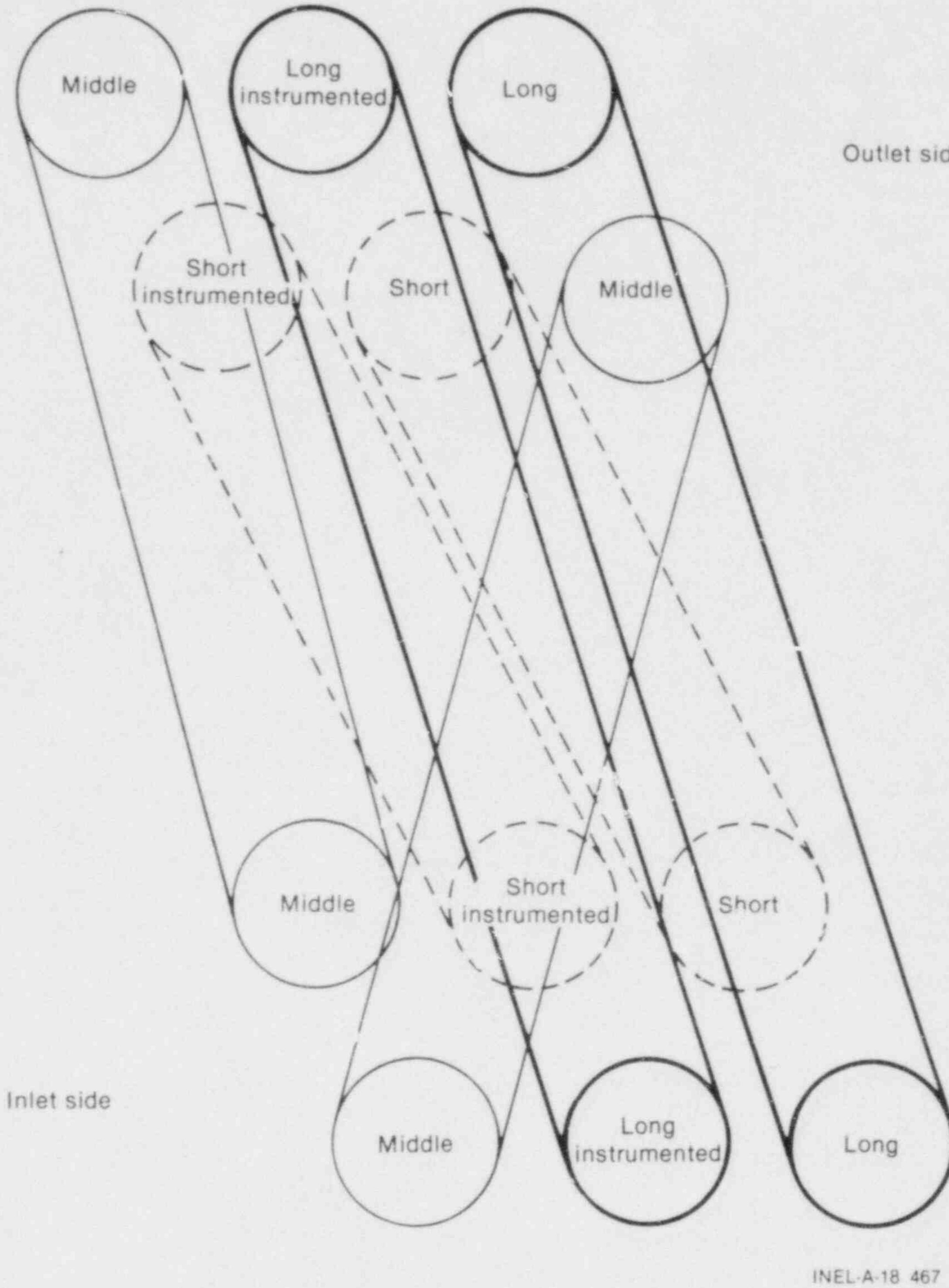

Figure 6. Semiscale Mod-2A intact loop steam generator tubes—horizontal cross section.

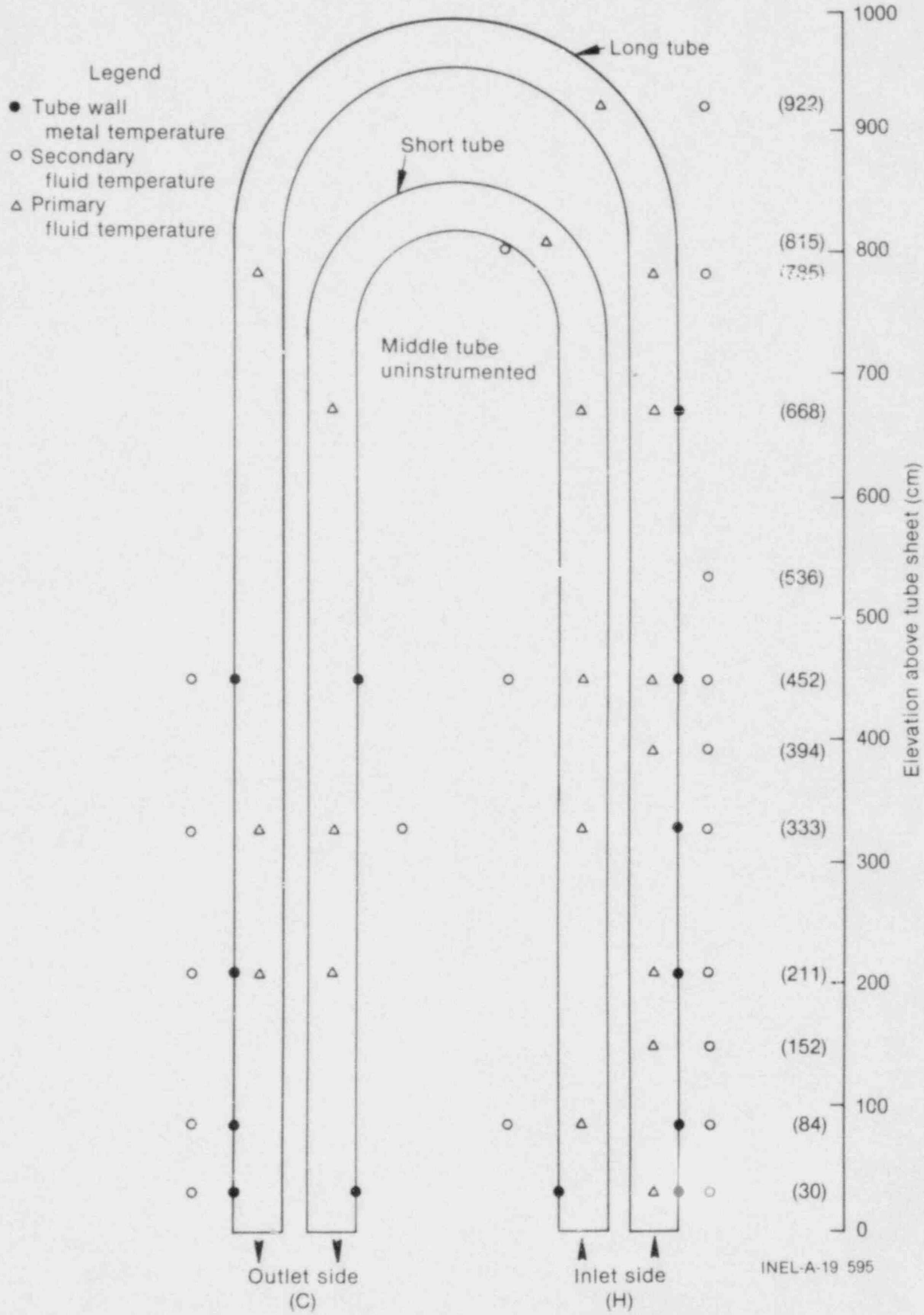

Figure 7. Semiscale Mod-2A intact loop steam generator thermocouple locations.

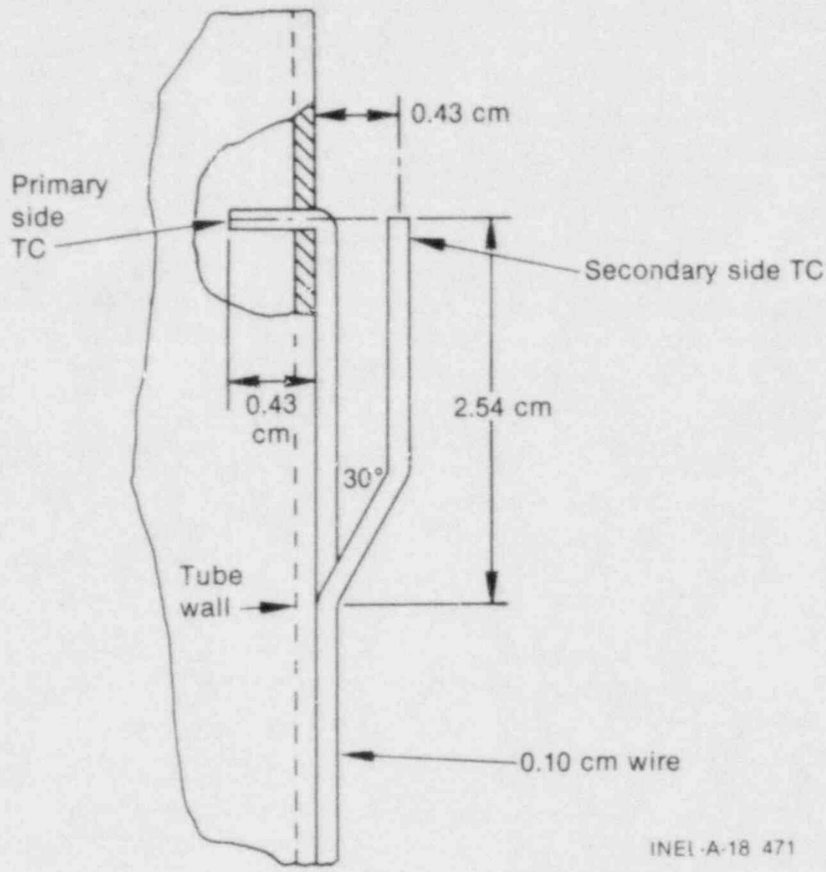

Figure 8. Semiscale Mod-2A steam generator fluid thermocouple installation.

the downcomer has fluid thermocouples at several axial positions. Other steam generator instrumentation includes primary tube (primary side) differential pressure ports allowing measurements of collapsed liquid level in the tubes. The sense lines connecting the measurement location and the differential pressure cell penetrate the side of the steam generator shell at several elevations. Differential pressure ports are located on the long primary tube that has the thermocouples as well as a middle tube and a short tube. Differential pressure ports are located at the following elevations (in cm) above the tube sheet: 970 cm in the long tube, 905 cm in the middle tube, 92, 462, and 838 cm in the short tube. The differential pressure ports are all located on the upflow side of the primary tubes. Ports are also located in the inlet and outlet plena.

References 1 and 2 give further details of the Semiscale Mod-2A system and its configuration for Test S-NC-1.

Test Preparation

In preparation for the test, the system was filled with treated demineralized water and vented at strategic points to ensure a liquid-full condition. Treated demineralized water in the steam generator feedwater tank was heated to 497 K, and the required liquid level was established in the steam generator secondary side. Before warmup, the system was checked for leakage, and system instrumentation checked for operation.

Warmup

Warmup to initial test conditions was accomplished using core power as a heat source and the steam generator secondary as a heat sink. Natural circulation flow thermally conditioned the system to specified steady-state values.

Test Sequence

For the first data point, makeup pumps were used to pressurize the primary system; for the remaining points pressurizer heaters were used to establish system pressure. For all cases, the primary pressure was maintained such that a minimum (no less than 2 K) of subcooling existed within the primary coolant system. Steam generator secondary fluid was kept at saturation throughout the test, and the steam generator tubes remained covered with water (collapsed level). Once a specified condition was met, sufficient time was allowed to establish a steady-state flow and temperature distribution. Except during the first steady-state condition, data were taken continuously.

A total of seven steady-state conditions were established, two of which involved varied external heater operation. The first low-pressure condition (0.48 MPa system pressure, 30 kW core power) was established without the use of external heaters because heat loss was very low. Next, the system was brought to a quasi-steady-state condition (3 MPa system pressure, 1.4 MPa secondary pressure, and 30 kW core power) without external heaters in operation. Following this, the vessel/downcomer external heater power was turned on to a predetermined value based on results from the Heat Loss Characterization Series, and the system allowed to reach another quasi-steady-state condition. Next, the loop external heaters were turned on and after flow and temperature stablization the second steady-state data point was taken. While maintaining system primary fluid subcooling, by using core power, secondary feed and bleed, and the pressurizer, the third, fourth, and fifth steady-state data points were established (8.5 MPa, 10.1 MPa, and 11 MPa system pressure; 30 kW, 60 kW, and 100 kW core power), with external heater power being adjusted according to results from the Heat Loss Characterization Test Series to maintain a net adiabatic pressure boundary.

One major experimental variable was primary system pressure. Primary pressure was adjusted via pressurizer pressure to maintain adequate subcooling in the hot leg, so that single-phase natural circulation was assured. Cyclic pressurizer heater operation caused small oscillations of primary pressure during steady-state; however, the magnitude was so small that no significant effect was observed. Secondary pressure was kept at the specified value for each steady-state natural circulation case, by controlling the steam discharge rate. The liquid level in the steam generator secondary was kept above the top of the longest tube, so that steam generator tubes were entirely covered with secondary coolant throughout the test. Also throughout the test, secondary pressure was lower than primary pressure, and the steam generator acted as a heat sink. Table 1 lists the sequence of major operations on a plot time basis.

Core power was another important test variable. Core power was varied to three different values during the test, to observe the effect on single-phase natural circulation. The sharp increase in core power between 160 and 250 minutes corresponds to operational variations during the pressurization process.

Data from Test S-NC-1 is presented in the following sections. This test consisted of five steady-state natural circulation cases representing a variety of system pressures and core powers and two quasi-steady-state cases designed to obtain information on external heater effects. The first set of data, labeled ANC1, is the data taken during steady-state condition 1. The second set of data, labeled BNC1, is the data taken during the two quasi-steady-state conditions and during the final four steady-state conditions.

Tabular Data for Test Conditions

Tables 2 and 4 show conditions in the Semiscale Mod-2A system at each steady-state test condition. Table 3 compares loop temperature distributions with and without external heaters on.

Table 1. Sequence of major operations

Real Time	Operations	Time After Tape Started (min)
8:00	System heatup	--
11:25	Case 1 condition (ANC1) data (taken for 10 minutes)	0 to 500 seconds
13:23	Data tape start (BNC1)	0
13:54	Vessel heater on	31
14:53	Hot leg, pump suction, cold leg heaters on	90
15:02	Feeding steam generator	99
15:31	Raising primary pressure	128
15:35	Case 2 condition data (taken for 10 minutes)	132
16:04	Increased all band heater power	161
17:55	Case 3 condition data (taken for 10 minutes)	272
18:26	Case 4 condition data (taken for 6 minutes)	303
18:51	Case 5 condition data (taken for 10 minutes)	328
19:01	End of data acquisition (BNC1)	338

Table 2. System parameters for steady-state test conditions

	ANC1	BNC1			
Parameters	Case 1	Case 2	Case 3	Case 4	Case 5
Primary system pressure (MPa)	0.48	3.5	9.1	10.1	11.2
Steam generator secondary pressure (MPa)	0.16	1.35	5.8	5.8	5.8
Core power (kW)	32.7	31.4	31.9	60	99.2
Total external heater power (kW)	--	31.98	41.9	41.9	41.9
Minimum subcooling (K)	5	14	6	5	2
Hot leg temperature (K)	410	498	568	577	586
Core ΔT (K)	32	27	20	29	29
ΔT across steam generator (K)	32	30	20	28	27
Mass flow rate (kg/s)	0.21	0.29	0.32	0.40	0.47

Table 3. Locp temperature distribution with and without external heaters (case 2 condition)

Location	Temperature Distribution (±2 K) External Heaters Off	External Heaters On
Hot leg near vessel (Spool 1)	465	500
Steam generator entrance (Spool 5)	463	500
Steam generator outlet (Spool 9)	447	469
Pump replacement spool (Spool PB)	442	472
Cold leg near vessel (Spool 22)	442	470
Downcomer near bottom (Elevation-435)	437	470

a. Heater power is 19.62 kW vessel-downcomer, 3.77 kW hot leg, 6.69 pump suction, 1.9 kW cold leg.

Table 4. Measured and calculated system parameters for steady-state test conditions

Parameter	Cases (measured/calculated) 1	2	3	4	5
Primary system pressure (MPa)	0.48 0.42	3.5 3.0	9.1 8.5	10.1 11.0	11.2 11.0
Steam generator secondary pressure (MPa)	0.16 0.12	1.35 1.6	5.8 6.0	5.8 6.0	5.8 6.0
Core Power (kW)	32.7 30.0	31.4 30.0	31.9 30.0	60.0 60.0	99.1 100.0
Minimum subcooling	5 13	14 17	6 11	5 18	2 6
Hot leg temperature (K)	410 404	498 490	568 561	577 573	586 585
Core ΔT (K)[a]	33 15	27 15	22 13	30 23	40 30
Core inlet flow rate (kg/s)[a]	0.21 0.45	0.29 0.44	0.32 0.45	0.40 0.49	0.47 0.52
Mid-plane heater surface temperature (K)	408	493	565	578	590
Steam generator liquid level (cm)[b]	998 1015	998 723	998 975	998 839	998 817
Steam generator ΔT (K)	30 15	30 15	20 13	28 23	27 30

a. See Reference 3 for explanation.

b. During the test, the steam generator liquid level was maintained above the top of the tubes. The minimum level was 998 cm.

III. DATA PRESENTATION

This report presents the data from Semiscale Mod-2A Test S NC-1 with brief comment. Processing analysis serves only to obtain appropriate engineering units and to ensure that data are reasonable and consistent. In all cases, analysis assumed a homogeneous fluid in converting transducer output to engineering units.

The performance of the system during Test S-NC-1 was monitored by 276 detectors. A digital data acquisition system recorded data for Test S-NC-1 part 1 (ANC1) at an effective sample rate of 1.82 points per second per channel and for Test S-NC-1 part 2 (BNC1) at 0.455 points per second per channel.

The data are presented as graphs in engineering units, the scales selected not reflecting the obtainable resolution of the data. Reference 1 and Appendix A describe the data processing techniques further. Figures 1 through 8 give information for interpretation of the data graphs. Table 5 groups the measurements according to type, identifies the location and range of the detector and actual recording range of the data acquisition system, comments briefly on the data, and references the detector and comments to their corresponding figure. Figures 9 through 416 (data graphs) present all the data obtained. Appendix A explains the capabilities of the data acquisition system, explains posttest data adjustments, and presents an analysis of the uncertainty associated with data measurements in the Semiscale Mod-2A System.

The data plots (Figures 9 through 416) and the appendix are on microfiche attached to the inside back cover of this report.

Table 5. Data presentation for S-NC-1

		Data Acquisition Range[a]			
Measurement	Location and Comments[a]	Detector	System	Figure[a]	Measurement Comments[b]
FLUID TEMPERATURE	Chromel-Alumel thermocouples, unless specified otherwise.				
Intact Loop		0 to 1533 K	0 to 820 K		
TFI*1	Hot leg, Spool 1, 50 cm from vessel center.			9;206	
TFI*3E	Hot leg, Spool 3, port E, 270 cm from vessel center.			10;207	
TFI*4	Hot leg, Spool 4, 300 cm from vessel center.			11;208	
TFI*5	Hot leg, Spool 5, 363 cm from vessel center.			12;209	
TFI*9	Cold leg, Spool 9, 1017 cm from downcomer center.			13;210	
TFI*15	Cold leg, Spool 15, 642 cm from downcomer center.			14;211	
TFI*PBB	Cold leg, Spool PB, 210 cm from downcomer center.			15;212	
TFI*21	Cold leg, Spool 21, 138 cm from downcomer center.			16;213	
TFI*22	Cold leg, Spool 22, 48 cm from downcomer center.			17;214	
Downcomer		0 to 1533 K	0 to 820 K		
TFV*DC-18	Downcomer extension, 18 cm below cold leg center.			18;215	
TFV*DC-84	Downcomer extension, 84 cm below cold leg center.			19;216	
TFV*DC-270	Downcomer extension, 270 cm below cold leg center.			20;217	
TFV*DC-293	Downcomer extension, 293 cm below cold leg center.			21;218	
TFV*DC-436	Downcomer instrument spool, 436 cm below cold leg center.			22;219	
Vessel		0 to 1533 K	0 to 820 K		
Vessel Lower Plenum					
TFV*LP-552	552 cm below cold leg centerline.			23;220	
Vessel Upper Plenum		0 to 1533 K	0 to 820 K		
TFV*UPR-38	38 cm below cold leg centerline at 240°.			24;221	
TFV*UPM-13	13 cm below cold leg centerline at 180°.			25;222	
Core Grid Spacers		0 to 1533 K	0 to 1580 K		
Grid Spacer 1	490 cm below cold leg centerline, 6 cm above bottom of heated length.				
TFV*D4+6	In space defined by Columns D and E, Rows 4 and 5.			26;223	
Grid Spacer 4	370 cm below cold leg centerline, 126 cm above bottom of heated length.				
TFV*B3+126	In space defined by Columns B and C, Rows 3 and 4.			27;224	
Grid Spacer 5	330 cm below cold leg centerline, 166 cm above bottom of heated length.				
TFV*B3+166	In space defined by Columns B and C, Rows 3 and 4.			28;225	
Grid Spacer 6	290 cm below cold leg centerline, 206 cm above bottom of heated length.				
TFV*B3+206	In space defined by Columns B and C, Rows 3 and 4.			29;226	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Grid Spacer 8	210 cm below cold leg centerline, 286 cm above bottom of heated length.				
TFV*A4+286	In space defined by Columns A and B, Rows 4 and 5.			30;227	
Grid Spacer 9	170 cm below cold leg centerline, 326 cm above bottom of heated length.				
TFV*A4+326	In space defined by Columns A and B, Rows 4 and 5.			31;228	
Grid Spacer 10	130 cm below cold leg centerline, 366 cm above bottom of heated length.				
TFV*A4+366	In space defined by Columns A and B, Rows 4 and 5.			32;229	
Steam Generator		0 to 1533 K	0 to 820 K		
Intact Loop, Primary Side	Between Spools 7 and 8.				
TFIP+LH30	In long tube, hot side, 30 cm above top of tube sheet.			33;230	
TFIP+SH84	In short tube, hot side, 84 cm above top of tube sheet.			34;231	
TFIP+LH152	In long tube, hot side, 152 cm above top of tube sheet.			35;232	
TFIP+LH211	In long tube, hot side, 211 cm above top of tube sheet.			36;233	
TFIP+LH452	In long tube, hot side, 452 cm above top of tube sheet.			37;234	
TFIP+LH668	In long tube, hot side, 668 cm above top of tube sheet.			38;235	
TFIP+LH785	In long tube, hot side, 785 cm above top of tube sheet.			39;236	
TFIP+SH815	In short tube, hot side, 815 cm above top of tube sheet.			40;237	
TFIP+LH922	In long tube, hot side, 922 cm above top of tube sheet.			41;238	
TFIP+SC668	In short tube, cold side, 668 cm above top of tube sheet.			42;239	
TFIP+SC333	In short tube, cold side, 333 cm above top of tube sheet.			43;240	
TFIP+LC333	In long tube, cold side, 333 cm above top of tube sheet.			44;241	
TFIP+SC211	In short tube, cold side, 211 cm above top of tube sheet.			45;242	
TFIP+LC211	In long tube, cold side, 211 cm above top of tube sheet.			46;243	
Intact Loop, Secondary Side		0 to 1533 K	0 to 820 K		
TFSC*IGFWU	In feedwater line to steam generator feed ring.			47;244	
TFSC*IGSTM	In steam line from steam generator steam dome.			48;245	
TFIS*D+914	In downcomer, 914 cm above top of tube sheet.			49;246	
TFIS*D+457	In downcomer, 457 cm above top of tube sheet.			50;247	
TFIS*D+152	In downcomer, 152 cm above top of tube sheet.			51;248	
TFIS+SH84	On short tube, hot side, 84 cm above top of tube sheet.			52;249	
TFIS+SC333	On short tube, cold side, 333 cm above top of tube sheet.			53;250	
TFIS+SH452	On short tube, hot side, 452 cm above top of tube sheet.			54;251	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Intact Loop, Secondary Side (continued)					
TFIS+LH30	On long tube, hot side, 30 cm above top of tube sheet.			55;252	
TFIS+LC30	On long tube, cold side, 30 cm above top of tube sheet.			56;253	
TFIS+LH84	On long tube, hot side, 84 cm above top of tube sheet.			57;254	
TFIS+LC84	On long tube, cold side, 84 cm above top of tube sheet.			58;255	
TFIS+LH152	On long tube, hot side, 152 cm above top of tube sheet.			59;256	
TFIS+LH211	On long tube, hot side, 211 cm above top of tube sheet.			60	ANC1 only.
TFIS+LC211	On long tube, cold side, 211 cm above top of tube sheet.			61;257	
TFIS+LC333	On long tube, cold side, 333 cm above top of tube sheet.			62;258	
TFIS+LH394	On long tube, hot side, 394 cm above top of tube sheet.			63;259	
TFIS+LH452	On long tube, hot side, 452 cm above top of tube sheet.			64;260	
TFIS+LC452	On long tube, cold side, 452 cm above top of tube sheet.			65;261	
TFIS+LH536	On long tube, hot side, 536 cm above top of tube sheet.			66;262	
TFIS+LH785	On long tube, hot side, 785 cm above top of tube sheet.			67;263	
TFIS+LH922	On long tube, hot side, 922 cm above top of tube sheet.			68;264	
Pressurizer		0 to 1533 K	0 to 820 K		
TF*PRZ+132	In top of pressurizer, 132 cm above exit to surge line.			69;265	
TF*PRZ-73	In surge line, 73 cm below entrance to pressurizer.			70;266	
TF*PRZ*I3D	In surge line, at entrance to intact loop, Spool 3 port D, 214 cm from vessel center.			267	BNC1 only.
METAL TEMPERATURE	Chromel-Alumel thermocouples unless specified otherwise.				
Intact Loop		0 to 1533 K	0 to 820 K		
TMI*1	Hot leg, Spool 1, 1.6 mm from pipe inside diameter (ID), 68 cm from vessel center.			71;268	
TMI*4	Hot leg, Spool 4, 1.6 mm from pipe ID, 300 cm from vessel center.			72;269	
TMI*15	Cold leg, Spool 15, 1.6 mm from pipe ID, 668 cm from downcomer center.			73;270	
TMI*P88	Cold leg, Spool P8, 1.6 mm from pipe ID, 243 cm from downcomer center.			74;271	
Downcomer		0 to 1533 K	0 to 820 K		
TMV*DC-18	Downcomer extension, 18 cm below cold leg center.			75;272	
TMV*DC-223	Downcomer extension, 223 cm below cold leg center.			76;273	
TMV*DC-294	Downcomer extension, 294 cm below cold leg center.			77;274	
TMV*DC-435	Downcomer instrument spool, 435 cm below cold leg center.			78;275	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Vessel		0 to 1533 K	0 to 820 K		
TMV*LPR587	Lower plenum, 587 cm below cold leg centerline at 240°.			79;276	
TMV*SC-352	Core housing, 352 cm below cold leg centerline.			80;277	
TMV*SC-212	Core housing, 212 cm below cold leg centerline.			81;278	
Steam Generator Intact Loop		0 to 1533 K	0 to 820 K		
TMIG+LH30	On long tube, hot leg OD, 30 cm above top of tube sheet.			82;279	
TMIG+LH84	On long tube, hot leg OD, 84 cm above top of tube sheet.			83;280	
TMIG+LH211	On long tube, hot leg OD, 211 cm above top of tube sheet.			84;281	
TMIG+LH452	On long tube, hot leg OD, 452 cm above top of tube sheet.				Detector failed.
TMIG+LH668	On long tube, hot leg OD, 668 cm above top of tube sheet.			85;282	
TMIG+LC30	On long tube, cold leg OD, 30 cm above top of tube sheet.			86;283	
TMIG+LC211	On long tube, cold leg OD, 211 cm above top of tube sheet.			87;284	
TMIG+LC452	On long tube, cold leg OD, 452 cm above top of tube sheet.			88;285	
TMIG+SC452	On short tube, cold leg OD, 452 cm above top of tube sheet.			89;286	
TMIG+FP2C	On filler piece number 2C.			90;287	
External Heaters	Thermocouples on pipe outside surface, under an external band heater.	0 to 1533 K	0 to 820 K		
Intact Loop					
TMEH*7	Hot leg, Spool 7, 447 cm fr[illegible]m vessel center.			91;288	
TMEH*8	Cold leg, Spool 8, 1082 cm from downcomer center.			92;289	
TMEH*16	Cold leg, Spool 16, 542 cm from downcomer center.			93;290	
TMEH*22	Cold leg, Spool 22, 42 cm from downcomer center.			94;291	
Vessel		0 to 1533 K	0 to 820 K		
TMEH*D-237	On downcomer, [illegible]7 cm below cold leg center.			95;292	
TMEH*V-360	Core housing, [illegible] cm below cold leg centerline.			96;293	
TMEH*V-196	Cr[illegible]e housing, 196 cm be[illegible]ow cold leg centerline.			97;294	
TMEH*V+101	Upper plenum, 101 [illegible]m above cold leg centerline.			98;295	
MATERIAL TEMPERATURE	Chromel-Alumel thermocouples unless otherwise specified.				
External Heaters	Thermocouples on external band heater outside surface, under insulation.	0 to 1533 K	0 to 820 K		
Intact Loop					
TEH*3	Hot leg, Spool 3, 174 cm from vessel center.			99;296	
TEH*7	Hot leg, Spool 7, 447 cm from vessel center.			100;297	
TEH*8	Cold leg, Spool 8, 1082 cm from downcomer center.			101;298	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a]		Figure[a]	Measurement Comments[b]
		Detector	System		
Intact Loop (continued)					
TEH*12	Cold leg, Spool 12, 900 cm from downcomer center.			102;299	
TEH*PBB	Cold leg, Spool PB, 243 cm from downcomer center.			103;300	
TEH*22	Cold leg, Spool 22, 42 cm from downcomer center.			104;301	
Vessel		0 to 1533 K	0 to 820 K		
TEH*D-237	On downcomer, 237 cm below cold leg center.			105;302	
TEH*V-360	Core housing, 360 cm below cold leg centerline.			303	BNC1 only.
TEH*V-196	Core housing, 196 cm below cold leg centerline.			106;304	
TEH*V+101	Upper plenum, 101 cm above cold leg centerline.			107;305	
CORE HEATER CLADDING TEMPERATURE					
High Power Bus Heaters		0 to 1533 K	0 to 1580 K		
THV*B2+39 THV*B2+196	Heater at Column B, Row 2. Thermocouples at 39 cm (90°), and 196 cm (50°) above bottom of heated length.			108;306 109;307	
THV*B3+354	Heater at Column B, Row 3. Thermocouple at 354 cm (180°) above bottom of heated length.			110;308	
THV*B4+322	Heater at Column B, Row 4. Thermocouple at 322 cm (0°) above bottom of heated length.			111;309	
THV*C2+321	Heater at Column C, Row 2. Thermocouple at 321 cm (180°) above bottom of heated length.			112;310	
THV*C3+79 THV*C3+231	Heater at Column C, Row 3. Thermocouple at 79 cm (75°), and 231 cm (54°) above bottom of heated length.			113;311 114;312	
THV*C4+187	Heater at Column C, Row 4. Thermocouple at 187 cm (182°) above bottom of heated length.			115;313	
THV*D2+254	Heater at Column D, Row 2. Thermocouple at 254 cm (351°) above bottom of heated length.			116;314	
THV*D4+179 THV*D4+352	Heater at Column D, Row 4. Thermocouples at 179 cm (26°), and 352 cm (270°) above bottom of heated length.			117;315 118;316	
Low Power Bus Heaters		0 to 1533 K	0 to 1580 K		
THV*A2+112	Heater at Column A, Row 2. Thermocouple at 112 cm (298°) above bottom of heated length.			119;317	
THV*A3+208 THV*A3+291	Heater at Column A, Row 3. Thermocouples at 208 cm (121°), and 291 cm (270°) above bottom of heated length.			120;318 121;319	
THV*A4+355	Heater at Column A, Row 4. Thermocouple at 355 cm (270°) above bottom of heated length.			122;320	
THV*B1+183 THV*B1+253	Heater at Column B, Row 1. Thermocouples at 183 cm (131°), and 253 cm (1°) above bottom of heated length.			123;321 124;322	
THV*B5+252	Heater at Column B, Row 5. Thermocouple at 252 cm (22°) above bottom of heated length.			125;323	
THV*C1+292	Heater at Column C, Row 1. Thermocouple at 292 cm (0°) above bottom of heated length.			126;324	
THV*C5+290	Heater at Column C, Row 5. Thermocouple at 290 cm (180°) above bottom of heated length.			127;325	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Low Power Bus Heaters (continued)					
THV*E4+230	Heater at Column E, Row 4. Thermocouple at 230 cm (355") above bottom of heated length.			128;326	
PRESSURE					
Intact Loop					
PI*1	Hot leg, Spool 1, 60 cm from vessel center.	0 to 17.24 MPa	0 to 21.95 MPa	129;327	
PI*5	Hot leg, (steam generator inlet leg), Spool 5, 363 cm from vessel center.		0 to 21.03 MPa	130;328	
PIC*LH970	Steam generator primary side, in long tube, hot side, 970 cm above top of tube sheet.		0 to 20.72 MPa	131;329	
PI*9	Cold leg (steam generator outlet leg), Spool 9, 1017 cm from downcomer center.		0 to 22.85 MPa	132;330	
PI*14	Cold leg (pump suction leg), Spool 14, 700 cm from downcomer center.		0 to 20.26 MPa	133;331	
PI*PBS	Cold leg (pump bypass leg), Spool PB, 210 cm from downcomer center.		0 to 21.76 MPa	134;332	
PI*22	Cold leg, Spool 22, 60 cm from downcomer center.		0 to 21.54 MPa	135;333	
Vessel					
PV*DC-435	In downcomer instrument spool, 435 cm below cold leg center.	0 to 17.24 MPa	0 to 20.04 MPa	136;334	
PV*LP-442	In lower plenum, 442 cm below cold leg centerline.		0 to 20.66 MPa	137;335	
PV*UP-13	In upper plenum, 13 cm below cold leg centerline.		0 to 21.64 MPa	138;336	
Pressurizer					
P*PRZ+158	In pressurizer steam dome, 156 cm above exit to surge line.	0 to 17.24 MPa	0 to 20.81 MPa	139;337	
STEAM GENERATOR					
Intact Loop	Secondary side.				
PSC*IGFDW	In feedwater supply line to intact generator.	0 to 17.74 MPa	0 to 21.06 MPa	140;338	
PSC*IGSTM	In steam discharge line from intact generator.	0 to 6.897 MPa	0 to 8.548 MPa	141;339	
DIFFERENTIAL PRESSURE	Elevation difference between transducer taps is zero unless specified otherwise.				
Intact Loop					
D-V13A*I1	From vessel upper plenum at 13 cm (0°) below cold leg center to hot leg, Spool 1, 60 cm from vessel center. Upper plenum tap is 33 cm below Spool 1 tap.	±4.97 kPa	±6.82 kPa	142;340	
DP1*1*3C	From hot leg, Spool 1, 60 cm from vessel center to hot leg. Spool 3, port C, 204 cm from vessel center.	±4.97 kPa	±7.005 kPa	341	BNC1 only.
DI*3C-G55E	From hot leg, Spool 3, port C, 204 cm from vessel center to steam generator entrance plenum, 55 cm below the top of the tube sheet and 488 cm from vessel center. Spool 3 tap is 185 cm below steam generator tap.	±24.87 kPa	±33.20 kPa	143;342	
DIG-55E+92	From steam generator entrance plenum, 55 cm below top of tube sheet to short tube, upflow leg at 92 cm above top of tube sheet. Entrance plenum tap is 147 cm below tube tap.	±24.87 kPa	±33.78 kPa	144;343	
DIG55E+462	From steam generator entrance plenum, 55 cm below top of tube sheet to short tube, upflow leg at 462 cm above top of tube sheet. Entrance plenum tap is 517 cm below tube tap.	±74.61 kPa	±101.1 kPa	145;344	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a]		Figure[a]	Measurement Comments[b]
		Detector	System		
Intact Loop (continued)					
DIG55E+838	From steam generato entrance plenum, 55 cm below top of tube sheet to short tube, upflow side of apex at 838 cm above top of tube sheet. Entrance plenum tap is 893 cm above tube tap.	±124.35 kPa	±162.7 kPa		Detector failed.
DIG55E+905	From steam generator entrance plenum, 55 cm below top of tube sheet to middle tube, upflow side of apex at 905 cm above top of tube sheet. Entrance plenum tap is 960 cm below tube tap.	±124.35 kPa	±167.4 kPa	146;345	
DIG-55E55X	From steam generator entrance plenum to steam generator exit plenum, across steam generator primary side. Both taps are 55 cm below top of tube sheet.	±74.61 kPa	±101.5 kPa	147	ANC1 only.
DIG*IG-55X*9	From steam generator exit plenum, 55 cm below top of tube sheet to cold leg, Spool 9, 1017 cm from downcomer center. Exit plenum tap is 108 cm above Spool 9 tap.	±4.97 kPa	±6.80 kPa	148;346	
DPI*9*14	From cold leg, Spool 9, 1017 cm from downcomer center to cold leg, Spool 14, 700 cm from downcomer center. Spool 9 tap is 380 cm above Spool 14 tap.	±24.87 kPa	±34.68 kPa	149;347	
DPI*14*PBA	From cold leg, Spool 14, 700 cm from downcomer center to cold leg Spool PB, port A, 402 cm from downcomer center. Spool 14 tap is 283 cm below Spool PB tap.	±24.87 kPa	±33.73 kPa	150;348	
DPI*9*PBA	From cold leg, Spool 9, 1017 cm from downcomer center to cold leg, Spool PB, port A, 402 cm from downcomer center. Spool 9 tap is 97 cm above Spool PB tap.	±12.43 kPa	±17.18 kPa	151;349	
DPI*PBA*B	From cold leg, Spool PB, port A, 402 cm from downcomer center to cold leg, Spool PB, port B, 210 cm from downcomer center. Across pump replacement orifice.	±689.50 kPa	±691.5 kPa		Detector failed.
DPI*PBB*22	From cold leg, Spool PB, port B, 210 cm from downcomer center to cold leg, Spool 22, 60 cm from downcomer center.	±24.87 kPa	±33.44 kPa	152;350	
D*I22+VD29	From cold leg, Spool 22, 60 cm from downcomer center to downcomer inlet annulus, 29 cm above cold leg centerline. Spool 22 tap is 29 cm below inlet annulus tap.	±24.87 kPa	±33.43 kPa	153;351	
Pressurizer					
LPRZ158+25	Liquid level in pressurizer, from 158 cm above exit to surge line, to 25 cm above exit to surge line. Elevation difference between taps is 133 cm.	±12.43 kPa	±18.15 kPa		Detector failed.
DP*PRZ*I3C	From pressurizer bottom, 25 cm above exit to surge line, to hot leg, Spool 3, port C. Across surge line. Elevation difference between taps is 156 cm.	±3447.5 kPa	±3442.0 kPa	154;352	
Steam Generator	Primary side liquid level.				
LIP970-55E	From long tube, upflow side of apex, at 970 cm above top of tube sheet, to entrance plenum, 55 cm below top of tube sheet. Elevation difference between taps is 1025 cm.	±124.35 kPa	±164.5 kPa	155;353	
LIP970-55X	From long tube, upflow side of apex, at 970 cm above top of tube sheet to exit pleuum, 55 cm below top of tube sheet. Elevation difference between taps is 1025 cm.	±198.96 kPa	±274.8 kPa	156;354	

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a]: Detector	Data Acquisition Range[a]: System	Figure[a]	Measurement Comments[b]
Vessel	Liquid level.				
LVD+29-170	Downcomer inlet annulus, 29 cm above cold leg centerline to downcomer extension, 170 cm below cold leg centerline. Elevation difference between taps is 199 cm.	±24.87 kPa	±33.22 kPa	157;355	
LVL170-578	Downcomer extension, 170 cm below cold leg centerline to vessel lower head, 578 cm below cold leg centerline. Elevation difference between taps is 308 cm.	±74.61 kPa	±107.6 kPa	158;356	
LVD+29-578	Downcomer inlet annulus, 29 cm above cold leg centerline to vessel lower head, 578 cm below cold leg centerline. Elevation difference between taps is 607 cm.	±124.35 kPa	±172.5 kPa	159;357	
LV-578-501	Vessel lower head, 578 cm below cold leg centerline to lower core region, 501 cm below cold leg centerline. Elevation difference between taps is 77 cm.	±12.43 kPa	±16.97 kPa	160;358	
LV-501-105	Vessel lower core region, 501 cm below cold leg centerline to heater rod ground hub, 105 cm below cold leg centerline. Elevation difference between taps is 396 cm.	±198.96 kPa	±266.0 kPa	161;359	
LV-105+140	Vessel heater rod ground hub, 105 cm below cold leg centerline to upper plenum end cap, 140 cm above cold leg centerline. Elevation difference between taps is 245 cm.	±74.61 kPa	±1^2.3 kPa	162;360	
LV-578-13M	Vessel lower head 578 cm below cold leg centerline to lower section of upper plenum, 13 cm below cold leg centerline. Elevation difference between taps is 565 cm.	±124.35 kPa	±176.1 kPa	163;36[illegible]	
LV-13M+140	Vessel lower section of upper plenum, 13 cm below cold leg centerline (at 180°) to upper plenum end cap, 140 cm above cold leg centerline. Elevation difference between taps is 153 cm.	±24.87 kPa	±33.28 kPa	164;362	
LV-578+140	Vessel lower head, 578 cm below cold leg centerline to upper plenum end cap, 140 cm above cold leg centerline. Elevation difference between taps is 718 cm.	±124.35 kPa	±168.4 kPa	165;363	
Steam Generator	Secondary side.				
DPSC*ICFA	Across orifice in intact loop steam generator feedwater supply line.	±198.96 kPa	±270.2 kPa	166;364	
DPSC*IGSTM	Across orifice in intact loop steam generator steam exhaust line.	±124.35 kPa	±168.2 kPa	167;365	
LI11178460	Intact loop secondary side liquid level from 1117 cm above top of tube sheet to 460 cm above top of tube sheet. Elevation difference between taps is 657 cm.	±124.35 kPa	±174.2 kPa	168;366	
LIS1117+90	Intact loop secondary side liquid level from 1117 cm above top of tube sheet to 90 cm above top of tube sheet. Elevation difference between taps is 1027 cm.	±124.35 kPa	±170.3 kPa	169;367	
VOLUMETRIC FLOW RATE	Turbine flowmeter, bidirectional.				
Intact Loop					
QI*1	Hot leg, Spool 1, 38 cm from vessel center.	±1.9 ℓ/s to ±19 ℓ/s	±9.0 ℓ/s	368	BNCI only.[c]
QI*6	Hot leg (steam generator inlet leg), Spool 6, 408 cm from vessel center.	±0.16 ℓ/s to ±1.6 ℓ/s	±4.0 ℓ/s	369	BNCI only.[c]
QI*15	Cold leg (pump suction leg), Spool 15, 629 cm from downcomer center.	±1.9 ℓ/s to ±19.0 ℓ/s	±9.0 ℓ/s	170	ANCI only.[c]
QI*PB	Cold leg (pump bypass instrument spool), Spool PB downstream from orifice, 225 cm from downcomer center.	±0.15 ℓ/s to ±6.3 ℓ/s	±4.0 ℓ/s	171;370	
QI*22	Cold leg, Spool 22, 38 cm from downcomer center.	±1.26 ℓ/s to ±12.6 ℓ/s	±9.0 ℓ/s	172;371	--[c]

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Vessel					
QV*DC-423	Downcomer instrument spool, 423 cm below cold leg center.	±0.13 ℓ/s to ±1.58 ℓ/s	±4.0 ℓ/s	173;372	
QV*UP+1	Core exit, 1 cm above cold leg centerline.	±2.8 ℓ/s to ±28.0 ℓ/s	±10.0 ℓ/s	373	BNCl on y.[5]
DENSITY					
Intact Loop		1.6 to 1600 kg/m³	0 to 1600 kg/m³		
RI*1T RI*1B RI*1C	Hot leg, Spool 1, 77 cm from vessel center. T (tangential) ranges 270° to 360°. B (body) ranges 30° to 330°. C is a mathematical composite of T and B.			174 175;374 176	ANCl only. ANCl only.
RI*5M RI*5I RI*5C	Hot leg (steam generator inlet leg), Spool 5 (vertical), 367 cm from vessel center. M (middle) ranges 0° to 180°. I(inside) ranges 40° to 120°. C is a mathematical composite of M and I.			177;375 178;376 179;377	
RI*PBT RI*PBM RI*PBC	Cold leg (pump bypass leg), Spool P8, 200 cm from downcomer center. T (top) ranges 40° to 120°. M (middle) ranges 0° to 180°. C is a mathematical composite of T and M.			180;378 181;379 182;380	
RI*22T RI*22B RI*22C	Cold leg, Spool 22, 73 cm from downcomer center. T (tangential) ranges 270° to 360°. B (body) ranges 30° to 330°. C is a mathematical composite of T and B.			183;381 184;382 185;383	
Vessel		1.6 to 1600 kg/m³	0 to 1600 kg/m³		
RV*DC-72	Downcomer, 72 cm below cold leg centerline. B (body) ranges 30° to 330°.			186;384	
RV*DC-260	Downcomer, 260 cm below cold leg centerline. B (body) ranges 30° to 330°.			187;385	
RV*DC-456	Downcomer, 456 cm below cold leg centerline. B (body) ranges 30° to 330°.			188;386	
RV*AB-6	Six cm below bottom of core heated length, between heater rod Columns A and B.			189;387	
RV*23+13	13 cm above bottom of core heated length, between heater rod Rows 2 and 3.			190;388	
RV*23+113	113 cm above bottom of core heated length, between heater rod Rows 2 and 3.			191;389	
RV*AB+173	173 cm above bottom of core heated length, between heater rod Columns A and B.			192;390	
RV*23+183	183 cm above bottom of core heated length, between heater rod Rows 2 and 3.			193;391	
RV*23+253	253 cm above bottom of core heated length, between heater rod Rows 2 and 3.			194;392	
RV*AB+332	332 cm above bottom of core heated length, between heater rod Columns A and B.				Detector failed.
RV*23+342	342 cm above bottom of core heated length between heater rod Rows 2 and 3.				Detector failed.
RV*UF-11	Vessel at base of core flow instrument housing, 11 cm below cold leg centerline.			195;393	
MASS FLOW RATE	Mass flow rate obtained by combining density (gamma attenuation technique) with volumetric flow rate (turbine flowmeter).	Range for mass flow is determined from ranges of individual detectors used in calculation.			

Table 5. (continued)

Measurement	Location and Comments[a]	Data Acquisition Range[a] Detector	System	Figure[a]	Measurement Comments[b]
Intact Loop					
QI*6, RI*5C	Hot leg (steam generator inlet leg), Spool 5/6.			394	BNC1 only.[c]
QI*PB, RI*PBC	Cold leg (pump bypass leg), Spool PB.			196;395	
QI*22, RI*22C	Cold leg, Spool 22.			197;396	c
Vessel					
QV*DC-423, RV*DC-436	Downcomer instrument spool.			198;397	
CORE CHARACTERISTICS					
High Power Bus					
IV*HIPWBUS	Core current.	0 to 10,000 A	0 to 10,030 A	199;398	
EV*HIPWBUS	Core voltage.	0 to 400 V	0 to 402 V	200;399	
Low Power Bus					
IV*LOPWBUS	Core current.	0 to 10,000 A	0 to 9330 A	201;400	
EV*LOPWBUS	Core voltage.	0 to 400 V	0 to 402 V	202;401	
Calculated Power					
KWH*HIC	Power for high power bus.			203;402	
KWH*LOC	Power for low power bus.			204;403	
KWH*TOTC	Total power for high and low power bus.			205;404	
BAND HEATER CHARACTERISTICS					
Power Supply 357	Core vessel and downcomer.				
EH*BAND357	Heater voltage.	0 to 200 V	0 to 250 V	405	BNC1 only.
IH*BAND357	Heater current.	0 to 300 A	0 to 400 A	406	BNC1 only.
KW*EH*VESS	Calculated power.			413	BNC1 only.
Power Supply 358	Intact loop, pump suction (Spools 13 through 16).				
EH*BAND358	Heater voltage.	0 to 200 V	0 to 250 V	407	BNC1 only.
IH*BAND358	Heater current.	0 to 500 A	0 to 400 A	408	BNC1 only.
KW*EH*ILPS	Calculated power.			414	BNC1 only.
Power Supply 360	Intact loop, cold leg (Spools PB, 21, and 22).				
EH*BAND360	Heater voltage.	0 to 200 V	0 to 250 V	409	BNC1 only.
IH*BAND360	Heater current.	0 to 100 A	0 to 200 A	410	BNC1 only.
KW*EH*CL	Calculated power.			415	BNC1 only.
Power Supply 361	Intact loop, hot leg (Spools 1 through 12).				
EH*BAND361	Heater voltage.	0 to 200 V	0 to 250 V	411	BNC1 only.
IH*BAND361	Heater current.	0 to 150 A	0 to 200 A	412	BNC1 only.
KW*EH*HL	Calculated power.			416	BNC1 only.

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 that 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.

c. Transducer not calibrated below the stated detector range. Use data for trend identification only.

IV. REFERENCES

1. L. J. Ball et al., *Semiscale Program Description*, TREE-NUREG-1210, May 1978.

2. G. G. Loomis and K. Soda, *Experimental Operating Specification—Semiscale Mod-2A Natural Circulation Test Series (Series NC)*, EGG-SEMI-5427, April 1981.

3. G. G. Loomis, K. Soda et al., *Quick Look Report For Semiscale Mod-2A Test S-NC-1*, EGG-SEMI-5492, July 1981.

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